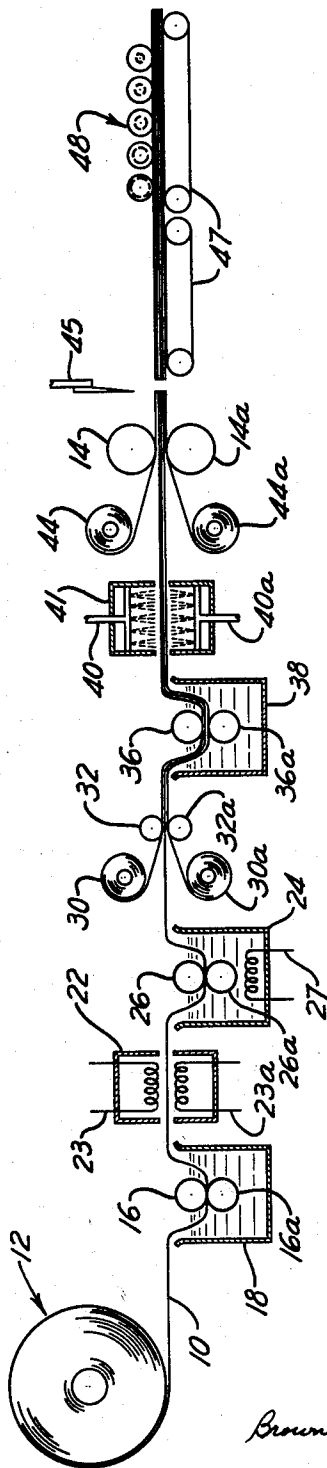


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PROTECTED METAL ARTICLES

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3,147,546

PROTECTED METAL ARTICLES

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This invention relates to protected metal articles that serve as sidewall and roofing panels and the like in the construction industry.

Protected metal articles, such as building panels, are commercial products that are widely produced and used. Typically these products comprise a sheet of a metal, such as aluminum or galvanized steel, that is covered with a coating material of a quality and character indicated by the end use of the panel. For example, the coating may be merely of a decorative nature for outside wall uses. Where an open flame or similarly hazardous situation exists, the panel may be covered with an asbestos layer to insulate the panel and prevent the conduction of heat to the remainder of the building. Roofing panels characteristically are coated with a weather resistant compound. Generally, all of these panels are corrugated and accordingly, one of the final steps of the processing is to mechanically deform a flat sheet provided with the desired covering to corrugate it.

The manufacture of materials of the character described is largely a hand operation. Prior to the present invention, no means of which we are aware, have been available to make such protected metal articles in a continuous fashion. Yet to maintain the commercial status of these articles, it is evident that substantial reduction in the cost of manufacture is essential. The present invention includes a continuous method of producing protected metal articles of the type hereinafter described.

It is therefore a primary object of the present invention to provide a process for the production of mechanically deformed protected metal articles, such as panels for the construction industry, which method is largely free from hand operation, and is characterized by producing a standardized product economically, rapidly, and having excellent characteristics for the intended use.

As noted above, protected metal articles comprise a metal having a protective coating on the surfaces. Frequently, intermediate coatings are also used, for example, to minimize corrosion, or to facilitate the adherence of the top coating. These materials are applied in the molten or liquid state. The use of continuous operations in producing such articles has been avoided in view of the difficulty in moving sheet material with a molten coating on it, and the destruction of such coating by the usual means used for continuous operations. Hence, prior to the present invention no continuous process for the manufacture of the protected metal articles, of the type hereinafter specified, has been available to the art.

A particular problem that has characterized this art is the occurrence of defects in the surface coat as a consequence of mechanical deformation, i.e. the corrugation. The mechanical operations can displace the coating, crack it or cause bubbles or delamination. Upon marring the coating material, its decorative and protective value may be effectively destroyed.

In accordance with the present invention, these and other problems have been overcome and a process is defined whereby articles, such as sheet material, are produced continuously without adversely affecting the coating materials. These advantages result largely in consequence of our discovery of applying to a metal core, protected metal article prior to the time that the outer or topcoat is wholly solidified, a thin plastic film continuous-

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ly over the entire topcoat. This film is suitably pressed lightly to the topcoat. By this operation, we have found that a coated article on a line by which it can be manufactured can be drawn through pull rolls without delamination and without stripping any of the topcoat from the metal core or sub-coats. Furthermore, the thus protected metal article can then be passed through a corrugating die or through rollers whereby the desired mechanical deformation is brought about without in any manner adversely affecting the coating. At this point, the plastic film can be removed by simply pulling it off. Preferably, however, it is permitted to remain in place because it provides a degree of protection during the shipping and installation of these materials, as in forming a building. The plastic sheet can be removed just as readily after the lapse of time inherent in shipping and installation of these materials.

The invention will be readily understood upon considering its description in conjunction with the attached drawing which illustrates the preferred method by which the invention can be practiced.

Referring to the drawing, the sheet or strip 10 of metal to be coated is provided in the form of a roll 12. The sheet is extended completely through the processing line to a pair of opposed pull rolls 14 and 14a that provide the force for moving the sheet through the various operations. Small conveyors (not shown) can be used at several points throughout the line both for conveying and support, if needed or desired for any reason.

The metal is cleaned, if necessary, to remove dirt, grease, and the like by any conventional means known to the art, such as an alkali cleaner. Where desired, a phosphate coating is applied to the sheet, though that is an optional procedure. Thereafter, a surface treatment is applied to minimize corrosion. For this purpose, a vinyl-epoxy resin containing red iron oxide is applied to the surfaces of sheet 10 in a thin layer. A typical composition, in weight percent, that can be used is as follows:

	Percent
Vinyl resin	33.0
Methyl ethyl ketone	40.0
Epoxy resin	7.0
Amine curing agent	0.2
Rust inhibiting pigment	19.8

Other thermosetting resins can be used if desired for this purpose. This coating is applied by passing sheet 10 between heated rollers 16 and 16a immersed in a tank 18 containing the anti-corrosion melt at about 400° F. The rolls 16 and 16a serve to insure that the entire sheet is covered and minimize the thickness to any desired level. Heat can be readily applied to these and other rollers by steam injected against their inside surface.

As the sheet emerges from the tank 18, it enters an oven 22, having heating means 23 and 23a therein, where the coating is baked by heating it sufficiently to raise the temperature of the coating and sheet to about 300° F. The heated sheet leaving the oven then is passed through a bath of an adhesive in a tank 24. A typical adhesive contains components such as rubber, an asphaltic material and a plasticizer as follows, in weight percent:

25 to 60% of a rubber—e.g. natural, butyl, isobutylene, isoprene
35 to 65% of asphaltic materials—e.g. asphalt, gilsonite, synthetic or natural pitch
5 to 15% of plasticizer—tackifier as commonly used in rubber adhesives

The bath of adhesive is maintained at a temperature of about 500° to 525° F., which is above the temperature of the sheet so that sufficient fluidity is imparted to it and a thin and continuous layer can be applied readily. To ob-

tain the thinness and continuity in the adhesive layer, it is advantageous to run the sheet in the bath through pressure rolls 26 and 26a maintained in that tank; suitably, the pressure rolls are heated to about 300° F. or higher by a heater 27 in the bath so that the adhesive will not tend to adhere to the rolls. A pressure of about 70 to 80 lbs./square inch on the rolls has been found adequate for the foregoing purpose.

The function of the adhesive is to retain a covering of asbestos on the metal article. Therefore, the sheet from the tank of adhesive is guided between opposing rolls 30 and 30a of a saturated asbestos paper, preferably one that has been treated with flame retarding materials. The continuous sheets of asbestos paper are forced against the sheet 10 by heated rolls 32 and 32a to permit the adhesive on the sheet to penetrate the fibers of the asbestos paper. If a colored product is desired, it is applied to the surface of the asbestos paper at this time by feeding it through a hopper or other spreader (not shown) and passing the resulting sheet through a set of rolls (not shown) to apply the color uniformly across the sheet. Alternatively and preferably, the coloring matter is applied along with a topcoat. A typical example of a mixture of topcoat including a color pigment is as follows, in weight percent:

	Percent
Short oil alkyd (100%) -----	55
Extender pigments -----	14.8
Modified phenolic hard resin -----	4.3
Tinting pigments -----	24.0
3% fused cobalt -----	0.6
Wax -----	1.3

The topcoat is applied in the molten state at a temperature of about 500° F., by passing the asbestos covered metal sheet through rolls 36 and 36a immersed in a tank 38 of the composition. The rolls are heated to a temperature on the order of 450° F. Thereafter, the topcoat is sprayed with a solution of methylcellulose through nozzles 40 and 40a in a spray chamber 41. Thus, a film is produced over the topcoat that serves as an anti-sticking agent. The methylcellulose solution is relatively cold as applied to cool, and therefore harden, the topcoat.

At this point, the coated sheet is essentially ready for corrugation. Passing such a sheet through a corrugating die or through a series of rollers adapted to roll a corrugation into the sheet has been found to be disadvantageous because the coats become marked, are displaced and their uniformity of thickness is adversely affected.

In accordance with the present invention, these disadvantages are avoided by applying to the surfaces of the coated sheet, prior to mechanical deformation, a thin continuous plastic film. Accordingly, such a plastic film is applied to each of the surfaces of the coated sheet from rolls 44 and 44a of the plastic and the resulting unit is advanced through the pulling rolls 14 and 14a. The anti-sticking agent limits the strength of the bond to the film, but the film does adhere firmly to the article. The plastic film that we have used most generally is a thin gauge polyethylene film. Our unique results, therefore, are considered particularly surprising because such a film is wholly flexible and it would be thought that the pull rolls or corrugating die would mark the coating or move it through such a sheet. Surprisingly, however, that does not occur.

The coated sheet with the plastic film in place is cut to the desired length as it comes from the pull rolls 14 and 14a by a cutting means 45. The cut sheets are carried by a conveyor system 47 to the forming means. These

lengths are then corrugated. In our invention, forming is accomplished by a set of rollers 48, for unlike most corrugating dies, rollers can process a variety of sizes without the necessity of changing operating conditions or dies.

Panels produced in accordance with the foregoing example have remarkable properties. The use of the plastic sheet insures essentially perfect surfaces after installation despite all the rough handling between the points of manufacture and use. The coats are continuous and free from the pin-holes frequently observed in this type of material. The abrasion of 200 liters of sand over a surface has been found to have no adverse effect. Adhesion is so sound that immersion of a coated panel in 1% sulfuric acid at room temperature for 30 days was accomplished with no peeling from the steel core. Immersion in a 3% salt solution at 100° F. for a week leaves no evidence of blistering or delamination. Tests have also shown the soundness of the units over a wide temperature range of as low as minus 40° F. to a temperature considerably above the usual ambient.

From the foregoing discussion and description, it is evident that our invention provides an effective continuous process for the production of protected metal articles, such as building panels. While some modifications can be made to the invention, it should be appreciated that the compositions processing conditions noted have been found essential to the successful operation of the invention.

According to the provisions of the patent statutes, we have explained the principle of our invention and have illustrated and described what we now consider to represent its best embodiment. However, we desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

We claim:

1. A method of manufacturing a metal core sheet comprising coating a sheet of metal with an antioxidant, baking said coating to harden it, applying an adhesive in the form of a uniform film to said baked coating, then applying an asbestos layer to the adhesive, topcoating said asbestos, covering the resulting top-coated asbestos with a continuous thin film of plastic, and subjecting the coated metal through said thin plastic film to mechanical treatment to provide the desired shape.

2. In the preparation of a corrugated metal core sheet in which a layer of asbestos is joined to a metal sheet, a topcoat is applied to the asbestos and the resulting metal core sheet is mechanically deformed to corrugate it, the improvement comprising applying to the surfaces of said topcoated asbestos prior to said mechanical deformation a thin continuous plastic film, lightly pressing said thin plastic film to said topcoat and then mechanically deforming the resulting article to corrugate it.

3. A method in accordance with claim 1 in which said plastic film is stripped from said article after mechanical treatment.

4. The method in accordance with claim 2 in which said thin continuous plastic film is a film of polyethylene.

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