

UNITED STATES PATENT OFFICE

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PREPARING METAL FOR DRAWING OPERATIONS

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6 Claims. (Cl. 205—21)

The present invention is a continuation-in-part of the invention disclosed in my Patent No. 2,338,045, issued December 28, 1943, and directed to the treatment of metal such as elongated ferrous rod or wire stock which is to be subsequently reduced in size by drawing through dies.

In my prior application I have disclosed the conventional step of first pickling rod or wire stock to remove scale or rust therefrom, and thereafter immersing it in a strong alkali solution such as No. 24 Oakite, to which the claims allowed in my prior application are limited, said Oakite alkali solution containing moisture approximately 16.6 per cent; sodium resinate 10.9 per cent; sodium hydroxide 30.8 per cent; sodium carbonate 29.8 per cent; and sodium silicate 11.9 per cent.

In common with the invention of the above identified application, an object of the present invention is to eliminate the formation of hard chemical compounds deleterious to the life of dies used in drawing limed rods and wire, and to eliminate the baking practice both as to the time and handling of the material itself and the large and expensive equipment required for the purpose.

Prior to my invention it has been the practice in the wire drawing industry to pickle the rod stock by placing it, for example, in a pickling bath of dilute sulphuric acid to remove the scale or rust therefrom, and thereafter to wash the rod stock in water and immerse it in a lime solution so as to coat the stock with the lime solution, whereupon the rod stock was sent to an oven or baker to drive off the moisture and leave a residual powder-like lime deposit thereon.

An objectionable characteristic inherent in conventional prior practices is that acid residues remaining on the rod stock as a result of the cleaning or pickling operations have eventually found their way into the lime tank. This has resulted in the undesirable formation of calcium sulphate, which precipitates on the surface of the rod stock. That chemical substance is of sandy texture, and exerts an abrasive action which is exceedingly destructive to the dies through which the rod stock is eventually to be drawn. Moreover, the prior practice of baking the lime on the rod or other ferrous stock required a large capital outlay for the construction of ovens or bakers of great size. In addition, the maintenance and operation of such ovens for fuel and labor have added greatly to the normal cost of wire drawing operations.

Heretofore the cleaning, liming and baking of the rod stock have usually been effected by the batch process; that is to say, the coils of rod were handled as such and were immersed in several tanks, the last of which contained lime in suspension in water, and passed through the bakers

or ovens on buggies. The coiled rod stock usually remained in the baker for an interval of from 24 to 36 hours, depending upon production requirements. Prior to my invention, such intervals of treatment in the baker were thought to be necessary, first, to dry the lime on the surface of the rod, and second, to drive off any residual acid that might still be present or to drive off hydrogen that might be occluded on the surface of the metal rods as the result of such acids.

It is the primary object of the herein claimed invention to eliminate or inhibit the formation of hard chemical compounds or substances deleterious to the life in the drawing of limed rod or wire stock.

A further object is to eliminate the baking practice heretofore regarded as essential, and thus cut down the time required to properly process the rod or wire stock and eliminate the large and expensive equipment heretofore necessary.

In order to make available to those skilled in the art the precise teachings of the herein claimed invention, reference should be made to the following detailed disclosure which by way of example sets forth a preferred sequence of operating steps which an actual reduction to practice has shown to be very effective.

Coiled bundles of ferrous metal rod or wire stock are thoroughly cleaned by immersing them in an aqueous pickling bath of dilute sulphuric acid so as to remove the rust or scale therefrom. This pickling may be done by lowering coils of rod or wire stock into a bath comprising an aqueous solution of sulphuric acid, the coils of rod or wire stock being lowered into the bath by an overhead crane. The coiled rods are withdrawn from the pickling bath and then immersed in a water bath or sprayed with water. This water bath or spray may be omitted in some instances, since the subsequent step may render it unnecessary, but the water dip or spray step need take but little time and its cost is negligible.

An essential step in the herein claimed method is the immersion of the rod or wire stock in a strong caustic or alkali solution. The stock should remain in this caustic solution, which is preferably maintained at a temperature of from 190° to 210° F., for an interval of 15 minutes or more. This alkali treatment is effective to thoroughly neutralize any acid remaining on the rod or wire stock, and also serves to preheat the wire to a temperature approaching that of the boiling point of the caustic alkali solution.

Upon removal from the caustic alkali solution, the coils of rod or wire stock are immersed in a hot lime bath (calcium hydroxide) which may run from 3 to 12 per cent of lime, this bath being maintained at a temperature of from approximately 150° to 212° F. The coiled rod or wire

stock is then removed from the lime bath and is suspended in air at ordinary room or atmospheric temperatures with or without the aid of a fan blowing thereon; or in some cases the limed stock is exposed to a hot atmosphere for a few seconds so as to thoroughly dry the coils of stock and particularly the bottom portions or convolutions thereof at which regions the moisture of the bundle necessarily gravitates.

The residual heat of the rod or wire stock plus the action of the fan or hot air currents is effective to rapidly dry the stock while it is suspended from the overhead crane; thus the precipitated coating of calcium hydrate is substantially pure, dry, soft and non-abrasive, and there is no necessity of sending the stock to a baker or oven as heretofore. Hence the invention makes possible an economic saving in the capital outlay for equipment, and effects a saving in fuel and time required over conventional prior practices.

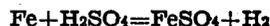
The step of immersing the rod or wire stock in the alkali solution prior to the time of application of the lime coating, for the purpose of removing the undesired effects of the acid pickling treatment, is new and to the best of my knowledge has not been done heretofore, and it is of major importance in the herein claimed method. The described sequence of steps is desirable since, when these steps are followed, acid from the pickling bath does not contaminate the material in the lime bath and it prevents the formation of the undesirable lime compound that inherently occurs in prior practice, for example, that disclosed in Cary Patent No. 2,235,825, issued March 25, 1941. The Cary method will result in the formation of a lime compound which will exert an abrasive action on the wire drawing dies when the wire or rod stock is subjected to conventional wire drawing operations. My herein claimed method avoids the formation of such abrasive lime compound.

The advantage of immersing the rod or wire stock in the alkali bath in the cleaning cycle above referred to, comes about largely because of the fact that such quantities of acid as are left after rinsing are completely neutralized by said alkali bath. Any lime products or compounds subsequently formed when the ferrous rod or wire stock is limed, are not deleterious to the subsequent wire drawing operation, whereas according to prior practice, in which the alkali treatment is not used, the acid which is not removed has produced calcium sulphate, which is highly detrimental to wire drawing, since it exerts an abrasive or cutting action on the dies when the stock is drawn.

Various alkali baths may be used in my method. While the No. 24 Oakite above referred to is preferred, I have now determined that any alkali capable of negating the undesired after-effect of residual pickling acid will be satisfactory, the important point being to follow a procedure which can positively be relied upon to prevent the formation of an abrasive such as calcium sulphate. For example, I have found in practice that instead of using No. 24 Oakite for the alkali dip step, I may substitute the commercially obtainable alkali made by the E. F. Houghton Company, known as No. 127 alkali. This particular alkali is of the following analysis: sodium resinate, 14.3 per cent; sodium carbonate, 14.9 per cent; sodium hydroxide, 28.2 per cent; sodium orthosilicate, 23.2 per cent; trisodium phosphate, .5 per cent; inert material and moisture, 18.9 per cent. I have also determined that the com-

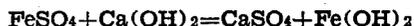
mercially obtainable alkali known as D-6, made by the Salta Products Company, can be used with satisfactory results. I do not desire to be limited to any specific alkali solution, since the advantages of the present method can be obtained by cleaning the ferrous metal stock in a conventional acid pickling solution capable of forming a sulphate of iron on the said stock, then immersing the stock in any alkali solution capable of reacting with the sulphate of iron and acid pickling solution remaining on the stock to form sodium sulphate, which is readily soluble in water, thereafter immersing the thus-treated stock in a water bath containing a lime suspension so as to acquire on the stock only a coating of substantially pure calcium hydrate which will have no abrasive action on the wire drawing dies.

Those skilled in the art are aware of the fact that when a bundle of iron or steel wire is cleaned in a conventional sulphuric acid pickling bath, sulphate of iron is formed on the wire according to the following formula:



Under conventional practice used for many years, the cleaned wire is removed from the acid cleaning tub and the acid is washed off as thoroughly as possible by thereafter dipping the bundles of wire in water or by spraying water on the bundles by means of a hose. Nevertheless some free acid and some sulphate of iron frequently remains on the wire when the bundles are subsequently dipped into the lime bath to be lime coated prior to drawing. Thus, when the bundles are dipped into the lime bath, the sulphate of iron on the wire will react with the calcium hydroxide constituting the lime bath, thus objectionably forming calcium sulphate, which gives the lime coating a sandy texture which rather quickly cuts out and damages the wire drawing dies.

The reaction between the sulphate of iron on the wire and the calcium hydroxide in the lime bath is expressed in the following formula:



The above action is avoided by the method herein claimed, involving dipping the rod stock in a hot alkali solution. The bundles of wire stock, although they have been dipped in water and washed after cleaning in the acid cleaning step, may still have some free acid and sulphate of iron remaining on the surface at the time the stock is dipped in the hot alkali solution.

The sulphate of iron on the surface of the wire reacts with the sodium hydroxide in a hot alkali bath to form sodium sulphate according to the following formula:



One of the principal ingredients of No. 24 Oakite above specified is sodium hydroxide (30.8 per cent). The other sodium compounds in said No. 24 Oakite will also react with sulphate of iron to produce additional quantities of sodium sulphate according to specified chemical formulae which, however, need not be given here, but there is a difference in solubility of the sulphate formed in both cases, that is, where no hot alkali bath is used and where it is used.

The solubility of the two sulphates mentioned above, in water, is as follows:

Calcium sulphate (CaSO_4) .209 part per 100 parts of water at 30° C.

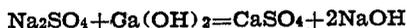
Sodium sulphate (Na_2SO_4) 40.8 parts per 100 parts of water at 30° C.

From this comparison it will be noted that the very injurious and objectionable calcium sulphate is only soluble in water to a very slight degree but that the sodium sulphate which results from the action of the sulphate of iron in the hot alkali bath is nearly 200 times as soluble in water as calcium sulphate.

It is because the calcium sulphate (CaSO_4) is so insoluble in water that it will stay on the wire after the bundles are immersed in and removed from the lime coating bath, that the difficulties occur which applicant is eliminating by the improved method herein described and claimed.

There are various alkalis that might be used in making up the hot alkali bath, such, for example, as potassium hydroxide, which will react with sulphate of iron to form the alkali metal sulphate, namely, potassium sulphate, which is also many times more soluble in water than calcium sulphate and, therefore, might be used to considerable advantage in overcoming the evil effects of prior art practice which promotes the formation of calcium sulphate due to the reaction of the acid with the sulphate of iron in the calcium hydroxide forming the lime coating bath.

After the wire rod stock has been dipped into the hot alkali bath according to applicant's method, it is later immersed in the hot lime bath which is a water suspension. Thus a soft, limey coating is applied to the stock. When the bundles of rod stock are removed from the hot alkali bath, the surface of the wire will, of course, be coated with sodium sulphate (Na_2SO_4) which may or may not be washed off by dipping the coils in water or washing with a stream of water from a hose. If the bundles of wire are dipped in a water wash, then practically all of the sodium sulphate on the wire should be removed, due to its solubility in water. However, should some of it remain, or should the bundles of wire not be washed in water at all after having been dipped in the hot alkali bath, in either case the sodium sulphate on the wire will react with the calcium hydroxide ($\text{Ca}(\text{OH})_2$) in the lime bath to form some calcium sulphate (CaSO_4), but that will be very little in comparison with that obtained when the bundles of wire are dipped into the hot lime bath without giving them the herein described step of immersion in a hot alkali bath. The sodium sulphate will react with the calcium hydroxide of the lime bath to form some calcium sulphate (CaSO_4) according to the following formula:



Actual practice has demonstrated that practically no calcium sulphate is formed on the wire by the novel method herein described and claimed, and my improved method has resulted in an important increase in production and an increase in the useful life of the wire drawing dies through which the treated rod or wire stock is passed during the manufacture of wire from said stock.

Although specific steps and ingredients are herein specified, it is to be understood that the detailed disclosure is to be interpreted in an illustrative rather than a limiting sense, since various modifications may be made, without invention, within the scope of the appended claims.

I claim:

1. The method of processing ferrous metal wire or rod stock for reduction in gauge, consisting in cleaning said stock in an acid solution, immersing said stock in an alkali solution effective to thoroughly neutralize any residual acid on the stock, immersing the thus-treated stock in a water bath of calcium hydroxide whereby there is acquired thereon only a non-abrasive coating of substantially pure calcium hydrate, and subsequently subjecting said stock to a drawing operation to reduce it in cross sectional area and elongate it.

2. The method of processing ferrous metal wire or rod stock for reduction in gauge, consisting in cleaning said stock in an aqueous sulphuric acid pickling solution capable of forming a sulphate of iron on said stock, immersing said stock in an alkali solution capable of reacting with the sulphate of iron and acid pickling solution remaining on the stock to form a sulphate which is readily soluble in water, immersing said stock in a water bath of calcium hydroxide so as to acquire on the stock only a coating of substantially pure non-abrasive calcium hydrate, and subsequently subjecting said stock to a drawing operation to reduce it in cross sectional area and elongate it.

3. The method of processing ferrous metal wire or rod stock for reduction in gauge, consisting in cleaning said stock in an aqueous sulphuric acid pickling solution capable of forming a sulphate of iron on said stock, immersing said stock in an alkali solution capable of reacting with the sulphate of iron and acid pickling solution remaining on the stock to form a sulphate which is readily soluble in water, immersing said stock in a water bath of calcium hydroxide so as to acquire on the stock only a coating of substantially pure non-abrasive calcium hydrate, and subsequently subjecting said stock to a wire drawing operation to reduce the gauge thereof.

4. The method of processing ferrous metal wire or rod stock for reduction in gauge, consisting of cleaning said stock in an aqueous sulphuric acid pickling solution capable of forming a sulphate of iron on said stock, immersing the stock in an alkali solution capable of reacting with the sulphate of iron and acid pickling solution remaining thereon to form sodium sulphate which is readily soluble in water, applying water to said stock, immersing said stock in a water bath of calcium hydroxide so as to acquire on the stock only a coating of substantially pure non-abrasive calcium hydrate, and subsequently subjecting said stock to a drawing operation to reduce it in cross sectional area and elongate it.

5. The method of claim 1, further characterized in that the alkali solution and the bath of calcium hydroxide are maintained at respective temperatures effective to dry the precipitated coating of calcium hydrate principally by the residual heat of the stock resulting from its immersion in said solution and said bath.

6. The method of claim 1, further characterized in that the alkali solution and the bath of calcium hydroxide are maintained at respective temperatures above 150° F. effective to dry the precipitated coating of calcium hydrate principally by the residual heat of the stock resulting from its immersion in said solution and said bath.

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