United States Patent [19]

Bills et al.

[11] **3,754,873**

[45] **Aug. 28, 1973**

[54] **COLD ROLLED SHEET**

[75] Inventors: **Max E. Bills**, Pleasant Hills Borough, Pa.; **Henry J. Hansen, Jr.**, Portage, Ind.

[73] Assignee: **United States Steel Corporation**, Pittsburgh, Pa.

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[21] Appl. No.: **112,362**

Related U.S. Application Data

[62] Division of Ser. No. 792,079, Jan. 17, 1969, Pat. No. 3,619,881.

[52] **U.S. Cl.** **29/183.5**

[51] **Int. Cl.** **B21b 1/28**

[58] **Field of Search** ..... 29/183.5, 180 SS

[56] **References Cited**

UNITED STATES PATENTS

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Primary Examiner—A. B. Curtis
Assistant Examiner—O. E. Crutchfield
Attorney—Arthur J. Greif

[57] **ABSTRACT**

A cold rolled steel sheet or strip has a plurality of closely spaced, low, generally frustospherical projections of substantially uniform shape and height throughout its surface, the arithmetic average roughness of the surface being between 20 and 400 microinches.

2 Claims, 4 Drawing Figures

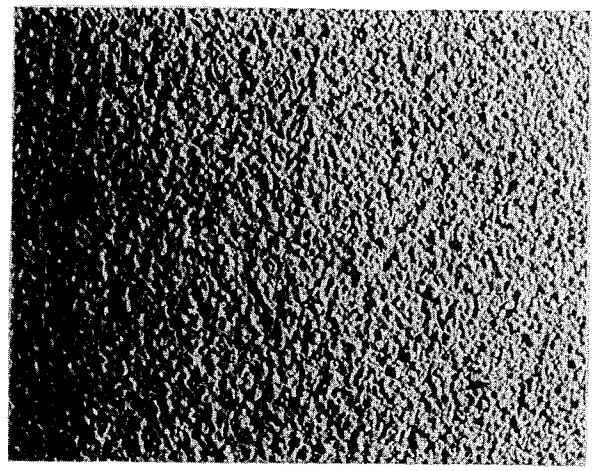


FIG. 3.

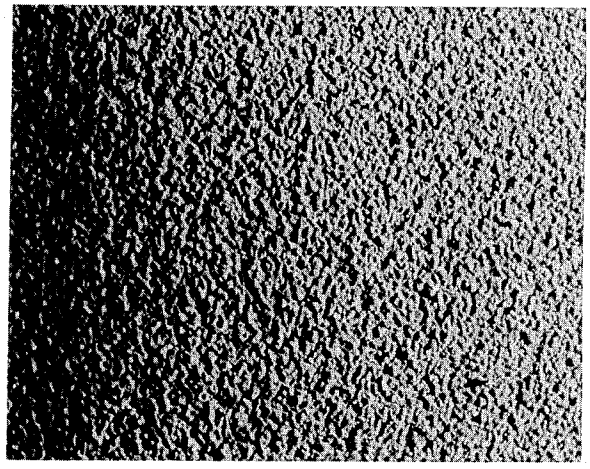
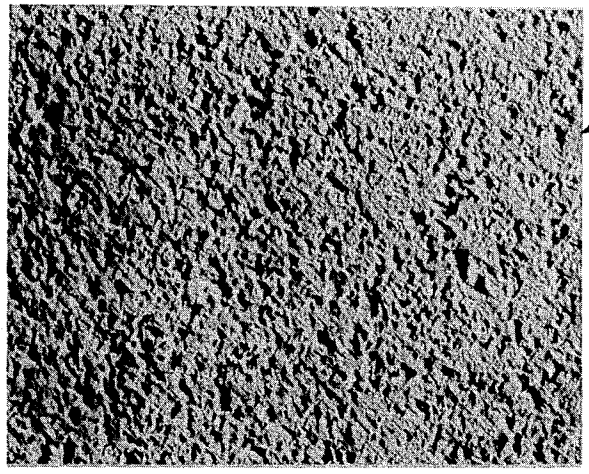


FIG. 4.



PRIOR ART

FIG. 1.

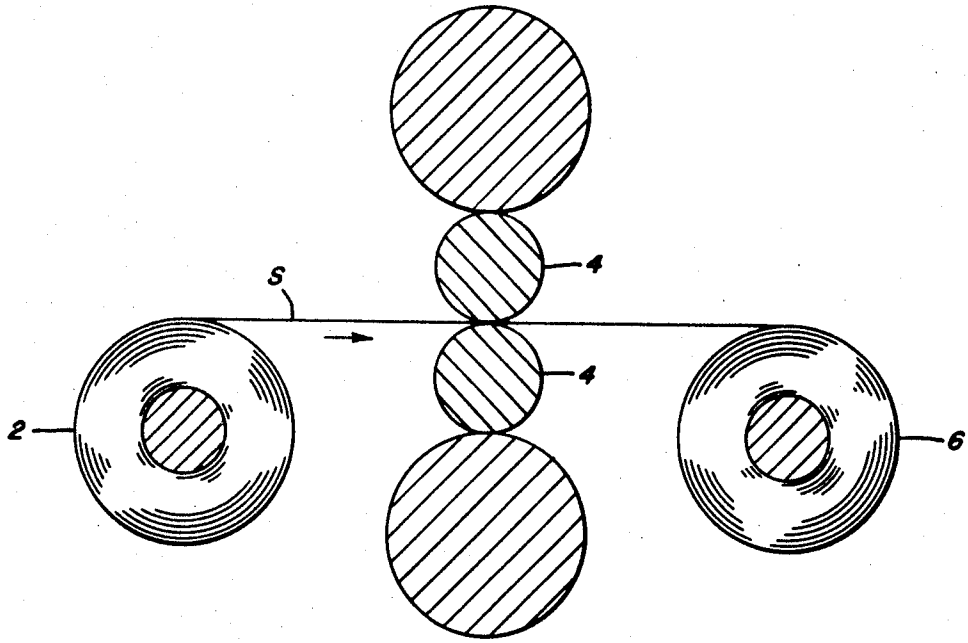
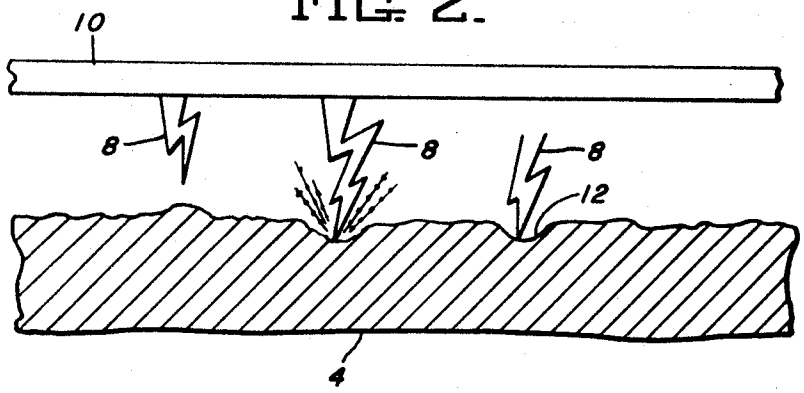


FIG. 2.



INVENTORS.
MAX E. BILLS AND
HENRY J. HANSEN, JR.
By Martin J. Carroll
Attorney

COLD ROLLED SHEET

This application, which is a division of my co-pending application Ser. No. 792,079, filed Jan. 17, 1969, now U.S. Pat. No. 3,619,881 relates to a cold rolled sheet and more particularly to a steel sheet having low projections thereon.

In the manufacture of cold rolled sheets it is necessary to control the surface finish of the product to the required degree of roughness so as to enhance the appearance and the performance of the material in subsequent operations. The required finish is commonly obtained in the final stages of manufacture by rolling the strip between rolls of controlled roughness which impress such roughness generally into the surfaces of the strip. It is thus vitally important that these rolls possess the proper roughness. Conventionally, the roll roughness is attained by carefully shot blasting the prepared roll surface, the depressions and associated peripheral upheaval thus created by particle impingement providing the desired roughness. This operation, however, is difficult to control because of differences in kinetic energy, size and angle of impingement of the shot blast particles. Thus, the resultant roll roughness pattern is characterized by randomness with respect to the shape, size and distribution of the topographical features. It is common practice for the customer to request a particular surface on the cold rolled strip, which is identified as so many microinches roughness as obtained by a standard profilometer measuring device. However, the reading obtained is such that it has relatively little relationship to the true type of surface. In other words, the same reading by the profilometer may result from surfaces having a substantial difference in appearance and/or a substantial difference in the shape and arrangement of the depressions. Since it is desirable that the surfaces of the strip have the same visual appearance and also that it have the same texture for receiving paint, it is clear that the process and the rolls now in use are not entirely satisfactory.

It is therefore an object of our invention to provide a cold rolled sheet having projections of such shape and arrangement that the visual appearance and surface of the sheet is relatively constant.

This and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIG. 1 is a view of a conventional temper rolling mill for rolling sheets;

FIG. 2 is a schematic view showing depressions being generated in the surface of the roll used in producing sheets according to our invention;

FIG. 3 is a magnified view of a replica of the surface of the roll of FIG. 2; and

FIG. 4 is a magnified view of a replica of the roll surface resulting from shot blasting according to the prior art.

Referring more particularly to the drawings, reference numeral 2 indicates an uncoiler from which strip S is uncoiled and passes through a set of rolls 4 to a coiler 6. It will be understood that additional stands of rolls may be used at the entry side of rolls 4. However, the number of stands is not important insofar as our invention is concerned, it only being necessary that the strip have a relatively smooth surface prior to passing through the rolls 4. According to our invention the rolls 4 are textured or roughened by means of the well known Electric Discharge Machining (EDM) operation, in which bursts of electrical energy 8 from electrode 10 volatilize and remove small amounts of metal from the surface of the roll. This method generates shallow depressions 12 in the outer surface of the roll, thus providing the desired roughening of the roll surface. Most all of the depressions are of substantially uniform shape and depth, and, while closely spaced, are randomly spread over the outer surface of the roll. It will be seen that the depressions 12 are rounded and are substantially frustospherical. FIG. 2 shows only a few depressions 12 for the sake of clarity, but in the finished roll they will be very closely spaced.

The depth and diameter of the depressions 12 may vary over wide limits depending on the desired degree of roughening, this being a matter of selecting the proper electrical parameters for the individual electrical discharges so as to generate the desired degree of roughness in the roll surface. This procedure is well known and presents no problem to the operator. When the depth of the individual depressions is such as to provide an arithmetic average (AA) roughness in the roll surface of about 60 microinches, as measured with conventional profilometer measuring equipment, the individual depressions associated with such roughness vary approximately from 0.0005 to 0.001 inch in depth and from 0.010 to 0.020 inch in diameter. It will be understood that further variation will occur from these figures because the electrical discharges are compounded on one another and act in this manner to alter the dimensions of the individual roughness features. Despite such phenomena, however, the individual depressions are always rounded and of comparable depth for a given electrical setting of the EDM equipment, and it is from this characteristic that the unique features of the surface finish of our invention are derived. Sharp corners are essentially eliminated. The roughness may vary from approximately 20 to approximately 400 microinches, but in most cases will be between 20 and 80 microinches. Increasing the intensity or size of the electrical discharge increases the roughness and decreasing the intensity or size of the electrical discharges lowers the roughness of the roll surface.

Since the time required to texture rolls to the smoother finishes can become prolonged, it may be advisable in some instances to provide deeper depressions than desired and then brush or otherwise smooth the surface of the roll to obtain a smoother finish. Care must be taken not to substantially alter the shape or other essential characteristics of the EDM type finish.

Since FIG. 3 is an enlarged photograph of a replica made of the surface of a work roll textured by Electric Discharge Machining methods, it represents the ideal strip surface finish obtainable when using our rolls. However, the work roll finish is superimposed to a degree over any other finish which the strip being rolled may possess, so that a perfect reproduction of the roll surface may not always be impressed into the steel surface. It is clear, however, that the EDM type of roll surface will generate a strip finish consisting of rounded topographical features of generally consistent shape and size. The regularity of shape and size of the topographical features of the EDM type surface shown in FIG. 3 are evident by contrast with the varying shape and size of the features of the shot blasted surface of FIG. 4.

While one embodiment of our invention has been shown and described, it will be apparent that other ad-

aptations and modifications may be made without departing from the scope of the following claims.

We claim:

1. A cold rolled metal sheet having a plurality of closely spaced low projections on at least one side thereof, substantially all of said projections having a generally frustospherical shape and substantially uniform height, said projections having been produced by cold-rolling through opposed rolls corresponding to the texture of the respective sides of said sheet, wherein the

frustospherical shaped projections of said corresponding rolls have in turn been produced by electrical discharge machining to remove metal from the surface thereof, to achieve a roll surface exhibiting an arthmetic average roughness within the range of 20 to 400 microinches.

2. A cold rolled metal sheet produced according to claim 1 in which the arithmetic average roughness of the roll surface is between 20 and 80 microinches.

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