United States Patent

Turner et al.

[15] **3,699,726**

[45] **Oct. 24, 1972**

[54] **METHOD OF DESCALING**

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[22] Filed: **March 26, 1971**

[21] Appl. No.: **128,275**

[52] **U.S. Cl.** **51/319,** 51/322, 51/324, 148/16

[51] **Int. Cl.**.....**B24c 1/00**

[58] **Field of Search**.....51/319, 320, 321, DIG. 10, 51/324, 8, 9, 322; 148/16.7, 16

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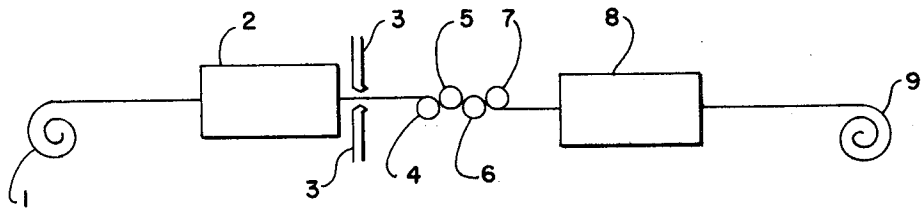
Primary Examiner—Donald G. Kelly

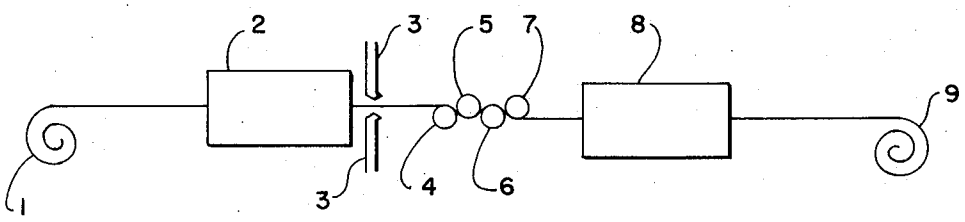
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[57] **ABSTRACT**

Dry descaling of steel strip by a combination of thermal and mechanical treatments. A strip of steel is heated in normal furnace atmosphere to a temperature at which the magnetite scale converts to softer, more porous wustite and then rapidly cooled by air jets. Subsequently, the cooled strip is flexed to crack the scale and abrasive blasted to remove the cracked scale.

8 Claims, 1 Drawing Figure




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METHOD OF DESCALING

BACKGROUND AND SUMMARY

The present invention relates to the cleaning of metal, and more particularly to the dry descaling of hot rolled carbon steel, although the process can also be used for descaling other steels.

The surface of a steel strip must be clean, particularly if it is to be galvanized or painted. Traditionally, this cleaning has been accomplished by pickling the metal in an acid bath. This process is expensive and requires a considerable amount of space. More important today, however, is the difficulty of disposing of the spent pickle liquor.

Attempts have also been made without great success to remove scale from metal by mechanical means, such as brushing or sand blasting, and by the production of oxides that can be more easily removed than the usual scale, which is magnetite.

It is an object of the invention to provide a method of cleaning hot rolled steel strip on a continuous basis. It is a further object of the invention to perform a sequence of operations on a continuously moving strip of steel to remove the oxide therefrom.

The ordinary scale formed on the surface of a sheet of metal is predominantly magnetite with a thin outside layer of hematite. These types of oxides are hard and dense. Thus, the removal of the scale by acid pickling is a difficult and costly problem. A third type of oxide or scale is wustite, which is relatively porous and more easily removed from the metal.

According to the invention, scale on the surface of the steel is converted, at least partially, from magnetite to wustite by thermal treatment, and is thereafter removed mechanically. The conversion and removal are carried out sequentially and continuously.

The various features of novelty which characterize our invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which we have illustrated and described a preferred embodiment of the invention.

DETAILED DESCRIPTION

The single FIGURE of drawing shows, diagrammatically, apparatus that is used in practicing the method of the invention.

A coil of hot rolled steel strip, indicated at **1** is moved through a furnace **2** where it is heated sufficiently to change the character of the scale. Immediately upon exiting from the furnace, the strip is passed between a pair of cooling air jets **3** that rapidly cool the strip below a scale conversion temperature. Strip **1** then passes around rolls **4**, **5**, **6**, and **7** which flex the strip sufficiently to crack such scale as is present on the strip, but not sufficiently to cold work the strip enough to change its physical characteristics. The strip then passes through a mechanical cleaner **8** in which the scale is removed by abrasive action. The cleaned strip is then coiled as at **9**, or supplied directly to a point of use or further treatment.

Hot rolled steel strip has a scale on its surface that comprises magnetite next to the parent metal with a thin layer of hematite on the surface. As the strip is passed through furnace **2** it is heated to above 1,000° F and to below the Ac_1 transformation temperature or about 1,400° F. Within this temperature range, and preferably about 1,350° F, the magnetite will convert to wustite. This type of oxide is softer and more porous than magnetite and more easily removed. The strip can be heated to a higher temperature than the Ac_1 without affecting the conversion to wustite. This is not desirable in most cases, however, since the higher temperature will alter the physical characteristics of the metal and will require a larger furnace.

The conversion of magnetite begins at the interface between the scale and the parent metal and progresses outwardly toward the surface of the scale. The conversion progresses at a rate dependent upon time and temperature and, when starting, is apparently independent of the type of atmosphere in which the strip is heated. Therefore, the furnace **2** can be fuel fired with the normal atmosphere of combustion gases that can vary to either side of neutral, or it can be an electric furnace. Since the interface is the important point in the removal of scale, it is not necessary for conversion to take place entirely through the layer of magnetite, although this would be satisfactory. The amount of conversion obtained after the strip reaches temperature will depend upon the speed of the strip through the furnace at any given temperature.

The conversion of wustite back to magnetite takes place at the fastest rate at 900° F, but the reconversion is easily retarded to retain the wustite formation by quickly cooling the strip down to below 600° F, and preferably to substantially ambient temperature. For this reason the strip is rapidly cooled by air jets from the ducts **3** immediately after it leaves furnace **2**.

Whether the scale on the strip was completely converted to wustite or whether it has a thin surface of magnetite, it can be more easily removed it the strip is flexed to crack the scale. To this end, the cooled strip is directed around flexing rolls **4**, **5**, **6**, and **7**. These rolls are of such a size that the strip is not critically strained. Flexing beyond this point produces an undesirable work hardening. The flexing can be accomplished by using rolls of **4** inches in diameter with the lowest point of the surface of rolls **5** and **7** at the same level as the axes of rolls **4** and **6**.

The scale can now be easily removed by mechanical means such as shot blasting as represented by **8**. Such equipment is well known. In operation, shot or other abrasive is impacted at high velocity against the strip. Such operation because of the prior treatment of the strip will remove the scale completely. The strip is then coiled or supplied directly to a point of use or further working.

The step of converting the scale, at least at the metal interface, to wustite, a soft, porous scale, results in a smooth boundary between the metal and scale. This, along with cracking of the scale, results in scale that can readily be removed. The shot blasting is one form of mechanical cleaning that can be performed quickly and economically. The result is a strip with a clean surface free of retained, imbedded or encapsulated scale which is superior to that resulting by acid pickling.

While in accordance with the provisions of the Statutes we have illustrated and described the best

form of embodiment of our invention now known to us, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention set forth in the appended claims, and that in some cases certain features of our invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. The method of descaling strip metal having a scale on its surfaces which comprises,

moving the metal continuously through a path having a plurality of stations located at spaced points along said path,

at a first station heating said strip to a temperature of at least 1,000° F in a normal furnace atmosphere,

rapidly cooling said strip in air to a temperature below 600° F at a second station that is located at a point along said path immediately beyond said first station,

flexing said strip in opposite directions as it is moving at a station located beyond the cooling station, and,

mechanically cleaning said strip by abrasive means at a station located beyond said flexing station in the path of travel of said strip.

2. The method of claim 1 in which said strip is heated in a gas fired furnace in the presence of combustion gases which may or may not include free oxygen.

3. The method of claim 1 in which the strip is cooled by blowing sheets of air against opposite surfaces of the sheet.

4. The method of claim 1 in which the strip is flexed by passing it partially around a plurality of parallel rolls whose axes are offset in the direction of the sheet surface.

5. The method of claim 1 in which the sheet is cleaned by impacting its surfaces with an abrasive material.

6. The method of claim 1 in which the heating of the strip continues for a length of time sufficient to change the character of the scale at least at the interface of the scale and the parent metal.

7. The method of claim 1 in which the strip is heated to a temperature between 1,000° F and 1,350° F.

8. The method of descaling cold-rolled, strip metal having a scale on its surface which comprises:

moving the strip continuously through a path having a plurality of stations located along said path,

heating the strip at a first station in said path by direct exposure to combustion gases to a temperature of between 1,000° F and 1,400° F for a time sufficient to change the character of the scale at least at its interface with the parent metal,

immediately after the heating step rapidly cooling the strip below 600° F at a second station by blowing sheets of air against its opposite sides,

at a third station along said path flexing the strip by bending it partially around a series of rollers located across said path, and

at a next location along said path impacting the surfaces of said strip with an abrasive to remove the scale.

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