Oct. 3, 1961 C. K. DUNLAP 3,002,433

SPIRAL WOUND PAPER TUBE HAVING SEAMLESS OUTER SURFACE

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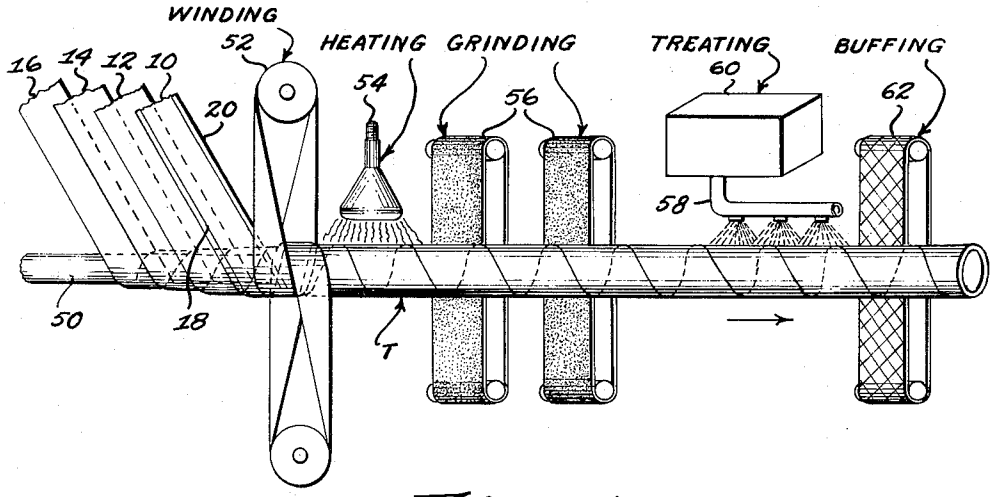


Fig. 1

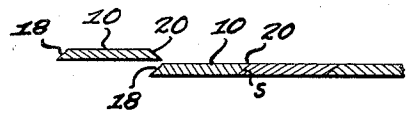


Fig. 2

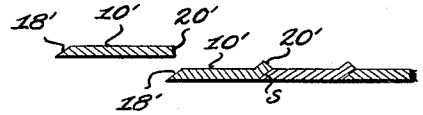


Fig. 3

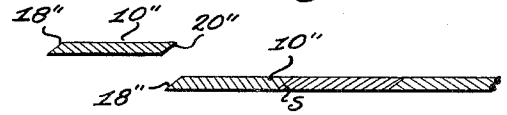


Fig. 4

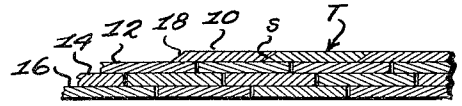


Fig. 5

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Fig. 6

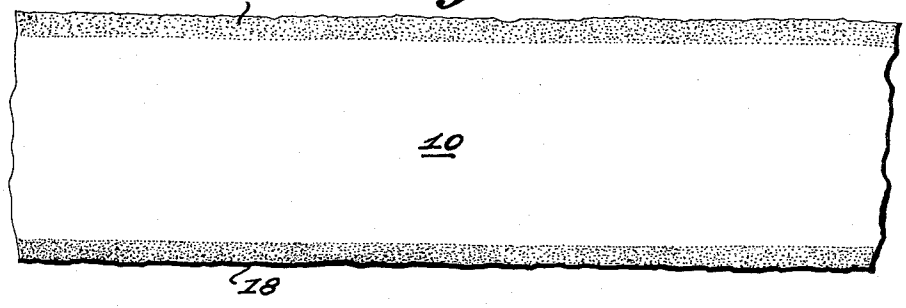


Fig. 7

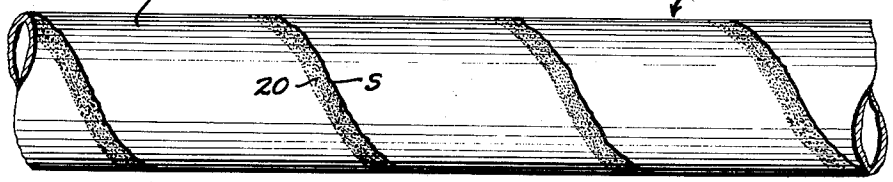


Fig. 8

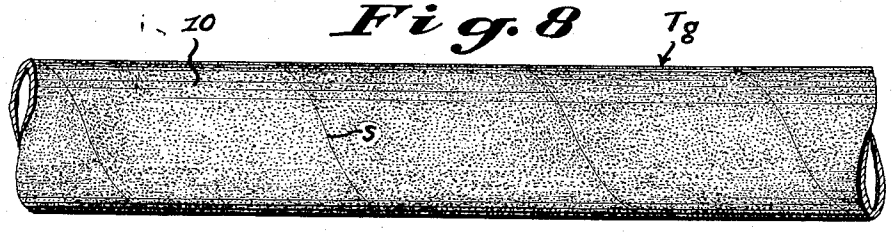


Fig. 9

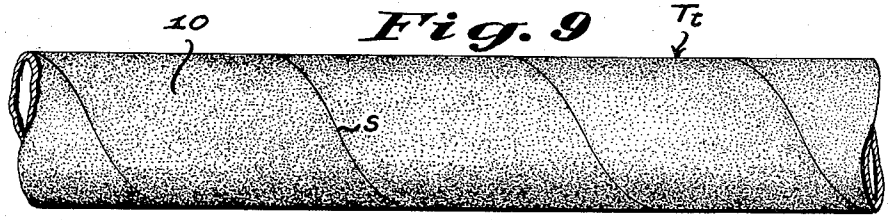
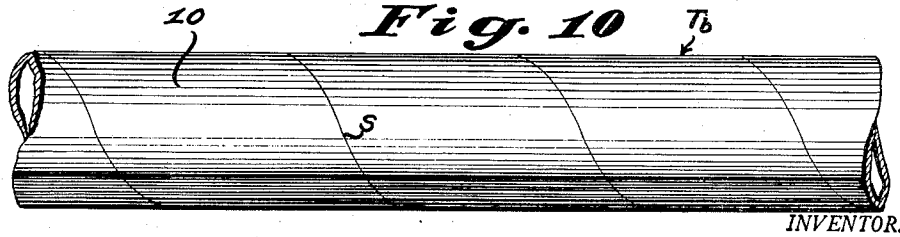


Fig. 10



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SPIRAL WOUND PAPER TUBE HAVING SEAMLESS OUTER SURFACE

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1 Claim. (Cl. 93—94)

This invention relates in general to the spiral winding of paper tubes and more particularly to a spiral wound tubular paper body in which the outer surface seam is made substantially indiscernible, so as to provide an outer surface that is seamless for all practical purposes, and to the method by which this result is obtained.

Spiral wound paper tubes are employed to a large extent as winding cores for various sorts of sheet material, and are well adapted for this purpose because they have an inherent relatively high strength and because spiral winding is a particularly efficient and relatively inexpensive manufacturing operation. However, because the usual edge abutting disposition of the plies in a spiral wound paper tube characteristically results in a spiral depression or irregularity at the tube surfaces, substantial difficulty has been encountered in adapting spiral tube winding cores satisfactorily for use with flexible sheet materials, such as cellophane, for example, in which any imperfection in the winding core will be reflected through each of the windings placed on the core to introduce a repeating imperfection in the sheet material that can render it useless.

According to the present invention this difficulty is overcome so as to provide a spiral wound tubular body having an entirely smooth and seamless outer surface by spiral winding all of the paper tube plies, except the outer one, in edge abutting relation while spiral winding the outer ply therewith to overlap itself fully at a beveled edge portion formed along at least one edge thereof, and then grinding and buffing the entire exterior surface of the outer ply smooth. In this manner it becomes possible to wind the outer ply so as to provide a tight and secure seam without requiring any particular attention to the surface smoothness at the seam during winding, and then to impart a finish over the entire outer ply surface of such smoothness that the identity of the spiral seam therein is substantially lost. In a typical spiral tube winding core formed in accordance with the present invention, the outer ply spiral seam remains only faintly visible and cannot be detected at all by touch, the finishing treatment having in practical effect produced a continuous surface across the spiral seam joint.

The foregoing and other features of the present invention are described in further detail below in connection with the accompanying drawings, in which:

FIG. 1 is a schematic representation of the manner in which a spiral wound tubular body is formed according to the present invention;

FIG. 2 is an exaggerated schematic representation in longitudinal section of the manner in which the outer ply is wound as illustrated in FIG. 1;

FIG. 3 is a further schematic illustration corresponding to FIG. 2 but representing the use of an alternative form of outer ply;

FIG. 4 is an additional schematic illustration corresponding to FIGS. 2 and 3 and representing the use of a still further alternative form of outer ply;

FIG. 5 is an exaggerated longitudinal section of a typical wall structure for a spiral wound tubular body formed in accordance with the present invention with any of the alternative forms of outer ply illustrated in FIGS. 2, 3 and 4;

FIG. 6 is a fragmentary exterior face plan view of an outer ply such as is illustrated in FIGS. 1 and 2;

FIG. 7 is a fragmentary elevation illustrating the appearance of a spiral wound tubular body immediately after winding when formed in accordance with the present invention with an outer ply of the form illustrated in FIG. 6;

FIG. 8 is a corresponding fragmentary elevation illustrating the appearance of the FIG. 7 spiral wound tubular body after grinding;

FIG. 9 is a corresponding fragmentary elevation illustrating the appearance of the FIG. 8 spiral wound tubular body after treating in preparation for buffing; and

FIG. 10 is a corresponding fragmentary elevation illustrating the appearance of the FIG. 9 spiral wound tubular body after buffing to complete a winding core in accordance with the present invention.

Referring now in particular to the drawings, FIG. 1 illustrates the spiral winding of an outer paper ply **10** with a plurality of inner plies **12**, **14** and **16** to form a spiral wound tube structure T, the outer ply **10** having outwardly facing beveled edge portions **18** and **20** formed along both edges thereof as is described more in detail further below. FIG. 1 further illustrates the manner in which the tube structure T is processed to form a seamless surface thereon in accordance with the present invention.

The spiral winding of the paper plies **10**, **12**, **14** and **16** may be carried out in the usual manner on a mandrel **50** by means of a conventionally arranged winding belt **52**, the outer ply **10** and intermediate plies **12** and **14** having first had adhesive applied to the under surfaces thereof for securing the resulting spiral wound tube structure T. Upon emergence from the winding belt **52**, suitable means such as is indicated at **54** in FIG. 1 is arranged to heat the wound tube structure T so as to set the securing or laminating adhesive therein and otherwise dry the tube structure before further processing. The further processing then comprises grinding the entire outer surface of the tube structure T by means of one or more abrasive belts **56** or the like as indicated at **56**, treating the ground tube structure T with a surface finishing material applied suitably from a spray line **58** supplied from a reservoir **60**, and finally buffing or polishing the ground and treated tube structure T by means of a leather buffing belt **62** or the like to complete the seamless outer surface of the present invention.

The manner in which the outer ply **10** behaves during the winding operation is illustrated further in FIG. 2 in which a sectional outline of the outer ply **10**, supplied for winding with outwardly facing beveled edge portions **18** and **20** at both edges thereof, is represented together with a comparable sectional outline representing a series of the outer ply spiral convolutions after winding. As indicated in FIG. 2 the outer ply **10** is wound so as to overlap fully the beveled edge portion **18** at the trailing edge of each preceding spiral convolution, the leading beveled edge portion **20** of the outer ply **10** as supplied for winding being deformed or displaced outwardly during the winding operation, as indicated in FIG. 2, to form a secure and tight spiral seam joint at the beveled edge portion **18** it overlaps.

As the beveled edge portions **18** and **20** may usually be formed most conveniently and to the best advantage on the outer ply **10** by abrasive grinding of the outer ply edge portions prior to winding, the result of winding the outer ply **10** in the above described manner is to turn the ground face of the leading beveled edge portion **20** outwardly at the surface of the resulting spiral wound tube structure T, as noted in further detail below, although it should be mentioned here that the apparent irregularity thus introduced at the tube surface is of no consequence according to the present invention, the emphasis at this stage being devoted to formation of the best possible spiral seam joint and the arrangement of the beveled edge

portions 18 and 20 to face outwardly allowing adhesive to be applied readily over the entire inner face of the outer ply 10 and thereby be available without special attention as fully at the spiral seam as elsewhere.

However, the results obtained according to the present invention are not dependent upon use of an outer ply 10 of the particular form illustrated in FIGS. 1 and 2. If desired, an outer ply 10' may be employed as illustrated in FIG. 3 with an outwardly facing beveled edge portion 18' ground only at the trailing edge thereof and with the leading edge 20' being left plain so as to be thrown up in a spiral ridge formation upon winding to overlap the trailing beveled edge portion 18. In this case, too, the inner surface of the outer ply 10' is originally left undisturbed for application of adhesive thereto in the usual manner prior to the winding operation, while the single beveled edge portion 18' thereon requires less grinding prior to the winding operation. In general, the choice of this alternative form of outer ply 10' as compared with the previously described form of outer ply 10 will depend upon whether the type of paper being used and the processing equipment available and other such factors allows the leading edge of the ply to be ground most efficiently before or after winding.

FIG. 4 illustrates a further alternative form of outer ply 10'' in which a trailing beveled edge portion 18'' is ground to face outwardly while a leading beveled edge portion 20'' is ground in staggered relation to face inwardly, so that the winding operation can be carried out without requiring any deformation of the outer ply 10'' at its leading edge. An outer ply 10'' of this form may be used to advantage when the paper being employed is of a plated type in which a special outer surface formation has been provided that should not be displaced along the spiral seam joint.

In any event, the resulting spiral wound tube structure T formed according to the present invention has the structural arrangement illustrated in FIG. 5 in which the inner plies 12, 14 and 16 are shown wound in the usual edge abutting arrangement, that characteristically results in gaps between the adjacent ply edges, while the outer ply is provided with a beveled spiral seam joint that may be wound tight and secure according to the present invention. Except for this tight spiral seam joint in the outer ply, the spiral wound tube structure T is of conventional form and may employ plies of the usual thickness or weight normally employed in forming spiral tubes of this sort. A common weight range for the plies of such spiral tube constructions is from about 20 to 37 point and the outer ply 10 arranged according to the present invention may be selected within this weight range on the basis of usual considerations as if a conventional spiral tube coustruction were to be wound.

FIG. 6 of the drawings illustrates more realistically the appearance of an outer ply 10 provided according to the present invention with the beveled edge portions 18 and 20 ground along the opposite edges thereof, the grinding of which normally results in rendering the ply edges irregular somewhat in the nature of a deckled edge, and in this connection it may be noted that a paper machine deckle might be employed to provide the necessary beveled edge portion if the ply widths desired could be obtained feasibly from a paper machine sheet. The remaining surface texture and condition of the outer ply 10 is not of particular importance as long as it is adapted adequately for effective spiral winding.

FIG. 7 illustrates the appearance of a fragmentary section of spiral wound tube structure T*w* as it appears immediately after winding when an outer ply 10 of the form illustrated in FIG. 6 is employed, the ground face of the leading beveled edge portion 20 appearing at the outer surface of the tube section T*w* adjacent to the spiral seam *s*, and having a somewhat irregular form as a result of the irregular edges of the outer ply 10 that are caused by grinding the beveled edge portions 18 and 20 thereon.

Upon setting of the adhesive in the wound tube structure T*w* by heating at 54, as previously mentioned, and subsequent grinding of the entire tube surface at 56, the surface appearance changes substantially as illustrated in FIG. 8 which shows a ground tube section T*g* on which the ground outer surface presents a substantially uniform texture and the spiral seam *s* is not nearly so readily distinguished. At this stage, the entire surface of the tube section T*g* presents a mass of slightly protruding fibers and the result of this condition is to bridge substantially the spiral seam *s* in preperation for eliminating its physical effect at the tube surface.

FIG. 9 next illustrates the appearance of a tube section T*t* after it has been treated, the result of this treatment being to lay the previously protruding ground fibers and consequently to make the spiral seam somewhat more visible. Also, depending upon the type of treating composition employed a more or less pronounced color change is apt to appear at the tube surface. This particular surface finishing material used may be selected in a matter of wide choice, although in the usual case exceptionally good results are obtained with an ethyl cellulose solution, to which wax may be added if a waterproofing effect is desired.

Finally, FIG. 10 illustrates the appearance of a tube section T*b* after buffing to produce the seamless outer surface of the present invention. At this stage a slick smooth surface is developed on the tube structure and the spiral seam *s* again fades very substantially so that it is hardly visible any longer and cannot be felt at the tube surface.

The grinding, treating and buffing steps employed in producing the seamless spiral tube surface of the present invention substantially complement each other in that the grinding step, in addition to initially placing a smooth continuous surface on the tube structure, prepares the tube surface advantageously to receive a surface finishing material effectively at the treating step, while the treating step can be carried out without impairing the continuous smoothness obtained by grinding and at the same time conditioning the tube surface so that the final buffing step can be carried out primarily for polishing effect without requiring any substantial sizing action on the tube structure which has already been ground smooth.

The present invention has been described in detail above for purposes of illustration only and is not intended to be limited by this description or otherwise except as defined in the appended claim.

I claim:

A method of producing a spirally wound tube having a substantially indiscernible outer surface seam comprising the steps of, beveling at least one edge of the outer surface of a paper strip to be wound and to constitute the outer surface of the tube to form an outwardly facing bevel, spirally winding said paper strip in overlapping relationship to form a spirally wound tube, winding said outer strip with its beveled edge overlapped by the edge of the adjacent convolution to thereby deflect said adjacent convolution edge radially outward producing a surface irregularity throughout the extent of the spiral seam, grinding the entire exterior surface of said tube only sufficient to remove the surface irregularity resulting from said deflection and to produce a uniform exterior surface on said tube having a substantially indiscernible outer surface spiral seam.

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