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METHOD OF MAKING TIN-PLATE

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1 Claim. (Cl. 148—16)

This invention relates to the manufacture of tin-plate and, in particular, to the annealing of cold-rolled steel strip, commonly called black plate, prior to coating with tin by the electrolytic or hot-dip method.

Most of the tin-plate now being produced is made from low-carbon steel strip which has been hot-rolled to intermediate gage, pickled, cold-rolled substantially to final gage, cleaned, annealed, temper-rolled and then coated with tin, usually by the electrolytic process. The annealing is usually carried out in a controlled atmosphere such as that designated "HNX," containing little or no water vapor, as evidenced by a dew point of the gases supplied to the furnace between —20 and —60° F. Tin-plate so produced is satisfactory for most container applications. When used for packing acid foods such as prunes and tomatoes, however, its corrosion resistance is not as high as is desired. This may result from various factors or a combination thereof.

I have invented a method of making tin-plate characterized by a greatly improved corrosion resistance so that it may be used for packing acid foods. In accordance with my invention, I carry out the annealing of the strip after cold-rolling in a "wet" atmosphere, i.e., a mixture of protective gases such as hydrogen and nitrogen containing a substantial amount of water vapor as evidenced by a dew point of the entering gases between 10 and 70° F.

In a preferred practice of the invention, I take hot-rolled strip about .070" thick, of steel containing about .08% carbon, about .40% manganese and minor amounts of the impurities usually present in such steel and, after pickling, cold-roll it substantially to gauge, i.e., about .010". After cleaning, the strip is then annealed, conveniently by drawing it in single ply through a continuous, tower-type furnace wherein it is heated progressively to from 1050 to 1350° F., preferably about 1200° F. A protective atmosphere is supplied to the furnace to prevent oxidation of the strip while at elevated temperature. The strip is held at annealing temperature from a few seconds to two or three minutes, conveniently about 60 seconds, and is then cooled quickly to atmospheric temperature. Thereafter, it is coated with tin by any desired process, preferably by electroplating in the known manner.

The protective atmosphere is composed largely of nitrogen with from 1 to 10% hydrogen and less than 1% of carbon monoxide and carbon dioxide together. A typical composition (except for water vapor) is hydrogen 5%, carbon monoxide less than .3%, carbon dioxide less than .3%, and substantially the balance nitrogen. According to

my invention, the atmosphere also contains a substantially quantity of water vapor. That is, the gas is relatively "wet" instead of being substantially dry as heretofore. More specifically, the protective atmosphere which I employ contains water vapor giving a dew point between 10 and 70° F., more particularly between 25 and 50° F., and preferably about 35° F. This atmosphere is strongly decarburizing in the temperature range stated above. The annealing may be carried out with the strip in coils, using cover-type furnaces or in single ply, using a conventional tower-type furnace.

I find that tin-plate made by my improved process has greatly improved corrosion resistance. This is shown by a marked reduction in the iron-solution values, particularly those above 20. While the reason for the observed increase in corrosion resistance is not entirely clear, it may be that the "wet" atmosphere in which the annealing is conducted removes, or changes to a removable form, material on the cold-rolled and pickled strip (black plate) which tends to impair the corrosion resistance of the final product, whether electrolytic or hot-dipped tin-plate. The improvement noted in the product characteristics is believed to result from a surface-cleaning action caused by shifting the equilibrium conditions of oxidizing, reducing, carburizing and decarburizing tendencies of the atmosphere. The moisture content of the gases is controlled in a simple manner, i.e., by omitting or reducing the drying treatments such as cooling or absorption, to which the gases have heretofore been subjected for removal of water vapor, or by adding water vapor directly to the entering gases as needed.

Although I have disclosed herein the preferred embodiment of my invention, I intend to cover as well any change or modification therein which may be made without departing form the spirit and scope of the invention.

I claim:

A method of making tin-plate which consists in cold-rolling low-carbon steel strip substantially to tin-plate gage, annealing the strip by heating it to a temperature between 1050 and 1350° F., maintaining about the strip during annealing a protective atmosphere which is strongly decarburizing in said temperature range, consisting of about 5% hydrogen, less than .3% carbon monoxide, less than .3% carbon dioxide and substantially the balance nitrogen except for water vapor in an amount such as to impart to the atmosphere a dew point between 25 and 50° F., and applying a coating of tin to the annealed strip.

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