April 10, 1973 E. F. HOGSTROM 3,726,711

METHOD AND APPARATUS FOR COATING METAL CAN BODIES

Filed Sept. 28, 1970 2 Sheets-Sheet 1

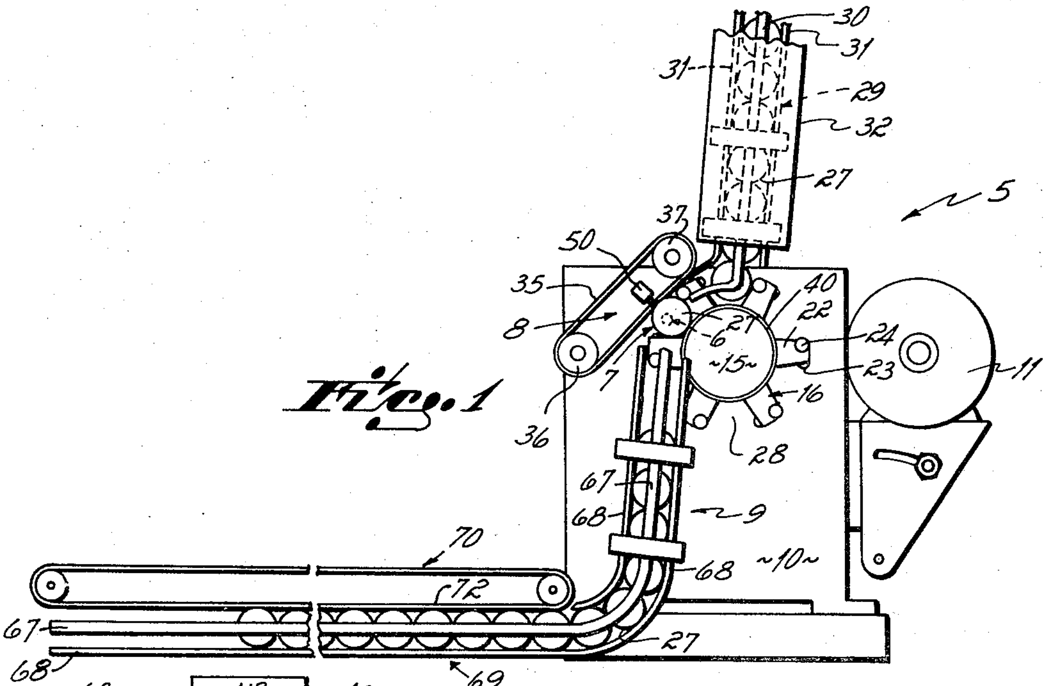

Fig. 1

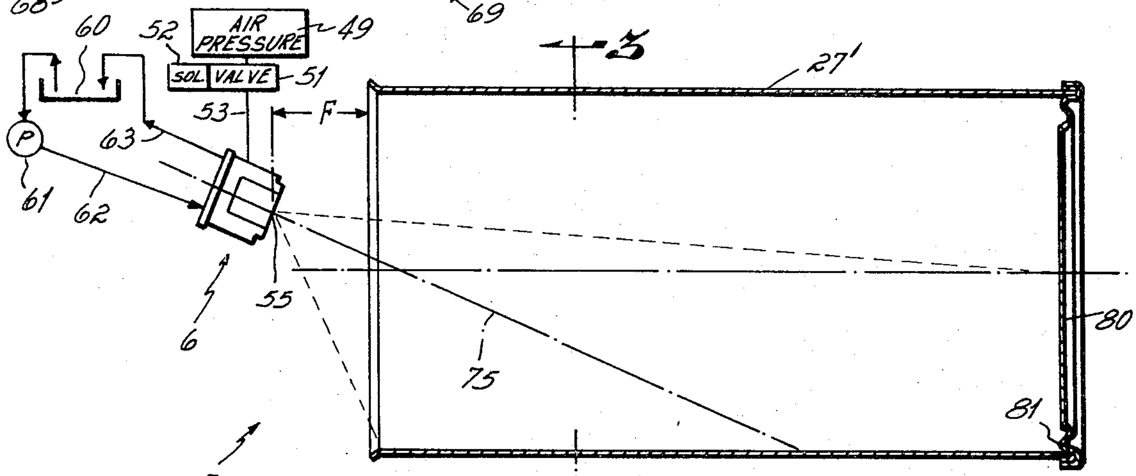

Fig. 2

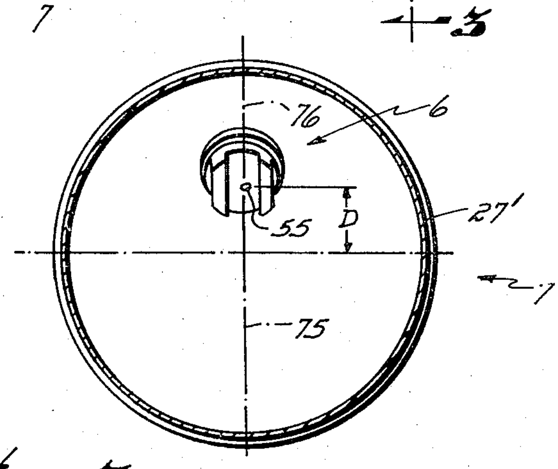

Fig. 3

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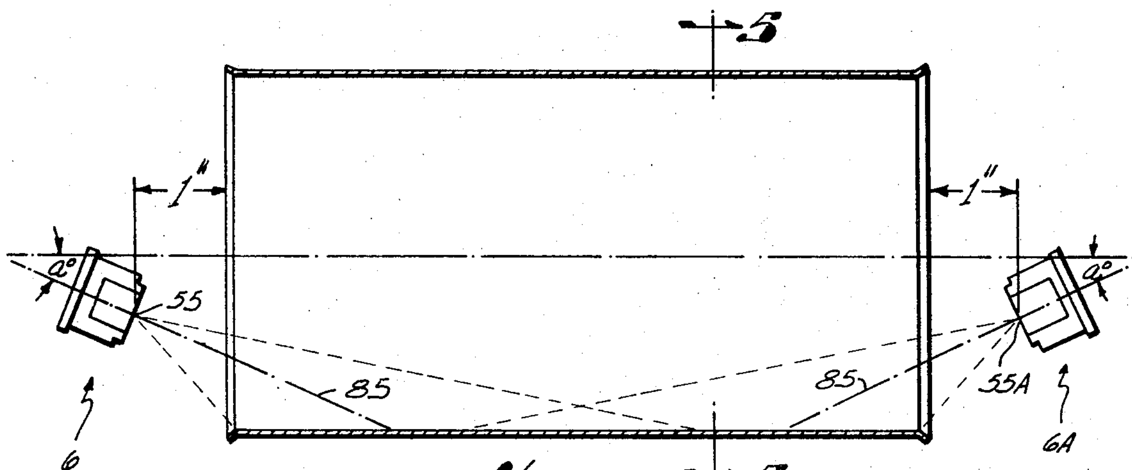

Fig. 4

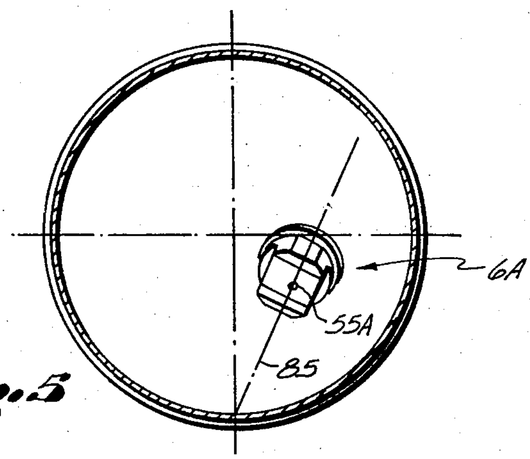

Fig. 5

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3,726,711

METHOD AND APPARATUS FOR COATING METAL CAN BODIES

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Int. Cl. B44d *1/02*
U.S. Cl. 17—96 29 Claims

ABSTRACT OF THE DISCLOSURE

A method and apparatus for applying a film of wax to the body of a can before the can is completely assembled with an end or ends. 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 under conditions which results in a thin film of 100% solids wax being applied over the complete interior surface of the can body.

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 from contacting and contaminating the packaged 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 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 applicable to cans made by both processes.

After can bodies and ends are completely configurated, but before the end or ends are assembled onto the body, the interior surface of both the bodies and the lids are coated with a protective coating, generally vinyl lacquers although numerous other materials, as for example, resins, lacquers, waxes and paints have been applied for this same purpose, i.e., to afford protection of the content of the can against contamination by the metal. Particularly beer, beverage 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 over 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, cracks or imperfections of any kind in the 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 ben 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

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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 aspect 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 bodies. The resulting can 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 because 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 the 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 body 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 of metal can bodies 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 body. 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 stream 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 bodies.

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 body 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 body 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 requires 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 cans 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 requirements 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.

Another advantage of this invention is that it results in a better protective coating being applied to the can interiors than results from the application of lacquers and resinous material now being widely used commercially. Consequently, the practice of this invention enables cans to be used for packaging foods, beer and beverages which are made from unprecoated sheet steel. Heretofore, cans made from sheet steel have always had to be precoated. Additionally, the practice of this invention may eliminate the necessity for striping the inside seams of cans so as to apply an extra or second coat of protective material over the interior of the can seam.

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 front elevational view of a machine upon which the invention of this application may be practiced;

FIG. 2 is a partially diagrammatic cross-sectional view illustrating the manner in which wax is applied from the nozzle onto the interior of a can body in one set-up for practicing the invention of this application;

FIG. 3 is a cross-sectional view taken on line 3—3 of FIG. 2 showing the position of the nozzle relative to the axis of the can;

FIG. 4 is a view similar to FIG. 2 but illustrating another set-up for coating the interior of three-piece can bodies according to the practice of this invention; and

FIG. 5 is a cross-sectional view taken along line 5—5 of FIG. 4.

Referring first to FIG. 1, there is diagrammatically illustrated one embodiment of a commercially available machine **5** upon which the invention of this application may be practiced. The machine is operable to feed closed bottom cans at the rate of approximately 200 cans per minute past a spray head or gun **6** located at a can coating station **7** of the machine. At this station, cans are rotated by a can rotating mechanism **8** while a spray of coating material is directed onto the complete interior surface of the can. After termination of the spray cycle, cans are dropped into a discharge chute **9** through which they are conveyed while rotation of the cans is continued until the coating material sets and solidifies sufficiently to prevent running and consequent uneven coating of the interior surface.

The machine **5** per se forms no part of the invention of this application. It has only been illustrated and described in this application for purposes of illustrating one embodiment of a machine upon which the invention of this application may be practiced or carried out. This particular machine is illustrated and described in detail in U.S. Pat. No. 3,452,709 of R. J. Hartmeister et al., which was issued July 1, 1969. Since it is described in detail in this patent it is only briefly described in this application and only insofar as it is necessary to understand and appreciate this invention.

Briefly, the machine **5** comprises a frame **10** which supports a motor **11** for driving the can rotating mechanism **8** as well as an indexing head or star wheel **16**. This star wheel **16** is rotatably mounted upon a drive shaft which also supports and drives a second can rotating wheel **15**. The indexing wheel is so mounted that it may be rotated intermittently and independently of the wheel **15**.

The star wheel **16** comprises a plurality of radially extending arms **22**, in each one of which are mounted three idler rollers; one idler roller **23** projecting peripherally from one side of the arm and a pair of idler rollers **24** projecting peripherally from the other side of the arm **22**. Each of the arms **22** is U-shaped in axial cross section and has the rollers **23, 24** so positioned in it as to be cooperable to guide one can **27** between them.

Cans **27** are supplied to the index head **16** through an enclosed and heated infeed chute **29**. This chute is defined by front and rear guide bars **30** located adjacent the can ends and side guide bars **31**, all of which are enclosed by a casing **32**. At the bottom end of the chute, the cans pass into pockets **28** of the star wheel for movement into the spray station **7**. As the cans move into the spray station, they contact the peripheral surface of the second can rotating wheel **15** and a pair of O-belts **35** of the first can rotating mechanism **8**. These belts **35** are mounted on drive pulleys **36** and idler pulleys **37**. The wheel **15** is constructed with a resilient tread **40** on its periphery and is accessible to the pockets **28** of the star wheel **16** between the arms **22**. In practice, the cans are held out of engagement with the tread **40** of the drive wheel **15** until they move from beneath the chute toward the spray station **7**. In so moving, the cans contact the tread of the constantly rotating wheel such that they are rotating at full speed shortly after arriving at the spray station **7**. Simultaneously, the side of the cylindrical can opposite from the wheel **15** contacts and is rotated by the O-belts **35** which travel at the same speed as the linear speed of the tread of the wheel **15**. As the can **27'** arrives at the spray station **7**, it trips a proximity switch **50**. This switch senses the presence of the can at the spray station and after a predetermined delay (measured in terms of milliseconds), a burst of liquid spray is initiated from the spray gun **6** onto the interior of the can as it rotates relative to the stationary nozzle.

Referring now to FIG. 2, it will be seen that actuation of the proximity switch **50** by the presence of a can **27'** at the spray station **7** is operable to close an electrical circuit to a solenoid valve **51**. The solenoid **52** of this valve then causes the spool (not shown) of the valve to move to a position in which air from a source of pressure **49** is directed via an air line **53** to the spray gun **6**. This air pressure actuates a pneumatic motor interiorly of the gun **6** causing it to move a check valve of the gun to an open position. Opening of this check valve (not shown) allows circulating liquid coating material, in this instance heated liquid wax, to flow out of a nozzle orifice **55** and be converted into an atomized spray. The liquid wax is supplied to the gun **6** from a source of melted wax **60**. The melted wax is pumped by a pump **61** through a line **62** to the gun. In one preferred embodiment the gun **6** is of the circulating type, i.e., it has a continuous flow

of liquid material pumped through it via a return line **63** to the tank **60**. In this way the temperature of the wax in the gun remains constant and has no chance to harden in the event that the gun is temporarily turned off. The gun is also preferably heated as is the line **62** through which melted wax is supplied to the gun.

The details of a pneumatically actuated gun suitable for this application are fully described in a copending application of Edwin F. Hogstrom et al., filed July 20, 1970, and entitled "Method and Apparatus for Striping Inside Seams of Cans." This application is assigned to the assignee of this application.

A predetermined time after the gun is turned on, it is automatically turned off by an electrical timing circuit which de-energizes the solenoid **52**, thereby opening the air line **53** to atmosphere through the spool of valve **51**.

After termination of the spray cycle and the closing of the discharge of liquid wax from the nozzle **55**, the coated can is carried by the star wheel through a small arc and is dropped by gravity into the discharge chute **9**. In this chute the can is guided by front and rear guide rods **67** and side guide rails **68**. The discharge chute is angulated slightly so that the can continues to roll as it falls down the chute and enters a horizontal stretch **69** of the discharge conveyor. The horizontal stretch has an endless drive belt **70** located above it so that cans entering the horizontal stretch of the discharge chute are contacted and rotated by the lower run **72** of the belt. This belt drives the cans in continuous rotation and moves them toward a packing station downstream of the horizontal section of the chute. The length of the discharge chute is such that it maintains the cans in rotation after completion of the spraying cycle and after indexing of the head away from the spray station **7** for approximately thirty seconds. During this time period, the wax hardens as a result of conversion from a liquid state to a solid state. This post spray rotation of the cans prevents the liquid spray material from running on the heated cans. In the absence of a post spray rotation until the wax sets, the wax forms into droplets which run and destroy the uniformity of the coating. The time period required for this post spray rotation may be shortened if so desired by injection of chilled air during the post spray rotation period.

The machine heretofore described is a conventional commercially available can coating machine except for the addition of the heated preheat can infeed chute **32**. In the absence of this preheat chute or of a preheat cycle (which may be in the form of infrared lamps or induction coils), it has been found that liquid wax sprayed onto the interior of cans cracks, blisters or frosts to form a nonhomogeneous film on the substrate. To avoid this cracking, blistering and frosting, the interior of the chute **32** is maintained at a temperature near the melting temperature of the wax, in one preferred embodiment 175° F., so that the cans are heated in the chute through a preheat cycle long enough for the cans to reach a surface temperature near the melting temperature of the wax.

Referring now to FIGS 2 and 3, it will be seen that the spray gun **6** is located externally of the closed end can **27'**. When the wax emerges from the nozzle it develops into a fan shaped spray because of the pressure with which the liquid wax is forced through the nozzle. The spray quickly atomizes so that it is a fine atomized spray before it reaches and contacts the interior surface of the can **27'**. Preferably the can goes through at least three complete revolutions while the atomized spray is directed onto the interior of the can so that the complete interior surface is exposed and evenly coated with coating material.

There are differing nozzle configurations available for this type of external spray coating of the interior of the cans. All of these differing configurations, though, have as their objective the application of a greater portion of the liquid material in the upper half of the spray pattern than is located in the lower half of the spray pattern as the pattern is viewed in FIG. 2. In other words, a greater amount of liquid spray is directed above the axial line **75** than is directed beneath the axial line as the fan shaped spray pattern is viewed in FIG. 2. This results in a greater amount of spray being applied to the bottom **80** and particularly the peripheral bottom corner **81** of the can than would otherwise be applied if the spray was directed through an even distribution conventional elliptically shaped orifice. One nozzle commonly used for achieving this type of pattern for spraying the internal surface of a can from a nozzle located externally of the can is a "drum head" nozzle. Another nozzle is a so-called 75–25 controlled pattern nozzle. Both of these nozzles as well as the spray pattern which results from their use are fully described in U.S. patent application Ser. No. 13,598 of W. C. Stumphauzer et al., for Spray Nozzle, Method of Making Same and Method of Spraying Closed End Cans, filed Feb. 24, 1970, and assigned to the assignee of this application.

The invention of this application is not concerned with the particular machine upon which the metal cans may be interiorly coated or with the location of the nozzle or even the type of nozzle utilized but rather is concerned with the determination of materials and conditions under which a 100% solids material, i.e., one which contains no solvent, may be sprayed upon the interior of cans under high speed production conditions in such a manner as to satisfy the criteria of the metal can industry with respect to the integrity, uniformity, or evenness, and cost of the coating material.

Conditions under which 100% solids materials have been satisfactorily applied to the interior of cans under conditions which meet or exceed all can company production requirements are depicted in the following chart:

	Test No. 1	Test No. 2
Material—National Wax Co.	No. 6528LL	No. 6528LL.
Temperature	310° F.–320° F	310° F.–320° F.
Melting temp	175° F	175° F.
Viscosity	3.5–5 cps. at 310° F	3.5–5 cps. at 310° F.
Wt./body	950–1,000 mg	752–802 mg.
Bodies/min	216	216.
Rev./body	3.72 rev	3.72 rev.
Body	1,850 r.p.m	1,850 r.p.m.
Spray time/body	120 m./sec	120 m./sec.
Nozzle	092–062	092–200.
Turbulence plate	027–314	027–314.
Pressure	500 p.s.i	400 p.s.i.
Type material	Wax	Wax.
Size can	2 11/16 x 4 13/16"	2 11/16 x 4 13/16".
Temp., time, preheat can	175° 7. for 3 min	180° F. for 2 min.
Max. mat./sq. inch	24.6 mg	19.7 mg.
Waco	3.3 ma. average	.43 ma. average.
Post roll	30 seconds	30 seconds.

Referring to the chart, there are two different tests set forth in the two columns. Both tests employ the set-up and the conditions of FIGS. 1–3 for spraying wax onto the interior of cans. In both tests the cans were standard beer cans 2 11/16" in diameter by 4 13/16" in length. The cans were made from tin plated sheet steel which had been precoated prior to stamping and forming. The nozzle orifice **55** was located on a diametral center line **76** of the cans during the spraying operation and was offset a distance D of 29/32" from the can axis. The nozzle orifice was offset a distance of 1 1/8" from the end of the can or outside the end of the can.

In both tests the wax which was used was a wax manufactured by the National Wax Company and identified by their number 6528LL. This is a blended wax which contains paraffin, microcrystalline waxes and low density resin additives. It has a melting temperature of 175° F.

In both tests the wax was heated to a temperature between 310–320° F. in the reservoir **60** and was maintained at that temperature by heat applied to the wax supply line **62** and to the gun **6**. The wax was heated to this temperature in order to lower its viscosity to approximately 3.5 to 5 centipoise at which it may be sprayed without graining or flaking when applied to a substrate. In both tests the cans were intermittently indexed past the spray gun **6** by the indexing head **16** at the rate of 216 cans per minute. While located at the station the cans were rotated by the can rotating wheel **15** and by the belts **35** at the rate of 1850 r.p.m. While so rotating, a burst of wax was sprayed through an airless spray gun **6** for 120 milliseconds or 3.72 revolutions of the cans onto the can interiors. In Test No. 1, the cans were preheated for three minutes at a temperature of 175° F. in the infeed tunnel prior to arrival at the spray station **7**. In the second test the cans were heated for two minutes at 180° F. in the can infeed tunnel before arriving at the spray station. In both tests the cans continued to roll and be rotated in the discharge chute **9** for a period of thirty seconds.

In Test No. 1 the nozzle employed was a commercially available nozzle identified as a Nordson nozzle 092–062 in combination with a Nordson Model No. 027–314 turbulence plate. This nozzle is a conventional drum head nozzle which has a flow rate of 180 cubic centimeters water at 40 p.s.i. gauge and at 77° F. The turbulence plate is inserted upstream of the nozzle to reduce the flow rate and better atomize the spray. This particular turbulence plate in combination with the nozzle reduces the flow from this nozzle to 150 cc. water at 40 p.s.i. and at 77° F.

In Test No. 2 the nozzle employed was a Nordson Model No. 902–200 nozzle in combination with a Nordson turbulence plate Model No. 027–314. This nozzle is a 75–25 control pattern nozzle which has the same flow rates with and without the turbulence plate as the drum head nozzle employed in Test No. 1. A complete description of both nozzles may be found in the above identified copending U.S. patent application Ser. No. 13,598 of W. C. Stumphauzer.

In Test No. 1, the wax was supplied to the gun **6** by the pump **61** at a pressure of 500 p.s.i. gauge. At this pressure and under the conditions specified in Test No. 1, the total weight of wax applied to the interior of the can varied between 950 and 1,000 milligrams per can. When divided by the area of the can this is a coating of 24.6 milligrams per square inch maximum over the can interior.

In Test No. 2 the melted wax at 310–320° F. was supplied by the pump **61** to the gun at 400 p.s.i. When sprayed onto the interior of the can under the conditions set forth in Test No. 2, the resulting wax coating or film of wax varied between 752 and 802 milligrams of wax per can. This was a maximum weight of 19.7 milligrams per square inch over the interior of the can.

In both tests, the cans utilized were cans which were ultimately intended for use as metal beer containers or beer cans. Can industry standards require these containers test out at an average of 2–5 milliamperes in a Waco Continental model can coating tester. In this model of coating tester the can is filled with a saline water solution. Specifically, the electrolyte consists of 10.2 grams of salt per litre of distilled water. When an electrical probe carrying pulsating D.C. voltage at 10 volts peak −1.5 volts valley, 60 cycles per second, is inserted into the water and the outside of the can is grounded, no more than an average of 5 milliamps current must pass through the coatings as read on a gauge of the Waco tester if the cans are to meet industry standards. In fact, these standards vary from can manufacturer to can manufacturer but the majority of them require that the average reading not be more than 5 milliamps for beer cans. Carbonated beverage can standards require no more than two milliamperes average readings on this Waco tester. In Test No. 1 the cans tested out at an average of 3.3 milliamperes using a standard Waco Continental Model No. 10780 can tester. In Test No. 2 the average wax tested out at .43 milliampere. Both of these test runs clearly fall within the standards of the can industry for beer cans and test run No. 2 clearly falls within the strictest standard for carbonated beverage containers.

The tests heretofore described involved cans made from precoated sheet steel, i.e., cans made from sheet steel which had been precoated in the sheet form before any can forming or shaping operations were performed on the steel. The results derived from these tests are so superior in protective qualities to result heretofore possible using prior art coating techniques and materials, that they may be applied to bare or unprecoated steel or metal cans. In this case, though, the amount of material applied to the can will be appreciably increased, possibly to as much as twice the amount required to give the same degree of protection on precoated metal cans.

Referring now to FIGS. 4 and 5, there is illustrated a second setup for spraying the interior of can bodies of so-called three-piece cans from spray nozzles located exteriorly of the bodies. Three-piece cans are those which are made from a hollow cylinder to which two ends or caps are crimped after the application of the protective coating to the interior surface of the open-ended cylindrical can and the two ends.

The setup depicted in FIGS. 4 and 5 may be utilized on the machine of FIG. 1 by simply locating two nozzles at opposite ends of the cylindrical can body. The two nozzles are positioned so that their sprays overlap near the longitudinal center of the can. In this set up, the two nozzle orifices **55**, **55A**, of the two guns **6** and **6A** are positioned approximately one inch from the vertical plane of the ends of the can at the spray station. The nozzles are positioned in a horizontal plane slightly below the horizontal plane of the can axis. While conventional airless spray nozzles having an elliptical configuration when viewed in the direction of the axis of the nozzle may be employed in this set up to lay down a generally fan-shaped spray pattern, a drumhead or a 75–25 controlled pattern nozzle is preferred. The spray pattern emitted from the drumhead or controlled pattern nozzles is applied with most of the spray material being located on that side of the nozzle axis **85** which is remote from the can opening near which the nozzle is located. The nozzle axis is preferably angulated at an angle *a* of approximately 25° for spraying cans 2$^{11}/_{16}$″ in diameter and 4$^{13}/_{16}$″ in length. The nozzle orifice is preferably offset approximately ⅜″ from the vertical plane through the can axis and has its orifice directed back to the bottom of the can so that the center line of the spray contacts the can in a vertical diametral plane of the can.

A complete description of the setup depicted in FIGS. 4 and 5 for spraying the interior of cans is described in copending application Ser. No. 16,733 of E. F. Hogstrom, filed Mar. 5, 1970, entitled "Method and Apparatus for Coating the Interior of Hollow Bodies," assigned to the assignee of this application. In general, the conditions depicted in the chart used to define the parameters of the conditions for spraying the interior of a closed bottom can, as set forth in the preceding chart, are applicable and suitable for applying wax to the interior of a can using the setup depicted in FIGS. 4 and 5.

As evidenced by the test results derived from the practice of this inventon, cans may be coated with a 100% solids wax without the addition of any solvent under commercial speeds, feeds and conditions by the practice of this invention. Heretofore, waxes have been sprayed onto the interior of cans but never heretofore on metal cans and never heretofore at the speeds at which metal cans must be coated to satisfy can industry production requirements. Nor prior to this invention has anyone ever been able to coat metal cans with a 100% solids material so as to meet the can industry requirements for uniformity and integrity of the coating material and specifically the Waco milliampere test rating standards of the metal can industry for can coatings. Waxes have though been applied to the interior of fibreboard containers in thicknesses many times that employed in the practice of this invention and at speeds a great deal slower.

The primary advantage of the practice of this invention is that it completely eliminates the requirement for the addition of solvents and the need to boil those solvents out of the coating material after it is applied to the can in order to cure the coating. It also has the advantage when applied in the thin weights derived from the practice of this invention of substantially reducing the cost of material employed to provide the protective coating required to meet the metal can industry standards.

Having described my invention, I claim:

1. The method of coating the interior of metal can bodies at commercial can production speeds with a film of tasteless and odorless protective wax which melts at a temperature of less than 200° F. and which is a solvent free 100 percent solids at ambient temperature, which method comprises the steps of

preheating the can bodies,

heating the wax for a sufficient time and at a sufficient temperature to melt it and convert it to a liquid state,

supplying the melted wax at a temperature of approximately 300° F. in the liquid state without the addition of any solvent to a nozzle of a spray gun,

ejecting the melted wax from the nozzle and directing it as a spray onto the interior of the heated can bodies while the surface temperature of the can bodies is at a temperature substantially above ambient temperature and as the can bodies move past and are rotated relative to the nozzle,

terminating the spray of melted wax onto the interior surface of the can bodies after an even coating of liquid wax is applied to the interior surface of the body but before the wax can build to an average thickness of more than 50 milligrams per square inch over the interior surface, and

continuing to rotate the bodies after the application of the spray until the temperature of the sprayed wax is reduced sufficiently for the wax to reconvert back to the solid state as a film on the interior of the can bodies.

2. The method of claim **1** in which the wax is supplied to the nozzle at a pressure in excess of 300 p.s.i.

3. The method of coating the interior of metal can bodies with a film of tasteless and odorless protective coating material which is a solvent free 100 percent solids at ambient temperature at commercial can production speeds, which method comprises the steps of

preheating the can bodies,

heating the solid material for a sufficient time and at a sufficient temperature to melt it and convert it to a liquid state,

supplying the melted material in the liquid state without the addition of any solvent to a nozzle of a spray gun,

ejecting the melted material from the nozzle as an airless spray and directing it as a spray onto the interior of the heated can bodies while the surface temperature of the can bodies is at a temperature substantially above ambient temperature and as the can bodies move past and are rotated relative to the nozzle,

terminating the spray of melted material onto the interior surface of the can bodies after an even coating of liquid material is applied to the interior surface of the body but before the material can build to an average thickness of more than 50 milligrams per square inch over the interior surface, and

continuing to rotate the bodies after the application of the spray until the temperature of the sprayed material is reduced sufficiently for the material to reconvert back to the solid state as a film on the interior of the can bodies.

4. The method of claim **3** in which said coating material is a wax and in which said material is heated to a temperature of at least 250° F. but less than 400° F.

5. The method of claim **3** in which said coating material is a wax and in which said can bodies are preheated to a temperature near or in excess of the melting temperature of the wax.

6. The method of claim 3 in which said coating material is a wax and in which said can bodies are preheated for several minutes at a temperature near the melting temperature of the wax.

7. The method of claim 3 in which the coating material is a wax and is heated to a temperature sufficient to lower its viscosity to at least 20 centipoise.

8. The method of claim 7 in which the wax is supplied to the nozzle at a pressure in excess of 300 p.s.i. and is applied as an airless spray.

9. The method of claim 4 in which the wax melts at a temperature of less than 200° F. and in which the wax is heated to a temperature of approximately 300° F. before it is supplied to the nozzle of the spray gun.

10. The method of claim 9 in which the wax is supplied to the nozzle at a pressure in excess of 300 p.s.i.

11. The method of coating the interior of metal can bodies with a film of tasteless and odorless wax material which melts at a temperature of less than 200° F. and which is a solvent free 100 percent solids at ambient temperature, which method comprises the steps of

preheating the can bodies,

heating the wax for a sufficient time and at a sufficient temperature to melt it and convert it to a liquid state,

supplying the melted wax in the liquid state at a temperature of approximately 300° F. without the addition of any solvent to a nozzle of a spray gun,

ejecting the melted wax from the nozzle and directing it as a spray onto the interior of the heated can bodies while the surface temperature of the can bodies is at a temperature substantially above ambient temperature and as the can bodies move past and are rotated relative to the nozzle,

terminating the spray of wax onto the interior surface of the can bodies after an even coating of liquid wax is applied to the complete interior surface of the body but before the wax can build to an average thickness of more than 50 milligrams per square inch over the interior surface, and

continuing to rotate the bodies after the termination of the spray until the temperature of the sprayed wax is reduced sufficiently for the wax to reconvert back to the solid state as a film on the interior of the can bodies.

12. The method of coating the interior of metal can bodies with a film of tasteless and odorless wax material which is a solvent free 100 percent solids at ambient temperature, which method comprises the steps of

preheating the can bodies,

heating the wax for a sufficient time and at a sufficient temperature to melt it and convert it to a liquid state,

supplying the melted wax in the liquid state without the addition of any solvent to a nozzle of a spray gun,

ejecting the melted wax from the nozzle as an airless spray and directing it as a spray onto the interior of the heated can bodies while the surface temperature of the can bodies is at a temperature substantially above ambient temperature and as the can bodies move past and are rotated relative to the nozzle,

terminating the spray of wax onto the interior surface of the can bodies after an even coating of liquid wax is applied to the complete interior surface of the body but before the wax can build to an average thickness of more than 50 milligrams per square inch over the interior surface, and

continuing to rotate the bodies after the termination of the spray until the temperature of the sprayed wax is reduced sufficiently for the wax to reconvert back to the solid state as a film on the interior of the can bodies.

13. The method of claim 12 in which said wax is heated to a temperature of at least 250° F. but less than 400° F.

14. The method of claim 12 in which said cam bodies are preheated at a temperature near or in excess of the melting temperature of the wax.

15. The method of claim 12 in which said can bodies are preheated for several minutes at a temperature near the melting temperature of the wax.

16. The method of claim 12 in which the wax is supplied to the nozzle at a pressure in excess of 300 p.s.i.

17. The method of claim 12 in which the wax is heated to a temperature sufficient to lower its viscosity to at least 20 centipoise.

18. The method of claim 17 in which the wax is supplied to the nozzle at a pressure in excess of 300 p.s.i. and is applied as an airless spray.

19. The method of claim 13 in which the wax melts at a temperature of less than 200° F. and in which the wax is heated to a temperature of approximately 310° F. before it is supplied to the nozzle of the spray gun.

20. The method of claim 19 in which the wax is supplied to the nozzle at a pressure in excess of 300 p.s.i.

21. The method of coating the interior of metal can bodies with a film of tasteless and odorless wax material which is 100% solids at ambient temperature, which method comprises the steps of,

preheating the can bodies,

heating the wax for a sufficient time and at a sufficient temperature to melt it and convert it to a liquid state,

supplying the melted wax in the liquid state without the addition of any solvent at a pressure in excess of 300 p.s.i. to a nozzle of a spray gun,

ejecting the melted wax from the nozzle and directing it as an airless spray onto the interior of the heated can bodies while the surface temperature of the can bodies is at a temperature substantially above ambient temperature and as the can bodies move past and are rotated relative to the nozzle, and

terminating the spray of wax onto the interior surface of the can bodies after an even coating of liquid wax is applied to the complete interior surface of the body but before the wax can build to a thickness of more than 50 milligrams per square inch over the interior surface.

22. The method of coating the interior of can bodies at commercial can production speeds with a film of tasteless and odorless protective coating wax material which melts at a temperature of less than 200° F. and which is 100 percent solids at ambient temperature, which method comprises the steps of

heating the solid material for a sufficient time and at a sufficient temperature to melt it and convert it to a liquid state,

supplying the melted material in the liquid state without the addition of any solvent to a nozzle of a spray gun at a temperature of approximately 300° F.,

ejecting the melted material from the nozzle and directing it as a spray onto the interior of the can bodies as the can bodies move past and are rotated relative to the nozzle,

terminating the spray of melted material onto the interior surface of the can bodies after a uniform, even coating of liquid material is applied to the interior surface of the body but before the material can build to an average thickness of more than 50 milligrams per square inch over the interior surface, and

continuing to rotate the bodies after the application of the spray until the temperature of the sprayed material is reduced sufficiently for the material to reconvert back to the solid state as a film on the interior of the can bodies.

23. The method of claim 22 in which the wax is supplied to the nozzle at a pressure in excess of 300 p.s.i.

24. The method of claim 23 in which the wax melts at a temperature of less than 200° F. and in which the wax

is heated to a temperature of approximately 300° F. before it is supplied to the nozzle of the spray gun.

25. The method of coating the interior of can bodies with a film of tasteless and odorless protective coating material which is 100 percent solids at ambient temperature at commercial can production speeds, which method comprises the steps of

heating the solid material for a sufficient time and at a sufficient temperature to melt it and convert it to a liquid state,

supplying the melted material in the liquid state without the addition of any solvent to a nozzle of a spray gun,

ejecting the melted material from the nozzle as an airless spray and directing it as a spray onto the interior of the can bodies as the can bodies move past and are rotated relative to the nozzle,

terminating the spray of melted material onto the interior surface of the can bodies after a uniform, even coating of liquid material is applied to the interior surface of the body but before the material can build to an average thickness of more than 50 milligrams per square inch over the interior surface, and

continuing to rotate the bodies after the application of the spray until the temperature of the sprayed material is reduced sufficiently for the material to reconvert back to the solid state as a film on the interior of the can bodies.

26. The method of claim **25** in which said coating material is a wax and in which said material is heated to a temperature of at least 250° F. but less than 400° F.

27. The method of claim **25** in which said coating material is a wax and in which said can bodies are preheated to a temperature near or in excess of the melting temperature of the wax.

28. The method of coating the interior of can bodies at commercial can production speeds with a film of tasteless and odorless protective coating material which melts at a temperature of less than 200° F. and which is 100 percent solids at ambient temperature, which method comprises the steps of

heating the solid material for a sufficient time and at a sufficient temperature to melt it and convert it to a liquid state,

supplying the melted material in the liquid state without the addition of any solvent to a nozzle of a spray gun at a temperature in excess of 250° F.,

ejecting the melted material from the nozzle and directing it as a spray onto the interior of the can bodies as the can bodies move past and are rotated relative to the nozzle.

terminating the spray of melted material onto the interior surface of the can bodies after a uniform, even coating of liquid material is applied to the interior surface of the body but before the material can build to an average thickness of more than 50 milligrams per square inch over the interior surface.

29. The method of coating the interior of can bodies with a film of tasteless and odorless protective coating material which is 100 percent solids at ambient temperature at commercial can production speeds, which method comprises the steps of

heating the solid material for a sufficient time and at a sufficient temperature to melt it and convert it to a liquid state,

supplying the melted material in the liquid state without the addition of any solvent to a nozzle of a spray gun,

ejecting the melted material from the nozzle as an airless spray and directing it as a spray onto the interior of the can bodies as the can bodies move past and are rotated relative to the nozzle, and

terminating the spray of melted material onto the interior surface of the can bodies after a uniform, even coating of liquid material is applied to the interior surface of the body but before the material can build to an average thickness of more than 50 milligrams per square inch over the interior surface.

References Cited

UNITED STATES PATENTS

2,028,798	1/1936	Murch	113—120
2,101,922	12/1937	Stoesling	117—105.1 X
2,124,853	1/1938	Grupe	117—96 X
2,952,987	9/1960	Clauson	117—105.1 X
3,563,791	5/1969	Janco	117—96 X
2,604,871	7/1952	Larson	118—59
3,189,242	6/1965	Orr	117—168 X
3,489,600	1/1970	Millar	117—168 X

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117—97, 105.1, 105.4, 135, 168; 118—318