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(54) **PAINT ROLLER WITH INTEGRATED CORE
AND COVER AND METHOD AND
APPARATUS FOR PRODUCTION OF SAME**

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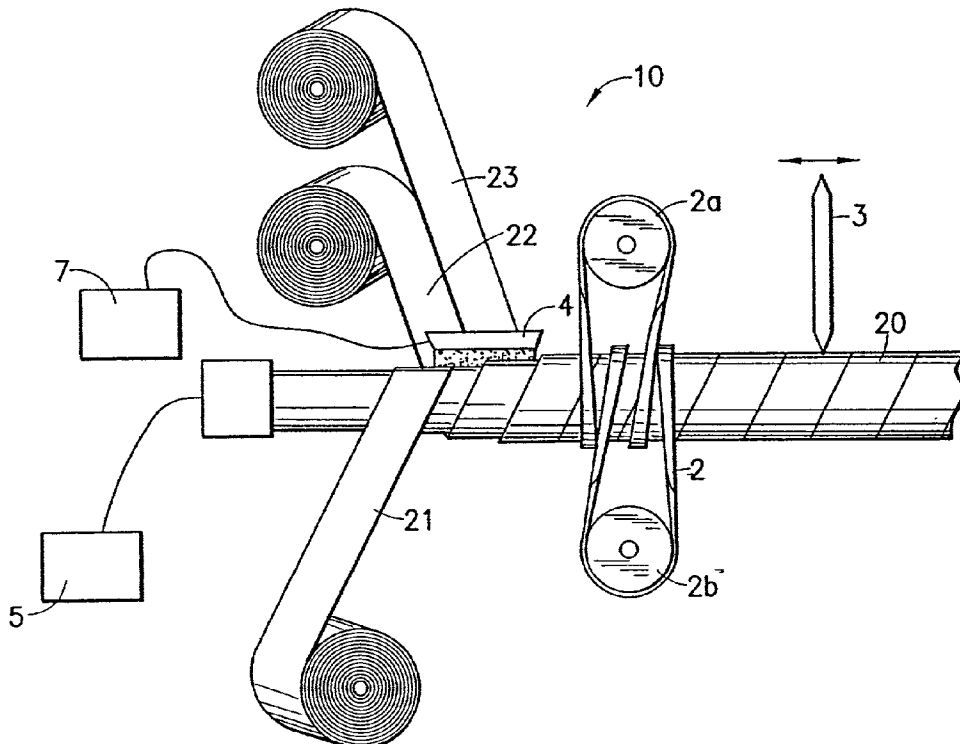
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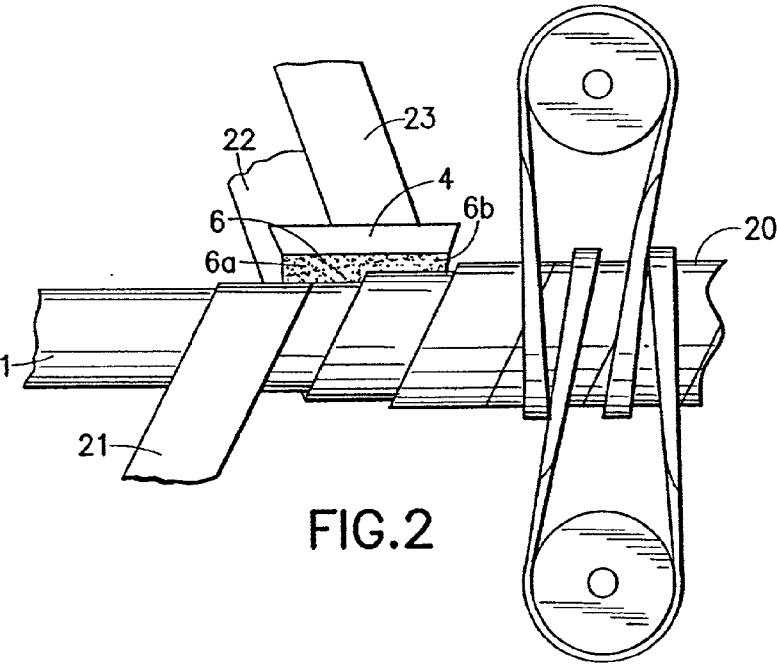
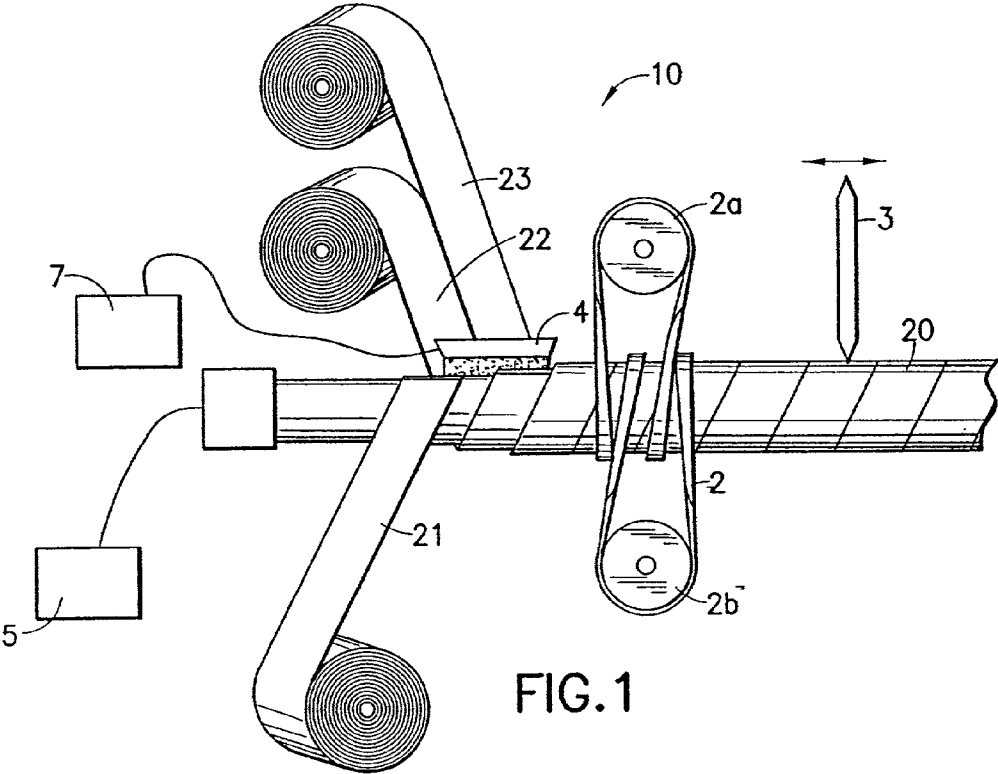
Related U.S. Application Data

(60) Continuation of application No. 09/515,267, filed on Feb. 29, 2000, which is a division of application No. 09/304,862, filed on May 4, 1999, now patented.

(57) **ABSTRACT**

An apparatus and method for the production of a thermoplastic tubular structure is disclosed. The apparatus comprises a stationary mandrel, a first and second feeder for feeding a first and a second strip to a mandrel at a first location and second location respectively, and a third feeder for feeding a cover strip to the mandrel at a third location, the third location being downstream of the second location. A transport system adapted to wind and advance the strips as they are being fed to the mandrel is used to helically wind the fed strips around the mandrel. A head for dispensing a width of a liquefied thermoplastic material is also disclosed. The head is oriented to dispense the width of the liquefied thermoplastic material on at least part of a winding of the first strip and part of a winding of the second strip. A cutter is used for cutting the thermoplastic tubular structure into predetermined sizes.





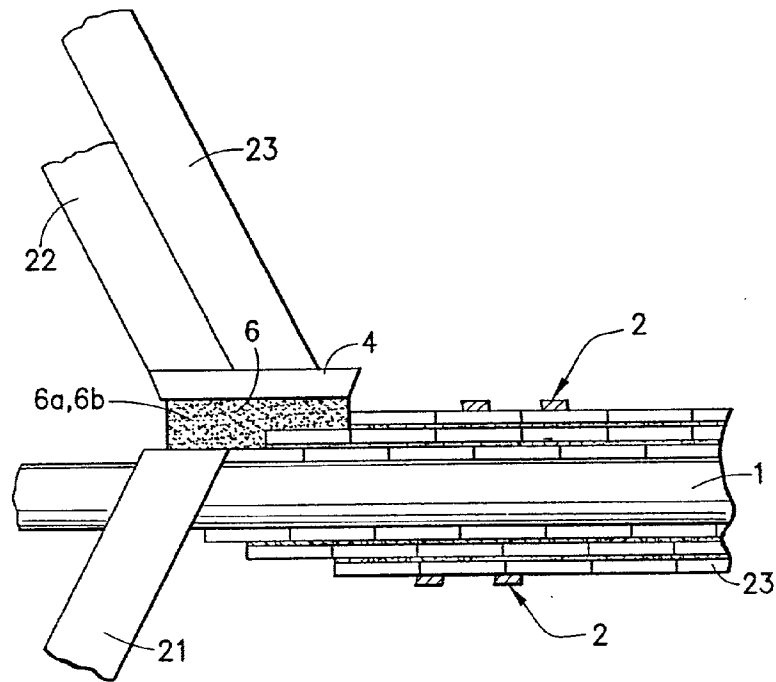


FIG. 2a

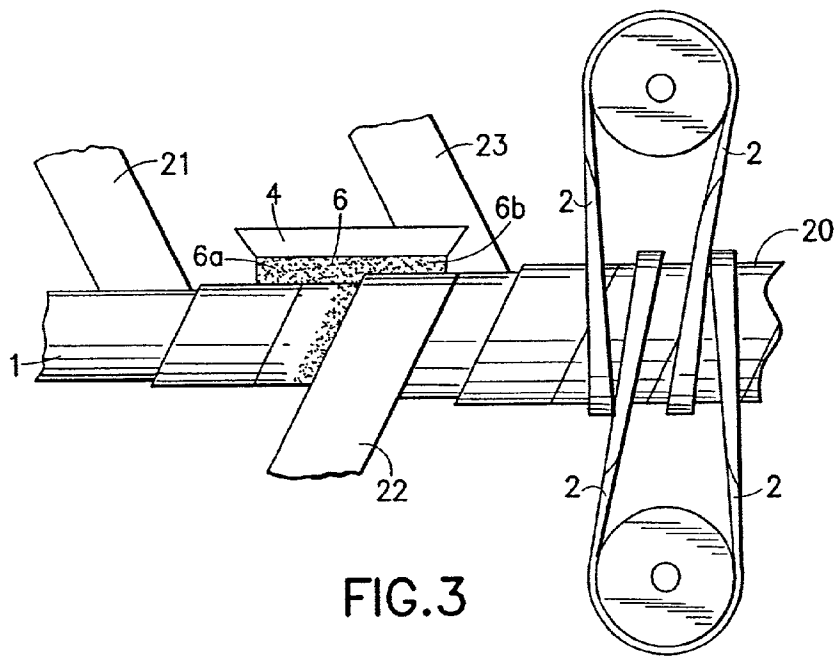


FIG. 3

FIG.4

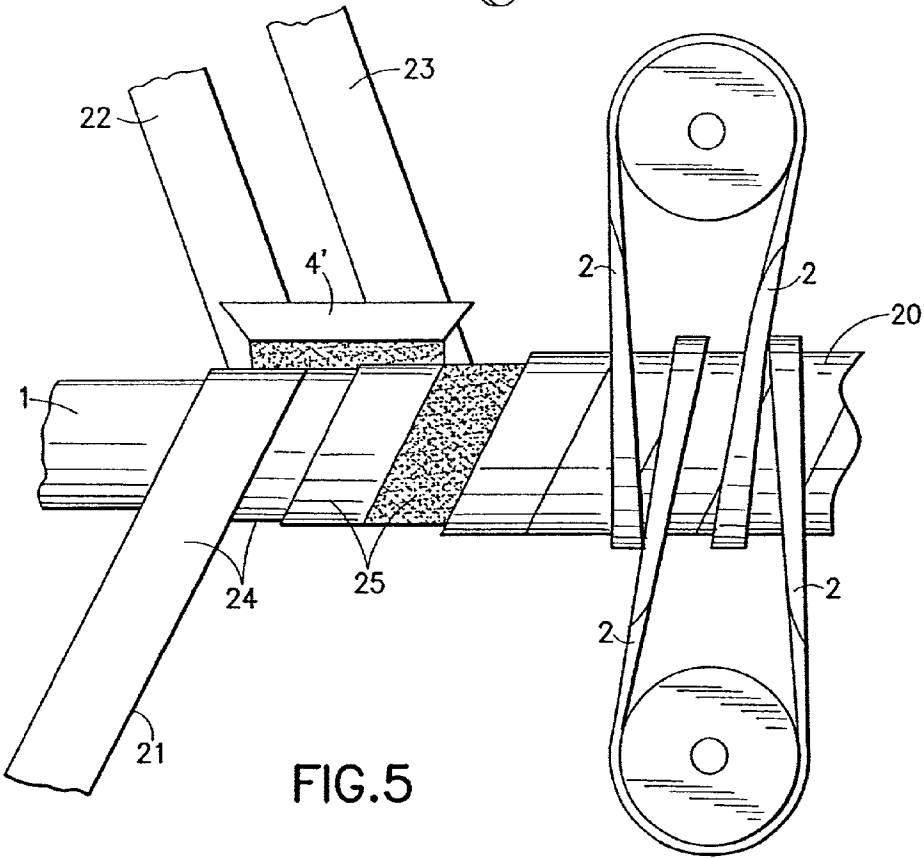
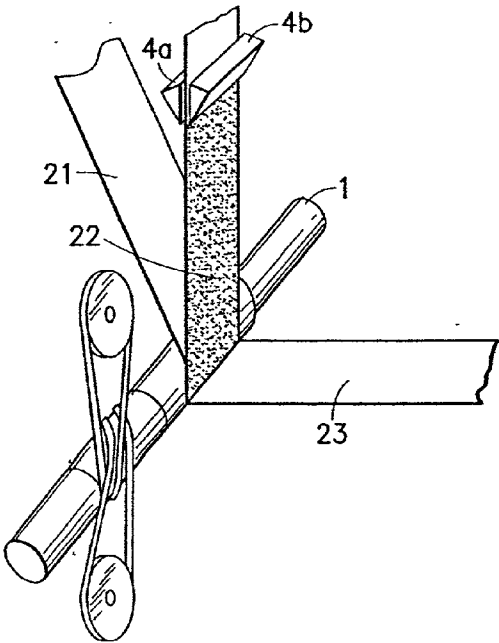
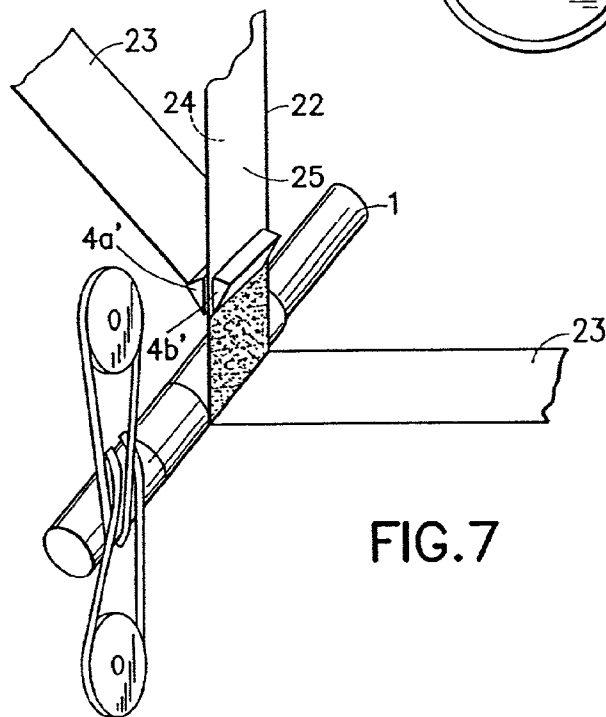
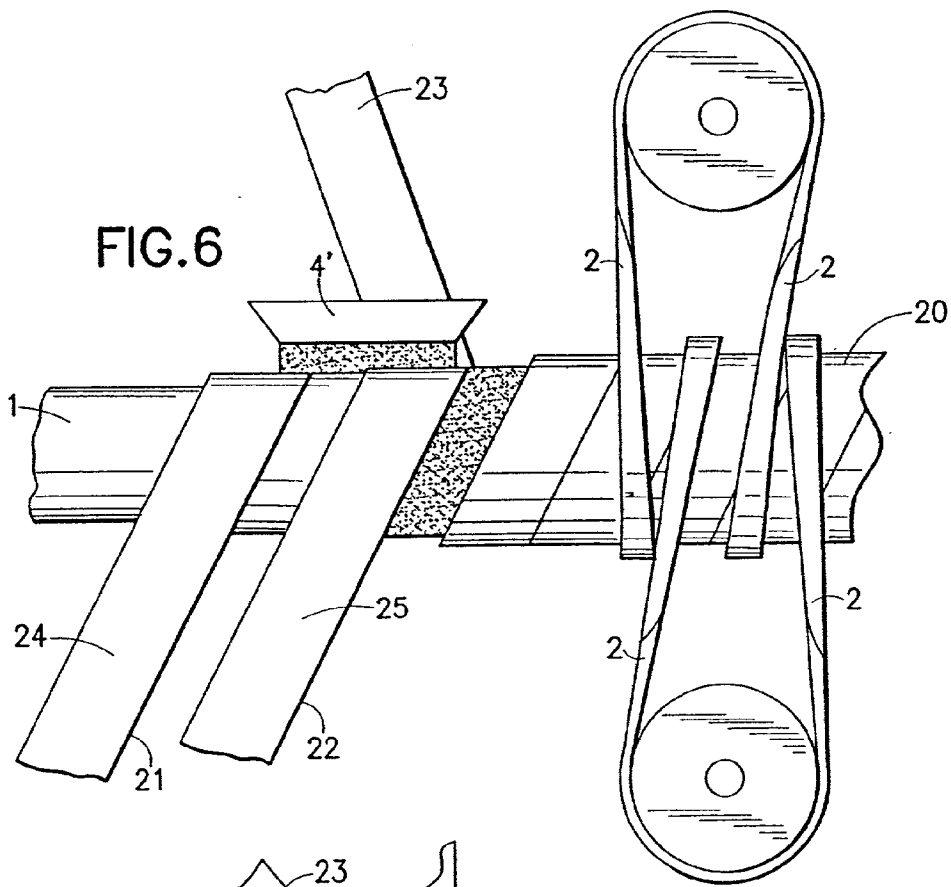


FIG.5



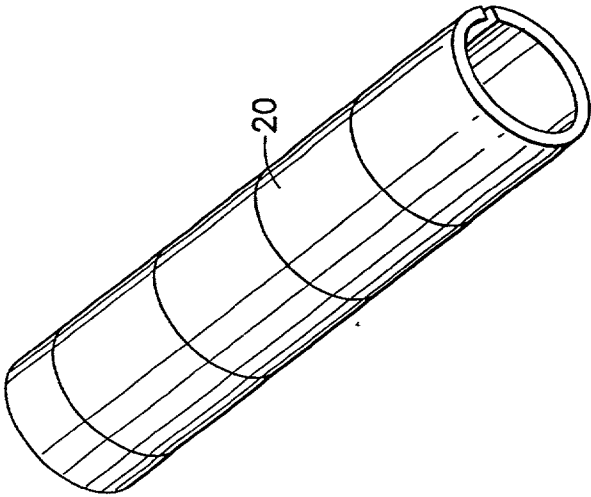


FIG. 8b

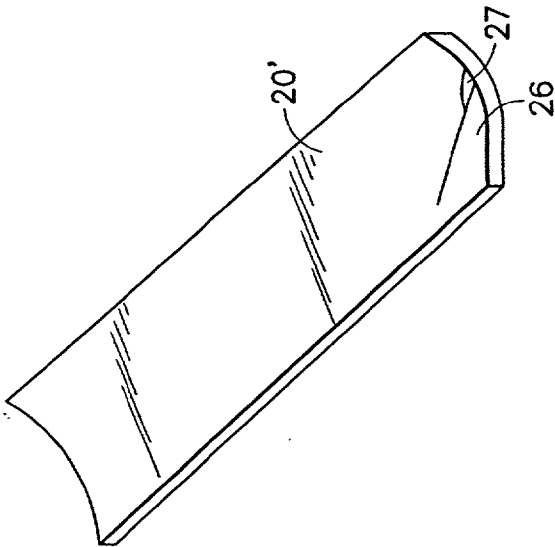


FIG. 8a
PRIOR ART

PAINT ROLLER WITH INTEGRATED CORE AND COVER AND METHOD AND APPARATUS FOR PRODUCTION OF SAME

FIELD OF THE INVENTION

[0001] This invention pertains to a method and apparatus for making paint rollers of the type used for applying paint to walls and the like. More specifically, the invention pertains to a method and apparatus for making paint rollers having thermoplastic (and preferably polypropylene) cores that are formed in a single-step 1G3 continuous process.

BACKGROUND OF THE INVENTION

Prior Art

[0002] Paint rollers are widely used by professionals and amateurs for applying paint to walls, ceilings, and other surfaces. Typically the roller is used with an applicator having a handle terminating in a rotatable member to which the roller is secured. The roller itself generally comprises a paint absorbing and spreading cover affixed to a generally cylindrical core. The covers may be made from materials such as wool or polyester, and other cover materials that are well known in the art.

[0003] Years ago paint rollers were manufactured using a paper or chipboard core. Some manufacturers still make such paper core paint rollers. The manufacture of such cores is well known. Such cores, however, and the paint rollers made out of them, would often fall apart during use or during cleaning, especially during cleaning with paint solvents (such as, for example, turpentine or mineral spirits, such paint solvents are well known in the art). It has always been desirable, and still remains desirable, to make the paint roller resistant to paint solvents.

[0004] An advance in making paint rollers came when the paper cores were replaced with phenolic cores, that is, cores made from paper impregnated with phenolic. Such paint rollers withstood exposure to paint solvents much better than their paper or chipboard counterparts. The process of manufacturing phenolic cores is also well known. For example, according to one known technique, a reusable disposable roller is made by first feeding three phenolic impregnated paper strips at an angle to a mandrel for overlapping, helical winding to form an endless core. Typically, the phenolic strips are supplied in rolls that can be mounted on spindles for continuous feeding, and a continuous thermosetting glue is applied to the outer surfaces of the strips as they feed off the rollers such that the strips adhere together as they are helically wound to form the core. As the endless core is belt driven down the line, the core is heated in a multi-stage infrared heater, after which a hot melt glue is applied to the core's outer surface and a continuous strip of the cover material, such as polyester, is helically wound on to the core where it is secured by the hot melt. All that remains is to cut the resulting endless roller down to usable sizes, which is usually accomplished in two steps, first using a fly away cutter to cut, e.g., 65 inch stock, and then using another cutter to cut the stock into usable lengths of, e.g., seven or nine inches.

[0005] The obvious drawback of reusable cores formed in this manner is that they require a long assembly line, due to the need of a heater, and because the phenolic must be

heated to a predetermined temperature, there is an obvious trade off between the number of heater stages and the speed of the line. Additionally, while the resulting rollers are termed reusable because they do not separate when placed in paint solvents, any prolonged exposure to such solvents, does result in breakdown of the paint roller and/or separation of the layers. Moreover, the manufacturing process for making phenolic core rollers is environmentally unfriendly.

[0006] Another reusable roller is disclosed in U.S. Pat. No. 4,692,975 issued to Garcia, wherein the roller is formed using a preformed core made of thermoplastic (e.g. polypropylene) tubular stock. In particular, the process disclosed mounting a preformed core on a rotating spindle, providing a carriage movable in a direction parallel to the spindle, and providing on the carriage a direct heat source and, at an angle to the spindle a continuous strip of fabric. The disclosed process consisted of igniting the direct heat source to begin heating the outer surface of the tubular stock and moving the carriage parallel to the spindle in timed relation to the spindle's rotation so that the fabric strip is wound on the heated portion of the plastic core in a tight helix. The heated portion of the plastic core was thereby heat-softened just in advance of the point where the fabric strip is applied, such that the fabric is bonded to the core as it is wound thereon. In effect, a portion of the polypropylene core surface is used as the bonding adhesive. One advantage of the roller disclosed in the Garcia patent is that the bond formed between cover and core is a strong one not easily subject to separation from exposure to paint solvents. Another advantage is that the manufacturing process does not require the application of a separate adhesive to bond the cover to the core. There are, however, drawbacks. For one, while prior art techniques use rolls of, e.g., chipboard or paper, the Garcia process requires preformed thermoplastic tubular cores which are considerably bulkier than rolls, more expensive to transport, and more difficult to handle. Another drawback is the anticipated speed limit of the Garcia process dictated by the necessity that the heater, which advances along the core just in front of the fabric strip, move slow enough to insure softening of the polypropylene core, in the absence of which the fabric cover will not bond. In addition, the application of direct heat to the preformed polypropylene core presents manufacturing hazards from the heat source and from the fumes and/or chemicals released during the heating process.

[0007] U.S. Pat. No. 5,195,242 issued to the present inventor resolved many of the foregoing problems by (i) forming the thermoplastic core on the fly instead of using preformed cores, and (ii) using preheated thermoplastic as a glue, both to form the core by applying it between the strips forming the core, and to affix the cover to the core by applying it to the outside of the core before wrapping the cover thereabout. The patent describes a process involving the wrapping of three strips of thermoplastic material (preferably polypropylene) around a mandrel in overlapping relation to form a core, the strips making the core are bonded together by applying a liquefied thermoplastic material (again, preferably polypropylene) thereto prior to wrapping them about the mandrel. After the core is thus formed a liquefied thermoplastic (again, preferably polypropylene) is applied to the outer surface of the core, and a cover wrapped thereupon. All that remains, as is well known, is to cut the resulting endless roller down to usable sizes, which, as described above may be accomplished in two steps, first

using a fly away cutter to make longer lengths, and then using another cutter to cut the stock into usable lengths. While this process was capable of making high quality rollers that were substantially unaffected by paint solvents, the process involved the use of multiple strips of thermoplastic material and numerous-points of application for liquefied thermoplastic. As a result, the process was difficult to set up, and required many continuous adjustments in its operation.

[0008] U.S. Pat. No. 5,468,207 issued to Bower discloses a continuous process like that disclosed in the '242 patent, except that Bower discloses using direct heat to bond the surface of the thermoplastic plastic strips instead of applying liquefied thermoplastic to the strips to bond them together. Additionally, Bower discloses using direct heat to the surface of the core to bond the cover rather than applying liquefied thermoplastic prior to applying the cover.

[0009] U.S. Pat. No. 5,572,790, also issued to the present inventor, among other things, resolved some of the complexity problems of the foregoing process. Under this process, which has become the de facto standard for roller manufacturing today, instead of forming a core by winding a plurality of strips in overlapping relation about a mandrel, and then affixing a cover thereto, it was disclosed to wind only a single strip about the mandrel, the adjacent edges thereby placed in a closely-spaced or abutting relation. A liquefied thermoplastic material (preferably, polypropylene) is then applied to the exposed surface of the wound strip, and a roller is formed by helically winding the cover over the liquefied material and the wound strip with sufficient tensile force so that the fabric cover lays smoothly thereupon. Again, as with other endless roller manufacturing, a fly-away cutter may be first used to cut the product into longer lengths, and then such lengths may be cut to usable lengths. This process represented an advance over the previous method invented by the present inventor because the entire paint roller was formed in a single step which made the assembly line easier to manage as there was only a single strip of material and a single application of liquefied thermoplastic. The resulting roller, however, is somewhat inferior. More specifically, a defect present in all such rollers, manifest itself as a weak point, often sticking out from the ends of a cut roller, or making the ends of the cut roller appear "out of round." This results from the high tension memory of the strip which tends toward unwinding or toward "open" with high hoop strength. Moreover, to achieve the desirable hardened feel of the multi-layer rollers, the single strip rollers are generally made using a thicker plastic strip. The thicker the plastic strip used, (especially in relation to the diameter of the core) the more pronounced the memory effect appears on the roller.

[0010] Another process for manufacturing thermoplastic paint rollers was disclosed in a very recently issued patent application. Specifically, U.S. Pat. No. 5,862,591 discloses another method of forming a paint roller in a single step. In this process, strips of thermoplastic are not used, and instead, a fluidized polypropylene is applied directly to a mandrel, and a cover is placed thereupon. The application of fluidized polypropylene to a mandrel has concomitant complications in synchronization and in the problems inherent in working with consistency of application of a fluidized layer in forming a polypropylene core. Like this-process, other proposals have been made for placing the pile fabric on a

heated core, as for example in French Patent Publication 2,093,060, in which pile fabric is placed on a hot, freshly extruded core. It is, however, believed that no such system has gone into practical use, possibly because of the difficulties associated with controlling the shrinkage variation which inevitably occurs in the matching of what is essentially a through heated core blank or strip blank and a cold (i.e., room temperature, for example) pile fabric.

SUMMARY OF THE INVENTION

[0011] It is an object of the present invention to provide an improved and less complex method for forming a reusable paint roller comprising a laminated core and a fully integrated cover.

[0012] It is another object of the present invention to provide a simplified process for manufacturing paint rollers having a laminate core formed from two polypropylene strips.

[0013] It is another object of the present invention to provide a method and apparatus for the manufacture high quality paint rollers in an extremely compact assembly area.

[0014] It is a further object of the present invention to provide a method whereby small cross sectional diameter paint rollers can be readily constructed in a continuous process.

[0015] Generally the present invention comprises a method for producing a paint roller in a single continuous integrated operation. The method of the present invention comprises the steps of: helically advancing a first strip of thermoplastic material about a mandrel; helically advancing a second strip of thermoplastic material about the first strip of thermoplastic material in offset relation therewith; helically advancing a cover about the second strip; providing an adhesive between outer surface of the first strip and the inner surface of the second strip; providing an adhesive between the outer surface of the outer strip and the inner surface of the cover; and forming a continuous laminated paint roller by applying a compressive force upon the cover.

[0016] In a preferred embodiment of the present invention the cover strip and adjacent adhered second polypropylene strip are laterally offset from each other whereby the cover strip spans adjacent winding of the second polypropylene strip. This provides additional structural strength in maintaining the rigidity of the roller. This is believed to be a significant factor in making small diameter rollers, which cannot be practically made by prior art, single strip methods of roller production.

[0017] Rollers made in accordance with the present invention provide sufficient resistance against unfurling of the core material to an extent whereby rollers of small diameter (0.5" roller core diameter as opposed to more common 1.5" cores) are made with utilizable structural integrity and resistance against end separation of strips.

[0018] Furthermore, as opposed to single-strip rollers made in accordance with the prior art, the integral roller core and cover material rollers of the present invention, when longitudinally slit, do not spring open, but instead substantially retain their original configurations, thereby demonstrating the different product so made.

[0019] The core and the roller are formed in a single step, and become essentially complete almost immediately after being compressed upon the cooled mandrel, to form the shape of the roller. The mandrel also provides a base for transport of the roller material towards a fly-away cutter for nearly immediate cutting into the finished product of specified length dimension. Variation in diameter of the mandrel determines the core diameter of the roller and its ultimate finished diameter dimensions.

[0020] The superior rollers of the present invention are thus formed with a simplified assembly line and process, comprising:

- [0021] a) two feeders for the two polypropylene strips,
- [0022] b) a feeder for the cover strip,
- [0023] c) a heater for activating an adhesive layer or an extruder for applying an adhesive layer,
- [0024] d) a stationary cooled mandrel,
- [0025] e) a transport means such as a helical drive belt to form and advance the endless roller, and
- [0026] f) a cutter.

[0027] The present invention comprises a novel combination using two strips of thermoplastic material, forming the laminate core and paint roller simultaneously, to provide an unexpectedly efficient method and apparatus for making superior paint rollers.

[0028] The above and other object, features and advantages of the present invention will become more evident from the following discussion and drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] FIG. 1 is a diagrammatic representation of an apparatus suitable for making rollers in accordance with the present invention;

[0030] FIG. 2 is an enlarged diagrammatic representation of a first preferred configuration for making rollers in accordance with the present invention;

[0031] FIG. 2a is a cutaway of the diagrammatic representation shown in FIG. 2.

[0032] FIG. 3 is an enlarged diagrammatic representation of a second preferred configuration for making rollers in accordance with the present invention;

[0033] FIG. 4 is an enlarged diagrammatic representation of a third preferred configuration for making rollers in accordance with the present invention.

[0034] FIG. 5 is an enlarged diagrammatic representation of a fourth preferred configuration for making rollers in accordance with the present invention;

[0035] FIG. 6 is an enlarged diagrammatic representation of a fifth preferred configuration for making rollers in accordance with the present invention;

[0036] FIG. 7 is an enlarged diagrammatic representation of a sixth preferred configuration for making rollers in accordance with the present invention.

[0037] FIGS. 8a and 8b are perspective views of rollers made in accordance with the prior art and the present invention respectively after having been longitudinally slit.

DETAILED DESCRIPTION OF THE INVENTION AND THE PREFERRED EMBODIMENTS

[0038] With reference to the drawings, in FIG. 1, a roller forming apparatus 10 comprises a stationary mandrel 1, cooled by cooler 5, on which the roller 20 is formed, helical drive belt 2 moves between drive rollers 2a and 2b to turn and move the formed endless roller 20 along the mandrel 1 to a fly-away cutter 3.

[0039] For ease of discussion in this application, the term "downstream" refers to the direction further along in the roller manufacturing process, or nearer the fly-away cutter 3, while the term "upstream" refers to the direction earlier in the roller manufacturing process, or further from the fly-away cutter 3.

First Embodiment

[0040] In a first embodiment, shown in FIG. 1, a detail shown in FIG. 2, and a cutaway detail shown in FIG. 2a, a continuous paint roller is manufactured from an inner strip of thermoplastic material 21, an outer strip of thermoplastic material 22, a cover 23, and an adhesive 6 applied from one or more heads 4. The thermoplastic material is preferably polypropylene. The cover 23 may be a well-known fabric cover for a paint roller, which can be made of polyester.

[0041] The inner strip 21 is helically advanced about the mandrel 1. The term helically as used herein means oriented about a mandrel so as to permit the downstream edge of a given wind of a strip to be in closely-spaced or abutting relation with the upstream edge of the preceding wind of the strip. As is well known in the art, a lubricant such as 5% mineral oil may be applied to the inner surface of the inner strip 21 prior to winding on the mandrel 1.

[0042] The outer strip 22 is helically advanced about the inner strip 21. Preferably, the edges of the outer strip 22 are offset from the edges of the inner strip 21 as the two strips are advanced along the mandrel 1. The offset between outer strip 22 and inner strip 21 causes outer strip 22 to overlap the portion of the inner strip 21 where its upstream and downstream edges are in closely-spaced or abutting relation. It is believed that the a stronger product is yielded from having an offset between the inner strip 21 and the outer strip 22. An offset of between one-quarter and three-quarters of the width of the inner strip 21 is found to achieve acceptable results.

[0043] The cover 23 is helically advanced about the outer strip 22.

[0044] The head 4 provides a layer of adhesive material 6 from a source of such material 7, the adhesive material 6 is preferably polypropylene. The source of adhesive material 7 is preferably an extruder, but may be any source of adhesive material including a melter. The head 4 may be any type of head appropriate for providing adhesive material 6 from the source, such as a nozzle or a die. In a preferred embodiment, where the source 7 is an extruder, the head 4 is preferably a die.

[0045] Prior to forming the roller, the two layers of adhesive material 6a, 6b must be applied. The first layer of

adhesive material 6a is applied so that it will advance between the inner strip 21 and the outer strip 22. The second layer of adhesive material 6b is applied such that it will advance between the outer strip 22 and the cover 23. In a preferred embodiment, the first layer of adhesive material 6a is applied to the outer surface of the inner strip 21, and the second layer of adhesive 6b is applied to the outer surface of the outer strip 22. Both the first and the second layer of adhesive 6a, 6b may be applied from a single head 4. A single head 4 would preferably be placed in a position to permit the adhesive layers 6a, 6b to be applied to the strips 21, 22 as close as is feasible to the cover 23. Preferably, the material would be dispensed from the head 4 with its width being parallel to the direction of the mandrel 1. Care should be taken to prevent any adhesive 6 from contacting the outer surface of the cover 23. While using a single head 4 is believed to provide the easiest setup and yield the most consistent results, two or more heads can be used to apply the layers of adhesive 6a, 6b.

[0046] Prior to the hardening and setting of the two layers of adhesive material 6a, 6b, the belt drive 2 applies pressure to the outer surface of the cover 23, imparting inward forces on the component parts, and thereby forming the continuous roller about the mandrel. In addition to foming the roller, the belt drive 2 advances the thus-formed endless roller along the mandrel, and continuously rotates the endless roller, thereby also advancing the strips 21, 22 and the cover 23 toward and around the mandrel.

[0047] The width and thickness of the strips 21, 22, and the cover 23 width and pile may be those that are appropriate for manufacture of the desired roller. For example, a typical high quality roller having a 1.5-inch diameter core and a 60-wall can be manufactured with the following materials:

	Width	Thickness
Inner Strip	2.750"	0.015"
Adhesive Layer One	2.750"	0.015"
Outer Strip	2.750"	0.015"
Adhesive Layer Two	2.750"	0.015"
Cover	2.875"	Desired Pile

[0048] A typical high quality roller having a 1.5-inch diameter core and an 80-wall can be manufactured with the following materials:

	Width	Thickness
Inner Strip	2.750"	0.020"
Adhesive Layer One	2.750"	0.020"
Outer Strip	2.750"	0.020"
Adhesive Layer Two	2.750"	0.015"
Cover	2.875"	Desired Pile

[0049] A typical high quality roller having a 1.5-inch diameter core and a 90-wall can be manufactured with the following materials:

	Width	Thickness
Inner Strip	2.750"	0.025"
Adhesive Layer One	2.750"	0.020"
Outer Strip	2.750"	0.025"
Adhesive Layer Two	2.750"	0.020"
Cover	2.875"	Desired Pile

[0050] As used herein, the term "wall" or "mil" means thickness in thousandths of an inch.

[0051] Such widths and thickness-and the methods of determining them are well known in the art. It will be apparent to one of skill in the art that almost infinite variation is possible depending upon the characteristics of the desired roller.

[0052] In addition to the well known high quality roller having a 1.5-inch diameter core, it desirable to manufacture rollers having a 0.5" core. The manufacture of 0.5" core rollers using single strip technology, such as U.S. Pat. No. 5,572,790, has been found not to produce a satisfactory result. Instead, it has been found that the present invention may be applied to 0.5" core rollers. A 0.5" core 60-wall roller can be manufactured, for example, with the following materials:

	Width	Thickness
Inner Strip	1"	0.015"
Adhesive Layer One	1"	0.015"
Outer Strip	1"	0.015"
Adhesive Layer Two	1"	0.015"
Cover	1.125"	Desired Pile

[0053] As described above, in a preferred embodiment, a single head 4 may supply both layers of the adhesive 6a, 6b. The width and thickness of the layers 6a, 6b may be varied, but preferably, the width should be substantially the same width as the strips 21, 22. The overall volume of adhesive to be applied must be sufficient to permit bonding of the inner strip 21 to the outer strip 22 and to permit bonding of the cover 23 to the outer strip 22. The amount of adhesive used in the second layer 6b should depend to some extent on the cover 23 material.

[0054] A head 4 may be used that is significantly shorter than the preferred width. Using such shorter head 4 may be accommodated by adjusting the flow rate, by shaping the die, by moving the die in a direction along its width or in other ways that are readily apparent to one of skill in the art. Similarly, the invention can be practiced with a head 4 that is significantly longer. Using such a longer head 4 can be accomplished by shaping of the die, or in other ways that are readily apparent to one of skill in the art. Although the invention will accommodate a rather large variation in the width of the head 4, and therefore in the width of material that is supplied by the head 4, it is believed that using a head 4 that provides the desired width of adhesive onto the strips 21, 22 will yield the most consistent results.

[0055] It is further possible, without departing from the invention, to use more than one head to apply the adhesive

to advance between the strips **21, 22** and to advance between the cover **23** and the outer strip **22**. Regardless of the width or number of heads, in order to produce a quality laminated continuous roller, pressure must be applied inwardly upon the cover before the two layers of polypropylene are permitted to harden and set.

[0056] The first embodiment orientation of feed for the strips **21, 22** and cover **23**, as shown in **FIG. 2**, permits the cover **23** to be advanced toward the mandrel **1** adjacent and parallel to the outer **20** strip **22**. Such positioning permits the use of a single head **4** that can apply adhesive **6a, 6b** to the outer surface of the inner strip **21** and to the outer surface of the outer strip **22** simultaneously. Additionally, this positioning permits the adhesive **6a, 6b** to be exposed uniformly and for a very short period prior to being sandwiched between the inner and outer strips **21, 22** or the outer strip **22** and the cover **23**. Further, this positioning permits a very short assembly line for the continuous manufacturing process.

Second Embodiment

[0057] It is believed that providing an offset between the outer strip **22** and the cover **23** could yield an even sturdier product, a method permitting such offset is disclosed. Turning now to a second embodiment, having a detail shown in **FIG. 3**, a continuous paint roller is manufactured from an inner strip of thermoplastic material **21**, an outer strip of thermoplastic material **22**, a cover **23**, and an adhesive **6** applied from one or more heads **4**. The thermoplastic material is preferably polypropylene. The cover **23** may be a well-known fabric cover for a paint roller, which can be made of polyester.

[0058] The second embodiment differs from the first in the orientation of feed for the strips **21, 22** and cover **23**. In the second embodiment, the cover **23** is offset from the outer strip **22**.

[0059] The inner strip **21** is helically advanced about the mandrel **1**. As is well known, a lubricant may be applied to the inner surface of the inner strip **21** prior to winding on the mandrel **1**. The outer strip **22** is helically advanced about the inner strip **21** in offset relation. The cover **23** is helically advanced about the outer strip **22**, in offset relation. The head **4** provides adhesive material **6** from a source of such-material **7**, such as an extruder.

[0060] Prior to forming the roller, the two layers of the adhesive material **6a, 6b** are applied. The first layer **6a** is applied such that it is advanced between the inner strip **21** and the outer strip **22**, and the second layer **6b** is applied to be advanced between the outer strip **22** and the cover **23**. Both the first and the second layer of adhesive **6a, 6b** may be applied from a single head **4**. A single head **4** would preferably be placed in a position to permit the adhesive to be applied to the strips **21, 22** as close to the location where the cover **23** is wrapped about the outer strip **22**. Alternatively, two or more heads **4** can be used to apply the first and second layers of adhesive **6a, 6b**.

[0061] Prior to the hardening and setting of the two layers of adhesive material **6a, 6b**, the belt drive **2** applies pressure to the outer surface of the cover **23**, imparting inward forces on the component parts, and thereby forming the continuous roller about the mandrel. In addition to forming the roller,

the belt drive **2** advances the thus-formed endless roller along the mandrel, and continuously rotates the endless roller, thereby also advancing the strips **21, 22** and the cover **23** toward and around the mandrel.

[0062] The assembly line for this embodiment is somewhat longer than the assembly line for the first embodiment. The additional length of the assembly line, however, may be only one or two inches, or less, so this is not considered significant.

[0063] The second embodiment does cause non-uniform exposure of the adhesive layer **6** prior to being sandwiched. The significance of the non-uniform exposure of the adhesive is unknown, however, if it should prove to be a problem, a multi-head system may be used to resolve it. For example, one head **4** may be used for the first layer **6a** and a portion of the second layer **6b**. A second head **4** may then be used to apply the remaining portion of the second adhesive layer **6b** at a slightly higher temperature, thus compensating for the difference in exposure.

Third Embodiment

[0064] Turning now to a third embodiment, having a detail shown in **FIG. 4**, a continuous paint roller is manufactured from an inner strip of thermoplastic material **21**, an outer strip of thermoplastic material **22**, a cover **23**, and an adhesive (not shown) applied from two heads **4a** and **4b**. The thermoplastic material is preferably polypropylene. The cover **23** may be a well-known fabric cover for a paint roller, which can be made of polyester.

[0065] The third embodiment differs from the first two in the orientation of feed for the strips **21, 22** and cover **23**. The third embodiment consists of the shortest assembly line. The inner strip **21** is helically advanced about the mandrel **1**. As is well known, a lubricant may be applied to the inner surface of the inner strip **21** prior to winding on the mandrel **1**. The outer strip **22** is helically advanced about the inner strip **21** in offset relation. The cover **23** is helically advanced about the outer strip **22**, the cover may but need not be in offset relation.

[0066] Prior to forming the roller, two layers of the adhesive material (not shown) are applied. Two heads **4a, 4b** provide adhesive material from a source of such material **7**, such as an extruder. Head **4a** applies a first layer of the adhesive to the inner surface of outer strip **22**, while head **4b** applies a second layer material to the outer surface of the outer strip **21**.

[0067] Prior to the hardening and setting of the two layers of adhesive material, the belt drive **2** applies pressure to the outer surface of the cover **23**, imparting inward forces on the component parts, and thereby forming the continuous roller about the mandrel. In addition to forming the roller, the belt drive **2** advances the thus-formed endless roller along the mandrel, and continuously rotates the endless roller, thereby also advancing the strips **21, 22** and the cover **23** toward and around the mandrel.

Fourth Embodiment

[0068] A fourth embodiment of the present invention will be described with reference to **FIG. 5**, a continuous paint roller is manufactured from an inner strip of thermoplastic material **21**, an outer strip of thermoplastic material **22**, a

cover **23**, and a head **4**. The thermoplastic material is preferably polypropylene. The cover **23** may be a well-known fabric cover for a paint roller, which can be made of polyester.

[0069] A first adhesive layer **24** is present on the outer surface of the inner strip **21**, and a second adhesive layer **25** is present on the outer surface of the outer strip **22**. The adhesive layers preferably comprise polypropylene. Although this embodiment is so described, it is within the skill of the art to recognize that the first and second adhesive layers **24, 25** could also be placed, on the inner surface of the outer strip **22** and on the inner surface of the cover **23**, respectively. It is only important that the head **4'** is able to activate the adhesive layers **24, 25**, and that the adhesive layers **24, 25** will become sandwiched between the inner strip **21** and the outer strip **22**, and the outer strip **22** and the cover **23**, respectively.

[0070] The inner strip **21** is helically advanced about the mandrel **1**. As is well-known, a lubricant may be applied to the inner surface of the inner strip **21** prior to advancing. The outer strip **22** is helically advanced about the inner strip **21**, in offset relation. The cover **23** is helically advanced about the outer strip **22**.

[0071] The head **4'** provides heat. The head **4'** may be an electric heater, it may be gas operated, or it may be any other type of heater appropriate for activating the adhesive layers **24, 25** on the strips **21, 22**. (An adhesive layer is activated by being liquefied, that is, brought into a tacky, molten state.) Prior to forming the roller, two layers of adhesive **24, 25** are activated by the head **4'**. Both the first and the second layer of adhesive **24, 25** may be activated from the single head **4'**. The head-**4'** would preferably be placed in a position to permit the adhesive to be activated on the strips **21, 22** within the region designated by the measurement **A** in the FIG. 2. Preferably, the head **4'** is oriented parallel to the direction of the mandrel **1**. Care should be taken to prevent the heat emanating from the head **4'** from heating the outer surface of the cover **23** to a degree that would melt or otherwise adversely affect its properties. In order to prevent such damage to the cover **23**, the cover **23** is advanced about the outer strip **23** a wind downstream from the head **4'**. Alternatively, a heat shield (not shown) may be employed. While using a single head **4'** is believed to provide the easiest setup and yield the most consistent results, two or more heat sources can be used to activate the layers of adhesive.

[0072] Prior to the hardening and setting of the two layers of adhesive **24, 25**, a belt drive **2** is used to apply pressure to the outer surface of the cover **23**, imparting inward forces on the component parts, and thereby forming the continuous roller about the mandrel. In addition to forming the roller, the belt drive **2** advances the thus-formed endless roller along the mandrel, and continuously rotates the endless roller, thereby also advancing the strips **21, 22** and the cover **23** toward and around the mandrel.

Fifth Embodiment

[0073] A fifth embodiment of the present invention will be described with reference to FIG. 6, a continuous paint roller is manufactured from an inner strip of thermoplastic material **21**, an outer strip of thermoplastic material **22**, a cover **23**, and a head **4'**. The fifth embodiment differs from the fourth embodiment in that the cover **23** is offset from the

outer strip **22**. In this embodiment the cover **23** is spaced on one-half wind from the head **4'**. This is thought to present an advantage in that the cover **23** is closer to the head **4'**, but no heat shield is likely to be required.

Sixth Embodiment

[0074] A sixth embodiment of the present invention is described with reference to FIG. 7, a continuous paint roller is manufactured from an inner strip of thermoplastic material **21**, an outer strip of thermoplastic material **22**, a cover **23**, and two heads **4a', 4b'**.

[0075] A first adhesive layer **24** is present on the inner surface of the outer strip **22**, and a second adhesive layer **25** is present on the outer surface of the outer strip **22**. The adhesive layers preferably comprise polypropylene.

[0076] The inner strip **21** is helically advanced about the mandrel **1**.

[0077] The outer strip **22** is helically advanced about the inner strip **21**, in offset relation. The cover **23** is helically advanced about the outer strip **22**. Two heads **4a', 4b'** provide heat to activate the two adhesive layers **24, 25**. The heads **4a', 4b'** may be electric heaters, gas operated, or any other type of heater appropriate for activating the adhesive layers **24, 25** on the strips **21, 22**.

[0078] Prior to forming the roller, two layers of adhesive **24, 25** are activated by the heads **4a', 4b'**. The heads **4a', 4b'** are preferably be placed in a position to permit the adhesive layers **24, 25** to be activated at a point close to where the outer strip **22** is advanced about the inner strip **21**. Preferably, the heads **4a', 4b'** are oriented in a direction perpendicular to the length of the outer strip **22**. Care should be taken to prevent the heat emanating from the heads **4a', 4b'** from heating the cover **23** to a degree that would melt or otherwise adversely affect its properties. A heat shield (not shown) may be employed.

[0079] Prior to the hardening and setting of the two layers of adhesive **24, 25**, a belt drive **2** is used to apply pressure to the outer surface of the cover **23**, imparting inward forces on the component parts, and thereby forming the continuous roller about the mandrel. In addition to forming the roller, the belt drive **2** advances the thus-formed endless roller along the mandrel, and continuously rotates the endless roller, thereby also advancing the strips **21, 22** and the cover **23** toward and around the mandrel.

[0080] While providing both adhesive layers **24, 25** on the outer strip **22** is believed to provide the easiest setup and yield the most consistent results, it is within the scope of the invention to provide and activate the first adhesive layer **24** on the outer surface of the inner strip **21**. It is also within the scope of the invention to split the first adhesive layer **24** between the inner surface of the outer strip **22** and the outer surface of the inner strip **21**. Having so split the adhesive layer **24**, either multiple heads **4a** may be employed, or alternatively, a single head **4a'** could be located near the point where the inner strip **21** and the outer strip **22** first make contact.

[0081] In making the inventive paint roller using the process described herein, it is desirable to have the belt drive **2** closely follow the point in the manufacturing process at

which the cover is wrapped. Preferably, the belt drive **2** immediately follows such wrapping thus permitting the belt drive **2** to impart physical force to the component parts before the thermoplastic hardens and sets, thereby creating an endless roller **20**. Permitting the belt drive **2** to act on the not-yet completely set roller has been found to provide a superior roller **20**.

[0082] As is well known in the art, the endless roller **20** may be cut by the fly-away saw **3** into lengths after it has set sufficiently.

[0083] Employing the present invention, the entire length of the assembly line required to manufacture superior quality paint rollers can have less than 20 inches of mandrel **1**, and less than 20 inches between the belt drive **2** and the fly-away saw **3**.

[0084] Aside from the rapidity in which completed rollers are formed with minimal line equipment, the rollers formed are of superior structural integrity. As seen in **FIGS. 8a** and **8b** slit rollers **20** (present invention) and **20'** (single strip prior art) differ in shape. The prior art roller **20'**, with a longitudinal cut experiences an unwinding force retained by the roller and springs open to a shallow curve section. This is indicative of constant hoop forces operating against the core structure thereby causing end sections **24** to separate from adjacent section **26** in an unsightly fashion. In addition the high hoop forces render the manufacture of smaller diameter single strip roller almost infeasible both in terms of integrity and proper construction. In contrast roller **20** of the present invention experiences little or no unfurling even with smaller diameter roll cores. This is believed to result, at least in part, from the laminating effect of the multiple usually thinner strips.

[0085] An unexpected benefit of the instant process is that the cost is significantly less than the cost for manufacturing a comparable roller using single strip technology such as U.S. Pat. No. 5,572,790. The cost benefit results from the fact that polypropylene extruded into strip form is significantly more expensive by the pound than polypropylene in pellet form, which latter form is used in an extruder to form the adhesive. With a laminated process, two layers of adhesive between 0.15" and 0.25" are applied, whereas, with the single strip process, the maximum layer of adhesive is 0.25". Thus, to make almost any roller, the amount of extruded polypropylene can be reduced, and a better yet less expensive produce can be produced.

[0086] As the number of strips rise, so too does the complexity of the process. Accordingly, the manufacture of four, five or more strip products is not likely to be feasible. Moreover, the present invention permits the use of a single head for the application of adhesive. A process having three or more strips of-polypropylene would require at least two heads.

[0087] The above embodiments and preferences are illustrative of the present invention. It is neither necessary, nor intended for this patent to outline or define every possible combination or embodiment. The inventor has disclosed sufficient information to permit one skilled in the art to practice at least one embodiment of the invention, and has disclosed the ways the inventor now believes are the best ways to practice the invention. The most obvious variations to the present invention include variation in the placement or

orientation of the strips **21**, **22** and the cover **23** and variations in the placement of the head **4**, **4'**, **4a**, **4b**. It is understood that the above description and drawings are merely illustrative of the present invention and that changes in components, structure and procedure are possible without departing from the scope of the present invention as defined in the following claims.

What is claimed is:

1. An assembly line for the continuous manufacturing of a thermoplastic tube with a cover, the assembly line comprising:

- a. stationary mandrel;
- b. first feeder for feeding a first strip to a mandrel at a first location, the first strip comprising a thermoplastic material;
- c. second feeder for feeding a second strip to the mandrel at a second location, the second location being downstream of the first location, the second strip comprising a thermoplastic material;
- d. third feeder for feeding a cover strip to the mandrel at a third location, the third location being downstream of the second location;
- e. transport system adapted to wind and advance the strips as they are being fed to the mandrel, thereby helically winding the fed strips around the mandrel;
- f. head for dispensing a width of a liquefied thermoplastic material, the head being oriented to dispense the width of the liquefied thermoplastic material on at least part of a winding of the first strip and part of a winding of the second strip such that the width of the liquefied thermoplastic material forms a substantially uniform layer between the second strip and the cover strip; and
- g. cutter for cutting the thermoplastic tube and cover to predetermined sizes.

2. An assembly line for the continuous manufacturing of a thermoplastic tube with a cover, the assembly line comprising:

- a. stationary mandrel;
- b. first feeder for feeding a first strip to a mandrel at a first location, the first strip comprising a thermoplastic material;
- c. second feeder for feeding a second strip to the mandrel at a second location, the second location being downstream of the first location, the second strip comprising a thermoplastic material;
- d. third feeder for feeding a cover strip to the mandrel at a third location, the third location being downstream of the second location;
- e. transport system adapted to wind and advance the strips as they are being fed to the mandrel, thereby helically winding the fed strips around the mandrel, the transport system causing a substantially uniform layer of a

- liquefied thermoplastic material to be formed between the second strip and the cover strip;

f. head for dispensing a width of the liquefied thermoplastic material, the head being oriented to dispense the width of liquefied thermoplastic material on at least
- part of a winding of the first strip and part of a winding of the second strip; and

g. cutter for cutting the thermoplastic tube and cover to predetermined sizes.

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