March 19, 1957 J. T. YOVANOVICH 2,785,700

PAPER TUBE AND METHOD OF MAKING THE SAME

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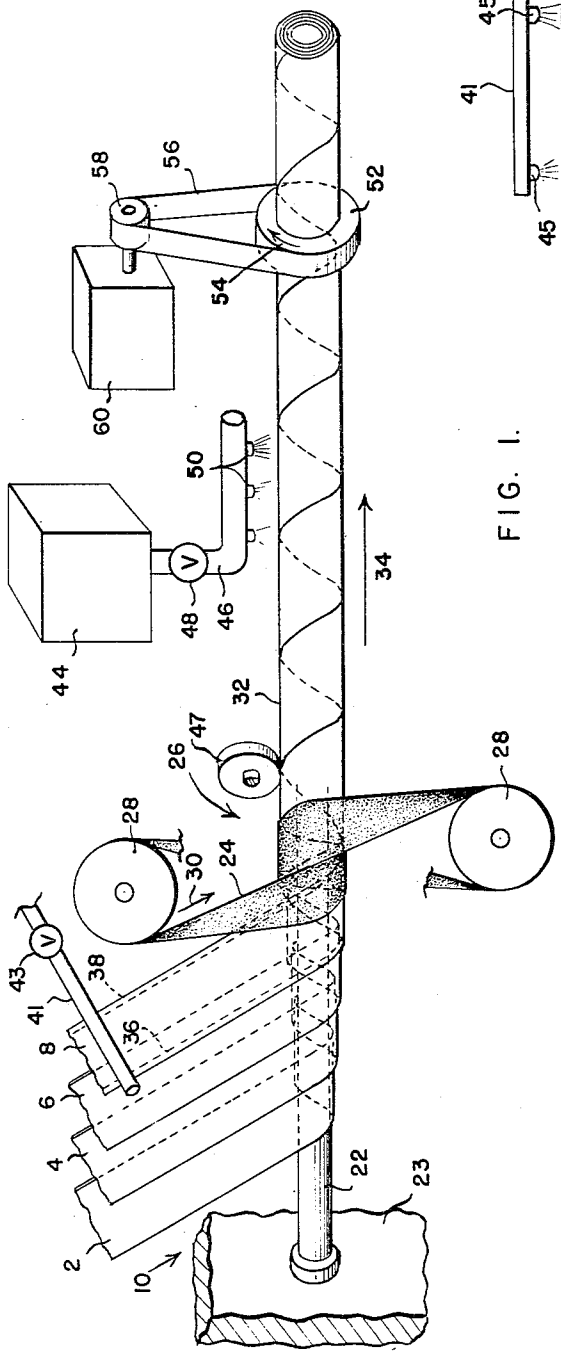


FIG. 1.

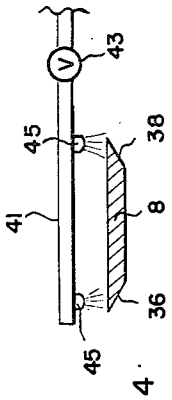


FIG. 4.

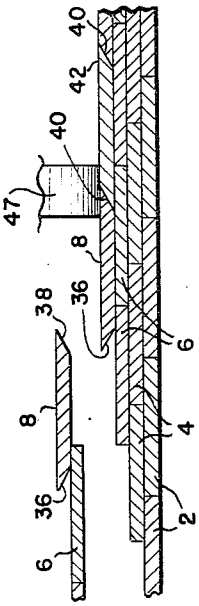


FIG. 3.

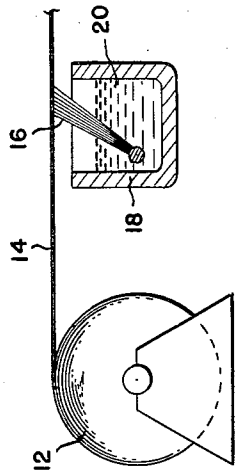


FIG. 2.

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PAPER TUBE AND METHOD OF MAKING THE SAME

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7 Claims. (Cl. 138—78)

This invention relates to a paper tube and to a method for making paper tubes. More particularly, the invention relates to a method of manufacturing spiral wound tubes which are formed from a plurality of overlapping strips of material each wound in spiral convolutions, each strip being wound with the adjacent edges of its successive convolutions desirably lying in engagement with each other.

Heretofore, spiral wound tubes have been known in the art but have all presented irregular exterior surfaces. The adjacent edges of successive convolutions of the outermost strip of material, if not fitted perfectly, give rise to irregularities principally in the form of depressions or raised edges on the surface of the tube extending therealong in spiral fashion coincident with the region of adjacent edges of the outermost wrapped strip. If these mating edges could be made to align perfectly, the outer surface of the tube would be substantially uniform. However, as a practical matter, it is substantially impossible to provide perfect alignment and engagement of these mating edges.

In order to simplify the problem of register and to reduce the adverse effects of improper register or mating of the adjacent edges of the outer strip, the edges of the outer strip may be bevelled and the overall width of the strip extended in order that the bevelled edges of successive convolutions of the outer strip will overlap each other and thus small errors or variations in register will produce irregularities which are substantially reduced due to the bevelled or inclined overlapping edges of the strip. Even this method of manufacture is attended by certain difficulties in that the bevelled edges of the strip are generally produced in skiving apparatus by means of abrasive wheels and thus have a roughened surface which appears on the exterior of the tube.

It is the object of the present invention to provide a tube which has a substantially perfectly smooth exterior surface.

It is a further object of the invention to provide a tube in which the exterior convolutions of spiral wound strip are formed with skived edges and in which the skived surfaces face downwardly, thus providing a smooth unroughened surface exteriorly of the finished tube.

It is a further object of the invention, when paper or similar material is employed for the outer convolution of a tube, to soften the skived edges of the outer convolution to substantially a point of disintegration and, after the tube is wound, to fuse the overlapping skived edge to the underlying portion of the tube by the application of pressure and sometimes also by the application of heat.

It is a still further object of the invention to impregnate the exterior surface of the tube after the tube is wound with a binding and/or fixative material which will not only serve as a lubricant for a sizing or burnishing operation but which will also serve to securely adhere the upper or outer skived edge to the underlying skived edge of the outer spiral wound strip.

These and other objects of the invention relating to procedure of manufacturing the tube and to the tube itself will become evident from the following description when read in conjunction with the accompanying drawing in which:

Figure 1 is a diagrammatic representation of the various steps involved in the manufacture of the tube;

Figure 2 is a showing of apparatus for applying adhesive to the underside of one of the strips from which the tube is wound;

Figure 3 is a fragmentary longitudinal section of the wall of the tube during manufacture thereof; and

Figure 4 is an elevation of a fragmentary portion of the apparatus shown in Figure 1.

In Figure 1 there is shown four strips **2**, **4**, **6** and **8** from which the tube described herein is formed. The strips may be formed of paper, fabric or other suitable flexible material. Each of the four strips are traveling in the direction indicated by the arrow **10** in Figure 1 and have been drawn from a spool such as that shown at **12** in Figure 2 and carried as a strip **14** over a brush **16** positioned within a container **18** containing a glue or other suitable adhesive **20**. It will be evident that various known adhesive applying means may be employed and that the particular adhesive need not be described in detail, many types of conventionally employed adhesives being well known in the art.

The four strips are fed over a mandrel **22** which is fixed in a stationary position and attached to a suitable support member **23**. The four strips each having its underside covered with a layer of adhesive are fed in overlapping relation as shown in Figure 1 and are rolled around the stationary mandrel **22** by means of a belt **24** which makes one turn around the mandrel and the strips of material thereon as indicated generally at **26** in Figure 1. The belt **24** is carried and driven by a pair of rollers **28**. It will be evident that with the belt **24** advancing in the direction of the arrow **30**, shown in Figure 1, that the four strips of material will be caused to rotate around the mandrel and form adjacent convolutions and successive layers of a tube which is constantly rotating and is constantly advancing in the direction of the arrow **34** in Figure 1. The procedure thus far described is conventional in the tube wrapping art.

It will be evident that substantial difficulty is encountered in maintaining perfect alignment of adjacent edges of successive convolutions of each strip of material employed in the winding process. The result of this difficulty is that the abutting edges of the outermost strip are either too close together providing slight raised ribs extending in a helical path along the surface of the tube or are too far apart providing a slight gap or depression extending in a helical path. In order to minimize the effects of imperfect register, the outermost sheet **8** is provided with bevelled or skived longitudinally extending edges as indicated at **36** and **38**. These bevelled edges are provided both on the same side of the strip and on the underside of the strip as it is wound into the tube. For this reason the glue applying apparatus described in connection with Figure 2 preferably employs a brush **16** in order to more adequately apply the adhesive to the bevelled portions **36** and **38** of the strip than would be accomplished if, for example, a roller were used.

As the strip **8** is wrapped on the tube, the bevelled edge **38** will fall over the prior wrapped bevelled edge **36** deflecting the prior wrapped bevelled edge **36** downwardly. Thus, as indicated at **40** in Figure 3, the adjacent edges of the outermost strip are in overlapping relation and the outer surface of the strip **8** adjacent to this overlap, as indicated at **42**, presents a smooth hard surface which has not been disturbed by the skiving operation.

The overlap indicated at 40 minimizes the effect of poor register and slight misalignment of the successive convolutions of the outermost strip 8 produces only relatively small deviations in surface contour. A steam line 41 connected through a valve 43 to a suitable source is provided with a pair of nozzles 45 through which there is directed a jet of steam onto each of the edges 36 and 38 of the outermost strip 8. These steam jets serve to soften the bevelled edges of the strip to substantially a point of disintegration.

After the strip is wound by the belt 24, the finished tube 32 passes under a roller 47 which is positioned to roll over the overlapping edge 38 of the outer convolution 8 as indicated at 40 in Figure 3. The roller may be supported by conventional support means and rotated merely by the passage of the longitudinally moving and rotating tube thereunder. Pressure applied by this roller will serve to fuse the softened disintegrated edge to the underlying portion of the tube. The application of adhesive by means of an arrangement such as that shown in Figure 2 will provide an adhesive coating on the surface of the edge 38 which will be effective in securing the edge to the tube. It will be evident that if desired, in order to avoid disturbing the softened bevelled edges of the outermost strip 8, the drive belt 24 may be positioned ahead of the application of the outermost strip 8. Thus strips 2, 4, 6 and any other inner strips employed would be wound and passed under the belt 24, and in a position subsequent to the belt 24, the outermost strip 8 would be wound onto the tube, being drawn thereon purely by rotation of the tube. With an arrangement such as this, the roller 47 provides a pressing down action in place of that which might otherwise have been provided by the belt 24 without encountering the possible gathering of the softened edges of the strip 8 by the belt 24. While the arrangement shown in the drawing discloses the use of two jets, one directed toward each edge of the strip 8, it will be evident that at least partial results may be obtained by the use of only one jet such as that directed onto the edge 38 of the outer strip 8 which is the overlapping edge strip.

To further insure the perfection of the outer surface of the tube, as the tube is formed it advances from the wrapping stage and there is continuously applied to the tube a fixative or binding material preferably in liquid form. As shown in Figure 1, this material may be supplied from a suitable reservoir 44 in liquid form through a conduit 46 under the control of a valve 48 and applied to the surface of the rotating and advancing tube through spray nozzles 50. If the spray nozzles 50 extend longitudinally of the tube for the length of one convolution of the strip 8, then as the tube is advanced and rotated, the entire surface of the tube will be coated with the fixative material.

Suitable materials may be, for example, waxes carried in emulsified form, waxes carried in solvents, various penetrating adhesive materials which may be in either water solution or otherwise carried in liquid form. These and numerous other materials which would suggest themselves to one well versed in the art may be employed, the essential function of the material being to provide lubrication for the burnishing operation which will hereafter be described and to provide a certain amount of penetration by a fixative material ino the surface of the tube.

Following the application of the fixative material, the tube passes through a burnishing ring 52. The inside surface of the burnishing ring presents a smooth surface in engagement with the outer surface of the tube and is of slightly reduced diameter from the diameter of the tube entering the burnishing ring. The ring is driven for rotation around the tube in the direction of the arrow 54 by means of a belt 56 passing over a pulley affixed to the burnishing ring and driven by a pulley 58 connected to the output shaft of a suitable motor 60. Sizing and

burnishing operations per se are well known in the art and the operation and the apparatus therefor need not be described in detail herein. The essential consideration involved in this burnishing operation is that it it is accomplished over a tube which has been coated with a fixative material which, in part, provides lubrication between the surface of the burnishing ring and the tube surface and, further, provides an impregnation of the surface of the tube which both hardens and polishes the tube surface. Furthermore, the impregnation by the fixative material insures adherence of the outermost portions of the bevelled edge 38 to the surface of its adjacent convolution.

From the foregoing it will be evident that the method of manufacture disclosed provides an improved tube structure as well as an improved method of manufacturing of a tube. The method of manufacture is important by virtue of the fact that an improved surface is provided with the maintenance of wrapping tolerances which heretofore provided an irregular tube surface. The application of the fixative material provides not only an improved surface condition but an improved burnishing operation in that the burnishing operation is facilitated by the lubricating coating and the effects of the burnishing operation are enhanced due to the impregnation of the tube surface by the fixative material both before and during the burnishing operation. Additionally, the ultimately produced tube has not only a more uniform and harder surface but also has a surface in which the outermost portions of the bevelled edges of the outer convolutions are firmly secured to the tube.

The substantially perfectly smooth outer surface of the tube makes the tube particularly suitable for carrying plastic film materials and other similar thin strip or sheet material which may acquire a permanent deformation when deformed for extended time intervals. When materials such as these are wound on a tube having an irregular surface, the irregularities produce deformation in the material for a plurality of convolutions thereof on the tube. Thus, a substantial loss can be avoided if a tube is employed having a perfect surface.

From the foregoing it will be evident that the method disclosed produces an improved tube structure and that various modifications may be made in the disclosed embodiment of the invention without departing from the scope of the invention as set forth in the following claims.

What is claimed is:

1. A spiral wound tube, comprising a plurality of overlapping strips of material each coated with an adhesive material on its underside and wound in spiral convolutions, the outermost strip having its underside bevelled along both of its edges and lying with one bevelled edge overlapping and radially inwardly deflecting the opposite bevelled edge of its prior convolution.

2. A tube as claimed in claim 1 having a burnished adhesive coated surface.

3. A tube as claimed in claim 1 in which the strips lying below the outermost strip are wound with adjacent edges of successive convolutions of each strip lying substantially in engagement with each other.

4. A method of producing a tube formed by a plurality of overlapping spiral wound strips, said method comprising beveling both edges of the underside of the strip to be wound on the outer surface of the tube, applying an adhesive coating to the undersides of the strips to be wound in overlapping relation, spiral winding the strips in overlapping relation into a tube, and winding the outer strip with one bevelled edge overlapping and radially inwardly deflecting the opposite bevelled edge of its prior convolution.

5. A method of forming a tube as claimed in claim 4 including impregnating the surface of the tube with an adhesive binding material and burnishing the adhesive impregnated surface.

6. A method of forming a tube as claimed in claim 4 in which the strips lying below the outermost strip

are wound with adjacent edges of successive convolutions of each strip lying substantially in engagement with each other.

7. The method of forming a tube as claimed in claim 4 including softening at least one of the bevelled edges of the outermost strip prior to winding the strip into the tube.

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