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Coster

[11] **3,816,206**

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[54] **METHOD FOR PROTECTING RAW METAL EDGE OF INSIDE LAP OF ADHESIVELY BONDED LAP SIDE SEAM TUBULAR BODY**

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[52] **U.S. Cl.** **156/218,** 156/231, 156/244, 229/4.5

[51] **Int. Cl.** **B29d 23/10**

[58] **Field of Search** ..... 229/4.5; 156/218, 291, 156/292, 203, 195, 157, 217, 212, 192, 230, 231, 244, 203, 466; 113/11 A, 12, 120 KN, 116 QA, 120 A

[56] **References Cited**

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[57] **ABSTRACT**

The raw metal edge of the inside lap of an adhesively bonded lap side seam of a tubular body is coated and protected from chemical attack by a corrosive substance contained within the tubular body by applying a ribbon of side seam adhesive along one marginal edge portion of the body blank, the ribbon having a fillet thereon located along its inner edge, forming the blank into tubular form, bringing the marginal portions together in an overlapping opposing relation, and pressing the marginal portions together to assemble the lap side seam in a manner such that the raw metal edge of the inside lap is pressed into a portion of the fillet and is overlapped, coated and thereby protected by that portion of the fillet.

10 Claims, 5 Drawing Figures

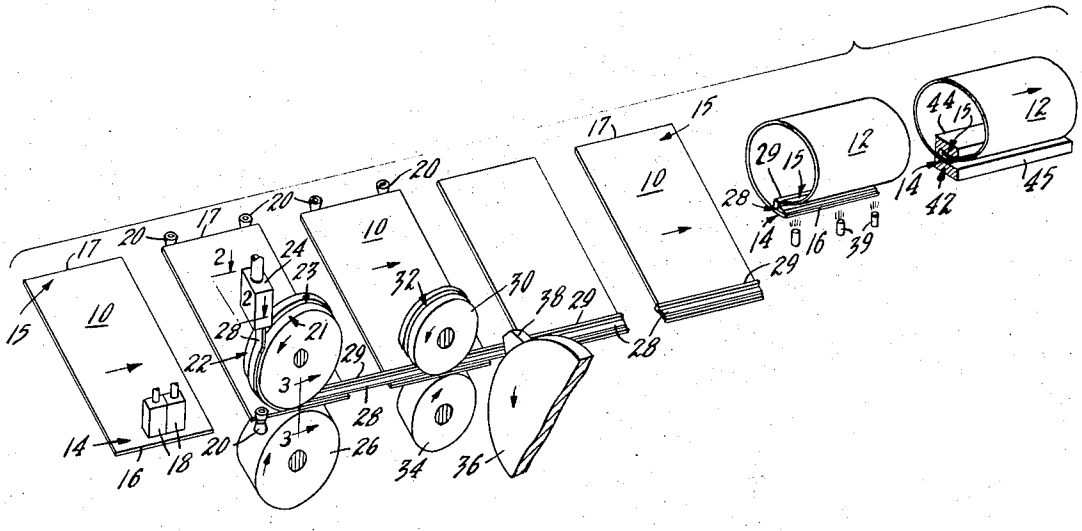


FIG. 3

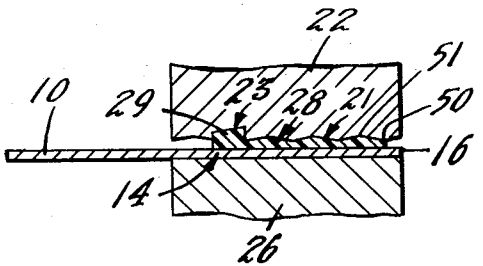


FIG. 2

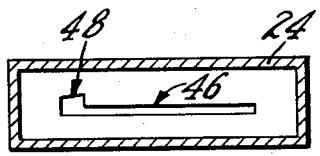
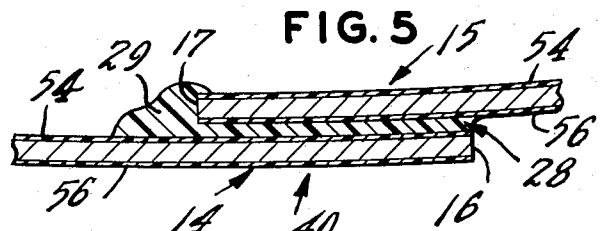


FIG. 1

FIG. 4

FIG. 5



METHOD FOR PROTECTING RAW METAL EDGE OF INSIDE LAP OF ADHESIVELY BONDED LAP SIDE SEAM TUBULAR BODY

BACKGROUND OF THE INVENTION

This invention relates to tubular bodies formed with a longitudinally extending adhesively bonded lap side seam. More particularly, it is concerned with the construction of the adhesively bonded lap side seam.

In the formation of a lap side seam, each overlapped marginal edge usually terminates in raw metal edge. The outer surface of the tubular body and the raw edge of the outer lap can readily be protected against various forms of chemical attack by the application thereover of one or more suitable protective coatings.

However, it has been found exceedingly difficult to adequately protect and cover the raw metal edge of the inside lap by means heretofore known in the prior art. This is the case, for example, where the tubular body is a container used to package particularly corrosive substances such as a carbonated beverage.

Accordingly, the present invention is concerned with a novel method and apparatus for coating the raw metal edge on the inside lap in an adhesively bonded lap side seam of a tubular body, during the assembly of the lap side seam.

The advantage or benefit, therefor, to be gained by treating the raw metal edge with a coating is the protection of the raw metal edge on the inside lap from chemical attack by a corrosive substance within the tubular body. This raw metal edge treatment is especially valuable in making adhesively bonded lap side seam container bodies suitable for carbonated beverages. With respect to lap side seams for such container bodies, the advantage in treating the raw metal edge on the inside lap is in the substantial reduction of iron pickup by a corrosive carbonated beverage which will ultimately be packaged within the container. Whereas heretofore iron pickup values were inconsistent and often as high as 3 p.p.m., under this invention, iron pickup values are consistently below 1 p.p.m.

Even though the present invention has particular importance with regard to tubular bodies used as containers for carbonated beverages, the invention also has been found useful in connection with other uses for lap side seam tubular bodies where certain materials within the tube may chemically attack any exposed raw metal surfaces.

SUMMARY OF THE INVENTION

This invention relates to a method and apparatus for coating and protecting the raw metal edge of the inside lap of an adhesively bonded lap side seam of a tubular body. As a novel manner of providing protection of the raw metal edge on the inside lap from chemical attack from corrosive materials within the tubular body, a ribbon of side seam adhesive is applied along one marginal portion of a body blank, the ribbon having a fillet thereon adjacent to and along the length of its inside edge. The body blank is then made into tubular form to adjacently overlap one marginal portion with an opposite marginal edge portion. When this is done the overlapped marginal portions are pressed together to form the lap side seam. When the overlapped marginal portions are pressed together the raw metal edge of the inside lap is pressed into a portion of the fillet and is abuttingly overlapped, coated and thereby protected by that portion of the fillet. The filleted ribbon can be applied by extruding it onto an applicator wheel having an annular groove therein for receiving the fillet of the ribbon, which transfers the ribbon to an aligned marginal edge of a body blank. The ribbon can then be ironed with a ironing roll to effect an initial adhesion of the ribbon to the blank. The ironing roll can also have an annular groove therein for receiving the fillet of the body blank.

BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a schematic view in perspective illustrating the method and apparatus of the present invention.

FIG. **2** is an enlarged sectional view of an extruder die orifice taken substantially along lines **2—2** of FIG. **1.**

FIG. **3** is an enlarged fragmentary side view taken substantially along line **3—3** of FIG. **1.**

FIG. **4** is an enlarged fragmentary sectional view of the overlapped marginal portions of a tubular body before an adhesively bonded lap side seam is formed.

FIG. **5** is an enlarged fragmentary sectional view of an adhesively bonded lap side seam formed with the marginal portions of FIG. **4.**

DETAILED DESCRIPTION OF THE INVENTION

As a preferred or exemplary embodiment of the instant invention, FIG. **1** shows a sequence of operations for forming a substantially rectangular body blank, generally designated **10** into an open ended tubular body generally designated **12,** wherein such sequence of operations, novel steps are provided which will be described hereinafter. The term tubular as used herein is meant to denote elliptical, rectangular or polygonal cross sectional-shaped as well as circular.

In the usual manner of fabricating tubular bodies having adhesively bonded lap side seams, an organic cement or adhesive is extruded or otherwise, in a suitable manner, deposited on one marginal portion of a body blank. A detailed disclosure of method and apparatus for preparing body blanks with an adhesive on one marginal portion thereof is more particularly set forth within U.S. Pat. No. 3,481,809 issued to Kaiser, Rein and Wahler on Dec. 2, 1969, which method and apparatus may be used in conjunction with the present invention.

As shown in FIG. **1,** a body blank **10** is moved along a path of travel from left to right by any suitable means, such as a conveyor as shown in the aforementioned U.S. Pat. No. 3,481,809. As a first step marginal portion **14,** also called a marginal edge portion, adjacent its side edge **16,** can be heated by heating means such as radiant heat elements **18.** Thereafter, body blank **10** is conveyed along the path of travel to where its side edges **16** and **17** are engaged by gauging means such as guiding rollers **20** (only a few shown) which guide the blanks into a desired position as will be explained later.

As the blank is so conveyed, heated marginal edge portion **14** passes between upwardly positioned applicator means which can include an applicator wheel **22** and extruder die **24,** and an underlyingly positioned back-up roller **26.** Extruder **24** can continuously extrude at a substantially uniform linear rate a ribbon **28** of a suitable organic cement or adhesive which is directed into contact with surface **21** of a preferably

chilled applicator wheel 22. The ribbon in its extruded form tends to adhere to applicator wheel surface 21 as wheel 22 rotates and thereby carries and transfers ribbon 28 into contact with heated marginal edge portion 14 of blank 10 whereupon ribbon 28 is applied to or pressed into engagement therewith by cooperating wheel 22 and roller 26. Ribbon 28 has an extended or lengthy bead or fillet 29 thereon located adjacent to and along the length of its inside edge, i.e., the one removed from side edge 16 of body blank 10. When ribbon 28 is extruded onto applicator wheel 22, fillet 29 is aligned or registered with an annular groove 23 in the applicator wheel 22. This preserves the shape of fillet 29.

Fillet 29 of ribbon 28 can be so aligned and can be applied to the same desired marginal edge portion 14 of each body blank 10 because guiding rollers 20 bring the respective side edges and marginal portions of the blanks into linear alignment with each other and with respective groove 23 and 32 of applicator wheel 22 and ironing roller 30. Although ribbon 28 can be brought into contact with and applied to any predetermined portion of heated marginal edge portion 14, preferably, the outer edge of ribbon 28 is removed up to 0.015 inch from side edge 16. This prevents adhesive material from extending over side edge 16 and from appearing on the outside of the tubular body.

Preferably, ribbon 28 is extruded from extruder 24 at a linear rate less than the peripheral speed of surface 21 of rotating applicator wheel 22 so that a stretching force is exerted on the intermediary free portion of the ribbon 28. This stretching force or tension uniformly decreases the width and cross section of the ribbon and eliminate irregularities therein due to the extruding process. This slight stretching maintains a slight tension on that portion of the ribbon and thereby minimizes the possibility of the ribbon shifting transversely on surface 21 of applicator wheel 22 and on the marginal edge portion 14 of body blank 10. The amount of stretching can be controled by adjusting applicator wheel speed and by changing the distance between extruder 24 and wheel 22.

As shown in FIG. 1, when a body blank 10 passes between applicator wheel 22 and back-up roller 26 and continues to advance on its path of travel in continuous engagement with guiding rollers 20, ribbon 28 is brought into bonding contact with the next succeeding blank such that ribbon 28 has a free portion bridging the gap between the succeeding blanks and thereafter continuously interconnecting succeeding adjacent blanks.

Body blank 10 is next conveyed further along its path of travel, to pass marginal edge portion 14 of blank 10 having adhesive ribbon 28 thereon between ironing means which can comprise pinch rolls such as ironing roll 30 and back-up roll 34. Passing the ribbon between such rolls aids in the obtaining of additional adhesion of ribbon 28 to marginal edge portion 14. Ironing roll 30 preferably is chilled and has an annular groove 32 therein aligned or registered with fillet 29, so that its shape is not ironed out or substantially effected by ironing roll 30. As disclosed in the aforementioned U.S. Pat. No. 3,481,809, applicator wheel 22 and ironing roll 30 are chilled so that ribbon 28 will be pulled away from and properly transferred to body blank 10 by the forces exerted on ribbon 28 by heated marginal edge portion 14 of body blank 10.

As body blank 10 advances further, marginal edge portion 14 having adhesive ribbon 28 thereon can pass through conventional cooling means (not shown) to cool the material and render it relatively solid and self supporting so that the ribbon can then be severed at a free interconnecting portion thereof to produce individual separated body blanks. This can be accomplished by means such as a cutter wheel 36 having cutting means such as cutter 38 thereon and timed to rotate faster than the speed of passing body blanks so that cutter 38 severs interstitial free portions of ribbon 28 without contacting the blanks.

Thereafter, body blank 10 can be moved to a conventional notching station (not shown) to provide notched corners therein which facilitate formation of the lap side seam.

Body blank 10 is then formed into an open ended tubular body 12 by any suitable means, for example on a high-speed automatic, can bodymaker by wrapping the blank around a mandrel, heating the side seam adhesive to a semi-fluid, tacky condition and compressing the overlapped marginal edge portions into intimate contact with the tacky side seam adhesive. Immediately thereafter the adhesively bonded lap side seam is chilled to set the adhesive and to secure the lapped marginal edge portions together. Details of a particular bodymaker and other means which may be used in carrying out the above described operations are shown in U.S. Pat. No. 1,625,091 issued on Apr. 17, 1927 and U.S. Pat. No. 3,508,507 issued on Apr. 28, 1970.

As schematically shown in FIG. 1, by the apparatus and method of the present invention, body blank 10 is rolled clockwise through a 180° path into tubular body 12 to place marginal edge portion 14 having the side seam adhesive ribbon 28 thereon and marginal edge portion 15 in overlapping facing positions (as shown in greater detail in FIG. 4). In such position, the outside surface of marginal edge portion 14 is heated by heating means such as burners 39 to render adhesive ribbon 28 tacky. Marginal edge portion 14 becomes the outside lap 14 and marginal edge portion 15 now becomes the inside lap 15 (See FIG. 4) which will subsequently be adhesively bonded into a lap side seam (See FIG. 5).

Compressing means, generally designated 42, comprising an upper spline means 44 and a lower hammer means 45, then bring the inside lap 15 into contact with side seam adhesive ribbon 28 on the inside surface of the outside lap 14 to thereby assemble and form the lap side seam 40 (See FIG. 5) of tubular body 12. As will be more particularly explained later, actually, compressing means 42 brings inside lap 15 down into engagement with a portion of fillet 29 so that raw metal edge 17 is abuttingly overlapped, coated and thereby protected by the engaging portion of fillet 29.

FIG. 2 is an enlarged sectional top view taken through extruder die 24 showing a ribbon-shaped orifice generally designated 46 and having a notched fillet orifice 48 therein. Orifice 46 is shaped larger than the size of ribbon 28 as it appears on body blank 10 because, as previously indicated, the counterclockwise rotation of applicator wheel 22 applies stretching force or tension upon ribbon 28 which pulls it out of the extruder and reducing its width and cross sectional dimensions. Notched orifice 48 has a slightly upwardly angled upper surface which coincides with that of fillet 29.

FIG. 3 is an enlarged cross section taken through applicator wheel 22 showing a portion of ribbon 28 and its fillet 29 being applied to the marginal edge portion 14 of body blank 10 whose lower surface is in abutting engagement with back-up roller 26. FIG. 3 shows that the planar width of ribbon 28 is narrower at the point of application shown in FIG. 3 than at the point of origin at orifice 46 of FIG. 2. FIG. 3 also shows that surface 21 of applicator wheel 22 is but need not be serrated with small annular ridges 50 and channels 51 therein which aid in preventing ribbon 28 from shifting transversely on surface 21 of applicator wheel 22.

FIG. 4 is an enlarged fragmentary sectional view showing marginal edge 15 of the inside lap in overlapping adjacent opposing relationship with outer lap marginal edge portion 14 which has on its inner surface ribbon 28 inwardly offset from side edge 16. Marginal edge portions 15 and 14 can each have an interior organic coating 54 and an exterior coating 56 on their respective interior and exterior surfaces. FIG. 4 also shows angled upper surface of fillet 29 as imparted by notched fillet orifice 48 and as maintained by respective grooves 23 and 32 of applicator wheel 22 and ironing roll 30, and it shows small annular peaks 52 and valleys 53 in the wider planar portion of ribbon 28 as imparted by serrated surface 21 of applicator wheel 22.

FIG. 5 is an enlarged fragmentary sectional view of the overlapped side seam after the marginal edge portions 15 and 14 have been compressed by compressing means 42 of FIG. 1. Marginal portion 15 is compressed into a portion of fillet 29 in a manner such that its side edge 17 is embedded into and is abuttingly overlapped, coated and thereby protected by that portion of fillet 29. It is significant to note that only a small portion of fillet 29 overlaps a short length of marginal portion 15 which is parallel to the inside surface of marginal edge portion 14. As marginal portion 15 and side edge 17 are compressed and embedded into ribbon 28 the offset between the outer lap side edge 16 and the edge of ribbon 28 is not appreciably effected although part of the material in fillet 29 is often moved leftwardly.

Although the side seam adhesive utilized as ribbon 28 can be any suitable conventional organic cement or adhesive known in the art, preferably the adhesive is a high strength superpolyamide generally characterized by having an intrinsic viscosity of at least 0.4, and by having recurring aliphatic amido groups separated by alkylene groups having at least two carbon atoms. These superpolyamides and the definition of intrinsic viscosity are disclosed in U.S. Pat. No. 2,130,948. Among the superpolyamides which are useful in the present invention are polypentamethylene sebacamide, polyhexamethylene adipamide, polyhexamethylene sebacamide, polydecamethylene adipamide, polydecamethylene sebacamide, poly-m-phenylene sebacamide, 6-amino-caprioic acid polymers, 7-amino-heptanoic acid polymers, 11-amino undecanoic acid polymers and 12-amino-stearic acid polymers, with poly-11 amino undecanoic being preferred.

As best shown in enlarged FIGS. 4 and 5, side seam adhesive ribbon 28 is not usually applied directly to the interior and exterior body surfaces of body blank 10 but rather to respective surface coatings 54 on the interior surface of marginal portion 14, and to the exterior surface coating 56 applied thereover. Although coatings 54 and 56 can be any suitable organic coating used in the art, it has been found that very strong lap side seams with high burst resistance strength especially advantageous for containers of carbonated beverages, can be obtained when ribbon 28 is the aforementioned preferred linear superpolyamide and it is applied directly to interior and exterior coatings 54 and 56 which preferably contain a 1,2-epoxide resin having before curing an epoxide equivalent of from 425 to 6000 and a number average molecular weight from 1,000 to 4,000. Such organic coatings are disclosed and described in U.S. Pat. application Ser. No. 202,096 filed on Nov. 26, 1971, now U.S. Pat. No. 3,773,589 by Edward William Kaiser and Kenneth Richard Rentmeester, such patent application being a continuation of application Ser. No. 830,918, filed May 22, 1969, in turn a continuation-in-part of abandoned application Ser. No. 491,291 filed Sept. 29, 1965, also in the names of Kaiser and Rentmeester. As described in U.S. Pat. No. 3,773,589 coatings 54 and 56 can consist essentially of, by weight, the heat reaction product of from 1 to 8 and preferably about 4 parts of a polyvinyl acetal resin; from 50 to 90 and preferably about 70 parts of a 1,2-epoxide resin; from 5 to 50 and preferably about 25 parts of a methylol phenol resin; and from 0.2 to 2.0 and preferably about 0.6 parts of an aliphatic amine phosphate acid salt. Coatings 54 and 56 can be applied as a solution or dispersion of the above described ingredients, before their inter-reaction, in a fugitive liquid. The solution method is preferable, and the particular liquids, whether solvents or dispersants, are not especially critical. It is necessary, however, that the liquid be volatile at baking temperatures which may be as low as 350°F. or as high as 650°F. At the lower temperature a baking period of about 20 minutes may be required and at 650°F. a time of 15 seconds may suffice. The aforementioned resins, acid salts and solvents which can be employed advantageously as coatings 54 and 56 are described in the aforementioned U.S. Pat. No. 3,773,589.

Ribbon 28 can be of any dimensions that will obtain the desired side seam strength and configuration, given for example the type of product to be contained in and the forces it exerts on the finished tubular container body. The dimensions of ribbon 28 finally obtained in the assembled side seams of particular tubular bodies can vary slightly depending for example upon manufacturing conditions such as the relative speeds of extruder die 24, applicator wheel 22 and conveyed body blanks 10, and the relative temperatures and cohesive forces between chilled applicator wheel 22 and heated marginal edge portions 14 of the body blanks.

For tin free steel body blanks, proper protection of raw metal edge 17 from corrosive carbonated beverages and side seams of high strength can be obtained when the interior and exterior surfaces of the blanks are coated with the aforementioned 1,2-epoxide resin coatings, and when the ribbon of side seam adhesive employed is an aforementioned linear superpolyamide.

A ribbon suitable for such body blanks can be initially formed by an extruder die orifice 46 whose overall width is about 0.375 inch of which about 0.045 inch is the width of fillet notch orifice 48, whose substantially planar orifice portion depth is about 0.013 inch, and whose fillet notch orifice depth is about 0.017 inch at its shallowest portion and about 0.019 inch at its deepest portion.

The ribbon extruded from orifice **46** stretches as it extends downwardly to and is pulled onto surface **21** of applicator wheel **22** so that when the ribbon contacts heated marginal edge portion **14** of body blank **10**, as shown in FIG. **3**, it will have an overall width of from about 0.175 to 0.205 inch preferably about 0.190 inch, a non-filleted planar portion thickness of about 0.005 inch, and a fillet thickness of about 0.006 inch at its highest point and about 0.004 inch at its lowest point, the applicator wheel **22** being set to provide a clearance sufficient to accomodate the aforementioned planar portion thickness of about 0.005 inch in addition to the body blank thickness of about 0.006 inch.

Just before the aforementioned ribbon is pressed between marginal edge portions **14** and **15** as shown in FIG. **4**, it can have dimensions which include an overall width of from about 0.175 to 0.205 inch preferably about 0.190 inch of which from about 0.045 to 0.050 inch is the width of fillet **29**, a planar portion thickness of about 0.005 inch, and a fillet thickness of about 0.004 inch at its thinnest portion, to about 0.006 inch at its thickest portion.

When side seam **40** is formed, the dimensions of the aforementioned ribbon **28** do not change appreciably although a portion of fillet **29** extends a little further to the left and the planar portion of the ribbon moves slightly to the right toward side edge **16**. The planar longitudinal edge of the ribbon is usually registered to be from about 0.005 to 0.015 inch from side edge **16**. The planar portion of the aforementioned ribbon **28** between marginal portions **14** and **15** of side seam **40** usually is from about 0.004 to 0.005 inch. The side seam fillet portion which abuttingly overlaps the interior surface of the inner lap marginal edge that is parallel to the inside surface of the outer lap marginal edge usually is only up to about 0.002 inch thick and usually is of a length that is less than the approximate thickness of the raw edge of the inner lap. Thus, including the thickness of marginal portions **14** and **15**, the typical overall thickness for such an aforementioned side seam are from about 0.018 to 0.020 inch. The aforementioned dimensions are merely exemplary and are not intended to be limiting in any manner.

Also, it is to be noted that the upper surfaces of fillet **29** need not be as shown but can be of any suitable shape and dimensions so long as a portion of the fillet abuttingly coats and overlaps, thereby protecting the raw metal edge of the inside lap of the side seam.

Body blanks **10** can be of any alloy or metal suitable for making tubular bodies. For example, body blanks **10** can be aluminum or low carbon steel, with or without external platings of aluminum, chromium, nickel or tin.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that various changes may be made in the form, construction and arrangement of parts of the apparatus mentioned herein and in the steps of their order of accomplishment of the process described herein without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the apparatus, and process hereinbefore described being merely a preferred embodiment thereof.

I claim:

1. A method of coating and protecting the raw metal edge of the inside lap of an adhesively bonded lap side seam of a tubular body, comprising the steps of:

applying a ribbon of side seam adhesive along one marginal portion of a body blank, said ribbon having a fillet thereon located adjacent to and along the length of the inside edge of said ribbon;

forming the body blank into tubular form to adjacently overlap the said one marginal edge portion with an opposite marginal portion; and

pressing the overlapped marginal portions together with pressing means to form said lap side seam, said pressing being effected in a manner such that the raw metal edge of said inside lap is pressed into a portion of said fillet and is abuttingly overlapped, coated and thereby protected by said portion of said fillet.

2. The method of claim **1** wherein said applying step includes the steps of:

extruding said ribbon onto an applicator means, and

transferring said ribbon from said applicator means to said one marginal portion of said body blank.

3. The method of claim **2** wherein said extruding step is effected in a manner that said fillet of said ribbon on said applicator means is in alignment with an annular groove therein.

4. The method of claim **3** wherein between said applying and said forming steps there is included the step of

ironing said ribbon on said blank with an ironing means without substantially affecting the shape of said fillet, to obtain better initial adhesion of said ribbon to said one marginal portion of said body blank.

5. The method of claim **4** wherein said ironing step is effected in a manner that said fillet of said ribbon is in alignment with a groove in said ironing means.

6. The method of claim **5** wherein before said applying step there is included the step of first heating said one marginal portion so that said applied ribbon will adhere thereto, and, between said forming and pressing steps there is also included the step of heating said one marginal portion so that said adhesive will become tacky and will bond said marginal portions to form said lap side seam.

7. The method of claim **6** wherein before said first heating of said one marginal portion there is included the step of coating both surfaces of said body blank with an organic coating formulation, and baking the coated body blank at a temperature sufficient to cure said surface coatings.

8. The method of claim **7** wherein said applying, ironing and pressing steps are effected after chilling said respective applicator, ironing and pressing means.

9. The method of claim **8** wherein said applied ribbon is continuous, and wherein between said ironing step and said forming step there is included the step of cutting said applied ribbon at lengths at least the width of said one marginal portion of said body blank.

10. The method of claim **9** wherein said coating step includes coating the entire inside and outside surfaces of said body blank with said organic coating formulation, which contains a 1,2-epoxide resin having before curing an epoxide equivalent of from 425 to 6,000 and a number average molecular weight of from 1,000 to 4,000, and said side seam adhesive is comprised of a linear superpolyamide having an intrinsic viscosity of at least 0.4 and having recurring aliphatic amido groups separated by alkylene groups having at least two carbon atoms.

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