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Hogstrom

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[54] **METHOD AND APPARATUS FOR APPLYING WAX TO CAN ENDS**

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[*] Notice: The portion of the term of this patent subsequent to Apr. 10, 1990, has been disclaimed.

[22] Filed: **June 11, 1971**

[21] Appl. No.: **152,117**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 76,167, Sept. 28, 1970, and a continuation-in-part of Ser. No. 76,168, Sept. 28, 1970, Pat. No. 3,726,711.

[52] **U.S. Cl.**..... **117/105.4,** 117/105.4, 117/135, 118/302, 118/320

[51] **Int. Cl.**..... **B05b 7/16,** B05b 13/02, B44d 1/08

[58] **Field of Search**..... 117/43, 168, 135, 104 R, 117/105.1, 105.4; 118/300, 302, 320

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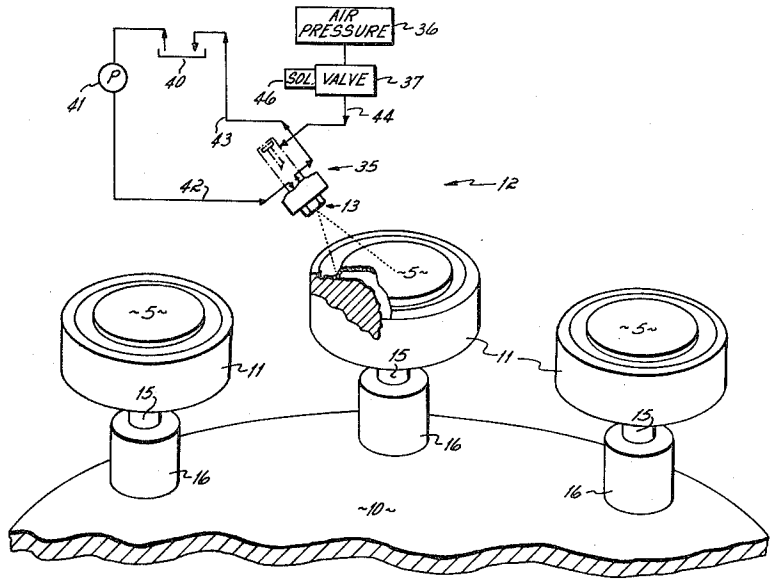
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[57] **ABSTRACT**

A method and apparatus for applying a film of wax to the interior surface of a can end before that end is assembled onto the body of a can. The wax is applied by melting a 100% solids wax and forcing it as a liquid without the addition of a solvent through an airless spray nozzle onto the rotating can end under conditions which result in a thin film of 100% solids wax being applied to the complete interior surface of the can end.

31 Claims, 6 Drawing Figures



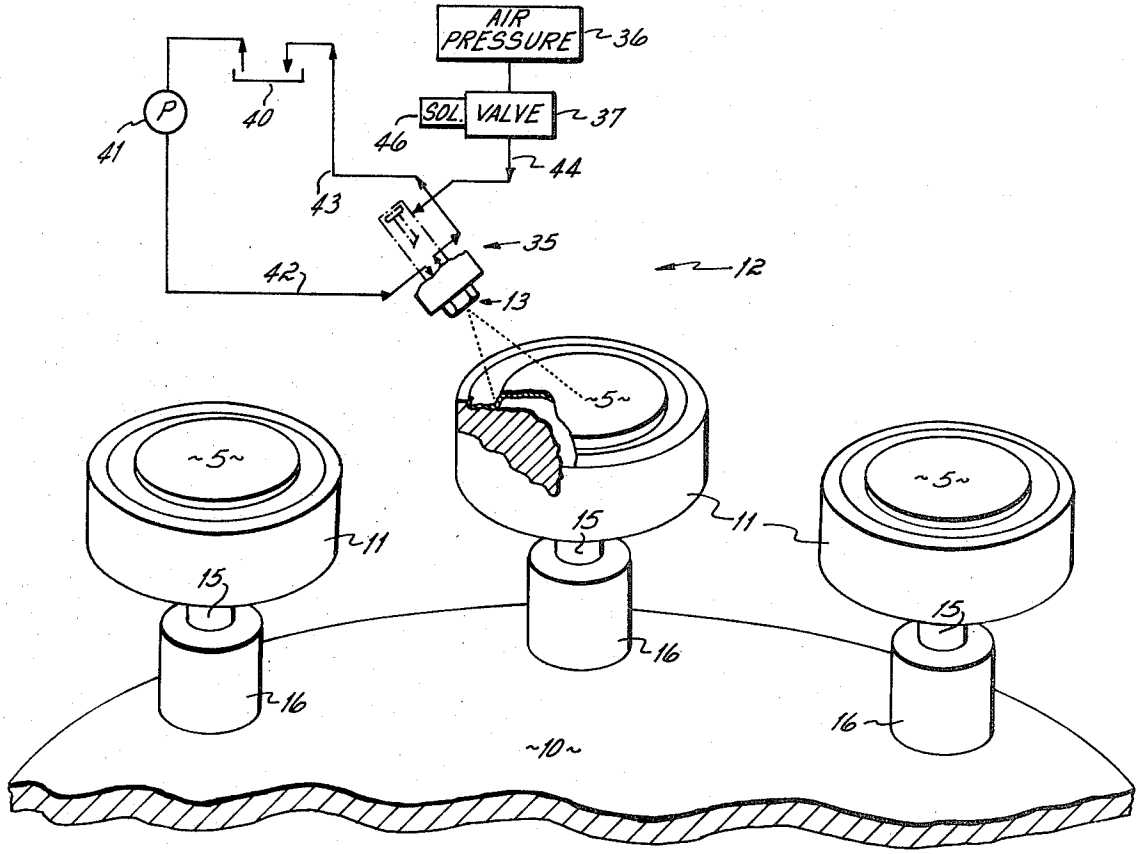


Fig. 1

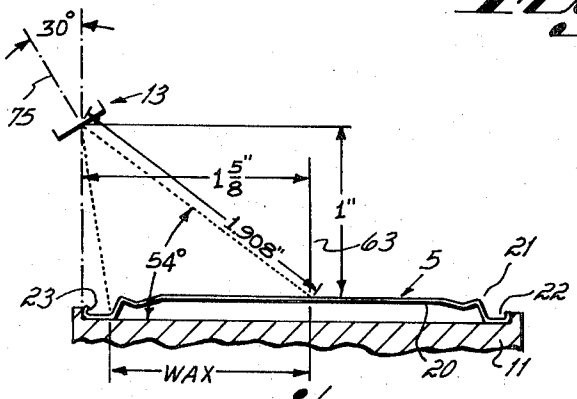


Fig. 2

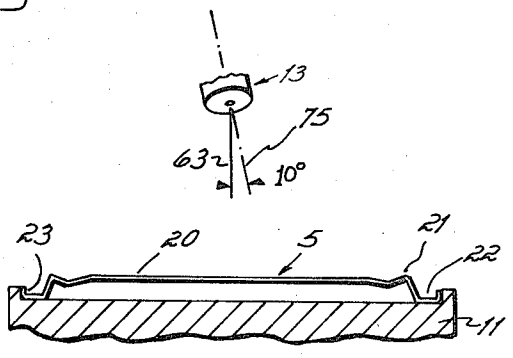


Fig. 3

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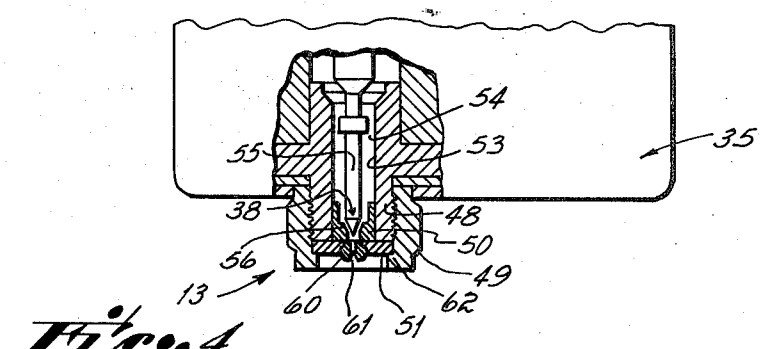


Fig. 4

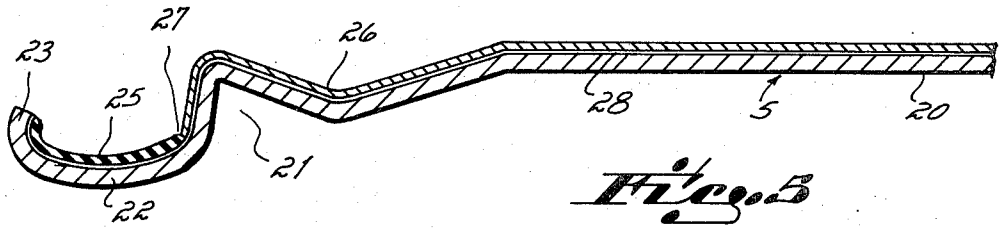


Fig. 5

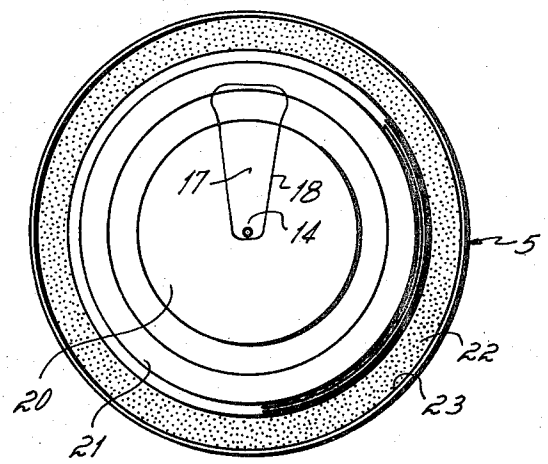


Fig. 6

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METHOD AND APPARATUS FOR APPLYING WAX TO CAN ENDS

This application is a Continuation-in-Part of application Ser. No. 76,167, filed Sept. 28, 1970, and of application Ser. No. 76,168, filed Sept. 28, 1970, now U.S. Pat. No. 3,726,711.

BACKGROUND OF THE INVENTION

This invention relates to the manufacture of metal cans, and more particularly to the coating of the interior of the cans to prevent the interior metal surface of the cans from contacting and contaminating the contents of the cans.

Metal cans are made by either one of two processes. One process, the two-piece can process, involves forming a drawn cup from a cylindrical slug or stamping of metal and then deep drawing the cup to a can configuration. The other process, the three-piece process, involves forming a cylindrical can body from a sheet of metal and then attaching two lids or ends to the opposite ends of the body. The invention of this application is concerned with the manufacture of the can ends and is therefore applicable to cans made by both processes.

Metal cans, and particularly steel cans, are made from precoated sheet material which is coated with protective material, as, for example, vinyl lacquer, phenolic lacquer, or modifications of either, while the steel is still in its sheet form. After the can bodies and ends are completely configurated and assembled, the interior surfaces are coated with a second protective coating, now generally vinyl lacquer, although numerous other materials, as, for example, resins, lacquers, waxes and paints are applied for this same purpose, i.e., to afford protection of the contents of the can against contamination by the metal. Particularly beer, beverages and foods must be protected against metal contamination by the application of a tasteless and odorless protective coating material to the interior of the can.

This protective material on the interior of the can must be continuous and uniform throughout the entire interior surface. The continuity requirements are absolute. There can be no pin holes, scratches or imperfections of any kind in this surface coating since any such minor imperfection will, during the shelf life of the can, result in deterioration of the can contents.

As long as metal cans have been used in the food canning industry, they have had to have this odorless and tasteless coating applied to the interior surface. In the earliest days of food packaging in cans, the protective coating was a paraffin wax. It was applied by melting the paraffin, pouring it into the can and then swishing it around the interior of the can until the interior surface was completely covered. The excess melted wax was then poured out of the can. Manifestly, this was a crude and imperfect coating technique. It was abandoned in favor of varnishes and lacquer which could be applied at higher rates by spraying techniques. When Bakelite and other phenolic resins became available, they were widely used in the form of a spray which was baked or cured on the interior surface. The phenolics were in turn replaced by vinyl resins and vinyl lacquers which are still widely used today. Generally, the vinyl lacquer is sprayed onto the interior of the can and then heated or cured to drive a solvent from the sprayed material.

There has always been and still is a quest in the metal can industry to find a material which affords the protection and which may be applied at less cost to the can manufacturer than that which they are currently using. While the cost of the material on any one can is not very great, when that cost is multiplied by the millions and billions of cans manufactured annually by any one can manufacturer, the cost is very appreciable. The principal objective of this invention has therefore been to find a new material and a method of applying it to the interior of cans which costs less to apply than coatings now being used in the can industry.

Present practice in the can industry is to apply the coating material mixed in a solvent which is sprayed onto the interior of the can. The sprayed can or can body is then heated or baked to cure the coating material and drive the solvent from it. The result is a hard thin film of material which completely coats the interior of the can. In the process of curing the coating material, though, the solvent is driven off and exhausted into the atmosphere, thereby giving rise to an atmospheric pollution problem. Within the last few years there has been a great deal of attention directed to atmospheric pollution and the atmospheric contamination which results from industrial exhaust. One of the contaminants at which attention is now directed is this exhausted solvent from can manufacturing companies' curing ovens.

Manufacturers have long desired, but never heretofore been able, to find a coating material which could be economically applied without the application of any solvent and which would cure or harden upon contacting a metal can without the application of any heat. This has always been a desirable concept, but one which has heretofore eluded the industry. It has therefore been another objective of this invention to find a material and a technique for applying it to the interior of cans which does not involve either a solvent or a heating step to cure a coating material and which can be carried out at speeds compatible with commercial metal can manufacturing equipment.

These objectives are accomplished and one apsect of this invention is predicated upon the concept of high speed spraying of thin films of melted wax (100% solids wax) without the addition of any solvent onto the interior of metal can ends. The resulting can end does not need to be baked to cure the wax and drive the solvent from it. Because there is no solvent used in this application, the added cost which results from its use is eliminated. Additionally, the objectionable atmospheric contamination or pollution which results from its use is eliminated.

As used throughout this application, the term "wax" is intended to include wax and waxlike materials including paraffin wax of the type commonly used in home canning, microcrystalline waxes, or combinations of the two formulated with or without additives to obtain particular hardening, melting, viscosity or other characteristics.

As used throughout this application, the term "100% solids wax" or "100% solids material" is intended to define a material which is 100% solids at room temperature and which may be converted to a liquid, generally by the application of heat so that it may be sprayed in liquid form without the addition of any solvent.

At the present time wax is being used commercially to coat the interior rims of can ends. It is applied to afford added protection over the rim of the can. Can coatings are particularly prone to fail at the rim be-

cause of cracks which develop during forming or shaping of the ends or because of scratches or imperfections which result from the high speed assembly of the ends onto the bodies and the subsequent crimping of the two together. To avoid or minimize this scratching as well as to provide an additional layer of coating material and protection at the joint, it is now common in the can industry to apply a film of wax onto the can in the form of an annular ring around the interior rim of the can. Present commercial practice is to melt 100% solids wax and mix it with a solvent so that the mix is diluted to 50% or less wax solids. This wax-solvent mix is then extruded as a bead at approximately 180° F. onto the rim of the can end. Because of its low viscosity, the bead then flows so that it ultimately forms an annular ring or film of wax-solvent around the interior peripheral surface. The end is then passed through an oven where the solvent is driven off or out of the wax-solvent mix. A lid with the cured wax applied around the rim may then be slapped onto the end of a can body at high speed and with much less danger of scratching or damaging the protective lacquer applied beneath the wax. The wax acts as a lubricant which facilitates sliding of the can end and can body mating surfaces without scratching the underlying protective lacquer. The wax also fills any voids and repairs any defects which may have occurred in the course of the application of the lacquer to the can end or the can body. The practice of this invention, though, distinguishes from that commercial practice of applying wax to can end rims in that it involves the application of a 100% solids wax to the complete interior of a can end as opposed to the application of a wax-solvent mix to the periphery of a can end rim.

This invention is principally predicated upon the determination of conditions and materials under which a 100% solids material may be applied to the interior surface of metal can ends at commercial can body manufacturing speeds and in such a manner as to meet or exceed present can industry manufacturing standards for protective coatings applied to the interior of metal cans.

One aspect of this invention is predicated upon the determination that an airless spray gun and nozzle may be utilized to apply a thin uniform thickness of 100% solids wax to the interior surface of a can end. Airless spray is a well known spraying technique which is different and distinct from conventional "air spray". It involves forcing a liquid material through a generally elliptical shaped orifice at high pressures, i.e., generally on the order of from 200–1,000 p.s.i. with the result that the spray fans out after emerging from the orifice and breaks up into an atomized spray without the impingement of any air against it. Conventional air spray on the other hand involves extruding a low pressure stream of liquid material from a nozzle at a pressure of from 10–50 p.s.i. and impacting that extruded stream with a high pressure of air on the order of from 35–100 p.s.i. to atomize and convert the extruded stream of fluid into a spray. The use of this airless spray technique in the application of 100% solids melted wax results in a very uniform thin film of wax being applied to the interior of can ends.

Still another aspect of this invention is predicated upon an empirical determination of conditions under which an airless spray technique may be utilized to apply a wax film consisting of 100% melted wax solids to the interior of a can end so as to meet can industry standards. Specifically, it has been determined that if the wax is heated to a temperature substantially above its melting point so as to lower its viscosity, and is forced through a properly sized and configurated orifice, at controlled pressures, and if the substrate or can body is maintained in a heated condition at a temperature substantially above the ambient temperature, a film of 100% solids wax may be applied to the interior of a can end so as to satisfy all requirements of the can industry for interior can surface coatings. Specifically, the resulting film is very thin and uniform and employs a minimum of coating material. The cost of this material is approximately one-half the cost of material now being utilized. Additionally, the protection afforded by this wax coating is better than the protection afforded by the lacquers now being applied to the interior of the can ends in the sense that it is more uniform and will provide a longer can shelf life.

The application of wax by the technique which forms the subject matter of this invention has numerous advantages over present commercial practice. Specifically, and most importantly, it reduces by approximately 50% or more the cost of material required to provide a thin protective film of material over the interior of a can. It also affords better protection of the contents of the can and a resulting longer lived can shelf life.

Another primary advantage of this invention is that it eliminates the use of solvent in the protective material applied to the interior of the can. This has several inherent advantages. Principally, it reduces the cost of material by eliminating the need for solvent and the expense incurred for that material which ultimately is wasted when the solvent is heated and boiled out of the protective material to cure it. Its elimination also avoids the pollution problem which results from exhausting that solvent to the atmosphere when the protective material is cured.

The elimination of the solvent from the system also has other advantages. Most solvents are explosive. Consequently, the entire area in which the protective material and solvent mix are applied must be explosion-proofed. The elimination of this solvent eliminates the requirement to explosion-proof the area.

Other advantages which accrue from elimination of this solvent are the elimination of the ovens and the fuel cost to heat the ovens required to cure the material and drive the solvent off so as to harden the protective coating. Additionally, the problem of mixing the solvent into the material and of maintaining the protective material-solvent mix in homogeneous condition is avoided.

These and other objects and advantages of this invention will be more readily apparent from the following description of the drawings in which:

FIG. 1 is a diagrammatic illustration of an indexing table and a system for applying wax to the can ends incorporating the invention of this application;

FIG. 2 is a cross-sectional view of the nozzle and of the can end to which wax is applied showing the relationship between the nozzle and the can end;

FIG. 3 is a cross-sectional view similar to FIG. 2 but viewing the end and nozzle from a different angle;

FIG. 4 is a cross-sectional view through the nozzle of the gun of FIG. 1;

FIG. 5 is an enlarged cross-sectional view of a portion of the can rim of FIG. 3; and

FIG. 6 is a top plan view of a can end looking down upon the inside surface of the end.

Referring first to FIG. 1 there is diagrammatically illustrated an airless spray system for applying wax to can ends incorporating the invention of this application. The system includes an indexable table **10** upon which there are mounted multiple individually rotatable heads **11.** The heads rotate at a speed of approximately 1,800 r.p.m. when the heads **11** are located at a wax application station **12.** At this station, wax is sprayed from a nozzle **13** onto the can end or lid as the lid rotates through slightly more than three full revolutions. This requires approximately 110 milliseconds.

The individual heads on the indexing table are mounted on shafts **15** supported in bearings **16.** The shafts **15** and the attached heads **11** may be rotated by belts, electric motors or air motors mounted beneath the table. In actuality, all three systems are used on tables manufactured by different manufacturers. These tables are commercially available and are well known in the can manufacturing industry. One such machine is manufactured by Dewey Almey Company and is identified as their Can End Repair Machine. Another commercially available machine is Crown Cork and Seal Company's Can End Repair Machine. Since these machines are commercially available and are well known, the details of the machine have not be illustrated. Specifically, the mechanism for feeding can ends **5** onto the top surface of the individual heads **11** and the mechanism for removing the can ends from the heads has not been illustrated since it forms no part of the invention of this application. Nor has the mechanism been illustrated for holding the individual lids on the top of the heads during rotation. The commercially available Dewey Almey Company machine utilizes a vacuum hold-down. As in the case of the mechanism for rotating the heads and the mechanism for feeding lids or ends onto and off the indexing table, the end hold-down mechanism has not been illustrated since it forms no part of the invention of this application.

A typical can end **5** of the type with which this invention is concerned is illustrated in FIGS. **2** and **4.** The end **5** illustrated in the drawings is a so-called pull tab end which has a pull tab **17** demarked by a score line **18** and a pull ring (not shown) secured to the outside surface by a rivet **14.** While the invention has been illustrated in connection with a pull tab end, it should be understood that it is equally applicable to a "full" or unscored end.

The end **5** comprises a generally planar circular section **20** around the periphery of which there is a groove or rim **21** and a flange **22** which terminates in a hook **23.** The flange **22** is intended upon assembly to overlie a flared rim of a cylindrical can body. The flange **22** and flared rim are then subsequently crimped together so that together they form the chime of the assembled can.

Referring now to FIG. **2,** there is illustrated an end which is inverted or turned upside down with the inside surface of the end on the top. This is the position of the end when a sealing compound **25** is applied to the recess formed by the flange and when the thin film of wax **26** is applied to the interior surface of the end according to the practice of the invention of this application.

The film of wax **26** on the interior surface of the end extends from the inside edge **27** of the compound **25** over the rim **21** and over the circular portion **20.** Functionally, this wax film serves to supplement and repair a previously applied protective coating **28** which extends over the complete interior surface of the can as well as the complete interior surface of the can. The protective coating **28** is applied to the metal or steel while it is still in sheet form as a very thin film. In the case of beer and beverage cans, it is absolutely critical that the protective coating **28,** generally a vinyl lacquer, or the coating which supplements that coating, completely cover the interior surface of the can. Any imperfections, whether they be pin holes, cracks or just uncovered areas, render the can unsuitable as a food or beverage container.

In order to apply the wax as a thin film to the interior of a can end or lid, the wax is atomized and sprayed onto the end from the nozzle **13** of a spray gun **35.** In the practice of a preferred embodiment of this invention, this gun **35** is a pneumatically operated airless spray gun in which the pneumatic pressure functions under the control of a solenoid valve **37** (FIG. **1**) to open and close a check valve **38** (FIG. **4**) of the gun. Liquid pressure alone forces this liquid wax through the gun and causes it to emerge as a fan-shaped spray.

The wax which is applied by the gun **35** is a 100% solids wax. The significance of the 100% solids is that the wax is completely solid at room temperature. Heretofore it has been common practice to apply wax as an annular ring around the periphery of can end rims **21.** This has been done by heating the wax and mixing it with at least 50% by weight of solvent, usually a liquid acetone or hexane solvent, before applying it onto can ends via an extrusion process. In my copending application Ser. No. 76,167, of which this application is a Continuation-in-Part, there is described an apparatus and method of applying wax by an airless spray technique to the rims of can ends. This application is distinguished from that application in that it is directed to a method and apparatus for applying wax to the complete interior surface of can ends as opposed to the rims.

By the practice of this invention, the wax is heated and sprayed as a 100% solids without the addition of any solvent. This is accomplished by heating the wax in a reservoir **40** to a temperature of approximately 350° F. This heating may take place in a nitrogen atmosphere to avoid degradation of the wax. The melted wax is then pumped via a pump **41** through a heated hose **42** into the spray gun **35.** In the preferred embodiment, the gun is of the so-called circulating flow type because it has a return line **43** through which wax is returned to the reservoir **40.** There is a continuous flow of heated wax through the gun so that the wax cannot solidfy or harden in the gun when the line is temporarily shut down. The gun, other than the nozzle, forms no part of the invention of this application and therefore has not been described in detail. A complete description may be found in an application of E. F. Hogstrom et al, Ser. No. 56,304, filed July 20, 1970, and entitled "Method and Apparatus for Striping Inside Seams of Cans" . That application is assigned to the assignee of this application.

Air pressure from a source **36** is supplied via a pneumatic line **44** under the control of the solenoid valve **37** to control opening and closing of the check valve **38**

interiorly of the gun **35.** The solenoid **46** of the valve is controlled by a conventional electric control and timer circuit. It is operable to open the check valve **38** for the preferred number of turns, e.g., slightly more than three full revolutions of an end **5** on the rotatable table **11.** If the end is rotating at 1,800 r.p.m., the timer control circuit is operable to open the check valve **38** for approximately 110 milliseconds to apply wax to each lid.

The nozzle **13** comprises an externally threaded nose piece **48** of the gun, an internally threaded nozzle cap **49,** a valve seat **50** and a nozzle plate **51.** The cap **49** is threaded over the nose piece **48** and has a flange **62** which secures the nozzle plate **51** onto the end of the nose **48.** Valve seat **50** is welded or otherwise fixed in position in nose piece **48.**

The nose piece **48** has a stepped axial bore **53,** the large diameter inner end of which serves as a chamber **54** for molten wax. The axially slideable closure needle **55** of the check valve **38** is slideable within this chamber **54** and is engageable with a shoulder **56** of the valve seat **50** to close the check valve.

The nozzle tip **60** is generally hemispherical in configuration. It has a hub portion which extends rearwardly from the hemispherical end and is brazed in the plate **51.** The approach passage extends from the rear of the nozzle tip up to the nozzle orifice **61.**

The nozzle orifice is a so-called "drumhead" orifice. It is generally elliptical in configuration when viewed in a direction parallel to the axis of the nozzle and is made by making a series of cuts into a generally hollow hemispherical shaped nozzle of substantially uniform wall thickness. The cuts are made by a grinding wheel which has a tapered edge. A complete description of a drumhead nozzle may be found in application Ser. No. 13,598 of W. C. Stumphauser, filed Feb. 24, 1970, and assigned to the assignee of this application.

Referring now to FIGS. **2, 3,** and **5,** there is illustrated the position of the nozzle **13** with respect to the orientation of a standard 2 11/16 inches diameter can end. As may be seen in these figures, the nozzle is positioned approximately 1 inch above the rim of the can end and 1 ⅝ inches from the axis or center of the end. At these distances the wax emerging from the nozzle orifice as a high pressure stream of wax breaks up into an atomized spray before contacting the end. The pattern of the atomized spray as it contacts the can end is shown in dotted lines in FIG. **6.**

As may be seen in FIG. **2,** the nozzle axis **75** is angulated at an angle of approximately 30° to the vertical in a radial plane of the can end **5.** When viewed in that radial plane, it is also angulated at 10° to the vertical plane. The 30° angulation is provided in order to obtain an even coating of wax over the inner surface of the can end. The 10° angulation is aimed into the direction of rotation of the can lid. It has been found that the wax or any liquid sprayed onto a rotating substrate bends in the direction of rotation of the substrate. Consequently, by angulating the nozzle slightly and aiming it into the direction of rotation the spray pattern contacts the rotating substrate at an angle of approximately 90°.

Throughout this application, the material being sprayed from the nozzle onto the can end rim has been described as a 100° solids wax. The formulation of this wax varies from manufacturer to manufacturer as do the characteristics of the wax. Some waxes are formulated with resins so as to melt at a slightly higher temperature than other waxes. Some are harder than others. Generally, the higher temperature melting waxes are used on beer cans in which the beer is pasteurized in the can. The term "wax" is therefore intended in this application to describe and encompass all wax and wax-like materials used on the can ends to protect the can contents against metal contamination. The wax may be the old fashioned paraffin wax used for home canning or it may be a more complex wax formulated for particular properties. Examples of such "waxes", all of which have been tested and sprayed onto can ends under the conditions set forth in this application are: Cerafilm wax sold by American Can Company, Mobile Oil Company wax No. 67–658, Standard Oil of Ohio wax No. 66–2242–6, National Wax Company wax No. 6396 LY, Bareco Division of Petrolite Corp.'s Be Square 170/175 Amber Wax, and National Wax Company wax No. 6528 LA. Additionally, conventional paraffin as well as DuPont's Elvax may be successfully sprayed onto can ends under the conditions set forth herein.

The specific conditions under which one particular wax (National Wax Company's Sarapoll, Formula No. 6528 LA) has been applied to the ends of beer and beverage size cans 2 11/16 inches in diameter are depicted in the following chart. Additionally depicted in the chart are the range of conditions under which other waxes have been or may be applied to ends of this size can.

	Example No. 1 Preferred	Permissible Range
Wax	National Wax Co. Sarapoll	Other waxes
Distance D	1.908"	1"–3"
Temp. Wax	350° F. ± 25° F.	140° – 350° F.
Nozzle	.090 g/min.	.015 – .160 g/min.
Restrictor Dia.	.008"	.006 – .015"
Wax Press	400 p.s.i.g.	150–750 p.s.i.g.
Appl. Rev.	3.3 rev.	1–5 rev.
End/r.p.m.	1,800 r.p.m.	800–3,200 r.p.m.
Wax/End	85 ± 10 mg.	40–160 mg.
Preheat	5 sec. at 180° F.	—
Postheat	3 sec. at 112° F.	—

By way of explanation of this chart, the distance D of the nozzle orifice from the can end center was 1.908 inch in the example of Column **1.** It may vary as shown in Column 2 from approximately 1.0 inch to 3 inches. In the example of Column 1, the wax temperature was 350° F. ± 25° F. At this temperature the wax in the example of Column 1 reaches its minimum viscosity so that any further heating serves no useful purpose. Other waxes have been heated and applied at tempera-

tures ranging from their melting temperature of approximately 140° F. through 350° F. The nozzle orifice in the example of Column 1 has a flow rate of .090 gallons per minute of water at 500 p.s.i. gauge. The permissible range of nozzle size varies from .015 gallons per minute to .160 gallons per minute water at 500 p.s.i.g. The diameter of the orifice of the restrictor plate in the example of Column 1 was .008. It may vary, though, in combination with the preferred nozzle from .006 inch through .015 inch. The pressure employed to eject liquid wax from the nozzle in the example of Column 1 was 200 p.s.i. gauge. Other waxes have been applied from 150–750 p.s.i. gauge pressure. In the example of Column 1, the wax was applied for approximately 3.3 revolutions of the can end while the end was rotating at 1,800 r.p.m. It may be applied from 1–5 revolutions, depending upon the speed of the can end. In the example of Column 1, an average of 85 milligrams of wax was applied per can end. Using other waxes under other conditions, the wax will vary from 40–160 milligrams.

In the preferred example illustrated in Column 1, immediately prior to application of wax onto the ends, the can ends were preheated for five seconds at 180° F. The particular wax used in this example melts at a temperature of approximately 180° F. By preheating the can ends to this temperature immediately prior to application of the wax, the wax is prevented from cracking and crystallizing upon contact with the end. The end was also postheated after application of the wax for three seconds at 112° F. The purpose of this postheating cycle was to slow the setting of the wax so as to avoid crystallization and surface roughness.

While in the preferred example the can ends were both preheated and postheated, either or both of these heat cycles may be omitted, depending upon the wax employed and the application for which the can end is intended. Alternatively, the time and temperatures of the preheat and postheat cycles may be varied to match the wax employed for the application.

In general, the practice of airless spray wax application to can ends according to the practice of this invention results in the application of a more consistent and uniform film of wax over the can than has heretofore been possible under production conditions over prolonged production runs. It also results in a thinner film of material, yet one which provides the same or a greater degree of protection to the contents of the can.

Probably the greatest advantage which accrues from the practice of this invention is the elimination of the necessity to add a wax solvent, as, for example, an acetone or hexane solvent, to the mix. With the elimination of the solvent, there is no need for an oven to drive the solvent from the wax after it is applied to the can lid or end, there is no need to bake the coating, there is no need to protect the atmosphere from pollution because no solvent must be baked from the wax, and there is no need to explosion-proof the area in which the wax is applied. Additionally, the practice of this invention enables the wax to be applied in a thinner film with less overspray and clean-up problems. Additionally, the film weights may be more closely and consistently controlled.

While I have described only a single preferred embodiment of this invention, those persons skilled in the arts to which it pertains will readily appreciate numerous modifications and changes which may be made without departing from the spirit of my invention. Therefore, I do not intend to be limited except by the scope of the appended claims.

Having described my invention, I claim:

1. The method of applying less than 29 milligrams per square inch of a 100% solids protective layer of wax to the complete interior surface of a can end without the addition of any solvent so that the end need not be baked to drive off solvent from the wax, which method comprises

rotating the end relative to the orifice of a nozzle of an airless spray gun,

melting a 100% solids wax and supplying it in the as melted condition to the nozzle of said spray gun without the addition of any solvent,

ejecting said melted wax in the form of an airless spray of liquid from said nozzle orifice at a pressure sufficient to cause said wax to atomize upon emergence from said nozzle and directing said atomized spray onto the rotating end for a time period sufficiently short that less than 29 milligrams per square inch of wax is applied over the complete interior surface of said can end.

2. The method of claim **1** which further includes the step of preheating said can end to a temperature approximately the same as the melting temperature of said wax prior to ejecting said melted wax onto said end.

3. The method of claim **1** which further includes the step of postheating said can end after ejection of said melted wax onto said end to a temperature sufficient to retard and slow the setting of the wax on the end and to avoid crystallization and cracking of the wax.

4. The method of claim **1** wherein said rotating end is located a sufficient distance from said nozzle orifice to permit said ejected wax to atomize prior to contacting said end.

5. The method of claim **1** wherein said end to which said spray of wax is applied is located approximately 1 inch from said nozzle orifice.

6. The method of claim **1** wherein said wax is heated to a temperature of approximately 350° F. before it is supplied to the nozzle of said spray gun.

7. The method of claim **1** wherein said wax is supplied to said nozzle of said spray gun at a pressure in excess of 150 p.s.i. but less than 750 p.s.i.g.

8. The method of claim **1** wherein said wax is supplied to said nozzle of said spray gun at a pressure of approximately 400 p.s.i.g.

9. The method of claim **1** wherein said wax is ejected from a spray nozzle which has a flow rate of less than .160 gallons per minute water at 500 p.s.i.g. but more than .015 gallons per minute water at 500 p.s.i.g.

10. The method of claim **1** wherein said wax is ejected from a spray nozzle which has a flow rate of approximately .090 gallons per minute water at 500 p.s.i.g.

11. The method of claim **5** wherein said wax is heated to a temperature of approximately 350° F. before it is supplied to the nozzle of said spray gun.

12. The method of claim **11** wherein said wax is supplied to said nozzle of said spray gun at a pressure of approximately 400 p.s.i.g.

13. The method of claim **12** wherein said wax is ejected from a spray nozzle which has a flow rate of ap-

proximately .090 gallons per minute water at 500 p.s.i.g.

14. The method of claim **13** which further includes the step of preheating said can end to a temperature approximately the same as the melting temperature of said wax prior to ejecting said melted wax onto said end.

15. The method of claim **14** which further includes the step of postheating said can end after ejection of said melted wax onto said end to a temperature sufficient to retard and slow the setting of the wax on the end and to avoid crystallization and cracking of the wax.

16. Apparatus for applying less than 29 milligrams per square inch of a 100% solids protective layer of wax to the complete interior surface of a can end without the addition of any solvent so that the end need not be baked to drive off solvent from the wax, which apparatus comprises

a spray gun having an airless spray nozzle and a nozzle orifice,

means for supporting a can end for rotation relative to the orifice of said nozzle,

means for melting a 100% solids wax and supplying it in the as melted condition to the nozzle of said spray gun without the addition of any solvent,

means for ejecting said melted wax from said nozzle orifice at a pressure sufficient to cause said wax to atomize upon emergence from said nozzle and for directing said atomized spray onto a rotating end for a time period sufficiently short that less than 29 milligrams per square inch of wax is applied over the complete interior surface of said can end.

17. The apparatus of claim **16** which further includes means for preheating said can end to a temperature approximately the same as the melting temperature of said wax prior to ejecting said melted wax onto said end.

18. The apparatus of claim **16** which further comprises means for postheating said can ends after ejection of said melted wax onto said end to a temperature sufficient to retard and slow the setting of the wax on the end and to avoid crystallization and cracking of the wax.

19. The apparatus of claim **16** wherein said end supporting means is located sufficiently far from the nozzle orifice to permit said wax to atomize prior to contacting said end.

20. The apparatus of claim **16** wherein said can supporting means supports said end approximately 1 inch from said nozzle orifice.

21. The apparatus of claim **16** which further includes means to heat said wax to a temperature of approximately 350° F. before it is supplied to the nozzle of said spray gun.

22. The apparatus of claim **16** wherein said means for ejecting said melted wax from said nozzle includes means for supplying said wax to said nozzle at a pressure in excess of 150 p.s.i.g. but less than 750 p.s.i.g.

23. The apparatus of claim **16** wherein said means for ejecting said melted wax from said nozzle includes means for supplying said wax to said nozzle at a pressure of approximately 400 p.s.i.g.

24. The apparatus of claim **16** wherein said nozzle orifice has a flow rate of less than .160 gallons per minute water at 500 p.s.i.g. but more than .015 gallons per minute water at 500 p.s.i.g.

25. The apparatus of claim **16** wherein said nozzle orifice has a flow rate of approximately .090 gallons per minute water at 500 p.s.i.g.

26. The apparatus of claim **20** which further includes means to heat said wax to a temperature of approximately 350° F. and to maintain it at that temperature until it is supplied to the nozzle of said spray gun.

27. The apparatus of claim **26** wherein the means for ejecting said melted wax from said nozzle includes means for supplying said wax to the nozzle at a pressure of approximately 400 p.s.i.g.

28. The apparatus of claim **27** wherein said nozzle orifice has a flow rate of approximately .090 gallons per minute water at 500 p.s.i.g.

29. The apparatus of claim **28** which further includes means for preheating said can end to a temperature approximately the same as the melting temperature of said wax prior to ejecting said melted wax onto said end.

30. The apparatus of claim **29** which further comprises means for postheating said can ends after ejection of said melted wax onto said end to a temperature sufficient to retard and slow the setting of the wax on the end and to avoid crystallization and cracking of the wax.

31. The apparatus of claim **30** wherein said spray gun includes a restrictor plate located upstream from said nozzle orifice, said plate having a restricted axial aperture approximately .008 inch in diameter.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,819,403 Dated June 25, 1974

Inventor(s) Edwin F. Hogstrom

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 6, after the word "can" insert--end--.
Column 9, line 44, after the word "can" insert--end--.

Signed and sealed this 8th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

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