July 5, 1955 D. S. HUBBELL 2,712,174

METHOD OF MAKING A PROTECTED METAL ARTICLE

Original Filed Sept. 9, 1950

Fig. 1

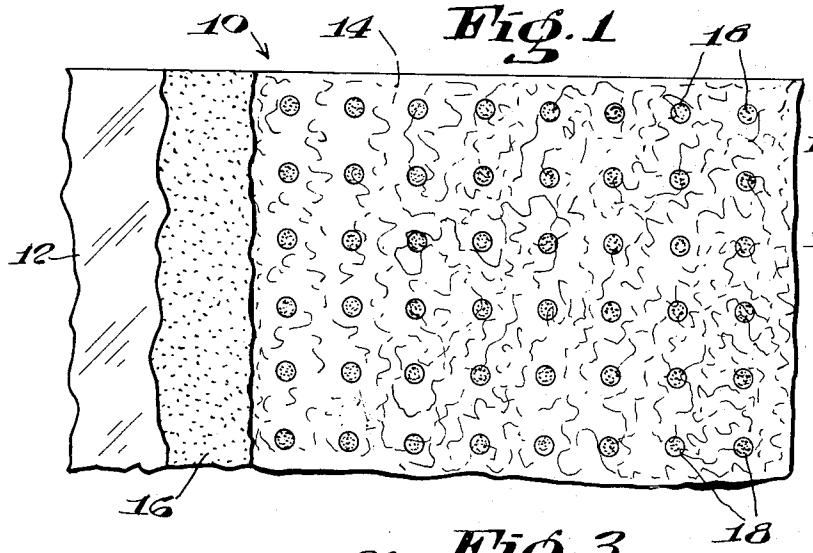


Fig. 2

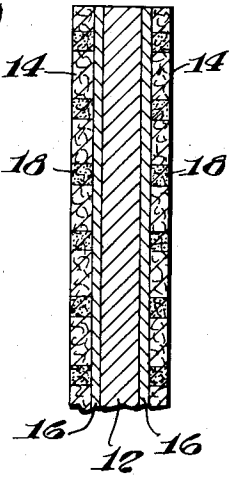


Fig. 3

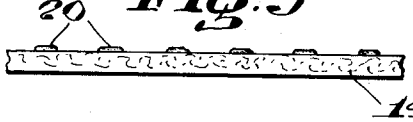
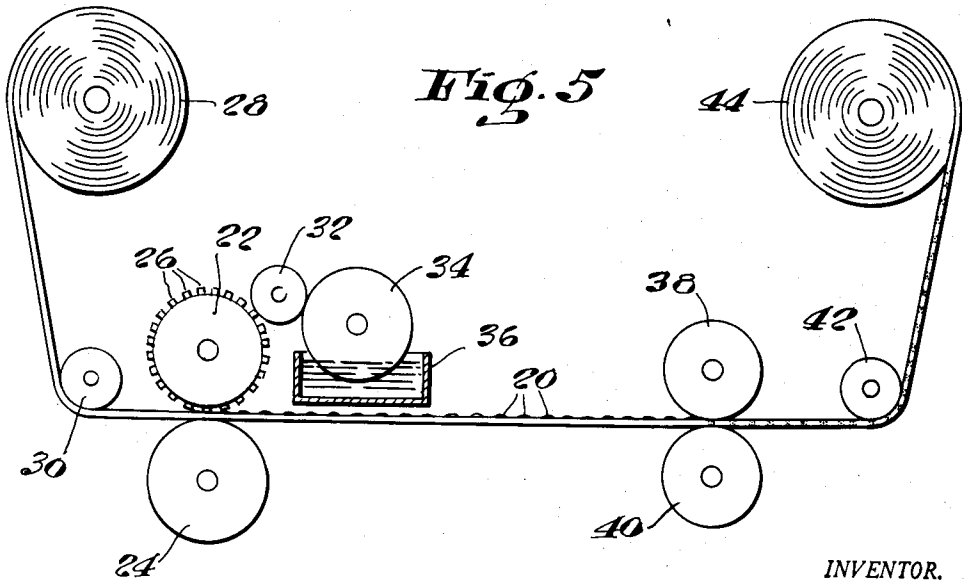


Fig. 4



Fig. 5



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METHOD OF MAKING A PROTECTED METAL ARTICLE

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Original application September 9, 1950, Serial No. 184,059, now Patent No. 2,668,348, dated February 9, 1954. Divided and this application October 9, 1951, Serial No. 250,426

3 Claims. (Cl. 29—473.1)

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

One object of the invention is to produce a novel and superior protected metal article of the general type disclosed in the United States Patents to Coffman Nos. 1,862,332 and 2,073,334 and in the United States Patent to Robertson No. 1,195,090, and in particular to provide a protected metal article of such type in which the tendency of the fibrous layers in the article to delaminate is reduced to a minimum, thereby to impart additional life and durability to the article in use.

Another object of the invention is to provide a novel and superior construction of fibrous sheet and particularly of felt adapted for use in producing the protected metal articles above referred to, which is characterized by superior resistance to delamination.

With these general objects in view and such others as may hereinafter appear, the invention consists in the protected metal article and in the improved fibrous sheet and felt hereinafter described and particularly defined in the claims at the end of this specification.

In the drawing I have illustrated the invention as embodied in a protected metal article wherein Fig. 1 is a plan and Fig. 2 a section on the line 2—2 of Fig. 1 of the protected metal article.

As illustrated in the patents to Coffman and Robertson, above referred to, a protected metal article, and particularly a protected steel sheet, suitable for use as a building sheet for roofing and siding purposes comprises a core sheet of steel to which fibrous sheets, such as asbestos felt, are secured by a metal adhesive as disclosed in the Coffman patents, or by a layer of bituminous material, such as asphalt, as disclosed in the Robertson patent. The fibrous layer is preferably thus secured to each side of the metal sheet, and in practice, the laminated assembly is preferably enveloped within an outer weatherproofing coating of bituminous material. Such protected metal sheets have been used extensively for roofing and siding purposes all over the world.

The success of the protective coatings and layers in resisting the weather and corrosive atmospheric conditions depends to a large extent upon the maintenance of the protective material about the steel core sheet, and one of the difficulties which is at times experienced in the handling, shipping, and erection of the protected metal building sheets flows from the structure of the asbestos felt, which is preferably used as the fibrous layers in the production of the protected metal sheet. In the manufacture of the asbestos felt a substantial but minor amount of an organic binding material, usually wood fiber, is utilized to assist in binding together the asbestos fibers to form the felt. The character of the asbestos fiber is such as to preclude the formation of a true felt in the stricter sense of the word inasmuch as the asbestos fibers are not held together by a mechanism by which a real felt is produced. In other words, in the manufacture of asbestos felt there is no real felting of the fibers, and reliance is placed to a large extent on the presence of the

organic materials, such as wood pulp and fiber in order to hold the laminations of the asbestos felt together.

From a consideration of the disclosures in the Coffman patents it will be appreciated that the contact of the asbestos felt with the extremely hot and molten zinc coating when the asbestos felt is being attached and bonded to the steel core sheet by the interposed layer of zinc as the metal adhesive produces a weakening to some extent of the bonding effect of the organic materials within the asbestos felt. In some instances the organic materials are actually charred, and as a result the resistance of the asbestos felt to delamination is not as great as is desired. During the handling, and particularly the shipment of the relatively heavy protected metal sheets slight adhesion of adjacent sheets being shipped is oftentimes sufficient to effect some delamination of the asbestos felt. Another instance of this difficulty occurs if there are any stresses in the outer weatherproofing coating, such as stresses set up by the drying out or contraction thereof, the effect of which is a tendency to lift off some of the laminations of the felt.

During the manufacture of the protected metal article, in accordance with the Robertson patent it has been found desirable to reinforce the felt by saturations with asphaltic saturants, and while these assist to some slight degree in imparting additional bond between the laminations of the asbestos felt, the saturants themselves do not possess sufficient strength to resist delamination under the conditions usually experienced in shipping, handling, and weathering of the commercial metal building sheets.

It has been recognized that these difficulties inherent in asbestos felt could be overcome by saturating the felt with a saturating material which upon cooling or drying, or in the case of resins upon polymerization, possessed relatively high strength. In this manner, it would be possible to bond the laminations of the felt securely together with sufficient strength so that the commercial delaminating difficulties might be overcome. However, all of the available saturating materials possessing the required strength are too expensive for commercial use, and more importantly their use as an all-over saturant for the asbestos feltings would produce a relatively stiff felt, and inasmuch as most of the building sheets are required to be corrugated or deformed into special shapes, such relatively stiff felt would crack during such deformation, thus destroying the protecting qualities of the coatings and layers which have been used in the attempt to form a successful protection for the inner core sheet of the protected metal sheet. The present invention contemplates saturation of the asbestos felt in a discontinuous manner instead of in an overall or continuous manner. Preferably, I prefer to apply to the fibrous sheet a high-strength saturant in the form of a uniform pattern of relatively small areas. These small areas form in effect strong rivets which successifully overcome the tendency of the asbestos felt to be delaminated, and overcome the difficulties in this respect, above referred to. It has been found that when such a fibrous sheet is used in producing a protected metal sheet in the manner described in either the Coffman or Robertson patents above referred to, the protected metal sheet may be successfully corrugated and deformed without any liability or cracking of the asbestos felt layers and of the protective coatings. In other words, the discontinuity of the high-strength saturant was found to avoid the production of excessive stiffness in the saturated felt. In addition, the marked reduction in the amount of saturant applied for a given area of the building sheet enables the more costly saturating materials to be used without destroying the competitive commercial aspect of the product.

For example, if the saturant is applied in areas approximating 1/16 of an inch in diameter in a uniform pattern

in which the areas were spaced apart on, say, ¼" centers over the entire area of the asbestos felt, then only about 5% of the area would be covered, and correspondingly only about 5% as much saturant would be required as that necessary to cover the entire sheet. This 5%, however, is effective in stopping delamination inasmuch as the small spots of saturant being in themselves relatively strong act like the through-ties that are used in quilting operations. Any of the known high-strength organic or inorganic saturants may be used, and the requirements are that the saturating material should be such as may be easily applied in the desired pattern and of a material such that it may be made to strike through the laminations of the felt. The residue left in the felt must effectively bind the asbestos fibers, and either be impermeable to moisture or easily subsequently saturated with a waterproofing material, such as the asphaltic saturants heretofore employed. Preferably, the nature of the saturants is such as to enable outer bituminous weatherproofing coatings to adhere to it without showing the saturating pattern, and when the protected metal sheet is made in accordance with the Coffman patents the saturant should not interfere with the bond of the asbestos felt to the metal adhesive.

Among the saturants which have been successfully used are solutions of phenol-formaldehyde resins, and other high-strength resins in appropriate solvents, and as illustrative of the inorganic saturants I have found that solutions of silicates, such, for example, as sodium, potassium and ethyl silicates, are suitable.

In practice, I prefer to apply the saturant to the felt prior to its incorporation into the protected metal article by passing the felt over embossing rolls to which a saturant has been applied. Then by passing the felt through heated rolls the saturant is driven through the entire thickness of the felt and this operation eliminates the solvent and polymerizes the saturant, as in the case of the phenolic resins referred, or other resins which may be used. In the case of the silicates the heating appears to promote some reaction with the asbestos effecting a strong rivet-like bond which successfully resists delamination.

Referring now to the drawings, **10** represents a protected metal article comprising a steel sheet **12** having secured to the opposite surfaces thereof layers **14** of fibrous material, such as asbestos felt, by an interposed metal adhesive, such as galvanizing coating **16**. This product may comprise the product disclosed in the Coffman patents above referred to. As shown in Fig. 1, the improved felt layer **14** is reinforced by a high-strength saturant applied in a pattern of spaced spots or points **18** arranged to extend or penetrate through the fibers of the felt and serving to bind the fibers together to provide a felt web having superior resistance to delamination and capable of flexing or being deformed without cracking.

In practice, the bonding saturant may be applied in liquid form in the desired pattern to provide a series of spaced droplets **20** of the saturant on the surface of a web of felt to be reinforced as illustrated in Fig. 3, and thereafter application of heat and pressure will effect driving or penetration of the saturant through the web to produce the reinforced web illustrated in Fig. 4.

As diagrammatically illustrated in Fig. 5, a preferred form of apparatus for producing the present reinforced felt may include an embossing or printing roll **22** arranged to cooperate with a lower roll **24** and having a series of radially arranged and spaced protuberances **26** disposed to correspond to the desired pattern. The felt web may be withdrawn from a supply roll **28** thereof, passed around a guide roll **30**, and then between the rolls **22, 24**. The printing roll **22** may be provided with the required saturant by an applying roll **32** cooperating with a supply roll **34** mounted to rotate in a supply tank **36** of the saturant so that in operation the saturant applied to the printing roll is transferred to the surface of the web in the form of spots or droplets **20**, as indicated. Thereafter, the web may be passed between heated rolls **38, 40** to effect penetration of the saturant through the entire thickness of the felt, whereupon the web may pass around a second guide roll **42** and be wound upon a rewinding roll **44**, as illustrated in Fig. 5. While the above-described method of applying the saturant has been found satisfactory, it will be apparent that other methods may be employed, such as by the use of hollow needles to effect application of the spots or droplets **20** on the surface of the web.

In practice, when the bonding saturant comprises a phenolic or other resin in a suitable solvent, the passage of the web through the heated rolls eliminates the solvent and polymerizes the saturant, the residue firmly bonding the fibers at the saturated points, and likewise, when the saturant comprises solutions of silicates, the saturant appears to promote some reaction with the asbestos fibers, thus producing a fibrous web having superior resistance to delamination.

While it is not intended to limit the disposition, size, or spacing of the spots of saturant in the fibrous web, it has been found in practice that good results may be obtained by an application of saturant at spaced points amounting to only five percent of the area of the web, such proportion being substantially maintained when the spots of saturant are approximately one-sixteenth in diameter and spaced one-quarter of an inch apart. Thus, the amount of saturant used correspondingly amounts to only five percent of the saturant which would be required to cover the entire web, such five percent being effective to prevent delamination. It will be apparent, however, that such proportions may vary over a wide range to produce the desired results.

In practice, the protected metal article **10** comprising the steel sheet **12** provided with the asbestos felt layers **14** affixed thereto by a metal adhesive **16** may be further treated by the application of an asphalt impregnant or saturant, and thereafter in order to further protect the metal article against weather conditions, fumes, or the like, the composite sheet may be provided with an outer bituminous weatherproof coating, as illustrated and described in the Coffman Patent No. 2,073,334. The present bonding saturant applied to the web at spaced points in accordance with the present invention does not interfere with the bond of the felt to the zinc-coated steel, and does not affect the ability of the remaining asbestos web to absorb the asphalt. Furthermore, the outer bituminous coating will adhere to the relatively small high-strength saturated areas as readily as to the remaining areas of the asbestos web and without showing the pattern of the saturated points.

The asbestos felt layers provided with the high-strength spot saturations as above described may be used with advantage in the production of protected metal articles, and particularly building sheets, in accordance with the disclosures of the Robertson patent, above referred to, wherein the asbestos felt layers are adhesively secured to the steel core sheet by asphalt or other bituminous material.

The present laminated sheet embodying the discontinuous saturated felt as above described is an improvement upon the protected metal sheets and articles forming the subject matter of the Robertson and Coffman patents above referred to and may be used with advantage for all of the purposes for which such protected metal sheets and articles may be used.

This application is a division of my application Serial No. 184,059 filed September 9, 1950, for Protected Metal Article and Method of Making the Same, now Patent 2,668,348.

While the preferred embodiments of the invention have been herein illustrated and described, it will be under-

stood 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. The method of making a protected metal sheet for building purposes which consists in applying to the surface of a laminable fibrous web a plurality of uniformly spaced, individual droplets of a liquid, high-strength saturant; then simultaneously applying heat and pressure to opposite sides of said web thereby driving said saturant through the entire thickness of said web to form individual spots of high-strength saturant binding the fibers of said web against delamination, while maintaining the spacing of said individual spots so that the combined areas of said spots constitute only a small fraction of the total area of said web; and then adhesively affixing the spot saturated web to a metal sheet by a metal adhesive.

2. The method defined in claim 1 wherein the web after it has been spot saturated with the high-strength saturant, is then saturated with a low-strength flexible waterproofing saturant to saturate the portions of the web between said spots.

3. The method of making a protected metal sheet for building purposes which consists in applying to the surface of a laminable fibrous web a plurality of uniformly spaced, individual droplets of a liquid, high-strength saturant arranged in rows substantially transversely of said web to leave the entire portions of said web between

adjacent transverse rows of said droplets free of said high-strength saturant; then simultaneously applying heat and pressure to opposite sides of said web thereby driving said saturant through the entire thickness of said web to form individual spots of high-strength saturant binding the fibers of said web against delamination, while maintaining the spacing of said individual spots so that the combined areas of said spots constitute only a small fraction of the total area of said web; and then adhesively affixing the spot saturated web to a metal sheet by a metal adhesive, the application of droplets of said high-strength saturant in rows substantially transversely of said web permitting flexure of the web without cracking after driving through and setting of said high-strength saturant by heat and pressure.

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