

(12) **Patent Application Publication**
Michel et al.

(43) **Pub. Date:** **Sep. 28, 2006**

Publication Classification

(51) **Int. Cl.**
B65H 75/24 (2006.01)

(52) **U.S. Cl.** 242/571.4

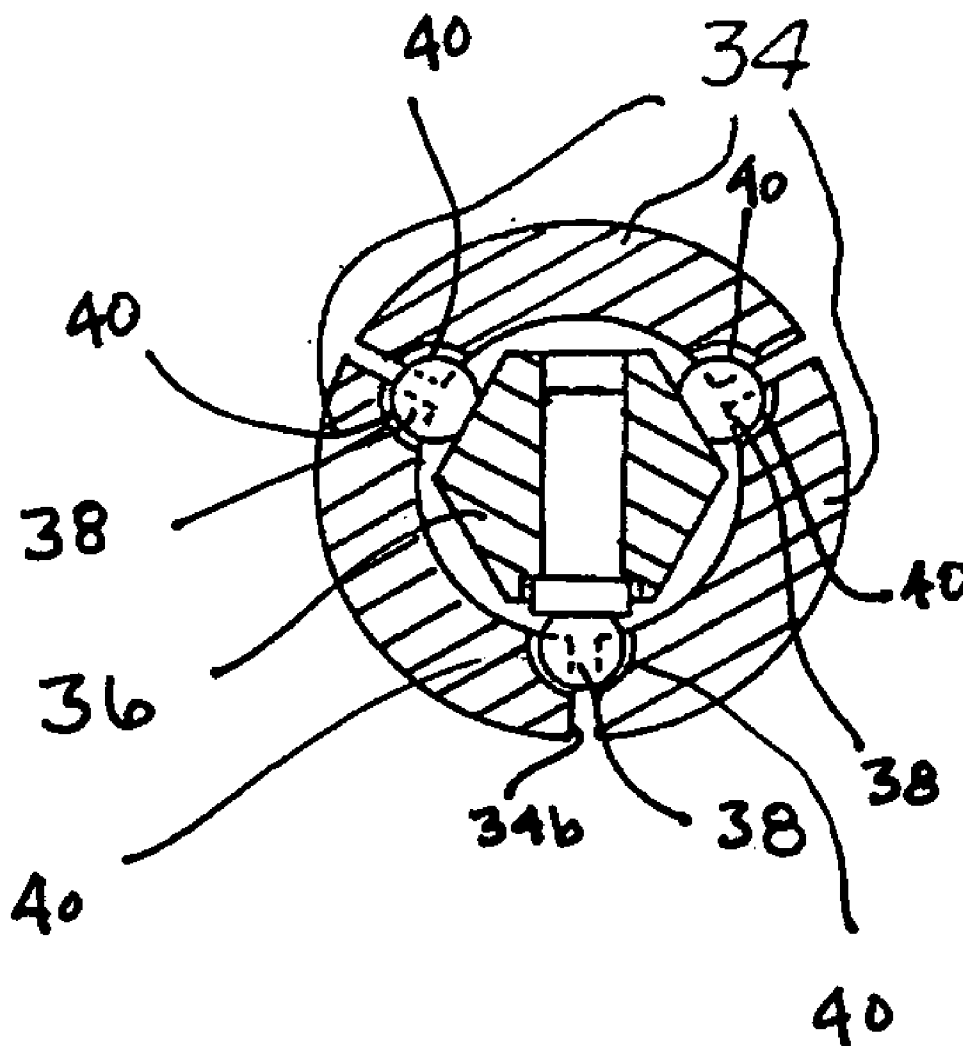
(57) **ABSTRACT**

(22) Filed: **Nov. 17, 2005**

Related U.S. Application Data

(60) Provisional application No. 60/629,327, filed on Nov. 17, 2004.

Disclosed is an apparatus for forming coreless paper rolls. The apparatus includes an expansible mandrel that can be used in conjunction with an existing rewinder. The mandrel is segmented, with the segments expanding when the mandrel is loaded into the rewinder. While in the rewinder, a web of material, such as the type used to form register receipt rolls, is wound upon the mandrel. After a sufficient amount of material has been taken up, the mandrel is removed from the rewinder. Upon removal, the segments contract whereby the cross section of the mandrel is reduced and the roll can be removed. The result is a coreless roll of material.



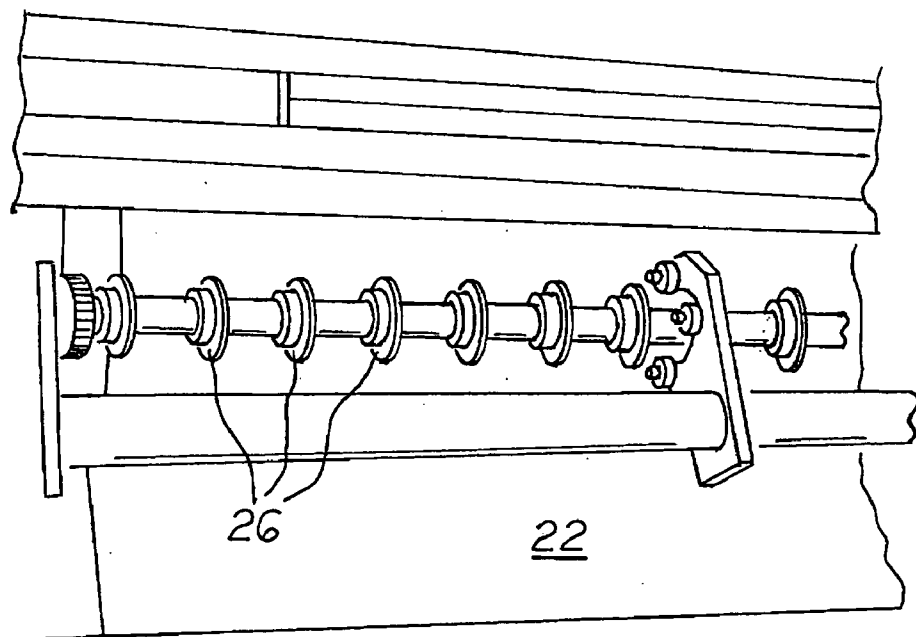
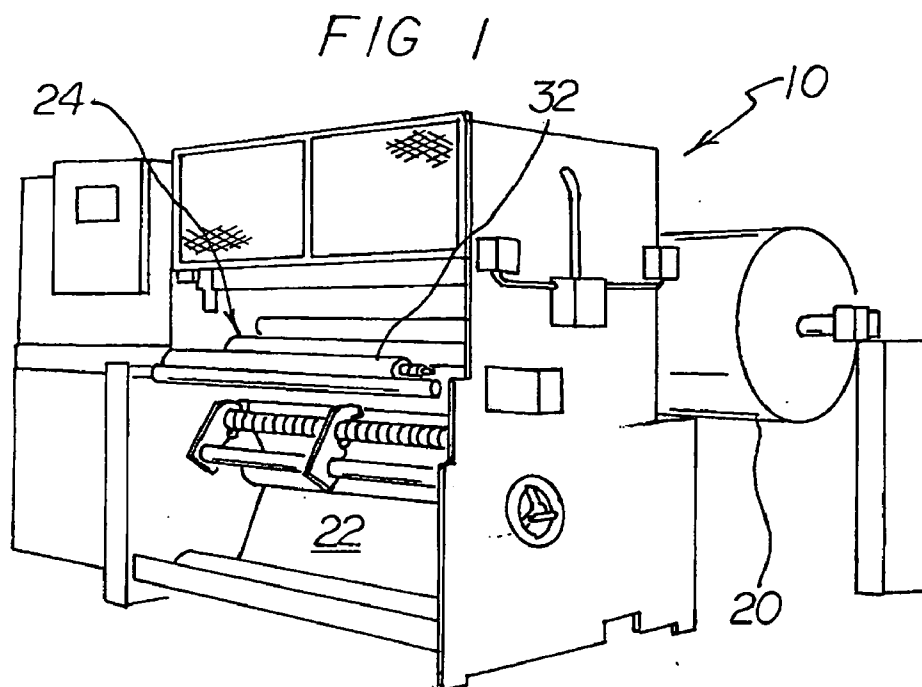
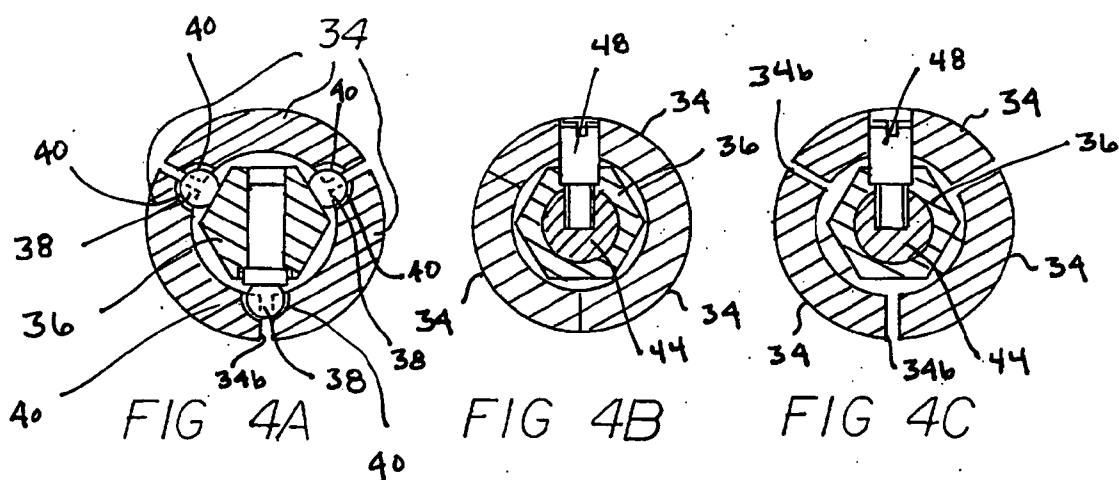
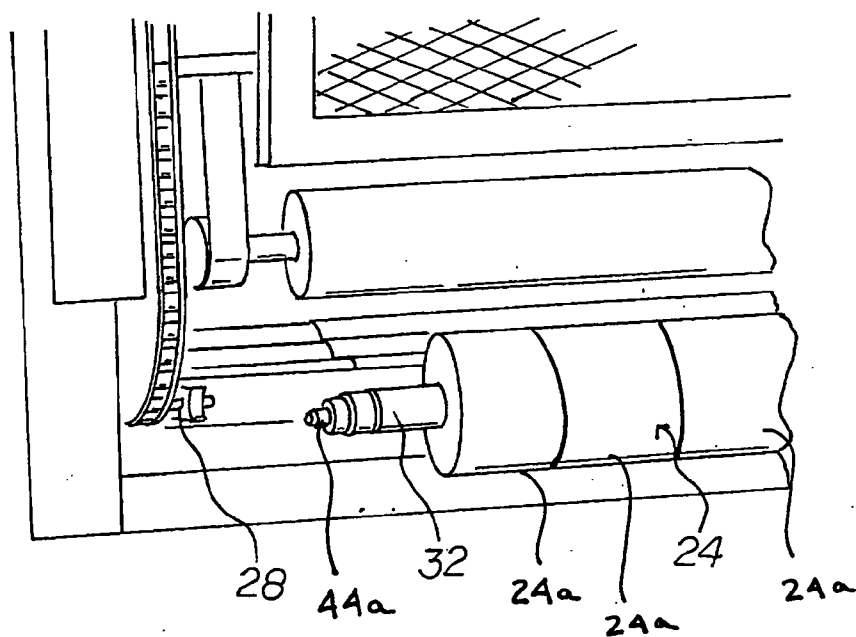


FIG 2

FIG 3



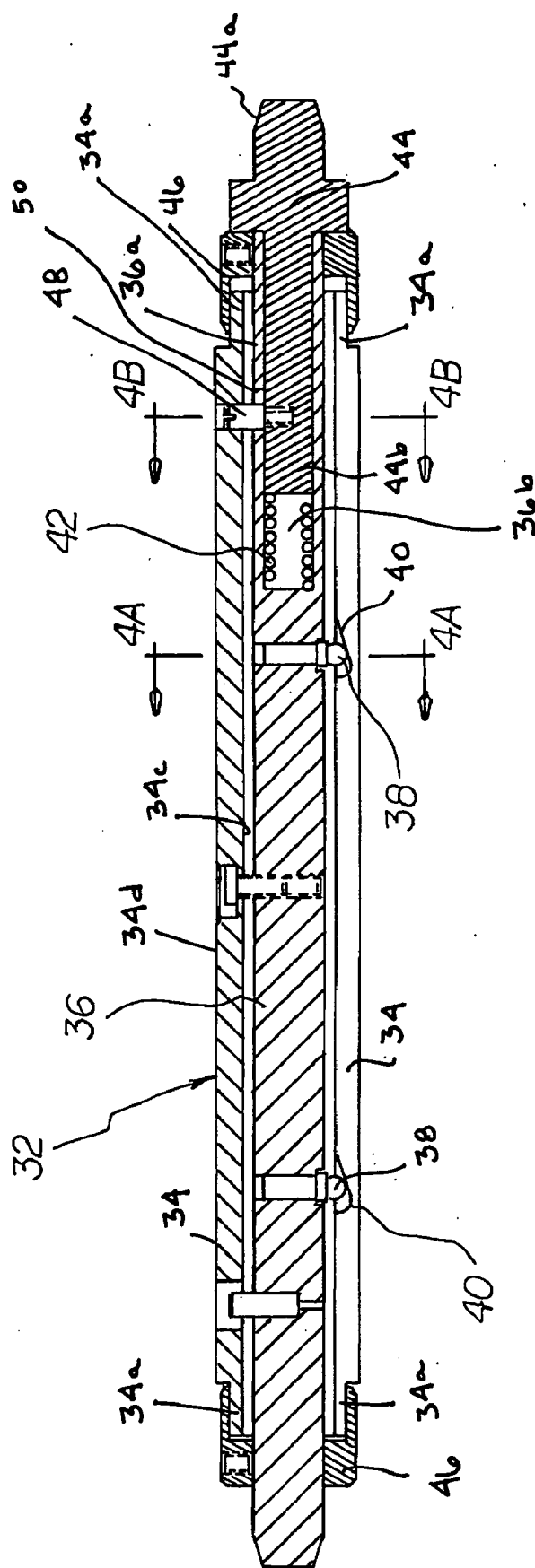


FIG 4

CORELESS WINDING APPARATUS

RELATED APPLICATION DATA

[0001] This application is a continuation-in-part of co-pending application Ser. No. 60/629,327 filed on Nov. 17, 2004 and entitled Coreless Winding Apparatus, the contents of this application are fully incorporated herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This invention relates to a coreless winding apparatus. More specifically, the present invention relates to a rewinding apparatus that employs an expansible mandrel whereby coreless rolls of paper can be created.

[0004] 2. Description of the Background Art

[0005] Devices for use in constructing coreless rolls are known in the art. For instance, U.S. Pat. No. 4,695,005 to Gietman discloses a winder for making coreless rolls of pliable sheet material, such as plastic, cloth, or paper. The paper is initially rolled about a pair of rods and after a sufficient amount of material has been wound, the rods are collapsed towards one another. Thereafter, an air cylinder is activated to cause a push off plate to force the roll off the rods. The result is a coreless roll of material.

[0006] Similarly, U.S. Pat. No. 5,497,959 to Johnson discloses a coreless winding method. The leading edge of a sheet of paper, such as the type used for bathroom or kitchen toweling, is secured to a mandrel by way of suction delivered axially through the mandrel. Once a sufficient amount of material has been wound upon the mandrel, the resulting log is stripped from the mandrel.

[0007] U.S. Pat. No. 5,453,070 to Moody discloses a system for manufacturing a coreless roll of a paper product. A roll is initially formed upon a mandrel, after which a portion of the roll is pushed onto a support shaft by way of a pusher device. With a portion of the roll on the shaft, a saw blade is used to cut the roll to a desired width and form a roll segment. The individual roll segments are then removed from the shaft by a pusher element.

[0008] Finally, U.S. Pat. No. 1,977,668 to Dallas discloses a winding machine including a rotatable arbor. The cross section of the arbor can be expanded or reduced by way of a series of slides to assist in ejecting a wound roll. With the cross section of the arbor in its reduced configuration, an ejector collar is used to push the roll from the arbor.

[0009] Although each of the above referenced inventions achieves its individual objective, they all suffer from a common drawback. Namely, all of the referenced inventions require complex and especially designed machinery to create coreless rolls. The present invention overcomes this deficiency by allowing coreless rolls to be formed on existing rewinding machines without the need to purchase costly and complicated equipment.

SUMMARY OF THE INVENTION

[0010] It is therefore an objective of this invention to facilitate the manufacture of coreless paper rolls.

[0011] It is another objective of this invention to provide an expansible mandrel that can be used to construct coreless rolls.

[0012] It is also an objective of this invention to enable existing rewinders to construct coreless receipt rolls.

[0013] These and other objectives are achieved by a mandrel including a support shaft having first and second ends and bearings positioned along the support shaft intermediate the first and second ends. Shell segments are included having first and second ends and pockets formed within the shell segments. The shell segments are positioned upon the support shaft with the bearings being positioned within the pockets. A stub shaft is slidably positioned relative to the support shaft, with the stub shaft having a compressed orientation and a decompressed orientation. Pins serve to interconnect the stub shaft to a corresponding shell segment. The pins functioning to translate the shell segments as the stub shaft is moved between the compressed and decompressed orientations and wherein with the stub shaft in the compressed orientation the bearings are positioned within the pockets so as to lift the shell segments from the support shaft and thereby enlarge the diameter of the mandrel. Furthermore, when the stub shaft is in the decompressed orientation the bearings are positioned within the pockets so as to decrease the space between adjacent shell segments and thereby reduce the diameter of the mandrel.

[0014] The foregoing has outlined rather broadly the more pertinent and important features of the present invention in order that the detailed description of the invention that follows may be better understood so that the present contribution to the art can be more fully appreciated. Additional features of the invention will be described hereinafter which form the subject of the claims of the invention. It should be appreciated by those skilled in the art that the conception and the specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings in which:

[0016] **FIG. 1** is a prospective view of the rewinder used in conjunction with the present invention.

[0017] **FIG. 2** is a detailed view of the slitters that are used on the rewinder of the present invention.

[0018] **FIG. 3** is a detailed view of a mandrel that is used in supporting a paper roll.

[0019] **FIG. 4** is a detailed view of the expansible mandrel of the present invention.

[0020] **FIG. 4A** is a cross sectional view taken along line 4A-4A of **FIG. 4**.

[0021] **FIG. 4B** is a cross sectional view of the mandrel in its decompressed orientation as taken along line 4B-4B of **FIG. 4**.

[0022] **FIG. 4C** is a cross sectional view of the mandrel in its compressed orientation as taken along line 4B-4B of **FIG. 4**.

[0023] Similar reference characters refer to similar parts throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0024] The present invention relates to an apparatus for forming coreless paper rolls. The apparatus includes an expandable mandrel that can be used in conjunction with an existing rewinder. The mandrel is segmented, with the segments expanding when the mandrel is loaded into the rewinder. While in the rewinder, a web of material, such as the type used to form register receipt rolls, is wound upon the mandrel. After a sufficient amount of material has been taken up, the mandrel can be removed. Upon removal, the segments of the mandrel contract, whereby the cross section of the mandrel is reduced and the roll can be removed. The result is a coreless roll of material.

Rewinder Apparatus

[0025] FIG. 1 illustrates a rewinder 10 that can be used in conjunction with the mandrel of the present invention. More specifically, the depicted rewinder is a surface winder sold by Dusenbery Worldwide. As is known in the art, such rewinders include a supply roll 20 from which a web of material 22 is unwound. Thereafter, web 22 is delivered over a number of transport rollers and a series of slitters 26. Slitters 26 are spaced to cut web 22 into a number of smaller webs whereby rolls of a desired width can be constructed. After being cut, web 22 is delivered onto a take-up roll 24.

[0026] FIG. 2 illustrates slitters 26 disposed at the lower portion of rewinder 10. The rewinder depicted has its slitters configured to form register receipt rolls. Rewinder 10 also includes a carousel 28 (note FIG. 3) that can accommodate a series of mandrels 32, each of which can accommodate a take up roll 24. The carousel 28 allows one mandrel to be unloaded while another mandrel is serving as a take-up roll 24.

[0027] FIG. 3 is a detailed view illustrating one of the mandrels 32 after a suitable length of paper web 22 has been wound upon it. The mandrel 32 has just been released from carousel 28 and the individual rolls 24a are ready to be removed. In the present invention, the cross section of mandrel 32 is reduced after being removed from carousel 28 such that the rolls can be easily removed. The exact operation of expandable mandrel 32 is described in greater detail hereinafter.

[0028] In conventional mandrels, web 22 is wound about both a mandrel and a series of cores (not illustrated) that are positioned on the mandrel. After winding is complete, the conventional mandrel is removed from carousel 28 and the mandrel is removed from the interior of the cores. The result is a series of individual rolls each supported by a disposable core.

Expandable Mandrel

[0029] The present invention eliminates the need for disposable cores by forming rolls 24a upon an expandable mandrel 32. Mandrel 32 is spring loaded and includes a circular cross section formed from three arcuate segments 34. Installing mandrel 32 on carousel 28 results in an axial load being applied to mandrel 32. The axial load, in turn, results in segments 34 being expanded to increase the

diameter of the mandrel. This gives mandrel 32 an enlarged cross section as web 22 is taken up. Thereafter, after a suitable amount of web 22 has been taken up, mandrel 32 is removed from carousel 28. By removing mandrel 32, segments 34 contract to reduce the cross section of mandrel 32. This reduced cross section enables individual rolls 24a to be removed from mandrel 32. The result is a coreless register receipt roll.

[0030] A more detailed description of the operation of mandrel 32 is described in conjunction with FIG. 4. In the preferred embodiment, support shaft 36 has first and second ends and a hexagonal cross section as noted in FIGS. 4A-4C. The first end 36a of shaft 36 includes an axial recess 36b that houses a spring 42. Bearings 38, alternatively referred to as locator balls 38, are positioned along the length of support shaft 36. In the preferred embodiment there is a set of three spaced locator balls 38 at each of two locations along shaft 36. Each set of three locator balls 38 is spaced equally about the periphery of shaft 36 as noted in FIG. 4A. These locator balls 38 serve to support arcuate shell segments 34.

[0031] As noted by FIGS. 4A-4C, in the preferred embodiment there are three arcuate shell segments 34 with each segment spanning approximately 120 degrees. However, the use of more or less segments is within the scope of the present invention. Each segment 34 is defined by first and second stepped ends 34a, elongated side edges 34b, an inner surface 34c and an outer surface 34d. Tapered pockets 40 are formed within the inner surface 34c of each shell 34. As noted in FIG. 4A, the locations of these tapered pockets 40 correspond to the locations of the locator balls 38. In the preferred embodiment, tapered pockets 40 are machined within the elongated side edges 34b of the shells 34. Pockets 40 of adjacent shells 34 cooperate to form enlarged pockets that accept a corresponding locator ball 38. With continuing reference to FIG. 4A, the shell segments 34 are interconnected to the support shaft 36 by way of the locator balls 38 being positioned within pockets 40.

[0032] With reference to FIG. 4, the stub shaft 44 is next described. Stub shaft 44 includes an outer loading end 44a and an inner end 44b of a reduced diameter. Inner end 44b is slidably positioned within axial recess 36b of support shaft 36 and is biased outwardly by spring 42. Thus, stub shaft 44 has a compressed orientation wherein spring 42 is compressed and a decompressed orientation wherein spring 42 is decompressed. FIG. 4 illustrates stub shaft 44 in the compressed orientation. This orientation is achieved when mandrel 32 is positioned within carousel 28 of rewinder 10. As explained hereinafter, in this compressed orientation mandrel 32 takes on an enlarged diameter. In one embodiment, the mandrel 32 has an outside diameter of 0.750 inches in the expanded state for winding and 0.730 inches in the contracted state for product removal.

[0033] Arcuate segments 34 are retained upon support shaft 36 via two retainer caps 46. The retainer caps 46 encapsulate the shell segments and maintain the integrity of mandrel 32. Specifically, each cap 46 is positioned over the ends of support shaft 36 and over the stepped ends 34a of shell segments 34. Pins can be employed in fixing the retainer caps 46 to underlying support shaft 36. As noted in FIG. 4, a small amount of clearance should be provided between the stepped end 34a and the retainer cap 46 to allow for the lateral movement of shell segments 34.

[0034] With continuing reference to FIG. 4, the three lateral loading pins 48 are described. Specifically, each pin 48 interconnects stub shaft 44 to a corresponding shell segment 34. In other words, separate loading pins 48 interconnect stub shaft 44 to different shell segments 34. Pins 48 serve two functions. First, pins 48 prevent shells 34 from migrating radially from their position on mandrel 32. Pins 48 further function to translate the shell segments 34 as stub shaft 44 is moved between the compressed and decompressed orientations. It is this translation of shells 34, both laterally and vertically, that allows the diameter of mandrel 32 to be expanded or contracted. In one embodiment, the lateral movement of the shells 34 is approximately 0.060 inches. To allow for the lateral movement of the pins 48 relative to support shaft 36, an elongated slit 50 is included within support shaft 36.

[0035] With stub shaft 44 in the compressed orientation, shell segments 34 are translated via pins 48 to force locator balls 38 into shallow areas within tapered pockets 40. This lifts the segments 34 from the underlying support shaft 36 and thereby enlarges the diameter of mandrel 32. Thereafter, when the mandrel 32 is taken out of winding apparatus 10, stub shaft 44 is placed in the decompressed orientation via the force of spring 42. Here, shell segments 34 are translated via pins 48 to force the locator balls 38 into the deep areas within tapered pockets 40. This allows the elongated side edges 34b of shell segments 34 to come together to form a continuous cylindrical surface and thereby reduce the diameter of mandrel 32.

[0036] Other pins and/or screws can also be included within mandrel 32. For instance, a shell retention screw can be located central to the shaft to reduce shell deflection when the mandrel 32 is being manually handled. Additional anti-rotation pins can be included at the opposite end of the mandrel 32 from pins 48. These pins, three in the preferred embodiment, prevent the tubular shells from migrating radially from their position on the mandrel.

[0037] The present disclosure includes that contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention.

[0038] Now that the invention has been described,

What is claimed is:

1. A mandrel for use within a winding apparatus, the mandrel permitting the production of coreless rolls and comprising in combination:

a hexagonal support shaft having first and second ends, an axial recess formed within the first end, a spring mounted within the recess, two sets of locator balls positioned along the support shaft intermediate the first and second ends;

three arcuate shell segments each shell segment having first and second stepped ends, elongated side edges, and inner and outer surfaces, tapered pockets formed within the inner surface of each of the shell segments, the shell

segments positioned upon the support shaft with the locator balls being positioned within the tapered pockets;

a stub shaft having an outer loading end and an inner end of a reduced diameter, the inner end being slidably positioned within the axial recess of the support shaft, the stub shaft having a compressed orientation wherein the spring of the axial recess is compressed and a decompressed orientation wherein the spring of the axial recess is decompressed, the compressed orientation being achieved when the mandrel is positioned within the winding apparatus;

a retainer cap secured over each of the ends of the support shaft and each of the stepped ends of the shell segments;

three lateral loading pins, each pin interconnecting the stub shaft to a corresponding arcuate shell segment, the pins functioning to translate the shell segments as the stub shaft is moved between the compressed and decompressed orientations and wherein with the stub shaft in the compressed orientation the locator balls are positioned within the tapered pockets so as to lift the shell segments from the support shaft and thereby enlarge the diameter of the mandrel and wherein when the stub shaft is in the decompressed orientation the locator balls are positioned within the tapered pockets so as to allow the elongated side edges of the shell segments to come together to form a continuous cylindrical surface and thereby reduce the diameter of the mandrel.

2. A mandrel comprising:

a support shaft having first and second ends, bearings positioned along the support shaft intermediate the first and second ends;

shell segments having first and second ends, pockets formed within the shell segments, the shell segments positioned upon the support shaft with the bearings being positioned within the pockets;

a stub shaft being slidably positioned relative to the support shaft, the stub shaft having a compressed orientation and a decompressed orientation;

pins interconnecting the stub shaft to a corresponding shell segment, the pins functioning to translate the shell segments as the stub shaft is moved between the compressed and decompressed orientations and wherein with the stub shaft in the compressed orientation the bearings are positioned within the pockets so as to lift the shell segments from the support shaft and thereby enlarge the diameter of the mandrel and wherein when the stub shaft is in the decompressed orientation the bearings are positioned within the pockets so as to decrease the space between adjacent shell segments and thereby reduce the diameter of the mandrel.

3. The mandrel as described in claim 2 wherein three shell segments are included and each of the shell segments spans approximately 120 degrees.

4. The mandrel as described in claim 3 wherein when the stub shaft is in the decompressed orientation the three shell segments are brought together to form a continuous cylinder.

5. The mandrel as described in claim 2 wherein the support shaft includes an axial recess and the stub shaft is slidably positioned within the axial recess.

6. The mandrel as described in claim 5 wherein the stub shaft and the support shaft are interconnected by a spring that urges the stub shaft into the decompressed orientation.

7. The mandrel as described in claim 2 wherein the pockets of the shell segments are tapered and include a shallow region and a deep region, so that with the bearings in the shallow region the diameter of the mandrel is increased and with the bearings in the deep region the diameter of the mandrel is decreased.

8. A mandrel comprising:

a support shaft having first and second ends, bearings positioned along the support shaft intermediate the first and second ends;

shell segments having first and second ends, pockets formed within the shell segments, the shell segments

positioned upon the support shaft with the bearings being positioned within the pockets, the shell segments being laterally movable between first and second orientations;

wherein in the first orientation the bearings are positioned within the pockets so as to enlarge the diameter of the mandrel and wherein in the second orientation the bearings are positioned within the pockets so as to reduce the diameter of the mandrel.

9. The mandrel as described in claim 8 wherein a stub shaft is employed in positioning the shell segments in either the first or second orientations.

10. The mandrel as described in claim 9 wherein the stub shaft is slidably positioned relative to the support shaft.

* * * * *