PROCESS OF MAKING CORRUGATED GALVANIZED STEEL SHEETS

Filed Nov. 26, 1945
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Application November 26, 1945, Serial No. 630,907

3 Claims. (Cl. 29—148)

1. My invention relates to the manufacture of corrugated galvanized steel sheets of the type commonly used for roofing. The object of the invention is to produce a high-strength, lightweight corrugated galvanized sheet that is also relatively inexpensive, in contrast with the high cost of such sheets heretofore produced by the use of alloy steels and other expensive practices.

The invention consists principally in the discovery that certain operations heretofore considered essential to make the sheet sufficiently ductile to be corrugated, but which have the disadvantage of softening and weakening the sheet, may be dispensed with, thus providing a stronger sheet with an ordinary steel base of the kind commonly used and at a cost no greater (in fact, possibly less) than the cost of making ordinary corrugated galvanized sheets. The invention further consists in the process heretofore described and claimed, and in the corrugated galvanized steel sheet made by said process.

Fig. 1 is a diagrammatic view showing operations that are common to the conventional process now in use and to my improved process. Fig. 2 is a diagrammatic view showing operations in the conventional process, some of which are omitted entirely from my process and one of which is considerably modified; and Fig. 3 is a diagrammatic view designating the conventional steps not used in my process and also showing the steps of my process that take the place of the conventional steps of Fig. 2.

Conventional process

It is believed that the invention can best be understood by setting forth the conventional process of making corrugated galvanized sheets from ordinary low carbon steel, either rimmed or semi-killed. The essential steps of the process commonly practiced are as follows:

Select a steel ingot A of standard or desired dimensions, say 16 inches by 30 inches by 60 inches, strip the incast from its mold, reheat it in a soaking pit to about 2250 degrees Fahrenheit and hot roll it down to a slab B in a slab mill B. A typical slab B is approximately 4½ inches thick by 28½ inches wide by 170 inches long.

After rolling, the ends of the slab are cropped off and the slab is reheated in a furnace C to about 2250 degrees Fahrenheit.

The scale is removed by means of hydraulic sprays and the slab is roughed down in a roughing mill D, the drawing illustrating a three-high mill through which the slab is passed from seven to eleven times.

Again the scale is removed with hydraulic sprays and the work is further reduced to a sheet e having a thickness of approximately .075 inch, the drawing illustrating a four-high five stand continuous mill E which is suitable for this operation.

The reduced sheet e is recoiled in a suitable coiler F.

After the coil f has cooled, it is run through a pickler G, where the scale is removed, the acid rinsed off, the surface oiled and the material recoiled.

The pickled coil g is further reduced in a cold strip mill H to a thickness of approximately .0152 inch and again recoiled with coil h.

The cold reduced coils h are annealed in a furnace I and the material in each coil j is then temper rolled in a temper mill J to give the necessary stiffness to the temper rolled material j to permit subsequent galvanizing thereof.

The material of the coils j is cut into sheets k of a flying shear K and the oxide normally resulting from the annealing operation and subsequent handling is removed in a pickler L, by means of sulfuric acid or other suitable material.

The sheets k are then fed into a hot dip galvanizing pot M, where they pass through a hydrochloric acid dip, through a hot salammoniac flux, through a molten zinc and finally through exit rolls to give the coating the proper thickness and other characteristics. The galvanized sheets m are corrugated by passing between the corrugated rolls n of a corrugating machine N and the corrugated sheets n are then ready for shipment.

A common roofing sheet is known as "2½-inch corrugated," although the corrugations are actually 2.67 inches from center to center. In corrugating the sheets, due allowance must be made for the resilience of the tempered material and the conventional corrugating rolls n for the material commonly used have a spacing of 2.65 inches from center to center of their corrugations. After removal from the dies, the resilience of the material in the sheets n causes the corrugations thereof to resume the desired spacing of 2.67 inches from center to center.

New process

My improved process is based upon the discovery that the conventional operations of annealing, temper rolling and pickling after temper rolling may be omitted. In the typical cold reduction described in the conventional process, the resulting strip h has a tensile strength of about
95,000 pounds per square inch. The annealing operation used in the conventional process reduces this tensile strength of the annealed coil to about 45,000 pounds per square inch necessitating a temper rolling operation as above described. These values will vary, of course, with the material, the amount of cold reduction and the type of annealing operation.

I have discovered that notwithstanding the low ductility or the cold reduced strip h, particularly across the direction of rolling, it is, nevertheless, possible to obtain flat, so that the final product does not have any sharp bends in its contour.

I have discovered that it is necessary to compensate for the lower ductility of the unannealed material by providing corrugating rolls O1 with a closer center-to-center spacing of corrugations O2. For instance, in the production of the so-called 2½-inch corrugated roofing above mentioned, the center-to-center spacing of the die corrugations is 2.35 inches, instead of the 2.65 inches spacing in conventional rolls N2 for corrugating annealed sheets.

Elimination of the annealing operation I obviously avoids the necessity for the temper rolling operation J, as the cold reduced material has a tensile strength far above that produced by temper rolling an annealed sheet. Elimination of the annealing operation also avoids the necessity for the pickling operation L before galvanizing, since the surface of the cold reduced sheet is protected by the rolling solution and is not so subject to oxidation as is an annealed sheet. It is possible, therefore, to clean the rolling solution from the cold reduced material, cut or shear it into sheets of proper length for roofing, as at K1, galvanize the sheets by any suitable method, as by a hot dip method M1 and corrugate the galvanized sheets in a corrugating machine O, the corrugating operation compensating for the greater resilience of the unannealed cold reduced material by providing an initial center-to-center spacing of corrugations O2 less than in the case of conventional material.

From the above it will be seen that my improved process has only the following essential steps:

1. Hot roll an ingot A of any suitable low carbon steel to a slab B, as in B.
2. Hot roll the slab to a strip having a thickness of approximately .100 inch to .075 inch and remove scale by pickling.
3. Apply rolling solution (oil) and cold reduce the strip to the desired thickness for a roofing sheet, as approximately .050 inch to .049 inch.
4. Clean the rolling solution from the strip.
5. Cut the strip into sheets K2 of the desired length for roofing material in a flying shear K1.
6. Galvanize the sheets, as by hot dipping, as at M1.
7. Corrugate the galvanized sheets M1, using corrugating rolls O1 having a center-to-center spacing of corrugations O2 less than that of standard dies for making the same finished corrugations in conventional annealed and temper rolled sheets, so as to compensate for the increased resilience of the unannealed material used in my process, as in the typical example above set forth.

My process is no more expensive than the conventional process and may be somewhat less expensive, due to the omission of the annealing, temper rolling and pickling operations. The finished product is stronger for a given thickness of sheet or a given strength may be obtained with a sheet of less than standard thickness. The strength of the material is such that it can be easily handled both in the galvanizing operation and in applying it to a roof.

The numerical values hereinbefore set forth are for a particular product only and are obviously subject to variation.

What I claim is:

1. The process of making corrugated galvanized steel sheets, which comprises galvanizing cold reduced strip material, omitting the conventional annealing, temper rolling and pickling operations and then corrugating such sheets to produce a sheet having greater resilience than sheets produced by the said conventional operations, the corrugating operation providing an initial shorter center-to-center distance between corrugations than in the case of conventional sheets that have been annealed and temper rolled, the resilience of the sheets causing them to elongate and have a final center-to-center distance between corrugations to be the same as in the case of said conventional sheets.

2. The process of making corrugated galvanized steel sheets, which comprises applying rolling solution to a low carbon steel strip, cold reducing said strip, cleaning said rolling solution therefrom, omitting the conventional annealing and temper rolling operations, shearing said strip into sheets, galvanizing said sheets and then corrugating said sheets, said corrugating step providing a center-to-center distance between corrugations that is less than in the case of conventional practice wherein the sheets have been annealed and temper rolled.

3. The process of making corrugated galvanized steel sheets, which comprises hot rolling an ingot of low carbon steel to a slab, hot rolling said slab to a strip, removing scale formed during said rolling operations, applying rolling solution to said strip, cold reducing said strip, cleaning said rolling solution therefrom, omitting the conventional annealing and temper rolling operations, shearing said strip into sheets, galvanizing said sheets and then corrugating said sheets, said corrugating step providing a center-to-center distance between corrugations that is less than in the case of conventional practice wherein the sheets have been annealed and temper rolled.

NICHOLAS P. VESSELD.

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