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METHOD OF MAKING A PROTECTED METAL ARTICLE

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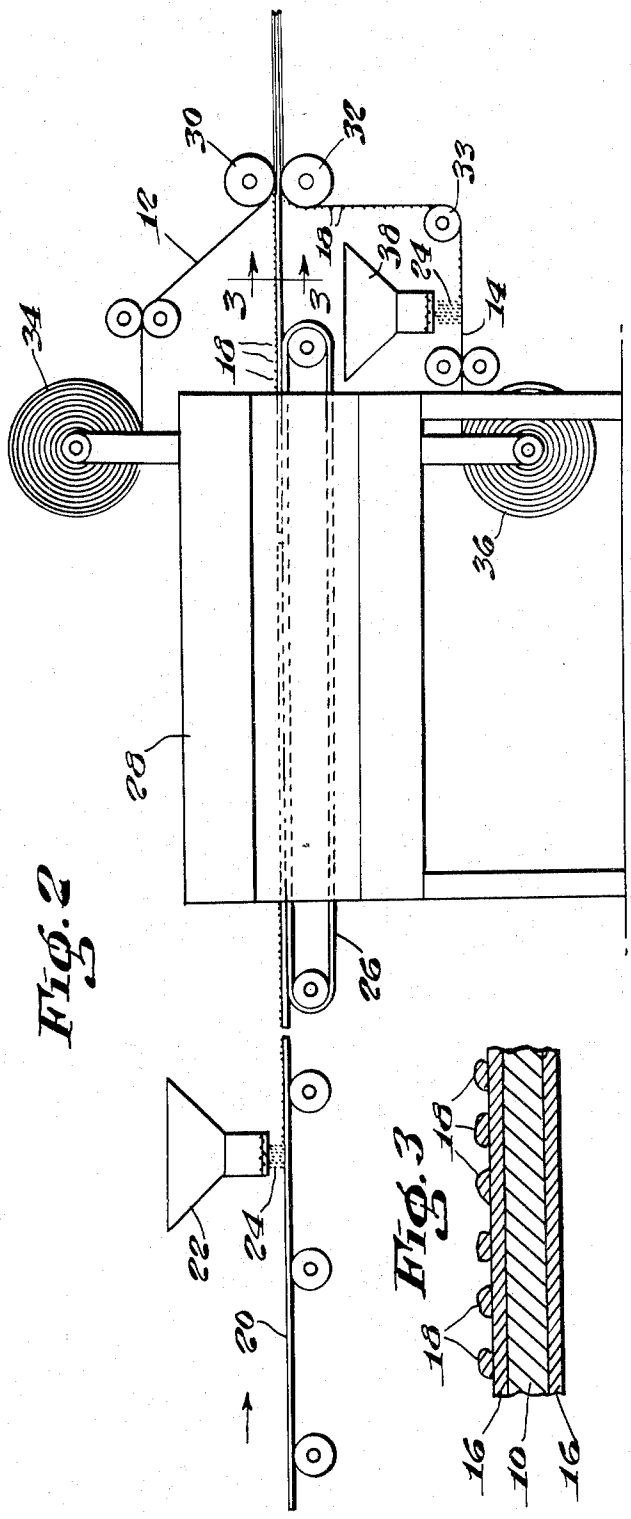


Fig. 2

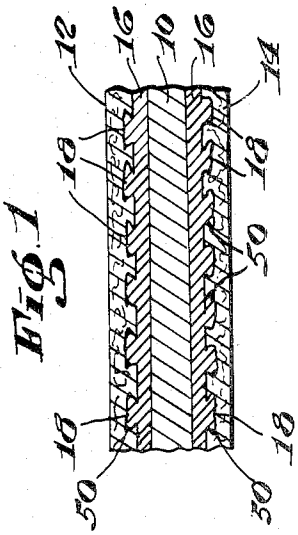


Fig. 1

Fig. 3

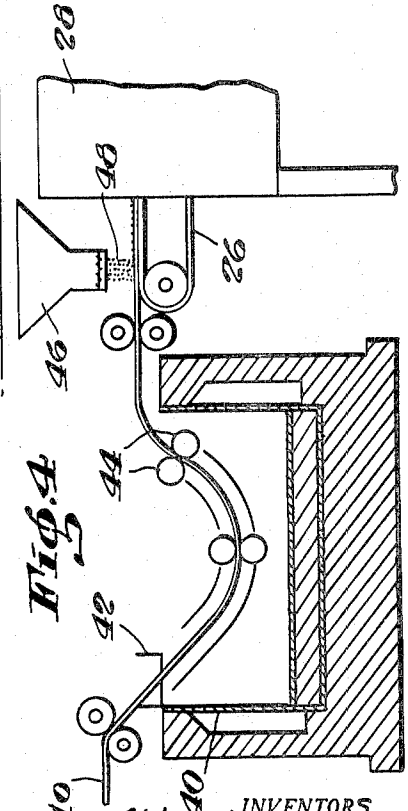


Fig. 4

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METHOD OF MAKING A PROTECTED METAL ARTICLE

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4 Claims. (Cl. 29—472.9)

This invention relates to a method of making a protected metal article.

The object of the invention is to provide a novel and superior process for producing protected metal articles of the type disclosed in the United States patents to Coffman, Nos. 1,862,332 and 2,073,334, in which the superior bonding of the fibrous sheet to the metal core sheet may be accomplished in a simple, practical manner and one in which the two operations of applying the metal adhesive, such as by galvanizing, and the operation of combining the thus coated metal sheet with the fibrous metal sheet or sheets may be carried on as separate operations contributing to the maintenance of control of the individual operations.

With this general object in view and such others as may hereinafter appear, the invention consists in the method of making the improved protected metal article hereinafter described and particularly defined in the claims at the end of this specification.

In the drawings illustrating the preferred embodiment of the present invention, Fig. 1 is a cross-sectional view of a protected metal article produced in accordance with the present invention; Fig. 2 is a side elevation of apparatus which may be employed in practicing the preferred method of producing the present article; Fig. 3 is a cross-sectional view of the article in the process of being produced, the section being taken on the line 3—3 of Fig. 2; and Fig. 4 is a cross-sectional view of a modified form of apparatus including an additional step which may be employed in practicing the present method.

Prior to the present invention, the protected metal building sheets disclosed in the Coffman Patents Nos. 1,862,332 and 2,073,334 have been produced commercially in large quantities. During the development of the commercial process it has been found that the process disclosed in the second Coffman Patent No. 2,073,334 has been the more practical process for the reason that in the process disclosed in the Coffman Patent No. 2,073,334 the fibrous sheets were pressed into the galvanizing coating upon the steel sheet before the galvanizing coating had an opportunity to solidify, and as a result the tendency of the zinc coating to oxidize was avoided. When the process of the first Coffman Patent No. 1,862,332 was followed some difficulty was experienced in producing most efficient adhesion because of the fact that any substantial amount of oxidization of the zinc coating when the galvanized sheets were reheated seriously interfered with the most successful bonding of the fibrous sheets to the steel coating.

The present invention represents an improvement upon the process disclosed in the aforesaid Coffman patents and contemplates the sprinkling or distribution of additional metal adhesive in a solidified finely divided form onto the metal sheet which has been previously coated with the metal adhesive. When zinc is used as the metal adhesive, additional powdered zinc is sprinkled or distributed onto the previously galvanized metal sheet. The sheet in this condition is then heated to a point above

the softening point of the zinc or other metal adhesive, and then the fibrous sheet or sheets are pressed into the surface or surfaces, preferably by passing the assembly between combining rolls. If preferred, the galvanized sheet immediately after it leaves the galvanizing bath may have the powdered zinc applied to the molten galvanizing coating before the latter has solidified and then passed rapidly through combining rolls between enveloping sheets of fibrous material before substantial cooling of the zinc-coated sheet has occurred. The relatively large heat capacity of the hot zinc-coated steel sheet as compared with that of the small particles of zinc is such that the latter are heated adequately without cooling the former below the point when successful bonding to the fibrous material is accomplished. As an alternative procedure, the metal powder may be sprinkled upon the surface of the fibrous material on the side of the sheet which will contact the coated metal core sheet. After the assembly has been passed through the combining rolls it is cooled, producing a laminated product wherein the additional particles of zinc are bonded to the metal galvanizing coating and extend up into the body of the fibrous sheet, penetrating several layers of the fibers. These individual particles of powdered zinc serve more or less as rivets by reason of the fact that during the combining of the felt with the sheet as the assembly is passed between the combining rolls, the individual particles are upset and clinched over the fibers through which they penetrate. In addition to the superior bonding effect, the present protected metal article is provided with an additional amount of zinc as compared with previous comparable products produced in accordance with the disclosures of the two Coffman patents above referred to, and this additional supply of zinc furnishes additional "cathodic protection" during weather exposure of the sheets in their use as roofing and siding sheets.

Referring to the drawing which illustrates the preferred method of producing a protected metal sheet suitable for use as a roofing or siding sheet, **10** represents a metal sheet, and preferably a steel sheet, having secured to the opposite surfaces thereof layers **12**, **14** of fibrous materials, such as asbestos paper or felt, by an interposed layer of metal adhesive **16**, such as zinc. The zinc layers **16** are bonded to the metal core sheet **10** and are keyed to the fibrous layers. The layers of metal adhesive **16** are also provided with a large number of small particles **18**, also of metal adhesive, and which may be initially applied to a previously coated metal sheet, such as previously galvanized metal sheet, or they may be applied on the surface of the galvanized or other coating immediately after the galvanizing operation and before the galvanizing coating has solidified. As shown in Fig. 1, these small particles or protuberances of metal adhesive are in the protected metal article, bonded to the metal adhesive layer and are themselves keyed and clinched to the fibrous layers as more or less diagrammatically illustrated in Fig. 1.

In Fig. 2, we have illustrated the preferred apparatus for practicing the present method of producing the improved protected metal sheet, and as therein shown, a previously galvanized steel sheet indicated at **20** is conveyed horizontally under a sifting hopper **22** containing a supply of the finely divided metal adhesive, which is to be applied to the metal sheet to form the protuberances **18**, above referred to. Preferably, the finely divided metal adhesive comprises zinc powder or zinc dust, and as the metal sheet is passed under the sprinkling hopper a light sprinkle of the zinc dust **24** is applied to the upper surface of the sheet. The sheet thus prepared is then conveyed by an endless conveyor **26** through a heating furnace, preferably an electric heating furnace, indicated more or less diagrammatically at **28**, where the sheet is

heated to a temperature above the softening point of the metal adhesive to thereby fuse the individual particles of zinc **18** to the surface of the metal adhesive layer **16**, which in the present instance comprises the previously applied zinc coating resulting from the previous galvanizing operation. Immediately after the metal sheet **20** emerges from the heating furnace **28**, and before both the metaal adhesive layer **16** and the protuberances **18** have cooled below the softening point, the sheet passes between a pair of combining rolls **30, 32**. Asbestos or other felt from the supply roll **34** is conducted between the combining roll **30** and the metal sheet, and this results in the pressure of the felt firmly against the relatively soft metal adhesive of both the original or primary adhesive layer **16** and the protuberances **18** with the result that after the sheet has passed between the combining rolls **30, 32** the fibrous layer **12** has been firmly keyed to the metal adhesive layer **16** and to the protuberances **18**, the latter penetrating through a substantial portion of the fibrous web **12** with the result that superior bonding results. In addition, the protuberances **18** are clinched over and around the adjacent fibers of the web **12** so that the fibrous layer **12** is firmly and mechanically anchored to the metal adhesive layer, and consequently to the core sheet **10**.

The process thus far described may be followed in applying the powdered zinc to one surface of the sheet, and in those instances where it is desired to apply the same to both sides of the galvanized sheet, the sheet may be turned over and the operations repeated.

In many instances, in practice, it is preferred to provide fibrous layers upon both sides of the metal core sheet, and conveniently this may be accomplished by the application of the finely divided metal adhesive particles **24** to the upper surface of a second web of fibrous material **14** as the latter is drawn from a supply roll **36** and fed beneath a second sprinkling hopper **38**, as indicated in Fig. 2. The metal particles **18** are pressed into the surface of the web sufficiently to enable the metal particles to adhere thereto until the sheet is conducted between the combining rolls **30, 32** during the passage of the sheet around an idler roll **33**. During the passage of the web **14** with the protuberances **18** thereon between the combining rolls **30, 32**, an action takes place similar to that previously described so that the lower web **14** is keyed to the metal adhesive **16** and also mechanically clinched by the protuberances **18** as indicated in Fig. 1.

From the description thus far, it will be apparent that in the apparatus illustrated in Fig. 2, the method above described for producing the metal adhesive **16** on the steel or other metal core sheet, and the operation of combining the metal sheet and fibrous layers, comprise separate operations, thus enabling each operation to be controlled independently of the other. In other words, in practice, previously galvanized steel sheets will be fed into one end of the apparatus shown in Fig. 2, and the rate of feed and the rate at which the zinc powder is applied together with the speed of operation of the combining rolls **30, 32** may be accurately controlled independently of one another in order to secure the most advantageous combining operation.

For some purposes, however, it may be desirable to apply the zinc or other metal adhesive powder to the surface of the galvanized sheet as the latter emerges from the galvanizing bath **40**, as shown in Fig. 4. In such instances, the sprinkling hopper **46** will be located adjacent the galvanizing bath **40** so that the galvanized sheet may be passed thereunder to be supplied with the stream of zinc dust or zinc powder **48** prior to the cooling of the zinc coating on the galvanizing sheet. Thereafter the remainder of the operation may and preferably will be carried on as indicated in the apparatus shown in Fig. 2, and as above described. The galvanizing bath **40** may and preferably will be heated in the usual manner and be provided with the usual flux box **42** and exit rolls **44**.

In practicing the present invention we have obtained satisfactory results utilizing the apparatus shown in Fig. 2 wherein previously galvanized steel sheets are fed into the apparatus and wherein the temperature of the heating oven **28** is maintained between 450 to 550 degrees centigrade. We have also observed that some overheating does not detract appreciably from the resulting adhesion obtained. The zinc powder may be of varying degrees of fineness, and we have experienced satisfactory results utilizing a paint grade zinc dust as well as a relatively coarser powder. The paint grade of zinc dust is of a degree of fineness approximately 90% finer than 325 mesh. An amount of such powder was sprinkled onto the sheets at a rate of approximately 2.4 grams per square foot, or 0.53 lb. per hundred square feet. When relatively coarser zinc powder was utilized, most of the particles were between 35 and 200 mesh, and these were sprinkled upon sheets at the rate of 1.38 grams per square foot, or approximately 0.31 lb. per hundred square feet. While the foregoing figures indicate the type of zinc powders and the amounts thereof which we have found to produce satisfactory results, nevertheless, it is not desired to limit the invention in this respect.

For the production of building sheets for roofing and siding purposes where the sheets are to be corrugated, a practical limit exists as to the thickness of the ordinary galvanizing coating which may be applied to the steel sheets. Beyond this thickness the galvanizing coating cracks, breaks loose from the steel and tends to scale off. In practicing the present process, however, it has been found that the additional zinc supplied in the form of a sprinkled powder entirely overcomes this prior disadvantage and enables far more zinc to be applied to the sheets while still maintaining their ability to be corrugated without cracking, than was the case with the ordinary galvanized sheet.

From the above description it will be observed that asbestos felt may be successfully combined with a previously coated and reheated steel sheet irrespective of any oxide formation during the reheating. The additional zinc initially applied in the form of zinc power or dust is fused with the galvanized coating of the reheated sheet and forms a plurality of spaced protuberances which penetrate several layers of fibers when the felt is pressed into the metal adhesive and the ends of the protuberances provide additional grip as the protuberances are upset under the pressure of the combining rolls to clinch over the fibers through which they have penetrated, as indicated at **50** in Fig. 1, thus forming a firm and secure bond. A steel sheet thus protected in accordance with the present invention is extremely durable and may be formed into various shapes with minimum liability of damage to the protective coating thereof.

While it is preferred to utilize a galvanized steel sheet and powdered zinc in the production of the present protected metal sheet, it will be understood that other fusible metals and alloys may be used instead of the galvanizing and powdered zinc, such for example as tin, lead, cadmium, and the like.

This application is a division of our application Serial No. 184,090 filed September 9, 1950, for Protected Metal Article and Method of Making the Same.

While the preferred embodiment of the invention has been herein illustrated and described, it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. In the method of making a protected metal article, the steps comprising applying a finely divided unfused metal adhesive upon a surface of a metal member having a previously applied continuous coating of metal adhesive covering the surface of the metal member to form a discontinuous layer, alloying the finely divided

metal adhesive to the continuous coating and rendering the metal particles deformable, and then pressing a fibrous sheet onto the discrete particles of metal adhesive while the latter are in a deformable condition to effect penetration of the upper portion of the discrete particles into the fibrous layer and deform such portions to firmly key the fibrous layer thereto.

2. In the method of making a protected metal sheet, the steps comprising applying a finely divided unfused metal adhesive upon a surface of a galvanized steel sheet to form a discontinuous layer thereof, passing the galvanized sheet with the discontinuous layer through a heating oven to effect alloying of the metal particles to the continuous galvanizing coating and also to render the metal particles deformable, then pressing a fibrous sheet onto the discreet particles of metal adhesive while the latter are in a deformable condition to effect penetration thereof into the fibrous sheet and to deform such portions to firmly key the fibrous layer thereto.

3. In the method of making a protected metal sheet, the steps comprising applying a finely divided unfused metal adhesive upon a surface of a galvanized steel sheet to form a discontinuous layer thereof, passing the galvanized sheet with the discontinuous layer through a heating oven to effect alloying of the metal particles to the continuous galvanizing coating and also to render the metal particles deformable, then pressing a fibrous sheet onto the discreet particles of metal adhesive while the latter are in a deformable condition to effect penetration thereof into the fibrous sheet and to deform such portions to firmly anchor the sheet thereto, and bonding the portions of the fibrous layer between said metal particles to the continuous galvanizing coating.

4. In the method of making a protected metal sheet, the steps comprising applying finely divided unfused zinc particles to the surface of a galvanized sheet while the galvanizing coating is in a molten condition, then applying with pressure a fibrous sheet to compress the zinc particles into the fibrous sheet and to deform said particles to firmly anchor the sheet thereto and to press the portions of the fibrous sheet between the zinc particles into the galvanizing coating and thereafter permitting the assembly to cool whereby the discreet zinc particles are mechanically keyed into the fibrous sheet and alloyed to the galvanizing coatings, and portions of the fibrous sheet between the zinc particles are bonded to the galvanizing coating.

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