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SCRATCH-RESISTANT WHITE-SILVER CHROMIUM PLATED STEEL PLATE

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ABSTRACT OF THE DISCLOSURE

An improved chromium coating of steel plate is obtained by applying a chromium coating of 0.005 micron–0.1 micron thickness on the plate which has been matte finished, said steel plate having a surface roughness of 0.8 micron to 3 micron in term of Hr.m.s. The treated steel plate is characterized by good scratch resistance in the non-lacquered state and excellent surface appearance in the lacquered state.

This invention relates to an improvement of the invention described in Japanese Patent No. 308,065 relating to the production of chromium treated steel plate by applying about 0.00005 mm. thickness of chromium coating directly on ordinary carbon steel plate or strip to provide various improved qualities such as good adherence with lacquer coatings, corrosion resistance, workability such as bending and drawing quality, heat resistance during baking finish, bright and good lacquered surface and atmosphere resistance in the final lacquered product. According to the above Japanese patent the commercially effective thickness of chromium coating resulting in the above desirable properties (qualities) is 0.005–0.1 micron.

Now, in case the steel plate has a smooth finish and its surface roughness is not more than about 0.1 micron in Hr.m.s., a chromium coated surface having metallic lustre is obtained. And when lacquer coating is applied on such chromium coated surface, a bright lacquered surface is obtained after lacquering.

However, such a chromium plated steel plate with smooth finish has a disadvantage in that a clear white-silver lacquered surface is hard to obtained in some cases where a certain type of lacquer is applied; for example when the chromium plated steel plate is used for a crown and a white coating is applied.

Further, when such a chromium plated steel plate is used in some other applications where no lacquer coating is applied, such as a motor oil can, paint can, detergent can, such a chromium plated steel has a disadvantage in that scratches easily take place during the roll forming operations in the non-lacquered state.

Therefore, one of the objects of the present invention is to completely solve the above disadvantages and to provide a chromium plated plate steel with good scratch resistance in the non-lacquered state and excellent surface appearance in the lacquered state without sacrificing its excellent properties.

The main feature of the present invention therefore lies in that a 0.005 micron–0.1 micron thickness of chromium coating is applied directly on the steel plate which has been matte finished.

Suitable surface roughness of the matte finished steel plate according to the present invention is from 0.8 micron to 3 microns in terms of Hr.m.s., preferably from 1 micron to 1.5 micron. Below 0.8 micron, good surface appearance in the lacquared state and good scratch resistance in the non-lacquered state cannot be obtained, while

above 3 microns, surface roughness will be undesirably excessive. Therefore, the appropriate roughness of matte fiinished steel plate is from 0.8 micron to 3 microns in terms of Hr.m.s.

In the field of tin plate, it is conventionally known to apply tin coating to a steel plate of suitable surface roughness and in an effort to make scratches inconspicuous, a so-called rough surfaced tin plate has been developed. The roughness of such tin plate is from 0.3 micron to 0.35 micron in terms of Hr.m.s. The surface apperance in this case, however, is noticably dull and no attempt to improve surface appearance is made. On the other hand, the so-called matte finish means the surface roughness of steel plate is not less than about 1 micron i.e. about 0.8 microns in terms of Hr.m.s.

The present invention therefore comprises providing the steel plate with a surface roughness of about 0.8 micron to 3 microns in terms of Hr.m.s. and then applying a chromium coating of 0.005 micron to 0.1 micron on said steel plate, whereby scratch-resistance in the non-lacquered state and excellent surface appearance in the lacquered state can be provided in addition to the excellent properties of thin chromium plated steel plate.

It has been found through experiments that with a thin chromium plating of 0.005 micron to 0.1 micron, the roughness of chromium plated surface is remarkably controlled by the surface roughness of starting steel plate, and thus the appearance of chromium plated surface is largely affected by the roughness of the starting steel plate which is used. In the case of tin plate, the thickness of tin plating is more than about 0.3 micron, which is thicker than the chromium plating according to the present invention, and therefore, even when the roughness of steel plate is increased, the roughness of tin plated surface does not provide any noticeable influence or improvement.

Now, since scratch-resistance depends largely on the surface roughness, it is understood that much better scratch-resistance can be obtained in the present invention than tin plate when the same surface roughness is used.

In general, both for tin plate and chromium plated plate, an advantage that scratches can be made inconspicuous is obtained by providing the plate with certain roughness and then applying dull finish to the plated surface.

However, the present invention aims not only to make scratches inconspicuous by improving the surface appearance but prevent positively occurrence of scratches. In this point, chromium plated steel plate with matte finish according to the present invention is remarkably different from the conventional tin plate.

According to the present invention, whate-silver bright lacquered surface is obtained by applying white coating of an epoxy or vinyl type, and thus chromium plated steel plate having a surface appearance of particularly higher commercial value than plated steel obtained from smooth finished plate can be obtained.

Further, chromium plated steel plate having similar surface appearance can also be obtained by applying a transparent lacquer coating of an alkyd type, for example.

Further, the chromium plated steel plate of matte finish according to the present invention has another advantage in that when it is used without lacquer coating, substantially no scratches result during the can forming operation, and scratch resistance of the present chromium plated steel plate is much better than that of the conventional tin plate with the same roughness.

The present invention will be described in more detail in the following example. However, this example is deemed to be illustrative and not limitative of the present invention.

EXAMPLE

Cold-rolled steel plate of 0.25 mm. thickness which had been matte finished (roughness of 1.3 micron Hr.m.s.) was subjected to electrolytic degreasing in a degreasing liquid containing 5% sodium hydroxide at 90° C. under current density of 10 a./dm.^{2} for four seconds, followed by washing, acid pickling in 100 g./l. sulfuric acid for four seconds and washing. Then the steel plate was subjected to electrolysis in an electrolyte maintained at 50° C. and containing 250 g./l. of chromic anhydride and 2.5 g./l. of sulfuric acid under current density of 40 a./dm.^{2} for five seconds using the steel plate as cathode to obtain 0.05 micron chromium plating thereon. The steel plate was then washed and dried, and coated with 3 mg./m.^{2} of cotton-seed oil to complete the chromium plating operation.

The chromium plated steel plate thus obtained was subjected to a loaded scratch test. No scratches were observed even after thirty times of scratching. On the other hand, scratches were observed on a chromium plated steel plate of smooth finish after ten times of scratching. In the case of a tin plate of matte finish having similar roughness, scratches were observed after twenty times of scratching.

Further, a white epoxy-type coating was applied on the chromium plated steel plate obtained above and a clear white-silver coating surface was obtained.

As seen from the above description, the present invention provides good scratch-resistance in the non-lacquered state and good surface appearance (color tone) in the lacquered state in addition to the excellent improved properties obtained by the invention described in Japanese Patent No. 308,065. Thus the commercial value of the present invention is very important.

In the present invention, either or both sides of the steel plate may be matte finished and chromium plated depending upon particular applications.

What is claimed is:

1. A scratch-resistant white-silver chromium plated steel plate obtained by applying 0.005 micron to 0.1 micron of chromium plating directly on steel plate which has been matte finished, said steel plate having a surface roughness of 0.8 micron to 3 microns in term of Hr.m.s.

2. A scratch-resistant chromium plated steel plate according to claim 1 in which the steel plate is matte finished on one side or on both sides thereof.

3. A scratch-resistant chromium plated steel plate according to claim 2 in which a resinous or lacquer coating is applied on the chromium plating.

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