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(54) **END SUPPORT FOR WOUND ROLLS MADE FROM MOLDED PAPER PULP**

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(57) **ABSTRACT**

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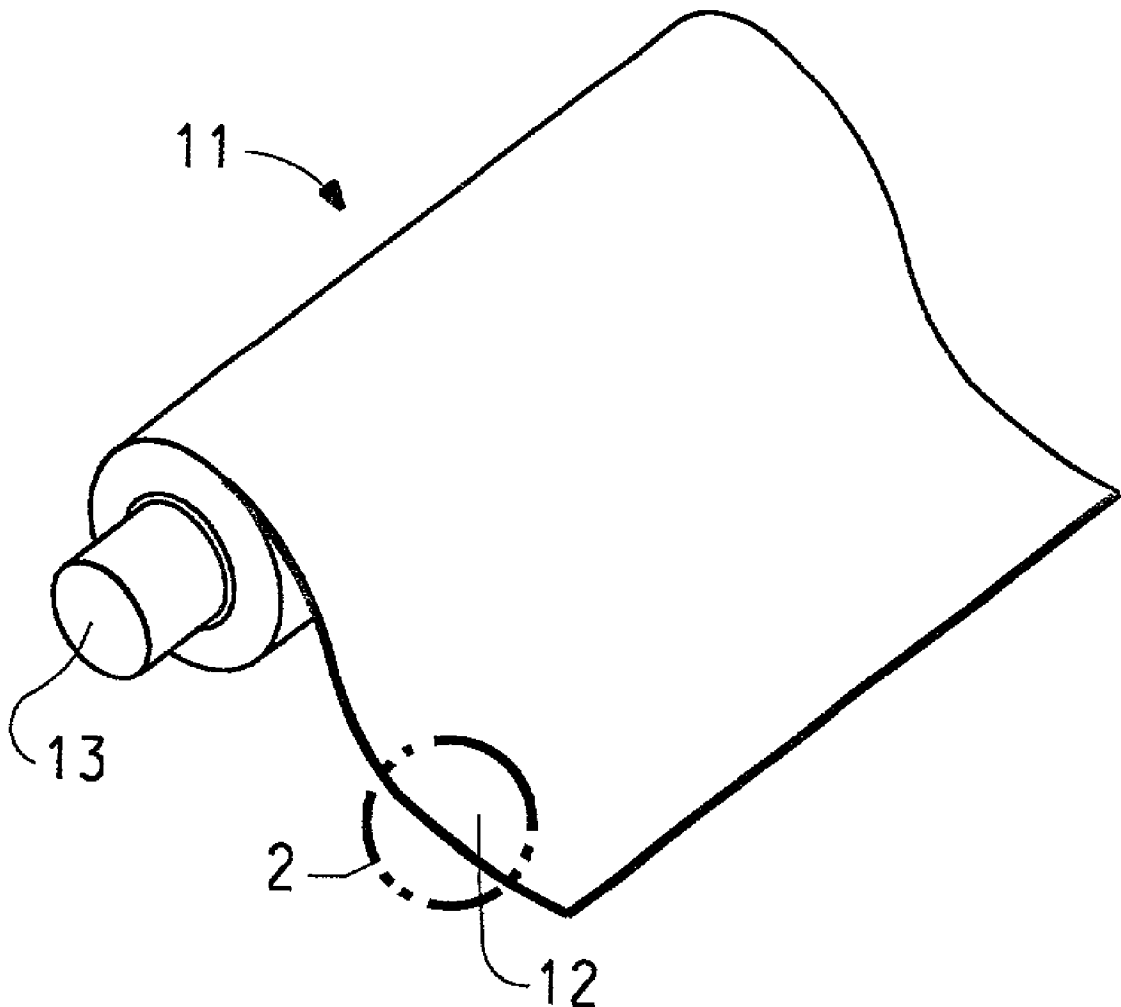
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An improved monolithic end support, made from paper pulp and adapted for supporting a roll of material wound on a substantially tubular core during shipping and storage. The roll of material has a predetermined weight up to about 70 lbs. (32 kg). The end support of the invention supports the roll of material in a substantially horizontal orientation. The end support includes a substantially planar rim and a central hub. The rim includes an annular rib, disposed about the hub, defining an annular support region therebetween. The annular support region and the hub have predetermined minimum cross-sectional thickness of a value sufficient for the end support to pass the Test in Test Procedure 2A of the International Safe Transit Association at the predetermined weight of the material and core.



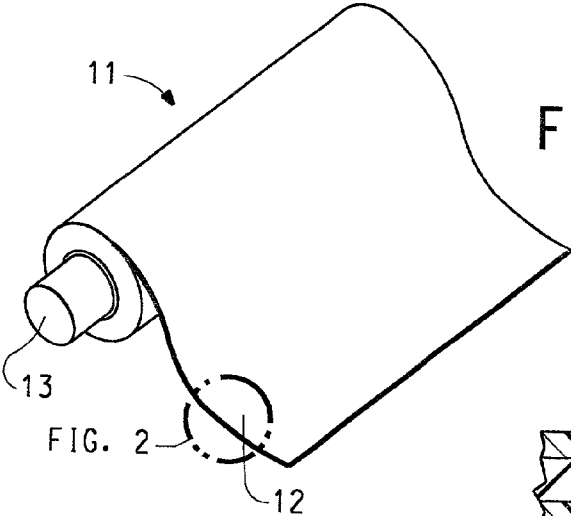


FIG. 1

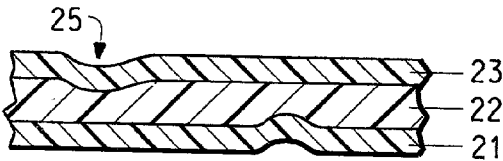


FIG. 2

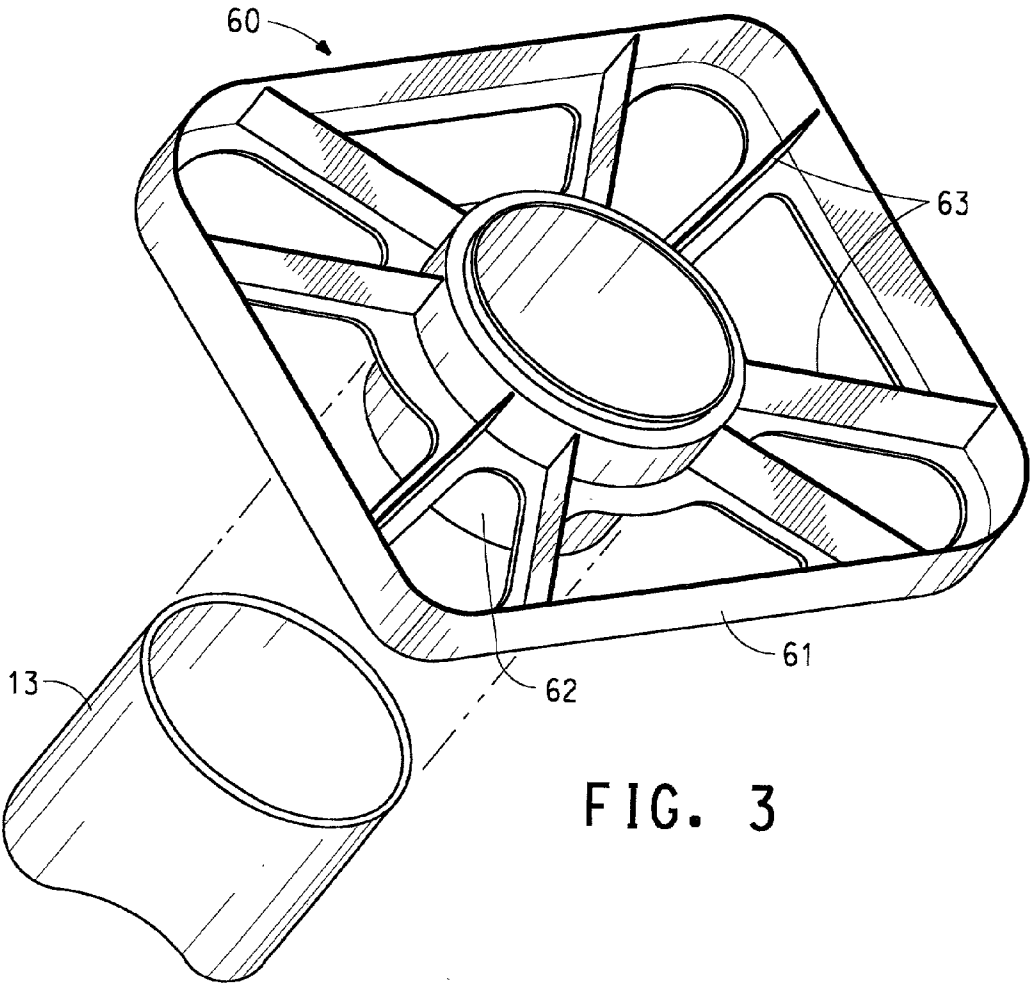


FIG. 3

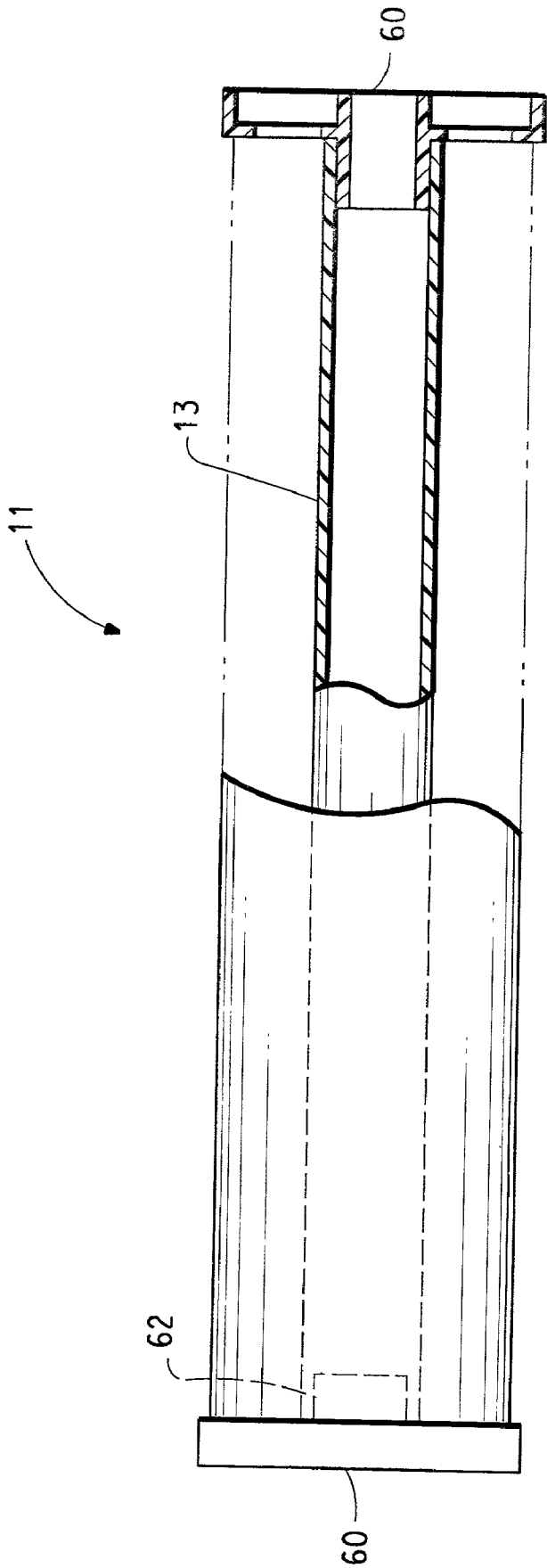


FIG. 4

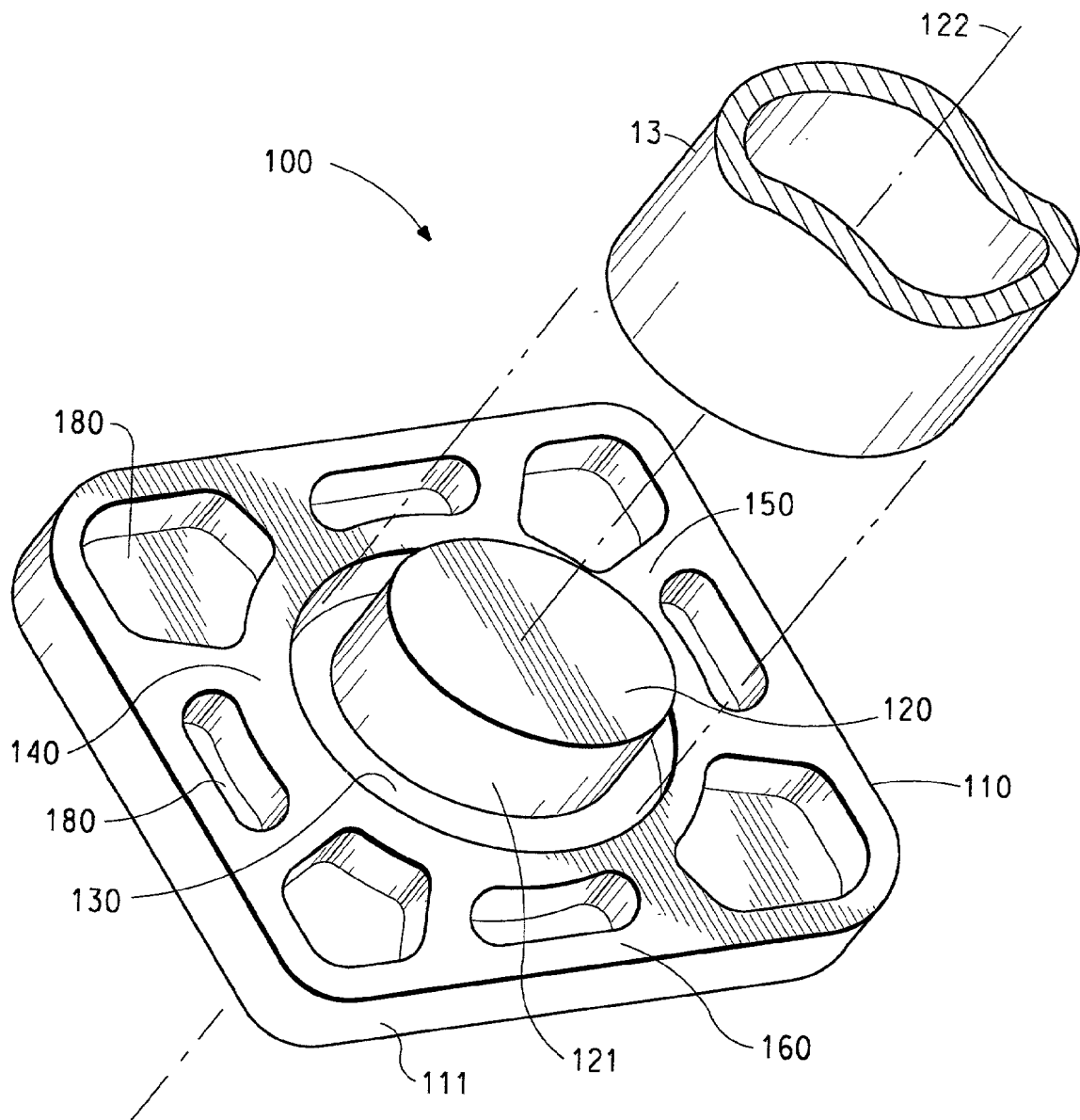


FIG. 5

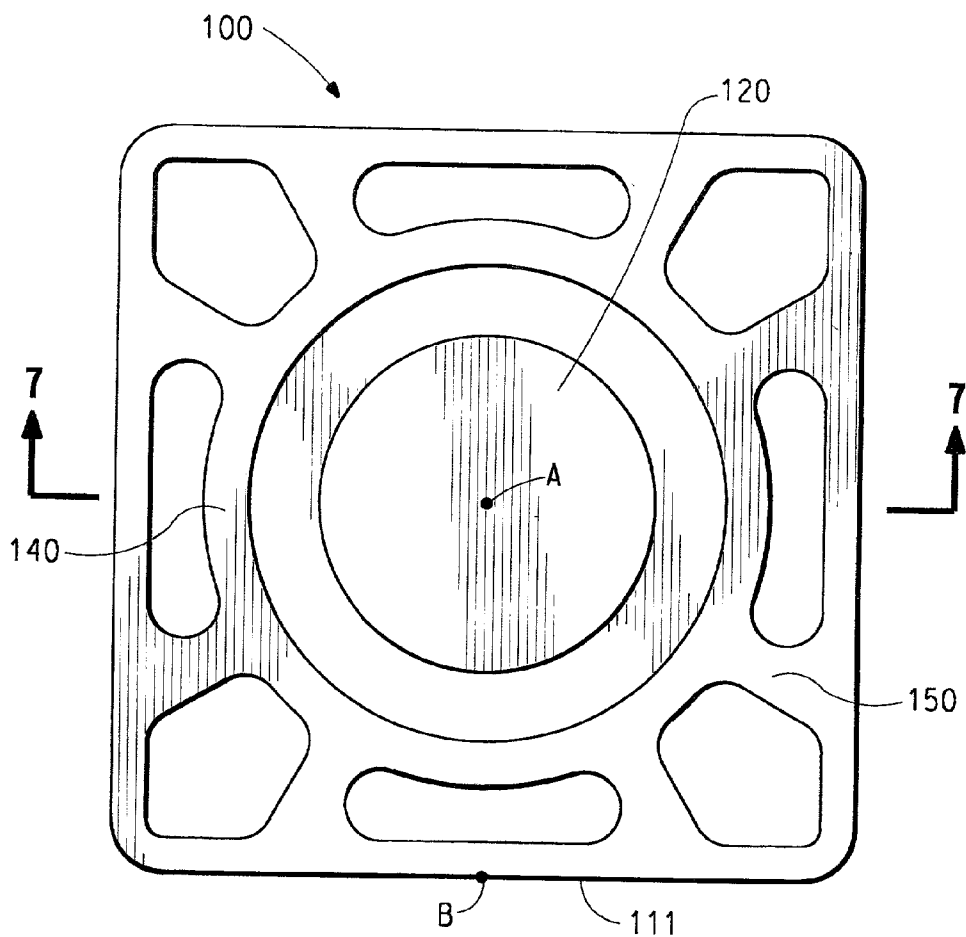


FIG. 6

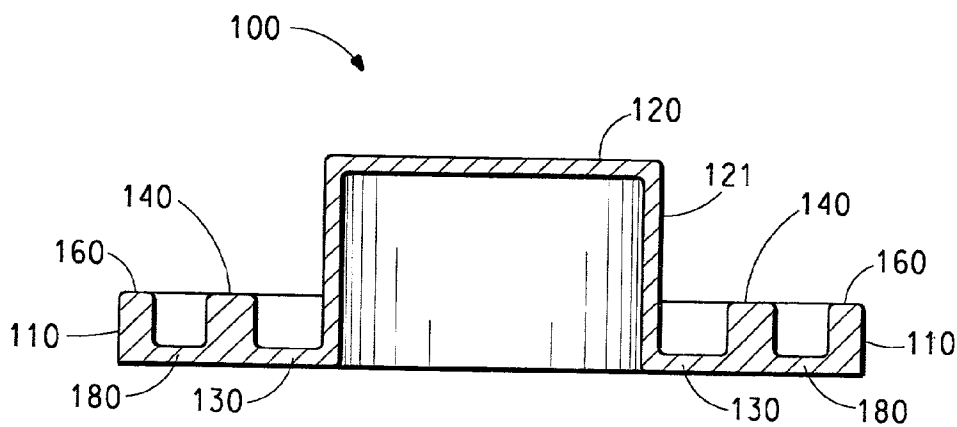


FIG. 7

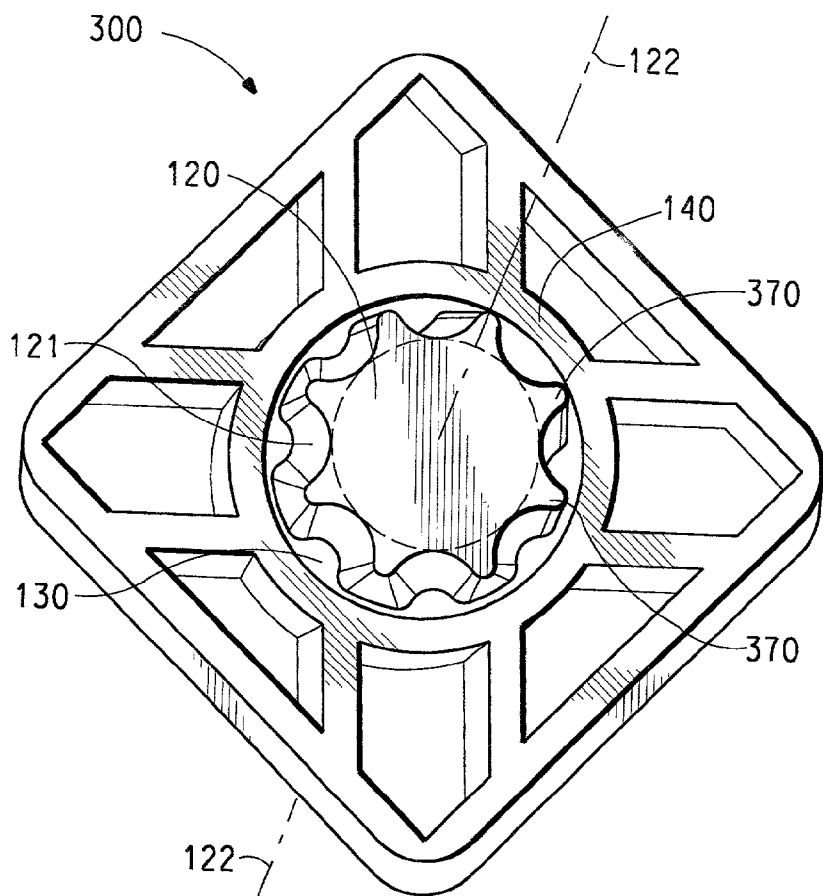
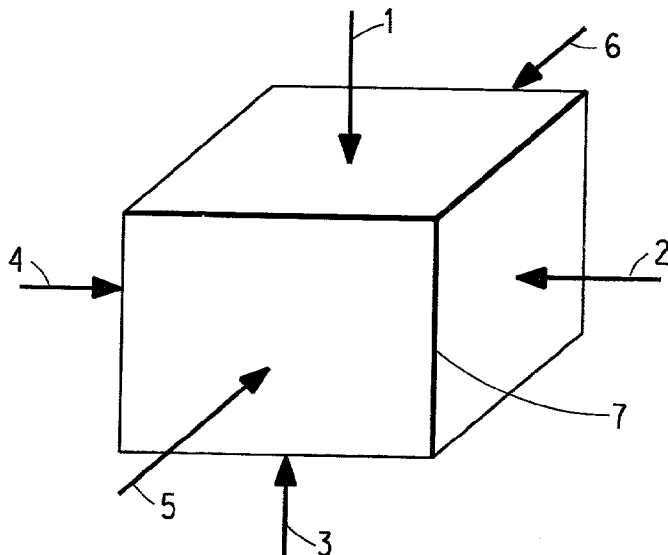


FIG. 8

FIG. 9



END SUPPORT FOR WOUND ROLLS MADE FROM MOLDED PAPER PULP

FIELD OF THE INVENTION

[0001] This invention relates generally to an end support that is used for supporting rolls of material to prevent damage to the rolls when they are shipped and stored in a horizontal orientation. It particularly relates to end supports that are made from molded paper pulp.

BACKGROUND OF THE INVENTION

[0002] Many materials are shipped and stored in the form of cylindrical rolls where the material is wound around a tubular core. Examples of such materials include film, paper, foil, fabric and composites thereof. In some cases, for example, with materials that are plastically deformable, the material can be damaged by being in contact with another surface. This is true with composites containing deformable layers, including photosensitive films, such as photoresists. Such composites generally comprise a deformable layer placed between two protective layers, such as a support and a coversheet. If the outer surface of the roll of composite contacts another surface this can result in thin spots in the deformable layer at that point.

[0003] FIGS. 1 and 2 illustrate a roll 11 that includes a tubular core 13 that has wound thereon a composite made up of a support layer 21, a deformable layer 22, and a coversheet 23. In the case where the composite is a photoresist, layer 22 is a photosensitive layer. Contact in area 12 results in thinning of layer 22, shown at 25. If there are thin spots in the outer layer of the roll, the entire roll is generally unacceptable to a customer.

[0004] As illustrated in FIGS. 3 and 4, it is known to use plastic end supports 60 for rolls of material 11. The end supports 60 extend farther out from the core than does the wound material, so that when in a horizontal orientation, the roll rests on the supports and the material does not touch the surface on which it is resting. The end supports must be of sufficient strength to support the weight of the roll and to withstand normal roll-handling and shipping processes. Heretofore, the supports have been made out of rigid plastics, such as polystyrene. However, plastics present disposal and recycling difficulties. Furthermore, plastic end supports considerably add to the cost of packaging the roll products.

[0005] A roll support made of molded paper pulp for use in storing and shipping a roll with the longitudinal axis of the roll (the long direction of the tubular core) extending vertically has been disclosed by Henry et al. in U.S. Pat. No. 5,829,592. However, wound rolls of material are preferably shipped and handled with the axis extending horizontally. In addition, in the vertical orientation the material of the roll can telescope off the tubular core. The wound rolls typically weigh from 25 to 70 lbs. (11 to 32 kg) and can even weigh up to 100 pounds (45 kg.). Thus, it has been generally believed that paper-based molded supports did not have the requisite strength to function as suitable end supports for shipping and handling wound rolls of materials in a horizontal orientation.

SUMMARY OF THE INVENTION

[0006] This invention relates to an improved monolithic end support for supporting a roll of material wound on a

substantially tubular core, said material and core having a predetermined weight up to about 70 pounds (32 kg), where the axis of the roll is substantially horizontal. The improved end support is made from molded paper pulp, preferably recycled paper pulp and comprises:

[0007] a substantially planar rim having at least one flat base member;

[0008] a central hub member affixed to said rim in the shape of a frustum, said frustum defining a central axis, said central axis being substantially normal to said planar rim, and said central hub member defining a wall having a first predetermined cross-sectional thickness measured in a direction perpendicular to the central axis;

[0009] an annular rib formed in said planar rim and disposed circumferentially about said central hub;

[0010] said annular rib and said central hub defining an annular core support region on said rim, disposed adjacent said central hub, said annular core support region having a second predetermined cross-sectional thickness measured in a direction parallel to the central axis at a plurality of locations in the annular support region;

[0011] said end support being molded from paper pulp and said first and second predetermined thickness being of a value sufficient for the end support to pass the Test in Test Procedure 2A of the International Safe Transit Association at the predetermined weight of the material and core.

[0012] The end support can optionally have an organic protective finish to minimize abrading of the end support and the formation of dust.

[0013] The end support can further comprise four base member, a plurality of ribs formed in the rim and extending radially from the annular rib to the base members; at least one rib parallel and adjacent to the base members; ribs on the central hub; and reinforcing webs between the ribs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a perspective view of a roll of wound material.

[0015] FIG. 2 is an enlarged cross-section of the wound material taken at area 2 of FIG. 1.

[0016] FIG. 3 is an exploded perspective view of a prior art plastic end support and part of a tubular core.

[0017] FIG. 4 is a cross-sectional view with parts in section of a wound roll on two end supports.

[0018] FIG. 5 is an exploded perspective view of an end support of the invention and part of a tubular core.

[0019] FIG. 6 is a plan view of an end support of the invention.

[0020] FIG. 7 is a cross-section through the end support of the invention taken on line 7-7 of FIG. 6.

[0021] FIG. 8 is a perspective view of an end support having ribs on the central hub member.

[0022] FIG. 9 is diagram of a packaged roll identifying the faces according to International Safe Transit Association Test Procedure 1A and 2A.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] Plastic end supports of the prior art generally have the square configuration shown in FIGS. 3 and 4. The support 60 defines base members in the form of four flat edges 61. The plastic support has a central hub 62 that is received in a tubular core 13 of a wound roll 11. The backside of the support generally has flanges 63 extending radially from the central hub. As described above, the support is generally made of polystyrene or other hard plastic materials. FIG. 4 illustrates the use of two end supports 60 with a roll of wound material 11. At each end of wound roll 11, an end support 60 is placed with the central hub 62 engaged inside the tubular core 13. The end support is sized so that when the wound roll core 13 is engaged with the central hub 62 and the wound roll 11 is placed on a surface in a horizontal orientation, the wound material does not contact the surface.

[0024] The end support of the invention is made of molded paper pulp. It is a monolithic structure made in one molding step. Referring now to FIGS. 5-7, a preferred embodiment of the end support of the invention 100 is illustrated. End support 100 has a rim 110 that is substantially square, and a central hub member 120. The rim presents four flat base members 111 adapted for contacting the surface upon which the wound roll is resting during shipping or handling of the wound roll in the horizontal orientation. As with the prior art end supports illustrated in FIGS. 3 and 4, the end support of the invention 100 is sized so that when the wound roll core 13 is engaged with the central hub 120 and the wound roll 11 is placed on a surface in a horizontal orientation, the wound material does not contact the surface.

[0025] In the illustrated embodiment of the end support of the invention 100, the flat base members 111 extend substantially across the full width of the rim 110. It is possible to have the flat base member only at selected portions of the rim, for instance, adjacent each of the corners. The base members 111 should have sufficient width to support the weight of the wound roll and, in accordance with the present invention, will be at least 0.5 inches (1.3 cm) in width.

[0026] As illustrated in FIG. 6, the distance between the center of the end support in the plane of the rim, shown as point A, and the center of the flat base member 111 upon which the weight of the roll will rest, shown as point B, should be greater than the radius of the wound roll which it is intended to support. This difference should be large enough to ensure that the wound material does not touch the surface on which the supported roll is placed. In accordance with the invention, the difference will be at least 0.5 inches (1.3 cm) and preferably it is at least 1 inch (2.5 cm). For wound rolls of photopolymer film, the length of the distance between parallel flat base members 111 may be in the range of 8-15 inches (20-40 cm).

[0027] The central hub member 120 is affixed to the rim 110. The hub member is generally in the shape of a frustum, defined by a hub wall 121, and may be a columnar or conical frustum. The part of the frustum which is closest to the plane of the rim is considered the base; the part of the frustum which is farthest removed from the plane of the rim is considered the top; and the distance between the base and the top is considered the height. The frustum of the hub projects outwardly from the plane of the rim, defining a

central axis 122 that is normal to the plane of the rim (FIG. 5). The wall 121 has a predetermined cross-sectional thickness, measured in a direction perpendicular to the central axis 122. The central hub is adapted to fit into the tubular core 13 of a wound roll. Thus the diameter of the central hub at its largest point, usually the base of the frustum, should be such that the hub will fit securely into the tubular core 13, but also be easily removable. In general, the largest diameter of the hub will be very nearly the same as the inside diameter of the tubular core, the hub being slightly smaller and the difference being less than 0.5 inch (1.2 cm) and frequently less than 0.1 inch (0.25 cm). The diameter of the top of the hub frustum may be smaller than the diameter of the base of the frustum, but generally this difference is small. The height of the frustum must be sufficient to secure the end support in place. Frequently the height is in the range of 1-4 inches (2.5-10.2 cm), more frequently 2-3 inches (5-7.6 cm).

[0028] Referring again to FIGS. 5-7, there is an annular core support region 130 adjacent to the central hub member 120. This area is subject to the bulk of the stress when the end support holds the wound roll. The annular core support region 130 has a predetermined cross-sectional thickness measured in a direction parallel to the central axis 122. This predetermined cross-sectional thickness will, of course, vary with the predetermined weight of the wound roll with which the end support is used.

[0029] The end support will also have an annular rib 140 adjacent to the annular core support region. A plurality of radial ribs 150 can extend radially from the annular rib 140 to the rim 110. In the illustrated embodiment, the radial ribs extend from the annular rib to all four base members 111. There is also a base rib 160 that is parallel and adjacent to each of the four base members. The end support will generally have reinforcing webs 180 between the radial ribs 150 and/or base ribs 160, which reinforcing webs are contiguous with the ribs. All of the above ribs can be substantially hollow, substantially filled, or partially filled. In most cases the ribs will be at least partially filled.

[0030] As illustrated in FIG. 8 in another embodiment of the end support of the invention 300, the central hub 120 can have ribs 370 located on the outer surface of wall 121. The ribs 370 are located at regular intervals on the wall 121 of the central hub member 120, extending from the base to the top. Thus, the overall cross-section of the central hub member may appear fluted. In this embodiment of the invention, only that portion of the annular core support region 130 that is disposed between the ribs 370 and annular rib 140 will be of the predetermined cross-sectional thickness. It will be understood that other cross-sectional geometry can be used in the end support of the invention.

[0031] In the end support of the invention, the predetermined cross-sectional thickness of the central hub member wall, 121, and the predetermined cross-sectional thickness of the annular core support region, 130, must be sufficient to enable the support to pass the Shock Test and the Vibration Test in Test Procedure 2A (export shipping) of the International Safe Transit Association (ISTA), in compliance with the apparatus section of ASTM D 5276-94 for a wound roll and core having a predetermined weight. In these tests, the wound roll on the end supports to be tested is placed in a shipping container and the boxed roll is separately dropped and vibrated. If there is no damage to the product on the roll,

the test is passed. It is preferred that the thickness of the annular core support region is at least 0.125 inches (0.32 cm) and more preferably, at least 0.25 inches (0.65 cm) when used to support a wound roll having a weight up to about 48 lbs. (22 kg). In the embodiment of the invention illustrated in **FIG. 8**, the predetermined cross-sectional thickness of that portion of the annular core support region **130** that is disposed between ribs **370** and annular rib **140** is at least 0.25 inch (0.65 cm) and the remainder of the annular support region (i.e. between ribs **370**) has a predetermined cross-sectional thickness of at least 0.125 inch, when used to support a wound roll having a weight up to about 48 lbs. (22 kg). It is preferred that the thickness of the central hub member wall, or any ribs associated therewith, is at least 0.150 inch (0.381 cm) or more, when used to support a wound roll having a weight up to about 48 lbs. (22 kg).

[0032] The end support of the present invention is constructed of molded paper pulp, preferably recycled paper pulp. The process of preparing articles by molding paper pulp materials and the recycling of paper products is well known and has been described in, for example, U.S. Pat. Nos. 5,064,504; 5,096,650; and 5,431,784. In general, the paper product is comminuted to form a pulp, which is mixed with water to form a slurry. An organic binder is optionally included. The slurry is then placed in the molding chamber of a press where it is formed into a molded article by the application of pressure and, optionally, heat and/or vacuum.

[0033] Different grades of paper pulp slurries are available which produce articles of varying strength. The grades vary in terms of the type of paper product used, the presence and type of filler and the process by which the slurry is made. The lowest grade, which has the least strength, contains a pulp made from recycled newspaper and generally contains an organic binder. The next grade contains a pulp made from recycled cardboard, again with organic binder. The next grade contains a pulp made from recycled newspaper and/or cardboard with an asphalt filler. The highest grade contains a pulp made from recycled newspaper and/or cardboard with a cheesecloth filler. The end supports of the present invention can be made from any of the above grades of paper slurries. However, it is preferred that the end support be made from recycled newspaper pulp or cardboard pulp, or a mixture of these. Any conventional paper pulp molding process and mold can be used.

[0034] The end supports of the invention can also be coated. Coatings are frequently desirable to prevent abrading of the end support due to friction, and the formation of dust. Any type of coating that is compatible with the paper material can be used. Examples of coatings include acrylics, urethanes, and epoxies, frequently in the form of aqueous emulsions. Preferred coatings are those that can be recycled with the paper pulp of the end support, such as emulsions of paraffin waxes. Such recyclable coatings are commercially available from, for example, Michelman, Inc. (Cincinnati, Ohio) as Resisto Coat™. The coatings are applied to the molded end support after molding, using any conventional coating technology.

[0035] The molded paper end support of the invention are particularly suitable for use with wound rolls weighing 25-70 pounds (11-32 kg), which is the upper limit for materials that can be handled manually by a single person, according to OSHA guidelines. One example of a deform-

able film that is shipped as a wound roll, is a photoresist. These films are generally supplied as 500-foot (15 meter) or 1000-foot (30 meter) rolls on a core having an internal diameter of 5.125 inches (13 cm). These rolls can weigh from 20 pounds (9 kg) to 50 pounds (23 kg). Typically, small rolls weigh about 26 pounds (12 kg); larger rolls weigh about 48 pounds (22 kg). The molded end supports of the invention cost about one-fourth to one-third as much as conventional polystyrene end supports. It will be understood that different diameter tubular cores can be used, resulting in wound rolls of different diameters. Other types of wound materials, such as plastic films, metal-clad films, unsintered ceramic films, and others can also be used.

[0036] The following examples illustrate certain features and advantages of the present invention. They are intended to be illustrative of the invention, but not limiting. All percentages are by weight, unless otherwise indicated.

EXAMPLES

Test Procedure

[0037] ISTA Test Procedure 1A and 2A are integrity tests for individual packaged products. Test Procedure 1A is for domestic shipping and Test Procedure 2A is for international shipping. Test Procedure 2A is the more rigorous of the two.

[0038] In the ISTA Test Procedures, a roll of wound material having two end supports engaged therewith is placed in a shipping box. The different faces of the box are identified via arrows 1-6 in **FIG. 9**. In **FIG. 9** the box is oriented so that one of the smallest width faces is in front (face **5**). Edges are identified using the numbers of the two faces forming that edge. Corners are identified using the numbers of the three faces that meet to form the corner.

[0039] In the following examples, the vibration test was carried out according to Test Procedure 2A, using fixed displacement vibration. The boxed roll is placed on a vibration table so that face **3** rests on the platform. The test machine is started, vibrating at 1-inch (25.4 mm) total displacement at the machine's lowest frequency. The frequency is increased to the test frequency, i.e. where the boxed roll begins to momentarily leave the surface of the platform and a metal shim can be intermittently moved between the bottom of the longest dimension of the box and the surface of the platform. The boxed roll is tested at the test vibration frequency for 7100 vibratory impacts, rotated horizontally 90°, and tested at the test vibration frequency for another 7100 vibratory impacts.

[0040] The Stock Test was carried out according to Test Procedure 2A. In this test, the boxed roll is dropped to a hard surface in several different orientations. The height of the drop is set based on the weight of the roll. The roll is first conditioned at the indicated temperature and humidity. It is dropped in ten different orientations designed to impact different faces, edges and corners of the box as follows:

Test	Orientation	Specific face, edge or corner
1	Corner	most fragile face 3 corner, if not known test corner 2-3-5
2	Edge	shortest edge radiating from the corner tested

-continued		
Test	Orientation	Specific face, edge or corner
3	Edge	next longest edge radiating from the corner tested
4	Edge	longest edge radiating from the corner tested
5	Face	one of the smallest faces
6	Face	opposite small face
7	Face	one of the medium faces
8	Face	opposite medium face
9	Face	one of the largest faces
10	Face	opposite large face

[0041] For both the vibration and the shock test, the roll of wound material is visually inspected after the test and evaluated as follows:

- [0042] 1. deformation of the edges of the end support=pass
- [0043] 2. damage to product on the roll=fail
- [0044] 3. central hub breaks off end support, partially or completely=fail

Example 1

[0045] A wound roll of Riston® photoresist film (E.I. du Pont de Nemours and Company, Willmington, Del.) was used. The roll was 1000 feet (305 m) long, 24 inches (61 cm) wide, and wound on a 6-inch (15 cm) plastic core. The roll weighed 48 pounds (22 kg). The molded end supports of the invention were constructed of molded newspaper with the geometry illustrated in FIG. 8. There were 8 ribs (370) on the central hub member (120). The wall thickness of each rib 370 was 0.156 inch (0.396 cm). The annular core support region (130) in the area disposed between the ribs (370) and annular rib 140 had a thickness of 0.25 inches (0.64 cm). The remainder of the annular core support region had a thickness of 0.125 inch (0.318 cm). The wound roll, having the molded end supports of the invention engaged therewith, was placed in a box made of 250 test weight card board that was 12×12×27 inches (30.5×30.5×68.6 cm), and sealed at the top flaps. The Shock Test was conducted at 70° F. (21° C.) and 40% RH, at a height of 18 inches (45.7 cm).

[0046] There was no damage to the product or end supports. The end support passed the test.

Example 2

[0047] The same wound roll and box were used as in Example 1. The molded end supports of the invention were constructed of molded kraft paper with the geometry illustrated in FIG. 5. The central hub member (120) had a wall thickness of 0.156 inch (0.396 cm). The annular core support region (130) had a thickness of 0.25 inch (0.64 cm). The Shock Test was conducted at 70° F. (21° C.) and 40% RH, at a height of 24 inches (61 cm).

[0048] There was no damage to the product; there was minimal damage to one corner of the end support. The end support passed the test.

Example 3

[0049] The same wound roll, end supports, and box were used as in Example 2. The Vibration Test was conducted at 70° F. (21° C.) and 40% RH and 210 cycles per minute for 68 minutes.

[0050] There was no damage to the product; there was minimal damage to the ends of the tubular core of the roll. The end support passed the test.

Comparative Example A

[0051] The same wound roll and box were used as in Example 1. The comparative molded end supports were constructed of kraft paper with the geometry illustrated in FIG. 5. The central hub member had a wall thickness of 0.156 inch (0.396 cm). The annular core support region (130) had a thickness of 0.093 inch (0.24 cm). The Shock Test was conducted at 70° F. (21° C.) and 40% RH, at a height of 24 inches (61 cm).

[0052] In both end supports the hub broke off at the annular support region, the wound roll fell to rest on the bottom of the box, and the wound material was damaged. The end support failed the test.

What is claimed is:

1. An improved monolithic end support, adapted for supporting a roll of material wound on a substantially tubular core in a substantially horizontal orientation, said material and core having a predetermined weight up to about 70 pounds (32 kg), said improved end support comprising:

a substantially planar rim having at least one flat base member;

a central hub member affixed to said rim in the shape of a frustum, said frustum defining a central axis, said central axis being substantially normal to said planar rim, and said central hub member defining a wall having a first predetermined cross-sectional thickness measured in a direction perpendicular to the central axis;

an annular rib formed in said planar rim and disposed circumferentially about said central hub;

said annular rib and said central hub defining an annular core support region on said rim, disposed adjacent said central hub, said annular core support region having a second predetermined cross-sectional thickness measured in a direction parallel to the central axis at a plurality of locations in the annular support region;

said end support being molded from paper pulp and said first and second predetermined thickness being of a value sufficient for the end support to pass the Test in Test Procedure 2A of the International Safe Transit Association at the predetermined weight of the material and core.

2. An improved end support in accordance with claim 1 wherein said predetermined weight is about 50 lbs. (22.5 kg) or less, the first predetermined cross-sectional thickness is greater than about 0.15 inch (0.381 cm) and the second predetermined cross-sectional thickness is at least 0.25 inches (0.64 cm).

3. An improved end support in accordance with claim 1 wherein said annular support region is has a uniform second predetermined cross-sectional thickness.

4. An improved end support in accordance with claim 1 wherein said central hub has a plurality of ribs formed thereon and said second predetermined cross-sectional thickness is measured in said annular support region between said ribs on said central hub and said annular rib.

5. An improved end support in accordance with claim 1 wherein said rim is substantially rectangular in shape and defines four flat base members, includes a rib parallel and adjacent to each of said four base members and has a plurality of radial ribs formed therein that extend radially from said annular rib to said base members.

6. An improved end support in accordance with claim 5 further comprising a plurality of reinforcing webs between the radial ribs and contiguous therewith.

7. An improved end support in accordance with claim 1 wherein the paper pulp is selected from recycled newspaper pulp, recycled cardboard pulp, and mixtures thereof.

8. An improved end support in accordance with claim 7 wherein the paper pulp is reinforced by the addition of a material selected from organic binders, particulate fillers, woven materials, and combinations thereof.

9. An improved end support in accordance with claim 7 wherein the end support has an outer coating to minimize abrasion and dust formation.

10. An improved end support in accordance with claim 9 wherein the outer coating comprises a paraffin wax.

* * * * *