June 30, 1942. L. P. CURTIN 2,288,182

CONTAINER MANUFACTURE

Filed April 6, 1939

FIG. 1.

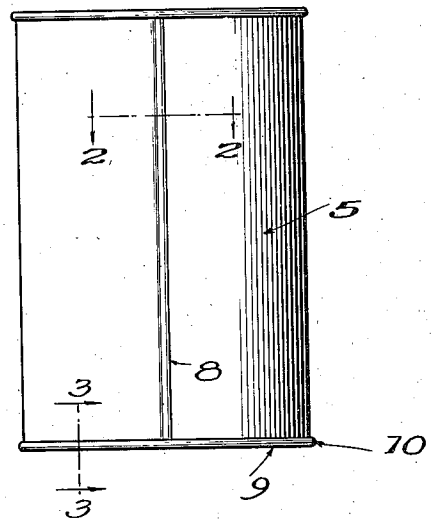


FIG. 2.

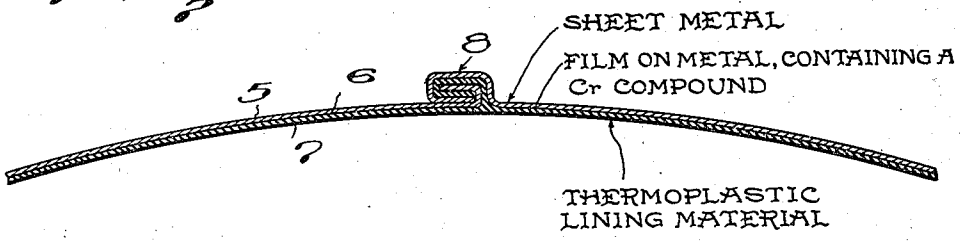
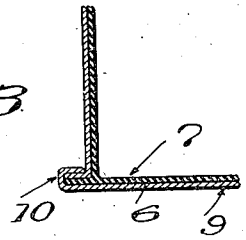


FIG. 3.



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CONTAINER MANUFACTURE

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Application April 6, 1939, Serial No. 266,424

3 Claims. (Cl. 113—120)

This invention relates to container manufacture; and it comprises a new and improved method of manufacturing lined containers for foodstuffs, beverages and other materials, wherein a substantially flat metal sheet is coated with a thermoplastic composition, advantageously a vinyl resin composition, adapted to form a resistant lining for the completed container, a can body is formed from the coated sheet, and said thermoplastic lining material is utilized in forming hermetic seals between the adjoining edges of the can body itself and the ends applied thereto, the seals being advantageously formed under heat and pressure; and it comprises an improved metal container for foodstuffs and other materials, said container having a ferrous metal base with or without a surface coating of tin or copper thereon, having at least its interior surfaces coated with a chemically-resistant, thermoplastic, lining material, advantageously a vinyl resin composition, and having solderless joints sealed with the said thermoplastic lining material; all as more fully hereinafter set forth and as claimed.

Metal cans and similar containers are widely used for packaging a great variety of foodstuffs, beverages and other materials. In many applications, it is desirable to provide the inner surface of such containers with a resistant lining or coating to prevent contact between the metal and the contents. In beer cans, for example, this internal coating is sometimes a vinyl resin composition applied over an organic priming coat which is applied to the tinned surface of the container body. Other coatings and lacquers are also used for such purposes.

In addition to the internal coating or lining of containers, it has also been a general practice to provide a decorative finish, or coating, on the exterior of metal containers. This coating has been applied heretofore by stenciling, lithographing, printing and other procedures, often after the container, or at least the container body, is completed.

Most of the metal containers heretofore employed for foodstuffs and liquids have been provided with a soldered longitudinal joint or seam, although the ends of the container have been frequently applied by mechanical procedures. For example, the ends are sometimes secured by crimped or folded joints, usually after coating a flange on the can body and the rim of the can end with a suitable sealing material. Also, the can bodies and ends have generally been made of tin-plate or tinned sheet iron, partially because it was believed necessary to have a tin coating to prevent contact of the packaged material with the ferrous metal can body, and partially because the presence of the tin facilitated the soldering of the longitudinal or vertical seam in the can body.

In this prior practice, the added cost resulting from the use of tin-plate has contributed substantially to the cost of the containers, and, of course, the goods packaged therein. Furthermore, it has led to a needless consumption of tin, which is not available as raw material in this country, and which is sometimes difficult to obtain in sufficient quantities for the container industry. Still further, the necessity of lining and coating the container after the body portion was formed has added materially to the cost of the containers.

I have now found that it is possible, and much more economical, to fabricate satisfactory metal containers for foodstuffs and other materials without soldering the longitudinal joint of the container body. I have also found that this method of manufacture results in substantial economies, since it makes it possible to perform all the coating and finishing operations on a flat sheet and in a continuous procedure, employing coiled steel strip, for example, as the starting material. Still further, since no soldering is involved in this process, and since suitable coatings may be applied directly to ferrous metal surfaces, the added cost of the use of tin-plate is eliminated; and the waste of tin (which is seldom recovered from used containers) is prevented.

In accordance with my invention, a substantially flat sheet of mild steel or other suitable ferrous metal is employed as the starting material. The surface of this sheet is cleaned and advantageously otherwise prepared for the reception of a coating of lining material, as described in more detail herein below. The lining material, which may be a vinyl resin lacquer or other suitable coating composition, is then applied to the surface of the sheet which is to constitute the interior of the container. If the sheet is not previously cut to size, the coated sheet is cut to a blank of the proper size, advantageously after drying the lacquer at least sufficiently to eliminate tackiness. If the lacquer is one of those which is baked to improve resistance and adhesion, the baking step may also be performed before the sheet is cut to size. When the container exterior is to be provided with a decorative or other coat-

ing, this is also applied to the flat sheet or strip, advantageously before cutting.

The blank for the container body, coated on one or both sides, is then formed into a body or shell of the desired size, without soldering. The solderless seam or joint in this container body may be finished in several different ways, depending on the nature of the contents to be packaged. For example, for packaging dry materials in relatively small containers, it is generally satisfactory if the edges of the can body merely overlap. With larger containers, or containers for liquid materials, it is advantageous to hook or interleave or fold the edges of the container body. In some instances, it is desirable to form very strong joints, such as the so-called Gordon seam, in which cooperating, substantially rectangular grooves are formed across the ends of the blank, and are hooked together, then rolled down to form a strong joint. Joints of this kind, as well as other folded and hooked joints, may be formed either on the exterior or the interior of the container. After the joint is formed, or the ends are overlapped, the joint-forming elements are subjected to heat and pressure by means of a heated roller, for example, to cause the thermoplastic lining material in and adjoining the seam to form a hermetic seal which is resistant to the passage of gas or liquids.

Before or after forming the longitudinal joint or seam in the manner described, the cylindrical ends of the can body are generally flanged outward. This is most conveniently done as part of the operation in which the blank is formed into the can body. The outwardly extending flanges at the end of the can body are, of course, coated with the thermoplastic lining material, as is the entire interior surface of this element. One or both of the can ends of similarly prepared metal, and advantageously having edges shaped or grooved to overlap the body flange, are then applied; and the end joints are completed by crimping or folding in known manner, advantageously with the application of heat and pressure to form a hermetic seal.

A container may be very economically fabricated in this manner, without any soldering or welding step. The lining material, which heretofore was ordinarily applied after the container body had been shaped, is much more economically applied to the flat sheet; and when so applied, it has the multiple function of lining the container and hermetically sealing its joints. If the lining material requires baking, this may be done prior to the forming steps, or advantageously after the container is completed; and baking at the latter stage improves the hermetic seal in the joints and the uniformity of the film lining the container and covering the joints.

In my improved method of container manufacture, the use of tin-plate is made unnecessary, and the soldering step is eliminated, as previously noted. In addition, the use of organic priming coats under vinyl resin coatings, which has been conventional in the past, is eliminated by giving the ferrous sheet metal base a proper surface treatment. The surface treatment which I have found most advantageous comprises a treatment to eliminate water-breaks from the surface, followed by an application of a compound of chromic anhydride in dilute aqueous solution, which is dried on the surface. The thermoplastic coating material is applied over the dried chromium-containing film, and forms a very adherent and resistant lining material equal or superior to similar coatings heretofore applied over organic priming coats. This invention differs from the prior practices in the art, in that the chemically inert thermoplastic coating for the interior surfaces of the can or other container is applied to a substantially flat sheet of metal, and in that this coating or lining is also utilized in forming joints tight to liquids and gases for the ends and side of the container. It has been proposed heretofore to employ cementitious films in the joints of containers, especially the end joints, but it has not been proposed heretofore to employ such films as chemically inert and adherent coatings for protecting the interior of the container from attack by the contents, while also protecting the contents from contamination by contact with the metal. Furthermore, the cementitious films heretofore proposed for use in the joints have not been of a character which would permit their use as lining materials for containers for foodstuffs, for example.

My invention will be better understood from a more detailed description of the steps involved in my improved method, which will now be described.

In an especially desirable embodiment of the invention, the starting material is coiled steel strip. It is advantageous to have this strip in a width equal to the width or length of the can body blanks to be produced, but it may be a multiple of a can body blank dimension, or some other width if desired. In any event, the selected coil is mounted on a suitable stand for unwinding and feeding it to the steps of my process, which is advantageously continuous in operation.

The first of these steps must generally be a thorough degreasing, which may be so conducted as to eliminate water-breaks. If the water-breaks are not completely eliminated during the degreasing step, this is accomplished by a subsequent treatment. One of the best methods of eliminating water-breaks is to contact the ferrous metal surface for a brief period, such as 5 to 30 seconds, with a dilute solution of ferric chloride. This solution may conveniently have a concentration of about 1 per cent, and is usually employed cold; but heated solutions and more concentrated solutions may be employed if desired, and act even more quickly. More dilute solutions may also be employed. It is often desirable to include in the ferric chloride solution a small amount, such as 1 per cent, of sulfuric acid or hydrochloric acid, to offset any tendency to form basic salts in the solution during the treatment and to insure that the treated surface is free from oxides. It is also sometimes beneficial to include about 0.5 per cent of sodium or potassium fluoride in the ferric chloride bath.

Another solution which is very effective in eliminating water-breaks contains about 1.2 per cent of sodium bisulfate and 0.05 per cent of copper sulfate pentahydrate. With this solution, a twenty second treatment at room temperature is generally sufficient.

The uncoiled steel strip is drawn through the ferric chloride solution or other bath selected to eliminate water-breaks, the bath being contained in a vessel of such size that the desired time of contact (a few seconds) is assured. After withdrawal from this solution, the strip is advantageously rinsed, and is then wetted with a dilute solution of a suitable compound of chromic anhydride. The best compound for use

in this stage, when vinyl resins are to be applied in the final coating, is cupric dichromate. Calcium dichromate is nearly as good. Magnesium dichromate and ammonium chromate and dichromate are also useful, although not quite as good as the dichromates of copper and calcium. Zinc dichromate is one of the best compounds when the final coating is not affected by it, but it is not as satisfactory as the others mentioned for use with vinyl compounds, since zinc tends to increase the decomposition of these compounds at elevated temperatures.

In all cases, the best results are obtained with dilute aqueous solutions having a concentration of about 1 to 3 per cent of the selected chromium compound. It appears that the chromic anhydride content should be at least 0.7 per cent by weight, and preferably a little more, for the best results. The selected chromating solution is applied to the surface by spraying or immersion, or by any other suitable procedure; and in all cases, the surface should be thoroughly wetted by the chromating solution. No substantial time contact is necessary, however, and the treatment may be at atmospheric or higher temperatures.

After wetting the surface of the strip with the chromating solution, at least a substantial part of the solution is dried on the surface, advantageously by the application of heat. Heating is not necessary, but expedites the drying which is especially desirable in a continuous process. The drying may also be accelerated by mechanical treatments, such as wiping with a squeegee, or rolling between soft surfaced rolls. I find that the rolling treatment is especially desirable. In using this step, the freshly chromated strip of sheet metal is passed between soft surfaced rolls (faced with soft rubber or fabric, for example) in a horizontal position, and the rolls are so adjusted that only very moderate pressures are applied to the wet sheet, so that it is not completely dried. Drying is then advantageously completed by passing the strip through an oven or drying chamber.

When such mechanical treatments are employed, it is advantageous to increase the concentration of the chromating solution somewhat —that is to employ concentrations of the order of 2 to 3 per cent, for example—so that the amount of chromate allowed to remain on the surface is about the same as when the wet sheet is dried directly with a less concentrated solution on it. In all cases, after the chromating solution is dried on the metal surface, a thin and substantially uniform film of a compound of chromic anhydride covers the surface. The finish coating or lining material is then applied over the chromate film.

It is generally desirable to coat at least one side of the sheet with a vinyl resin lacquer or varnish, and coatings of this type are especially desirable for use in contact with beer and other aqueous solutions. Containers for dry materials may often be lined with some other thermoplastic coating, such as a lacquer or varnish having a suitable resin base. Regardless of the specific coating selected, it is readily applied over the chromate film by any of several known procedures including brushing, spraying and immersion. Spraying is generally most convenient for the continuous process, and may be followed by light rolling to assure uniform application of the coating if desired. The film is then dried at least sufficiently to eliminate tackiness, and is sometimes baked at this time.

The film of vinyl resin lacquer or varnish may be applied in this manner to one or both sides of the metal strip, depending on what further treatments are to be applied. It is often advantageous to apply a vinyl resin film to the side of the sheet metal which is to constitute the interior of the containers, and after drying it, to apply a different coating to the other side. If the exterior is to be provided with a printed or lithographed coating, it is advantageously applied to the continuously moving strip at this stage, and then dried.

After the sheet metal is coated on one or both sides, it is cut into blanks of the desired size. This is done automatically, and the blanks are fed mechanically and continuously to a can-making machine where they are formed into can bodies. Advantageously, a machine is employed which forms the desired type of joint or seam between the adjoining edges of the can body, and which also flanges the ends of the body outward. The same machine also applies heat and pressure to the longitudinal or body seam, causing the vinyl resin or other thermoplastic material contained in the seam (and carried on the adjacent surfaces) to form a hermetic seal. In instances when no coating is applied to the external surface, and when the coating so applied is not thermoplastic, it is sometimes desirable to provide one or more edges of the external surface with a narrow band or strip of the thermoplastic lining material, to improve the seal effected in the joints.

Ends for the can are advantageously coated and stamped by a continuous procedure similar to that described for the production of the can body, and at least one end of the can is applied immediately after the body is formed. The can end, as previously stated, is advantageously shaped with an annular channel around its edge, this channel being of such size as to receive the flanged end of the can. The interior of this channel, as well as the rest of the interior of the can end, is covered with the thermoplastic lining material, such as vinyl resin lacquer. The can end is assembled with the can body, and its channel portion is rolled with the body flange, advantageously to form a double seam. Various machines are available for applying ends to containers in this way, and various types of seams or joints are thus produced. One or both ends may be applied to the can at this stage, depending on the shape of the ends and the material to be enclosed in the can. If desired, one end of the can may be thus applied, an the can then baked to cure the lining, after which it is filled and the other end is applied in the manner described.

Instead of using coiled strip steel for the starting material, similar results may be obtained by using flat sheets, and these flat sheets may be pre-cut to the size of the can body blank, or to suitable multiples of that size. Except for minor differences in mechanical handling, the procedure is exactly the same as when using coiled strip. It is generally cheaper and more convenient to use coiled strip, however.

While one of the advantages of my invention is that it makes it possible to manufacture useful containers directly from ferrous sheet metal, a similar process may be employed with other metal surfaces. For example, tin-plate may be employed in a similar manner if conditions jus-

tify it. When using tin-plate, my process eliminates the soldering step, and the preliminary coating with an organic bonding coat, both of which have contributed substantially to the cost of containers heretofore fabricated. Further savings result from application of the lining to the flat sheet.

In the accompanying drawing there is shown more or less diagrammatically an example of one good specific embodiment of the invention embodied in a metal container. In the drawing,

Fig. 1 is a view in elevation of the container,

Fig. 2 is a sectional view taken along line 2—2 of Fig. 1, and

Fig. 3 is a sectional view taken along line 3—3 of Fig. 1.

As shown, a sheet metal can body 5 is provided (while in sheet form) with a coherent Cr-containing film 6 as described. To this is bonded a thermoplastic coating 7, as described, and the body is formed with a longitudinal seam 8 sealed by the thermoplastic material as shown. A cover member 9 of sheet metal with coatings 6 and 7 is united to the body of a seam 10, similarly sealed by the thermoplastic material. The container is thus at once joined and sealed through the agency of the thermoplastic material, without need for solder.

In another modification of my process, the ferrous metal is coated with copper prior to the chromating and the application of finish coating. I have found that a copper coating may be readily and quickly applied to ferrous sheet metal by a non-electrolytic process to form a coating which is highly adherent and improves the bond between the finish coating and the ferrous metal base. Various copper salt solutions may be employed in producing the copper coatings, such as the acidified copper sulfate solution described in my application Serial No. 167,478, filed October 5, 1937, or more advantageously the solution containing fluorides described in my application Serial No. 229,221, filed September 9, 1938. Since the application of a dip coating of copper by these procedures generally eliminates all water-breaks from a clean ferrous metal surface, this coating step may be substituted for the rinse in ferric chloride, etc., described hereinabove. The subsequent steps of the process, including the application of a chromate film followed by the finish coating, and the shaping and sealing of the container, then proceed as previously described.

This invention has been described with particular reference to the use of vinyl resin lacquers and varnishes as the coating material for at least the interior surfaces of the containers produced. For many applications, vinyl lacquers are unequaled as coating materials, especially when they are baked at temperatures below 300° F., and advantageously between 250° and 275° F. Such coatings are sufficiently thermoplastic to provide resistant seals in all the joints of the container, and are also highly resistant to the action of aqueous solutions and other reagents, especially when baked at the temperatures specified. However, other coating materials are available which have sufficient thermoplasticity to form satisfactory seals in my process, and which are also sufficiently resistant to most materials which are packaged in containers of this type. The resistance of Vinylite (a commercially available co-polymer of vinyl chloride and vinyl acetate) and other lacquer coatings to severe service conditions, such as "processing" steps employed by canners, is generally improved by incorporating a small amount of aluminum powder in the coating, as described and claimed in my application Serial No. 256,821, filed February 16, 1939.

References herein to "substantially flat" sheet metal are intended to include uncoiled strip metal, as well as flat sheets; and references to "preparing metal surfaces for the reception" of coating materials are intended to include some or all of the steps of cleaning, degreasing, eliminating water-breaks and chromating. Also, references to forming joints "under heat and pressure" are intended to include instances in which the joints are formed or sealed by the application of pressure alone which, in some cases, develops sufficient heat for my purposes.

What I claim is:

1. A metal container for foodstuffs and the like, having at least its inner surface coated with a thermoplastic chemically-resistant lining material applied over a film comprising a compound of chromium and bonded to the metal thereby, and having longitudinal and end joints containing said lining material and hermetically sealed thereby.

2. The container of claim 1, wherein said lining material contains a substantial proportion of vinyl resin.

3. In making cans, the improvement which comprises applying to sheet steel an aqueous solution of a compound of chromic anhydride and drying the sheet steel whereby to leave thereon a film comprising a compound of chromium, applying to said dry film in bonding relation a coating of a thermoplastic chemically-resistant lining material, bending up the coated sheet steel into can body form to bring the coated edges of said sheet steel in interlocking contact and squeezing the interlocked edges together under heat, to unite the coatings together in the region of contact, joining to at least one end of the can body, to form an interlocking joint, a cover member of said sheet steel provided with said film comprising a compound of chromium and said coating of lining material, and squeezing the joint under heat, to unite the coating of the cover member to the coating of the body member at said interlocking joint.

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