FIG. 1.
FIG. 2.
FIG. 3.

REDUCTION REQUIRED FOR A 20° GLOSS OF 15, 20, OR 30
IN RELATION TO ROLLING SPEED

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FIG. 4.

REDUCTION REQUIRED FOR A 20° GLOSS OF 15, 20, OR 30
IN RELATION TO ROLLING SPEED

PERCENT REDUCTION

ROLL SPEED F.P.M.

15 GLOSS

20 GLOSS

30 GLOSS
METHOD FOR ROLLING STAINLESS STEEL

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ABSTRACT OF THE DISCLOSURE

This invention relates generally to the production of stainless steel, and, in particular to a method for producing stainless steel having a relatively dull surface finish. In accordance with the present invention, a dull surface finish is imparted to an initially bright stainless steel surface by using a lubricant during cold rolling while the strip is coated with a lubricant having a viscosity greater than about 200 SUS (Saybolt Universal Seconds at 100° F.) preferably 400 to 4000 SUS, with the optimum lubricant viscosity being within the range of about 1000 to 2000 SUS. By employing lubricants within these viscosity limits, 20 degree specular gloss ratings of preferably less than 40, and optimally of about 15 to 30, are achieved.

It is well known that stainless steel is used in decorative applications because of its bright reflective appearance. For instance, it is customary in the manufacture of trim for motor vehicles to use bright-finish stainless steel. This material, and consequently trim made therefrom, is highly reflective of sunlight. Consequently, bright stainless steel trim, particularly when it is located on a motor vehicle within the vision of the vehicle operator, as is the case with windshield wipers, can create a safety hazard by its glare and reflection. To eliminate this hazard, stainless-steel trim that is within the vision of the vehicle operator is desirably provided with a dull rather than a bright reflective finish.

While some dulled stainless steel has been previously produced by either chemical attack of the surface or by physical abrasion, such as grit or glass bead blasting, sanding or by using specially roughened work rolls during cold rolling, these methods have been proven generally time consuming, expensive and in many cases incapable of creating a uniformly dulled surface, which renders the product of inferior quality. As an example, the use of roughened work rolls during the last cold-reduction pass imparted to the steel delivers an acceptably uniform surface only until the rolls become smooth through use. The rolls therefore must be resurfaced frequently, which detracts from the economy of operation in that alternate sets of work rolls must be available at the mill, and the mill is subject to downtime for the period required to change work rolls.

It is accordingly the primary object of the present invention to provide a new and totally different method for producing flat rolled metal products such as stainless steel having a dull surface finish of improved uniformity, such being effected with standard rolling apparatus.

A further object of the invention is to provide a method for producing a dull surface on stainless steel during cold rolling without requiring special processing and apparatus such as the use of chemical agents or roughened work rolls.

A more specific object of the invention is to provide a method for producing a dull surface on stainless steel by using a high- viscosity lubricant on the material during a cold-rolling pass.

Another more specific object of the invention is to produce a dull surface finish on stainless steel by using a lubricant during a cold-rolling pass having a viscosity greater than about 200 SUS (Saybolt Universal Seconds at 100° F.) preferably 400 to 4000 SUS, with a lubricant viscosity within the range of about 1000 to 2000 SUS being optimum for the purpose.

These and other objects of the invention as well as a complete understanding thereof may be obtained from the following description and drawings, in which:

FIGURE 1 presents a series of curves showing the effect of viscosity and degree of reduction on surface finish of Type 343 stainless steel.

FIGURE 2 presents curves similar to those of FIGURE 1, except that they relate to Type 301 stainless steel.

FIGURE 3 shows a series of curves indicating the effect of rolling speed on the degree of dulling achieved at varying degrees of reduction on Type 434 stainless steel when using 1750 SUS viscosity lubricant; and

FIGURE 4 presents a series of curves similar to those of FIGURE 3 but with Type 301 stainless steel.

In the manufacture of stainless steel, it is customary practice to subject the material to a series of cold reductions and intermediate anneals. During cold reduction, a lubricant of a viscosity of about 35 SUS and at most 200 SUS is employed. Upon emerging from the final rolling pass, the material is characterized by an extremely bright highly reflective surface.

We have now found unexpectedly that metal surfaces may be dulled to controlled degrees without special equipment by employing during a rolling pass a lubricant having a viscosity substantially greater than that conventionally used. By way of example, for the purpose of automobile trim, 20 degree specular gloss ratings of 40 or less, preferably 15 to 30, and ideally about 20, are desired. We have found that the surface of stainless steel may be dulled readily to this degree or more during the final cold-rolling pass by employing a lubricant having a viscosity greater than about 200 SUS. Lubricant viscosities within the range of about 1000 to 2000 SUS are considered optimum. Under most conditions dulling in accordance with our invention is done during the final cold-rolling operation.

Any of the well-known natural or synthetic lubricants are suitable for use in the practice of the invention, so long as the necessary requirements with respect to high viscosity are met. For example, natural lubricants such as napthenic-base mineral oils, paraffin-base mineral oils, vegetable oils, as well as the silicone, phosphate ester, and glycol synthetic lubricants, may be employed.

Experimental work has shown, as will be described in greater detail hereinafter, that the degree of dulling imparted in the practice of the invention during cold rolling can be controlled by regulating several processing parameters. Foremost of these parameters is the lubricant viscosity, since it must exceed the previously stated minimum before it is effective as an agent for dulling the surface of the steel. Additionally, the speed of the steel through the rolling mill and the degree of reduction in the mill will also affect dulling.

The limits with respect to lubricant viscosity have been stated hereinabove and are clearly demonstrated by the curves presented in FIGURES 1 and 2. A lubricant viscosity of about 200 SUS is the minimum that can be used to produce a dull finish in accordance with our invention. Lubricants having a viscosity of about 1000 SUS to 2000 provide optimum operation because the desired degree of surface dulling can be achieved with minimal cold-rolling reduction. Application difficulties are encountered with lubricant viscosities exceeding about 4000 SUS.

As a specific example of the practice of the invention, Types 343 and 301 austenitic stainless steel samples were subjected to cold reductions using a napthenic-base mineral oil at viscosities of 1750, 1000, 200 and 100 SUS, and 4128 SUS with a paraffinic oil. The percent reduction...
at each lubricant viscosity was varied between the limits of about 4 to 42 to 55 percent. After rolling under these conditions, the samples were tested and their reflectivity determined in accordance with a 20 degree specular gloss rating.

The results of these experiments are presented in FIGURES 1 and 2. It may be seen from these figures that the degree of dulling generally increases as lubricant viscosity and reduction increase. Above about 1000 SUS, the degree of dulling does not change drastically in accordance with viscosity changes. At 100 SUS the desired degree of surface dulling could not be achieved.

FIGURES 3 and 4 report the results of Types 434 and 301 stainless steel, respectively, dulling in accordance with the invention. During these tests 20 degree specular gloss ratings of 15, 20, and 30 were achieved using a naphthenic base mineral oil lubricant at a viscosity of 1750 SUS.

As may be seen from the figures, as the rolling speed of the steel through the rolling mill increased, less reduction was required to achieve any given degree of dulling. At a rolling speed of about 130 to 160 feet per minute, the effect of further rolling-speed increases with respect to promoting dulling began to diminish.

The above-reported data show that at a lubricant viscosity of 100 SUS, the required dulling could not be achieved within desired reduction limits. Unexpectedly, when the lubricant viscosity was increased to 200 SUS, surface dulling to the desired degree resulted within acceptable reduction limits. When the viscosity was increased to within the range of about 1000 to 2000 SUS, specifically 1750 SUS, dulling to the desired degree was achieved over a wide range of reductions. Dulling was achieved to the extent desired with lubricant viscosities as high as about 4000 SUS.

The desired dulling is achieved within the above-stated lubricant viscosity limits by maintaining substantially complete and continuous separation between the work-roll surfaces and the workpiece surface during rolling. The separating fluid film, under pressure, imprints the workpiece surface producing a dull appearance. If this separation is not maintained, brightening or inadequate dulling of the workpiece surfaces will result; the degree of the brightening effect will increase correspondingly with increases in the amount of contact between the surfaces of the work rolls and workpiece.

It may be seen from the above that by the practice of our invention the surface finish of stainless steel after final cold reduction may be made dull to any desired degree without requiring any major changes in the rolling apparatus over that employed in producing typical bright finish Stainless steel. Specifically, it is not necessary to use roughened work rolls to achieve dulling as was typical prior to our invention. Hence, conventional stainless steel processing equipment may be used to alternately produce bright or dull stainless steel depending upon the needs of the customer.

The 20 degree specular glass rating is conducted in accordance with ASTM Test Method D 523. It is to be understood that the invention has primary application in the dulling during reduction of stainless steel having a characteristic bright surface finish. However, the invention could also be used to further dull, during rolling, stainless steel having an initially dull surface finish, such as that produced by a pickling operation.

Although various specific preferred embodiments of the invention have been described herein, it will be obvious to those skilled in the art that other adaptations and modifications may be made without departing from the scope and spirit of the appended claims.

What is claimed is:

1. A method for producing a dull surface finish on stainless steel comprising, subjecting said steel to a cold-rolling pass reducing the thickness thereof, and providing a lubricant of a viscosity within the range of about 400 to 4000 SUS at 100° F. between the surfaces of work rolls employed during cold-rolling and the steel when the reduction is being effected to dull the surface of said steel, said lubricant maintaining substantially complete and continuous separation between the work rolls and steel during reduction.

2. A method according to claim 1 wherein the lubricant viscosity is within the range of about 1000 to 2000 SUS.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,496,746       Dated February 24, 1970

Inventor(s) Harry L. Murphy et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

After the title, names of the inventors and their addresses, please change the assignee "Crucible Inc., a corporation of New Jersey" to "Crucible Inc., a corporation of Delaware--.

SIGNED AND SEALED
AUG 25 1970

(Seal)
Attest:
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