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Rood et al.

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[54] **APPARATUS FOR STRIPING INSIDE SEAMS OF CANS**

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[52] **U.S. Cl.** **118/2,** 118/317

[51] **Int. Cl.** **B05c 11/00**

[58] **Field of Search** 118/2, 317; 239/291, 412, 239/431, 434

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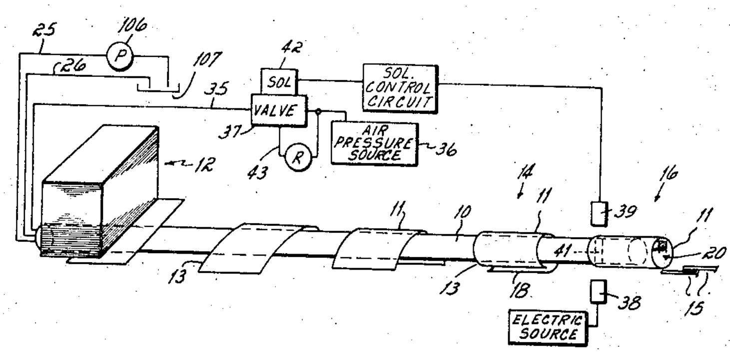
Primary Examiner—Mervin Stein
Assistant Examiner—Leo Millstein
Attorney, Agent, or Firm—Wood, Herron & Evans

[57] **ABSTRACT**

An apparatus for applying an impervious protective coating over the seams of cylindrical metal can bodies either before or after the seams are welded, soldered, or cemented and prior to spray coating the complete interior of the bodies. The apparatus is operable to intermittently apply an airless spray to the interior seams of the cans as they continuously move past an airless spray gun secured to the end of a stubhorn of a can forming line. The apparatus includes a new and improved airless spray nozzle which is operable to atomize the spray nearer the nozzle than has heretofore been possible. It also includes a pair of air jets located on opposite sides of the spray and operable to confine the atomized spray or fog to the seam of the can so that little or no excess material is sprayed onto that portion of the can located adjacent the seam.

13 Claims, 7 Drawing Figures



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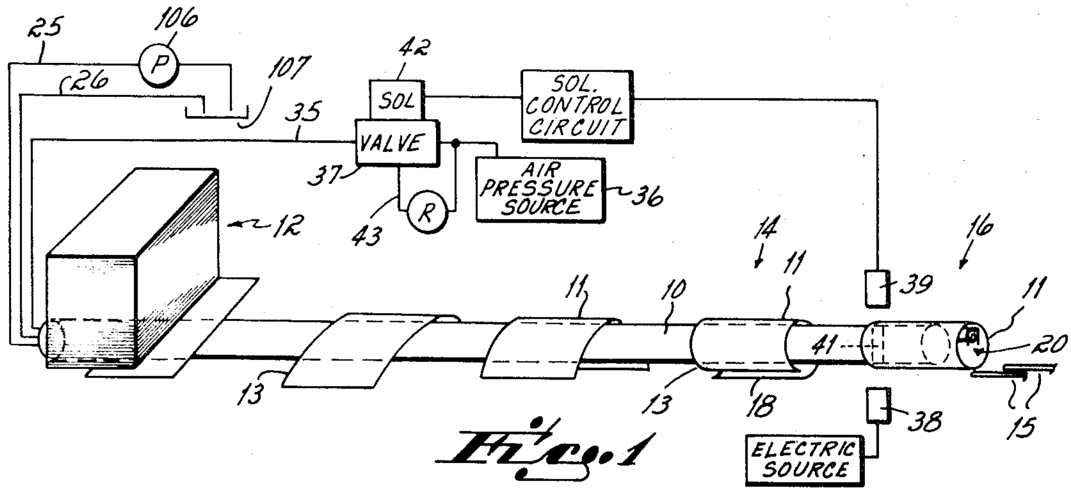

Fig. 1

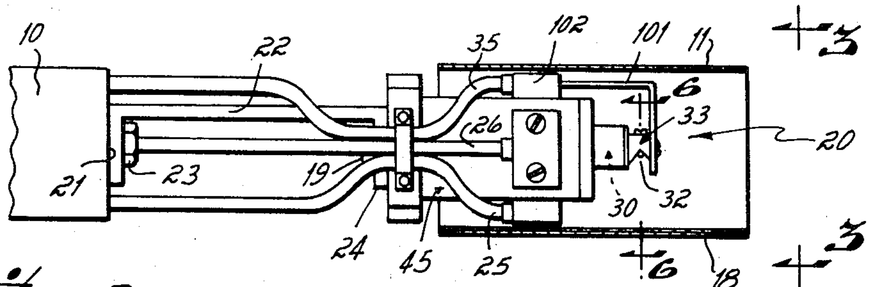

Fig. 2

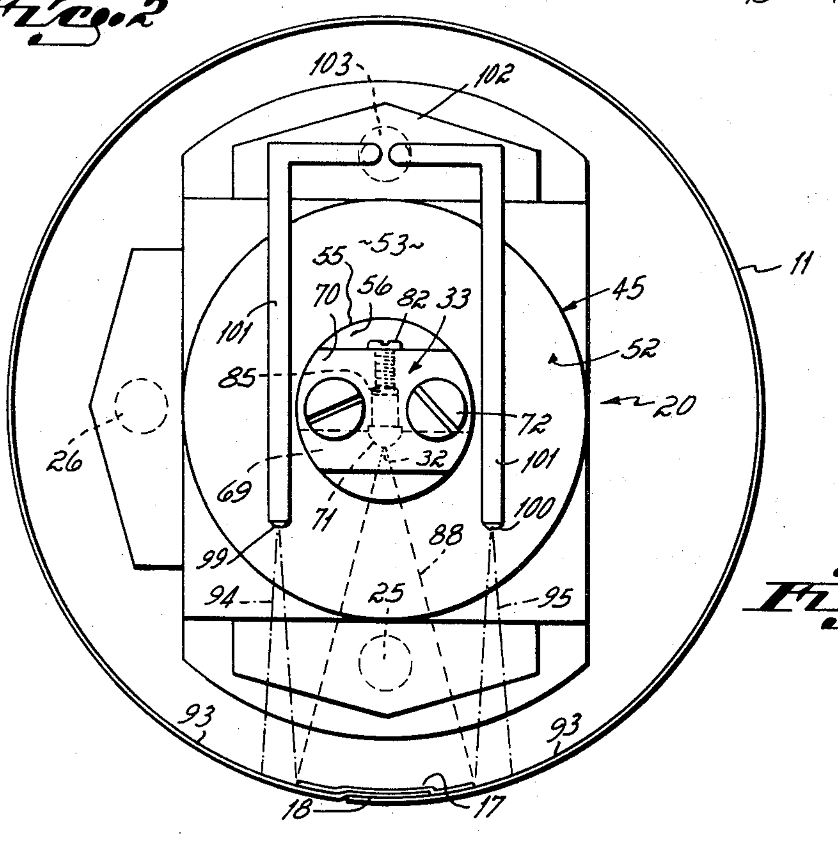

Fig. 3

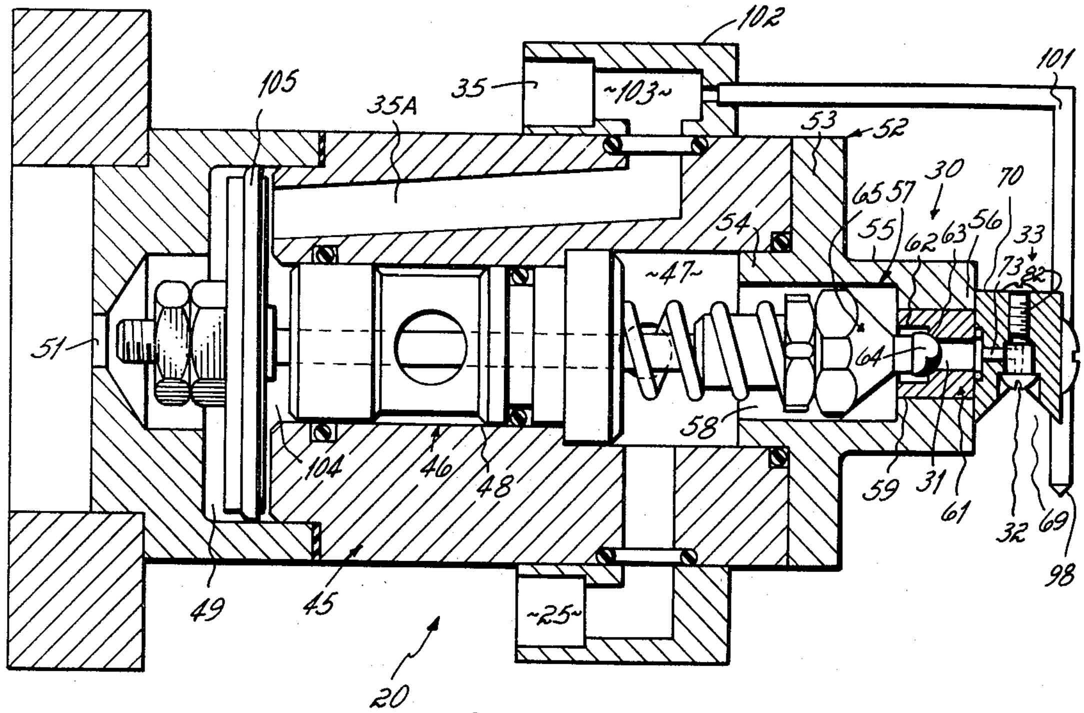
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Fig. 4

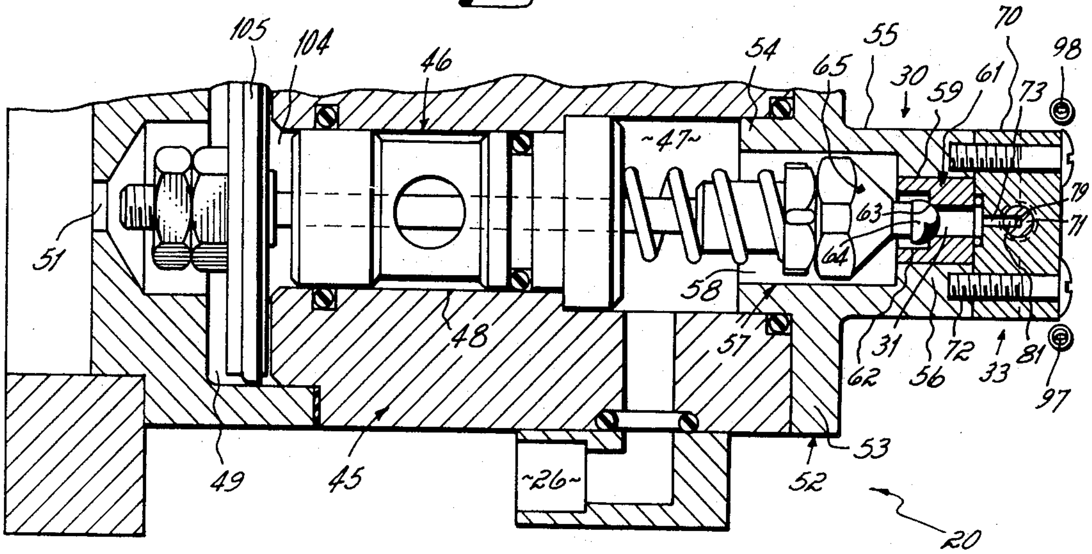
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Fig. 5

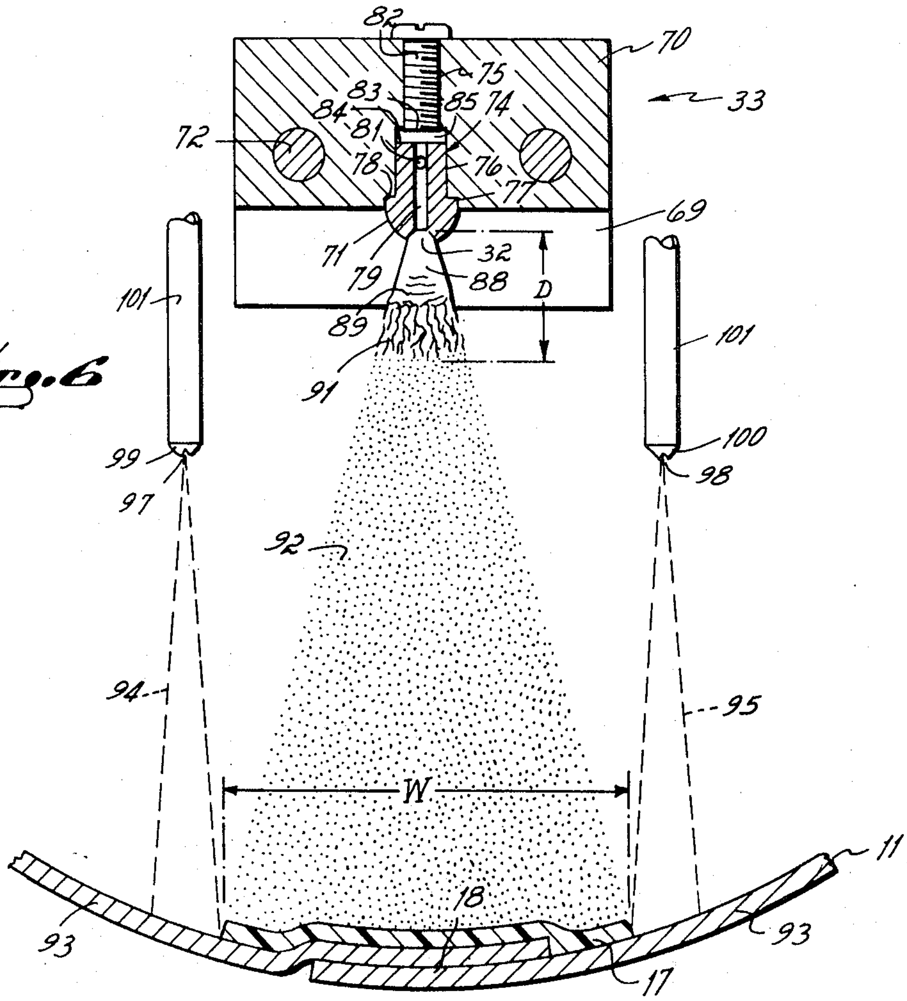
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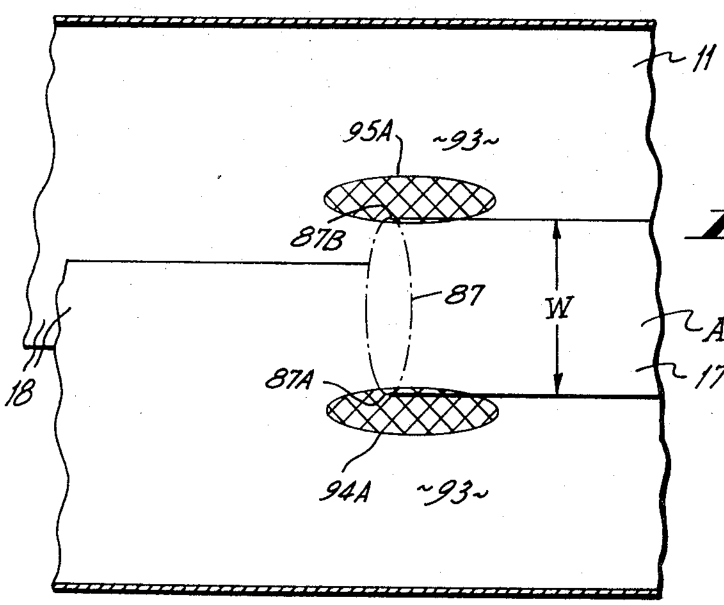
Fig. 6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87B
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17
94A
93

Fig. 7

APPARATUS FOR STRIPING INSIDE SEAMS OF CANS

This invention relates to the application of protective coatings to the interior of metal cans and more particularly to the application of a stripe of protective coatings to the interior soldered, welded, or adhered seam of a three-piece metal can.

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 concerned only with the application of protective coatings to three-piece cans.

In the manufacture of three-piece cans, the cylindrical bodies are formed by wrapping a sheet of metal around a so-called stubhorn. Prior to formation into the cylindrical configuration, the sheets **13** are generally roller coated on all but the lateral edges with a protective coating of lacquer or other similar material. After formation into the cylindrical, configuration, the lateral edges of the sheet are either butted or overlapped and secured together by either a welded seam, a soldered seam, or a cemented seam. The seam area and the previously uncoated lateral edges of the sheet are then spray coated with an epoxy or phenolic lacquer or some modification of these materials. Subsequently, the complete interior of the cylindrical body is coated with another complete protective coating which is generally of 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 in this way against metal contamination by the application of a tasteless and odorless protective coating material to the interior of the can.

The protective material which is applied to the interior of the can must be continuous throughout the entire interior surface. Any pin holes, cracks, or imperfections in the integrity of the coating render the can unsuitable for most applications. To avoid pin holes, cracks, or imperfections in the coating, it is now common practice in the can industry to first apply a stripe of protective material over the interior seam of a three-piece can body before a second or subsequent layer is applied to the complete interior of the can. The purpose of this stripe is to provide an impervious layer of protective material over that portion of the body which is most vulnerable to imperfections and where failures most often occur.

In co-pending application Ser. No. 56,304 filed July 20, 1970, and assigned to the assignee of this application, there is described an airless spray technique for applying a stripe of protective material or lacquer to the interior seams of cans as the cans pass over and off the end of the stubhorn of a can manufacturing line. This invention is an improvement upon the method and apparatus described in that application.

Specifically, there is described in that application an airless spray technique for intermittently applying a stripe of lacquer to the inside seams of can bodies as the cans pass an airless spray nozzle attached to the end of the stubhorn. The spray nozzle is so positioned on

the stubhorn that it is located on the interior of the can bodies as the bodies pass the striping station.

One of the problems encountered in spraying a stripe of protective material onto the seam of a can body is that of confining the spray to a stripe approximately ½ to 1 inch in width, depending upon the can application, without having the spray bounce up or fog onto the area or side of the can wall adjacent the stripe. This confining of the stripe to avoid its overlapping or splashing onto the side walls of can bodies is particularly critical in the case of soldered seam cans. Common practice is to spray the seam of the can with the protective stripe prior to soldering of the seam but after the seam has been formed and overlapped. After spraying, the seam is soldered and the area adjacent the seam is exposed during soldering to a temperature of 700°–900° F during which the stripe of protective material is cured. Thereafter, the complete interior of the can body is sprayed with a coating of lacquer or protective material but one which cures at a lower temperature, as, for example, 300° F. If any high curing temperature seam striping material inadvertently is sprayed onto the area adjacent the stripe, that lacquer is not subjected to the 700°–900° F. seam temperature and is therefore never cured, either during the soldering operation or during the subsequent curing of the low curing temperature material sprayed onto the complete interior of the can.

It has therefore been a primary objective of this invention to provide a new and improved apparatus for applying a continuous stripe of protective material or lacquer over the interior seam of a can without splashing, spraying, or bouncing protective material off the seam area onto the sides of the can body adjacent the seam area.

Still another objective of this invention has been to provide an apparatus for spraying a stripe of protective material over the seam of a can with a minimum quantity of material while still obtaining a continuous uniform coating of material over the seam.

These objectives are accomplished and one aspect of this invention is predicated upon the utilization of a new and improved nozzle for spraying the stripe of liquid protective material onto the seam of a can. This nozzle has an axial bore terminating in a fan-shaped nozzle orifice. Lacquer is supplied to the axial bore through a radial passage. The nozzle is mounted in a bore which includes a turbulence chamber behind the end of the nozzle. The combination of this radial injection of liquid into the nozzle, together with the provision of a turbulence chamber behind the nozzle, results in the emerging liquid spray being atomized much more quickly and closer to the nozzle orifice than has heretofore been possible. This quick atomization of the spray in close proximity to the nozzle tip eliminates what has heretofore been the most troublesome aspect of inside striping of cans, the bounce or splash of the spray onto and up the side walls of the can. This splash, or so-called overspray area, is never completely cured and as a consequence causes defective cans.

Still another aspect of this invention is predicated upon the concept of utilizing two air nozzles located alongside the liquid spray nozzle to contain the edges of the atomized spray to the can seam area. In the preferred embodiment, these air nozzles are so connected to the gun that the air spray is turned on and off simultaneously with the intermittent emission of liquid spray from the protective material nozzle. The air curtains which emerge from these air nozzles are generally fan-shaped and contain the liquid spray fog along the edges so as to prevent that fog from rolling out onto the area adjacent the stripe.

Still another aspect of this invention is predicated upon the empirical determination of nozzle design and conditions under which an airless spray stripe may be applied to the interior seam of a can body in a uniform continuous film which meets all can industry standards in terms of continuity, uniformity, weight of material, and application of the stripe to a confined area.

Still another aspect of this invention is predicated upon the development of a new and improved nozzle which has better spray atomization characteristics close to the nozzle orifice than has heretofore been possible.

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 a portion of a can forming line including the invention of this application.

FIG. 2 is an enlarged view, partially in cross section, of the end of the can forming line stubhorn of FIG. 1.

FIG. 3 is an end elevational view of the end of the stubhorn including the spray gun taken on line 3—3 of FIG. 2.

FIG. 4 is a cross sectional view through the spray gun of FIG. 1.

FIG. 5 is another cross sectional view through the spray gun taken in a plane normal to the plane of FIG. 4.

FIG. 6 is an enlarged cross sectional view through the spray nozzle taken on line 6—6 of FIG. 2.

FIG. 7 is a top plan view of the spray pattern which emerges from the liquid spray nozzle and the two air nozzles of FIG. 6.

Referring first to FIG. 1, there is illustrated diagrammatically a standard can production line used in the production of cylindrical can bodies. This line includes a stubhorn **10** which serves as a mandrel around which can bodies **11** are formed as they pass downstream. The can bodies **11** are moved longitudinally over the stubhorn from a magazine **12** by lugs on a chain conveyer which engage the rear edge **13** of the bodies and push them along the stubhorn. As bodies pass off the stubhorn, after having been formed into cylindrical configuration, they move into a network of rails **15** through which they then pass during continued formation of the cans.

In the final stages of movement of the can bodies over the stubhorn **10**, the ends of the sheet metal from which the body is made are overlapped or joined. If the bodies are to be seamed by adhesive, the adhesive is placed in the overlapping seams at the seaming station indicated by the numeral **14**. Alternatively, if the bodies are to be welded, they are butt welded at this station **14**. And if the bodies are to be soldered, they are crimped together at the seaming station **14**. As the bodies pass off the stubhorn **10** and into the rails **15**, they are passed through an inside striping station indicated by the numeral **16**. At this station a stripe of protective material **17** (FIG. 7) is sprayed over the overlapped seam **18** of the can. Soldered can bodies then require passage through a soldering station downstream of the striping station **16** to complete formation of the seam but the adhered and welded seams are completely formed when the bodies enter the rails **15**.

In order to apply the stripe **17** of protective material over the seam area A (FIG. 7) of the can body, a spray gun **20** is secured to the end of the stubhorn **10**. This gun is so positioned that the can bodies pass over it before passing into the rails **15**.

The gun **20** is secured to the end surface **21** of the stubhorn by a generally U-shaped bracket **22** secured onto the end of the stubhorn by a plurality of bolts **23**. Bolts **19** similarly secure the gun **20** to the opposite or downstream end **24** of the bracket **22**. The bracket **22** may be omitted and, in fact, in one preferred embodiment is omitted in which case the gun **20** is secured directly onto the end of the stubhorn.

The spray gun **20** is of the so-called circulating flow type; that is, there is a continuous flow of liquid or coating material to the gun through a liquid inlet line **25**. There is also continuous flow of liquid or coating material from the gun via a line **26** (FIGS. **4** and **5**). As a result of this continuous flow, the temperature of the liquid material may be maintained constant in the gun even when the gun is not in use and when the liquid would otherwise be stationary in the gun. Some can protective materials set up or harden at room temperature so that it is important that these materials not be permitted to stand and become hardened in the gun. The circulating flow of liquid through the gun precludes this hardening or setting of the material. In the case of other protective materials which are applied at ambient or room temperature, temperature control is not as important and a conventional non-circulating or one-fluid line gun may be used.

The gun contains a check valve, indicated generally by the numeral **30**, operable to open and close a passage **31** leading to an orifice **32** of a nozzle **33** in synchronization with movement of cans past the orifice **32**. The check valve is pneumatically opened by air pressure supplied to the gun via an air line **35** and is spring biased to a closed position. Air pressure at approximately 60 psi is supplied to the gun in the line **35** from an air pressure source **36** through a solenoid controlled valve **37**. An electric photocell circuit including a photocell **38** and receiver **39** control the flow of electric current to the solenoid of the valve **37**. The sender is operable to direct a light beam through a hole **41** in the stubhorn **10** so that cans entering the striping station **16** break the circuit and trip a solenoid **42**, thereby causing the valve **37** to be opened and air pressure supplied via line **35** to the gun.

The solenoid valve portion of the valve **37** is an on-off solenoid valve. It is used in combination with a conventional four-way spool valve **42**, to one end of which air is alternately supplied from a source **36** at a pressure of approximately 60 psi or to which air is vented to atmosphere under the control of the solenoid. Air of lesser pressure (as, for example, 20 psi) is supplied through the line **43** to the opposite end of the spool within valve **37** at all times, so that when the solenoid electrical circuit is broken, the solenoid valve connects the high pressure end of the spool valve **37** to atmospheric pressure and a low pressure (20 psi) at the opposite end then moves the spool toward the high pressure end. When the electrical circuit again energizes the solenoid, the valve **37** connects the high pressure end of the spool to 60 psi, and the spool immediately moves toward the low pressure end against the resistance offered by the low air pressure in line **43.** It has been found that the valve **37** may be more reliable with a low pressure line connected to the one end of the valve than it is when it utilizes spring return. It has also been found that the solenoid valve may act fast enough when used as a pilot valve to control flow to the gun but that if used with higher flow capacities without a second stage spool valve it may be too slow to keep up with current can production lines.

Referring again to FIGS. **4** and **5**, it will be seen that the gun **20** generally comprisea a two-piece cylindrical body **45** within which there is an axial or central bore **46.** This bore comprises a fluid chamber **47** adjacent the front end of the body, a smaller diameter connecting chamber **48,** and a large diameter piston chamber **49.** The rear side of the piston chamber **49** is open to the atmosphere through a small diameter section **51** of the bore **46.** An end cap **52** is secured to the body **45** by bolts (not shown) and closes the fluid chamber **47.** The cap **52** comprises a central disc **53** from which hub sections **54, 55** extend rearwardly and forwardly, respectively. The rearward hub **54** fits within, and with an O-ring, seals the fluid chamber **47.** The forwardly extending hub section **55** has an inwardly extending flange **56.** An axial bore **57** extends through the cap **52** and comprises a large diameter rear section **58** and a smaller diameter front section **59.**

A cylindrical metal insert **61** made from a hard material, as, for example, tungsten carbide, is brazed or otherwise fixedly secured within the small diameter section **59** of the cap. This insert **61** defines the seat of the check valve **30.** The insert has a stepped axial bore which comprises a large diameter rearward section **62** and the small diameter passage **31** interconnected by shoulder **63.** An arcuate seat is machined into the shoulder at the point where the shoulder joins the small bore **31.** This seat is configurated to cooperate with a generally semispherical end **64** of the check valve head **65** to form a seal.

The nozzle assembly **33** is bolted onto the flanged end **56** of the end cap **52.** Referring to FIGS. **4** and **6,** it will be seen that this assembly **33** comprises a nozzle mounting block **70** and a carbide nozzle tip **71.** The block **70** is fixedly secured onto the end cap by a pair of bolts **72.** This block **70** has one bore **73** which communicates with and is coaxial with the outlet passage **31** of the gun and a second passage **74** which intersects at 90° the first passage **73.** This second passage **74** also intersects the apex of an inverted V-shaped groove **69** formed in the bottom of the block **70.** This second bore or passage **74** extends completely through the block **70** and has a small diameter threaded end section **75,** an intermediate diameter section **76,** and a counterbored end section **77.** The carbide tip **71** is brazed or otherwise fixedly secured in the intermediate section **75** with a shoulder **78** of the tip abutting the counterbored shoulder of the bore **74.**

The tip **71** has an axial central bore **79** extending through it and intersected at a right angle by a transverse bore **81.** The bore or aperture **81** communicates with and is coaxial with the bore **73** of the mounting block **70** so that liquid may be transmitted through the bore **73** into the nozzle bore **79.**

There is a nozzle clean-out screw **82** threaded into the threaded small diameter section **75** of the bore **74.** The end **83** of this screw is spaced from the rear end surface **84** of the nozzle tip so that a turbulence chamber **85** is defined by the rear surface **84** of tip **71,** intermediate section **75** of the bore **74,** and the inner end **83** of the screw **82.** As explained more fully hereinafter, it has been found that the presence of this turbulence chamber **85** in combination with the injection of liquid into the axial passage **79** of the nozzle tip through the transverse bore **81** markedly improves the atomization characteristics of the nozzle.

The outer end of the nozzle tip **71** is generally hemispherical in configuration. The elliptical-shaped orifice **32** is machined into the top of the dome so as to intersect at a right angle the axial orifice **79** of the tip. Conventionally, this elliptical orifice is machined into the dome by a tapered grinding wheel. Liquid emerging at a high pressure or as a high pressure stream (as, for example, at 200 to 1,000 psi) from the elliptical-shaped orifice atomizes and assumes the elliptical pattern depicted by the dashed line **87** of FIG. **7.**

Referring back to FIG. **6,** it will be seen that as the high pressure stream of liquid emerges from the nozzle orifice **32** it spreads out or fans out to form a generally fan-shaped solid curtain **88** of liquid. As the curtain moves away from the nozzle, ripples or waves form in it, as indicated by the numeral **89.** The ripples then break up into longitudinal ligaments, indicated by the numeral **91.** These ligaments subsequently break up as they move away from the nozzle into droplets which then atomize into a fine spray, as indicated by the numeral **92.**

In order to apply a sufficiently thin film of lacquer or other coating material to the seam area A of a can and to limit the sprayed material to the stripe area or to the area immediately adjacent this stripe area, the film must be finely atomized before it strikes the can surface. If not sufficiently atomized, the spray or fog strikes the substrate, or the can side wall, with sufficient velocity and impact that it bounces and splashes onto the can side wall to form an oversprayed area on the area adjacent the seam area A.

One aspect of this invention is predicated upon the determination that the overspray problem or the splash problem is materially reduced or eliminated by the turbulence chamber **85.** By inserting a threaded plug or screw **82** into the threaded bore **75** of the nozzle mounting block but having the end **83** of the screw terminate short of the rear surface **84** of the nozzle tip **71,** there is provided a turbulence chamber **85** immediately behind the nozzle tip. This turbulence chamber in combination with the injection of liquid into the nozzle tip via a radial port **81** has the effect of materially reducing the distance D required for the spray to atomize after emerging from the nozzle orifice **32.** Specifically, it has been found that this arrangement reduces the distance D to approximately one-fifth the distance otherwise required for atomization when the same liquid is directed axially through the same size nozzle tip at the same pressure and temperature. When the distance D is reduced, the degree of atomization of the spray is improved and the velocity with which it strikes the substrate or can body is materially reduced. This finer atomization and reduction of particle velocity in turn eliminates the problem of the spray bouncing and climbing up the side walls **93** of the can outside the can stripe area A.

To further contain the finely atomized fog which results from this improved nozzle, a pair of air curtains

94, 95 are preferably provided adjacent the opposite ends of the elliptical-shaped pattern 87 of the liquid spray. These curtains are also elliptical in cross sectional configuration at the point where they strike the substrate or can body adjacent the stripe 17. As indicated by the cross hatched patterns 94A, 95A in FIG. 7, these air curtains 94, 95 have the effect of chopping off the ends 87A, 87B of the fan-shaped pattern 87 of atomized liquid spray so as to confine it to a width W.

To create the air curtains 94, 95, air is supplied to a pair of elliptical-shaped nozzle orifices 97 and 98 in a pair of nozzles 99 and 100. This air is supplied to the nozzles in synchronization with opening and closing of the check valve 30 of the gun 20. To this end, the nozzles 99 and 100 are mounted in the ends of tubes 101 which extend upwardly and are mounted in a manifold block 102 secured to the gun. The block 102 has a central passage 103 which communicates with the passages within the tubes 101. The passage 103 is supplied with air under regulated pressure of from 20 to 70 psig from the pneumatic line 35. It is also connected to a pneumatic line 35A of the gun. Consequently, air is supplied to the nozzles 99 and 100 in synchronization with opening and closing of the check valve 30 of the gun.

In operation, can bodies 11 are formed over the stubhorn 10 at the rate of approximately 550 plus or minus 50 cans per minute. This rate varies from one can manufacturer to another, but quite commonly today averages approximately 575 can bodies per minute per line in the production of standard beer or beverage cans. As the cans move along the stubhorn, a solder, adhesive or weld is commonly applied to the overlapping or abutting edges 18 of the sheet at the seaming station 14. This station is located immediately in front of the striping station 16 where the stripe 17 of protective material from the nozzle 33 and spray gun 20 is directed onto the seam. In the case of soldered cans, the seam is subsequently completed and the striping material simultaneously cured by the application of soldering heat to the seam at a subsequent soldering station. Generally, this heat raises the temperature of the seam to above 700°–900° F. so as to cure the protective coating of the stripe during the soldering operation. In the case of seam welded or seam adhered cans, the striping material is either heat or air cured at a much lower temperature farther down the can production line.

The emission of liquid spray from the nozzle 33 and the emission of the air curtains from the nozzles 99 and 100 are turned on and off in synchronization with movement of the can bodies 11 over the stubhorn and through the striping station. This is accomplished by the can bodies interrupting a light beam of the photocell sender and receiver unit 38, 39. Upon interruption of the light beam and after a predetermined time delay built into a solenoid control circuit, the solenoid control circuit is operable to shift the solenoid and move a valve spool of the valve 37 so as to connect the air line 35 to the source of air pressure 36, thereby connecting a forward end chamber 104 of the check valve control piston chamber to high pressure, i.e., 60 psi air. This results in movement of a piston 105 and opening of the check valve 30. Upon opening of this valve, the liquid protective material in the fluid chamber 47 is allowed to pass from the liquid chamber 47 past the head of the valve into the conduit or passage 31 and subsequently to the nozzle orifice 32 of the nozzle 33. Liquid in the chamber 47 is maintained at a pressure of approximately 250–800 psi, the pressure at which it is supplied by a pump 106 from a reservoir 107.

A predetermined time after interruption of the light beam, that can which has broken the light beam passes out of alignment with the nozzle 33. After that predetermined time, a timer circuit interrupts the signal to the solenoid causing it to be de-energized and the control circuit to be reset preparatory to interruption of the light beam by the next following can. Upon deenergization of the solenoid, low air pressure, i.e., 20 psi, in line 43 or spring pressure then moves the spool of the valve 37 to the position in which the air line 35 is connected to atmospheric pressure. This results in the venting of line 35A of the gun, causing the check valve 30 to be closed, which immediately cuts off the flow of liquid spray from the nozzle orifice 32 and the emission of air from the nozzles 99 and 100 until the next following can again interrupts the light beam.

In one preferred embodiment, the protective material applied to the can seam of a soldered seam beer can 2 11/16 inches and 4 11/16 inches in length is an epoxy resin coating material manufactured by the DeSoto Chemical Company of Chicago, Illinois, and designated as their No. 563–803 Epoxy Resin Can Coating. It is supplied to the nozzle at a temperature of 180°–190° F. at a pressure of approximately 400 psi and at a Zahn No. 2 cup viscosity of 16 seconds, 77° F. The preferred nozzle is one which has a flow rate of 0.015 gallons per minute of water at 500 psi and at ambient temperature. The nozzle orifice is preferably spaced 1 ¼ inch from the can seam and lays down a protective strip of material 9/16 inch to 11/16 inch in width W. The resulting stripe of material when subsequently cured weighs approximately 5 or 6 milligrams. Including the overspray, this stripe never exceeds 1 1/16 inch in width W, which width is adequately heated to curing temperature of approximately 750° F. during the subsequent soldering operation.

Prior to this invention it has been difficult to control the application of spray to a can seam so as to avoid overspray and material being applied to the side walls of the can over so wide an area that the material remained uncured even after the subsequent soldering operation. Primarily, the problem occurred because of the atomized spray bouncing off the seam stripe area of the can and rolling up the inside walls of the can into areas adjacent the stripe area, which areas never subsequently reached the material curing temperature and which material therefore remained uncured. By the practice of this invention, though, that problem is overcome with the result that this invention enables airless spray techniques to be utilized to apply a stripe of protective material to the seam of a can. The use of airless spray techniques in turn minimizes overspray and the quantity of material required to adequately protect the overlapped seam of a can.

While we have described only a single preferred embodiment of our invention, persons skilled in the art to which this invention pertains will readily appreciate numerous changes and modifications which may be made without departing from the spirit of our invention. For example, those persons skilled in the can manufacturing art will readily appreciate that the striping apparatus of this invention is equally applicable to outside can striping as to inside can striping. Therefore, we do not intend to be limited except by the scope of the appended claims.

Having described our invention, we claim:

1. Apparatus for applying an impervious protective coating to the longitudinal seams of spaced cylindrical can bodies as the can bodies move through a striping station of a can body forming line over which can bodies are formed into cylinders, which apparatus comprises

an airless liquid spray nozzle, means for securing the nozzle on a can assembly line in a position in which the nozzle has its orifice directed toward the seam of a formed body,

means for forcing an airless spray fan of liquid coating material at high pressure from the nozzle orifice and directing it in a stripe onto the surface of the seams of the can bodies, and

means for starting and stopping the emission of airless spray from the nozzle orifice in synchronization with movement of the spaced can bodies past the nozzle so that the airless spray is directed onto a seam of a can body as the body passes the nozzle orifice but it is turned off after that can body passes the nozzle orifice until the seam of the next following can body moves into alignment with the orifice, the improvement wherein

said airless spray nozzle has a first axial passage, said passage terminating at one end in a spray orifice,

said nozzle having a second liquid injection passage intersecting said first passage at approximately a right angle at a point spaced from said orifice, and

a turbulence chamber of greater cross sectional area than said first passage intersecting and coaxial with said first passage, the intersection of said turbulence chamber and said first passage being spaced from the intersection of said first and second passages in a direction away from said orifice.

2. The apparatus of claim 1 in which the nozzle is secured on a can assembly line in a position in which the nozzle is located interiorly of the cans and has its orifice directed toward the interior seams of the formed cans.

3. The apparatus of claim 1 in which the airless spray nozzle orifice has a flow rate of less than 0.040 but more than 0.005 gallons per minute of water at 500 pounds per square inch pressure.

4. The apparatus of claim 1 in which the liquid forcing means is operable to force the coating material from the nozzle orifice at a pressure less than 800 pounds per square inch but more than 200 pounds per square inch.

5. The apparatus of claim 1 in which the airless spray nozzle orifice has a flow rate of about 0.015 gallons of water per minute at 500 pounds per square inch pressure.

6. The apparatus of claim 1 in which the means for forcing the coating material from the nozzle is operable to force the material from the nozzle orifice at a pressure of about 400 pounds per square inch.

7. The apparatus of claim 1 which further includes a pair of air nozzles located on opposite sides of said liquid spray nozzle and means for supplying air under pressure to said pair of air nozzles and for directing an air curtain emerging from said nozzles onto the interior surface of the can bodies on opposite sides of the seam so as to contain and limit the liquid spray to the seam area of the can bodies.

8. The apparatus of claim 7 which further includes means for starting and stopping the emission of the air curtains from the air nozzles in synchronization with the starting and stopping of the emission of liquid spray from the liquid spray nozzle.

9. Apparatus for applying an impervious protective coating to the longitudinal seams of spaced cylindrical can bodies as the can bodies move through a striping station of a can body forming line over which can bodies are formed into cylinders, which apparatus comprises

an airless liquid spray nozzle,

means for securing the nozzle on a can assembly line in a position in which the nozzle is located interiorly of the cans and has its orifice directed toward the interior of the seams of formed can bodies,

means for forcing an airless spray fan of liquid coating material at high pressure from the nozzle orifice and directing it onto the interior surface of the seams of the can bodies, and

means for starting and stopping the emission of airless spray from the nozzle orifice in synchronization with movement of the spaced can bodies past the nozzle so that the airless spray is directed onto a seam of a can body as the body passes the nozzle orifice but is turned off after that can body passes the nozzle orifice until the seam of the next following can body moves into alignment with the orifice, the improvement wherein

said airless spray nozzle has a first axial passage, said passage terminating at one end in a generally elliptical-shaped orifice,

said nozzle having a second liquid injection passage intersecting at approximately a right angle said first passage at a point spaced from said orifice, and

a turbulence chamber of greater cross sectional area than said first passage intersecting and coaxial with said first passage, the intersection of said turbulence chamber and said first passage being spaced from the intersection of said first and second passages in a direction away from said orifice.

10. The apparatus of claim 9 which further includes a pair of air nozzles located on opposite sides of said liquid spray nozzle and means for supplying air under pressure to said pair of air nozzles and for directing an air curtain emerging from said nozzles onto the interior surface of the can bodies on opposite sides of the seam so as to contain and limit the liquid spray to the seam area of the can bodies.

11. The apparatus of claim 10 which further includes means for starting and stopping the emission of the air curtains from the air nozzles in synchronization with the starting and stopping of the emission of liquid spray from the liquid spray nozzle.

12. Apparatus for applying an impervious protective coating to the longitudinal seams of spaced cylindrical can bodies as the can bodies move through a striping station of a can body forming line over which can bodies are formed into cylinders, which apparatus comprises

an airless liquid spray nozzle, means for securing the nozzle on a can assembly line in a position in which the nozzle is located interiorly of the cans and has its orifice directed toward the interior of a seam of a formed body, means for forcing an airless spray fan of liquid coating material at high pressure from the nozzle orifice and directing it onto the interior surface of the seams of the can bodies, and

means for starting and stopping the emission of airless spray from the nozzle orifice in synchronization with movement of the spaced can bodies past the nozzle so that the airless spray is directed onto a seam of a can body as the body passes the nozzle orifice but is turned off after that can body passes the nozzle orifice until the seam of the next following can body moves into alignment with the orifice, the improvement wherein,

said airless spray nozzle has a first axial passage extending therethrough, said passage being threaded at one end and adapted to receive a nozzle tip at the opposite end,

a screw threaded into said threaded end of said passage,

a nozzle tip mounted in said opposite end of said passage, said tip having an axial passage extended therethrough and coaxial with said axial passage of said mounting block, said tip axial passage terminating at its outer end in a generally elliptical-shaped orifice,

said tip having a second liquid injection passage intersecting at approximately a right angle said tip axial passage at a point spaced from said orifice, and

a turbulence chamber located in said mounting block axial passage between the inner end of said screw and the inner end of said tip, said chamber being of greater cross sectional area than said axial passage of said tip.

13. The apparatus of claim **12** in which said turbulence chamber is defined in part by the inner end of said screw and in part by the inner end of said tip.

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