

[54] **PACKAGE OF FLEXIBLE MATERIAL**

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[21] Appl. No.: **55,407**

Related U.S. Application Data

[63] Continuation-in-part of Ser. Nos. 709,305, Feb. 29, 1968, abandoned, and Ser. No. 18,780, March 2, 1970.

[52] U.S. Cl. **242/163**, 206/59 A, 242/164, 242/171

[51] Int. Cl. **B65h 55/02**

[58] Field of Search.....242/163, 159, 170, 171, 168, 242/169, 164; 206/52 W, 59 A, 59 B, 46 Y, 52 R

[56] **References Cited**

UNITED STATES PATENTS

2,634,922	4/1953	Taylor, Jr.	242/163
3,178,130	4/1965	Taylor, Jr.	242/163
3,272,455	9/1966	Sternberg et al.....	242/171

FOREIGN PATENTS OR APPLICATIONS

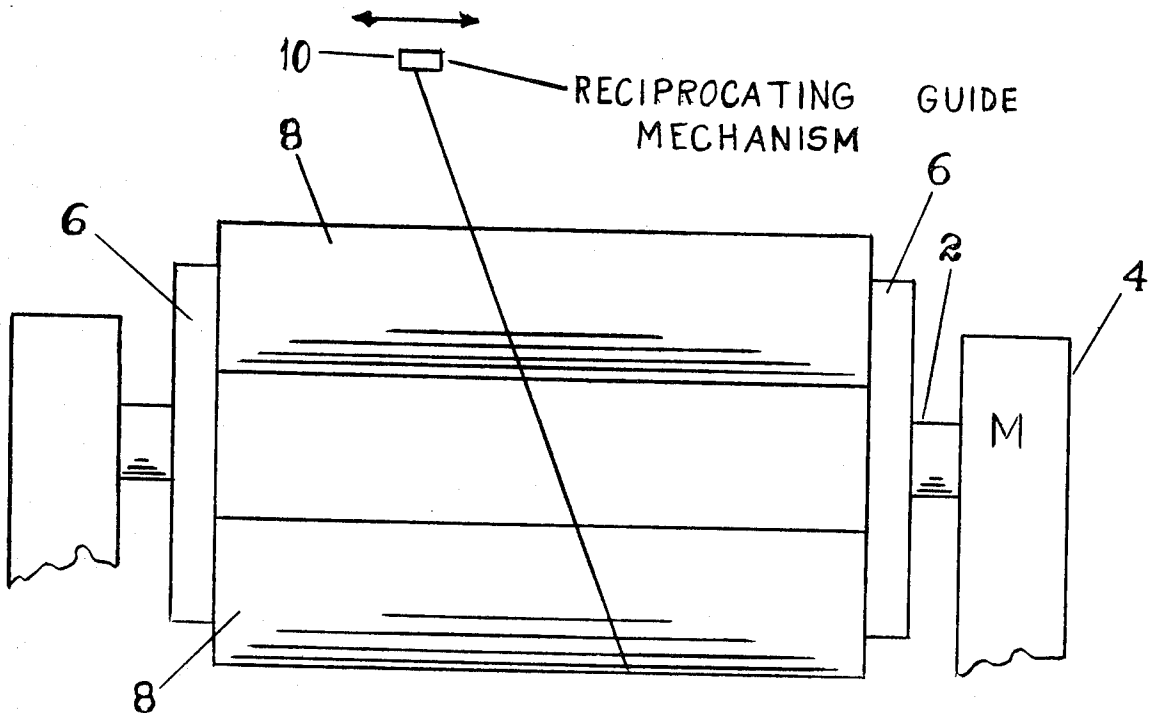
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[57] **ABSTRACT**

A package of flexible material is produced by a winding in the nature of a universal wind on a spindle of oblong shape, or by winding a package on a cylindrical spindle and thereafter compressing the package in a direction transverse to the spindle axis into an oval shape. A radial hole is built into the package, preferably substantially at one of the sides of the oblong, and the flexible material is fed out from the interior of the package through this hole by means of a payout tube inserted in the hole and extending into the central interior of the package where it flares outwardly. The completed package, if wound on a mandrel having flat sides, while the guide and the spindle maintain constant speeds, will be thicker in the elongated sides than in the substantially semi-edge portions because the cross-overs in the end portions are spaced further apart than in the side portions. Thus when one or both of the side walls are flattened, as by insertion in a container, the flattened side wall portions push inwardly so that the interior walls of the axial space are closer together at the center than at the sides. By driving the spindle at a suitable variable speed, the cross-overs can be spaced evenly around the package and the thickening of the longer sides is avoided.

14 Claims, 13 Drawing Figures



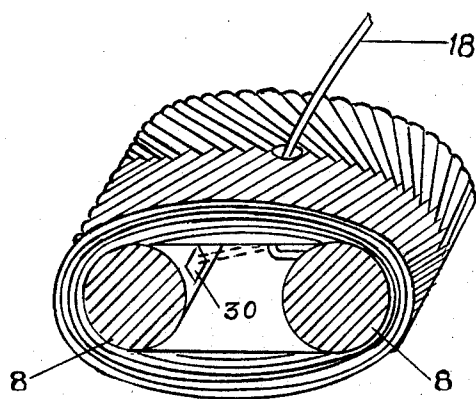


Fig. 1

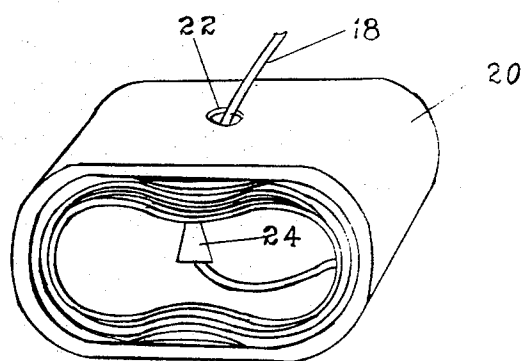


Fig. 2

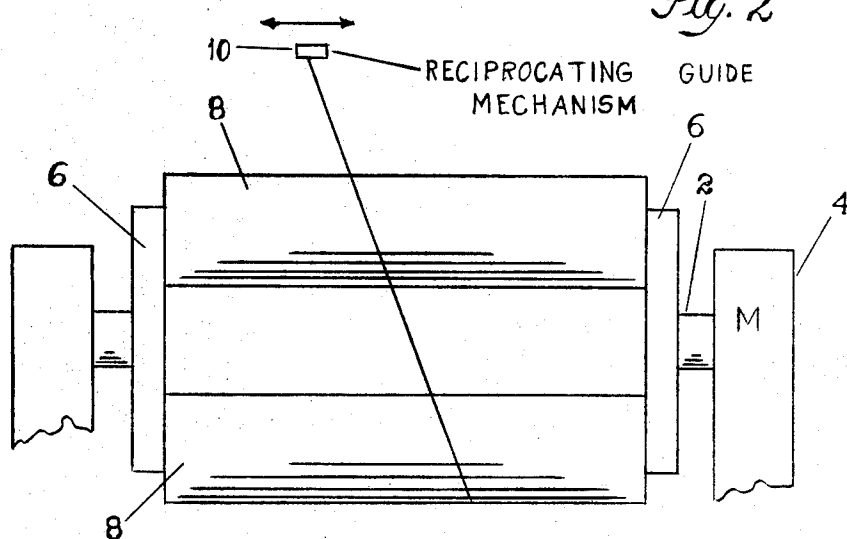


Fig. 3

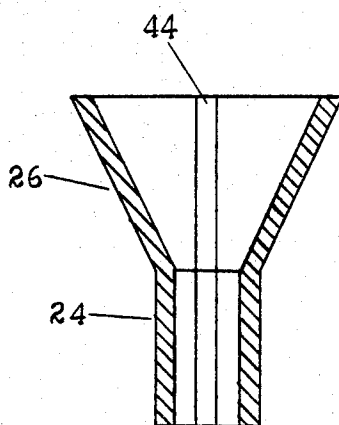


Fig. 4

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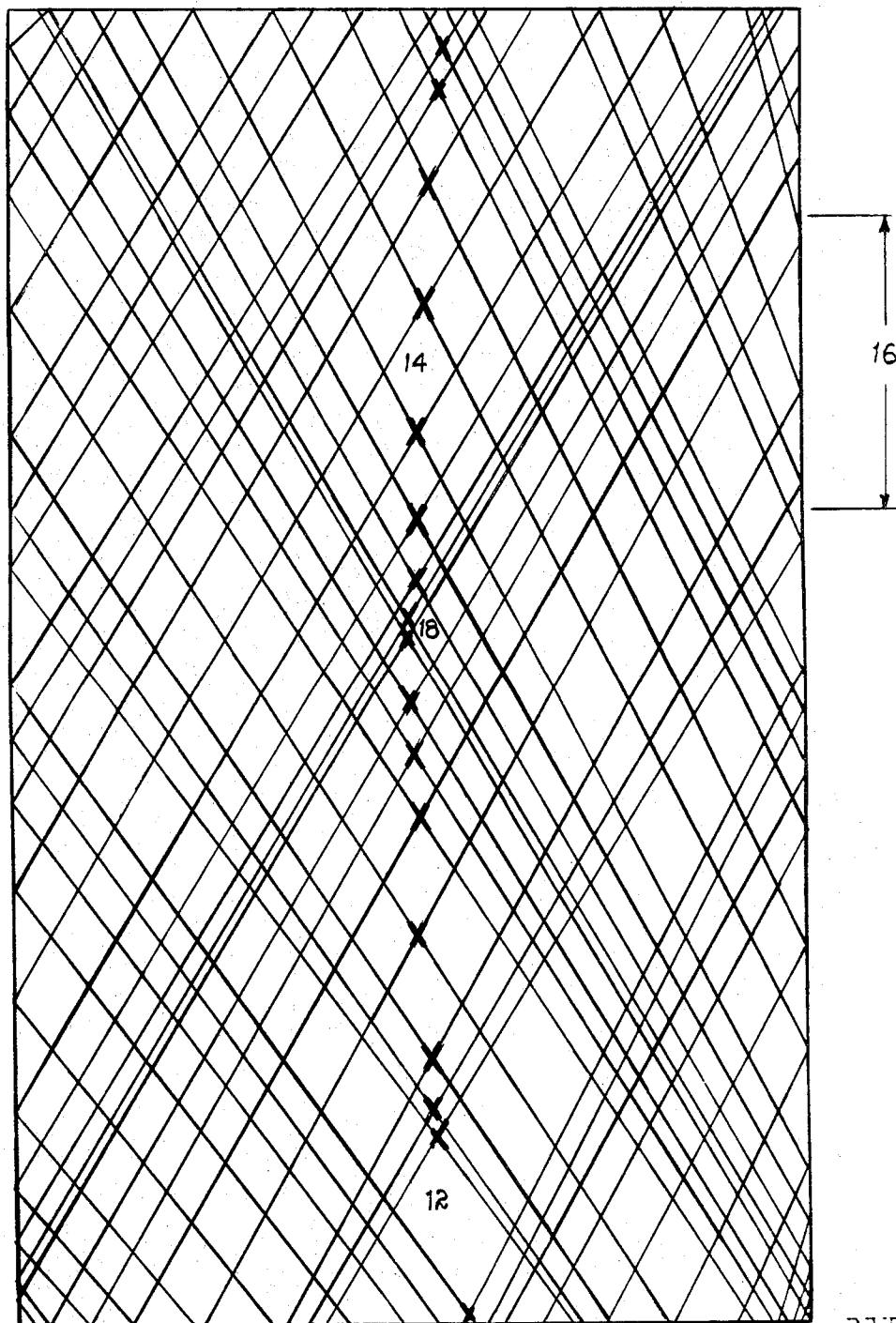


Fig. 5

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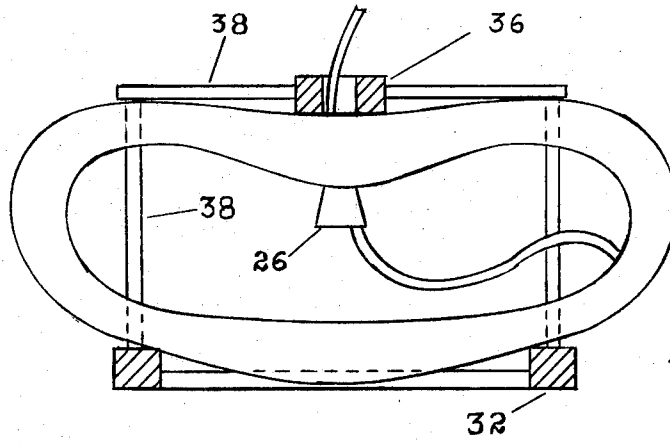


Fig. 6

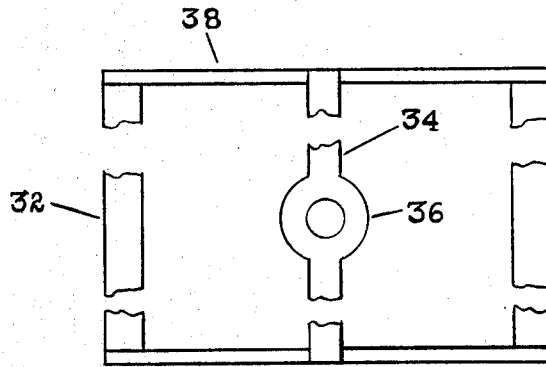


Fig. 7

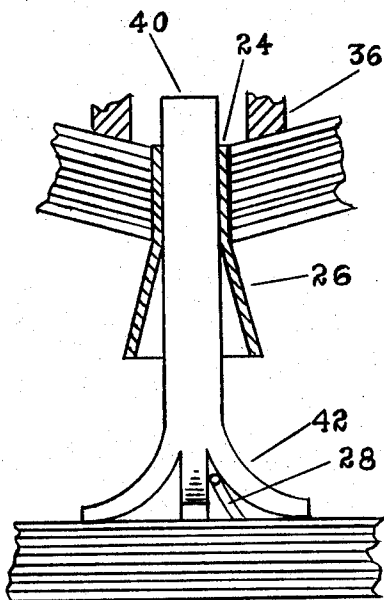


Fig. 8

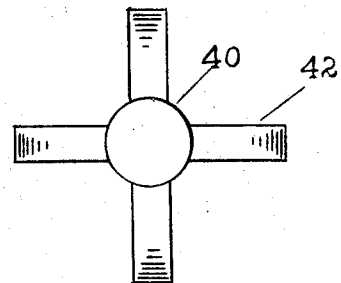


Fig. 9

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Fig. 10.

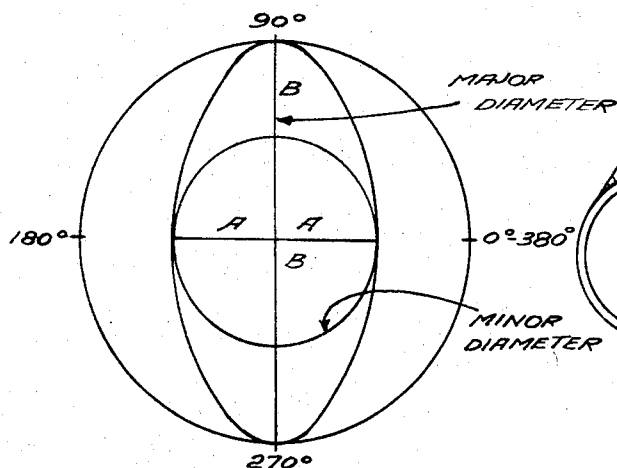


Fig. 13.

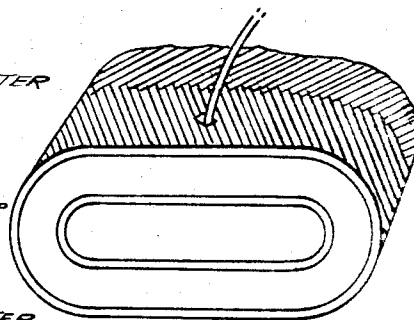


Fig. 11.

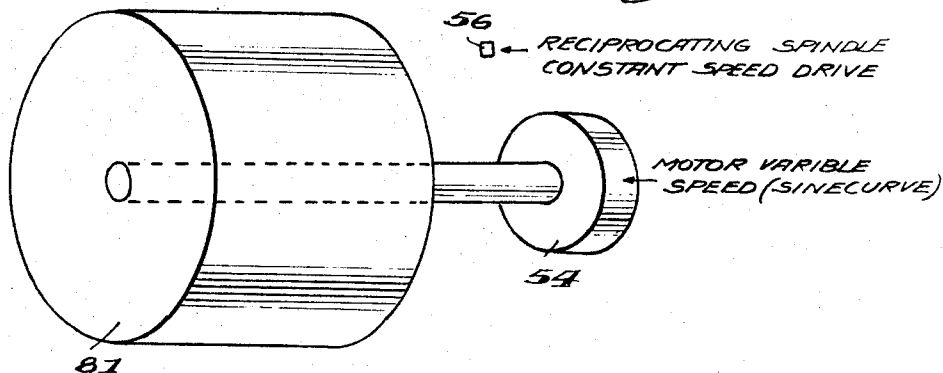
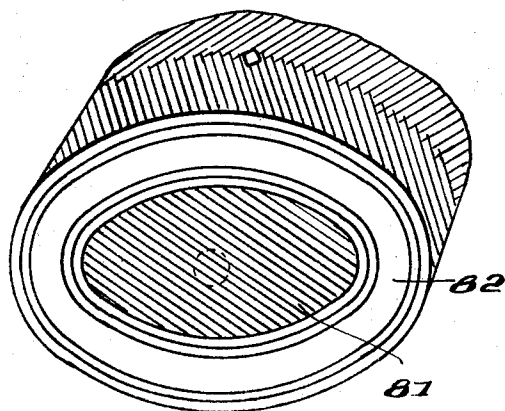


Fig. 12.



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PACKAGE OF FLEXIBLE MATERIAL

This application is a continuation-in-part of application Ser. No. 709,305 filed Feb. 29, 1968, now abandoned and of application Ser. No. 18,780 780 filed Mar. 2, 1970.

BACKGROUND OF THE INVENTION**1. Field of the Invention**

The invention relates to a package of flexible material and to a method and apparatus for producing such a package.

2. The Prior Art

Packages of flexible material wound in a universal wind and having a built-in radial hole are well known for example from Taylor U.S. Pat. No. 2,634,922. These packages are cylindrical in cross section. Taylor U.S. Pat. No. 3,178,130 suggests that such packages can be collapsed in various ways, including circumferentially. However, with all of these packages there is a tendency for the material being drawn out from the inside of the package to "birds-nest," that is, for a plurality of loops to come loose from the inner wall of the package at the same time which may become caught on each other and thus prevent positive payout from the interior of the package.

Application Ser. No. 709,305 discloses a package of flexible material produced on a mandrel composed of two spaced round bars, as a result of which, when the spindle and guide are driven at constant speed, the cross-overs are spaced further apart in the curved ends than in the elongated sides. This results in the building up of a thickened wall along each of the sides, which, when the package is compressed into a container with flat sides, may result in inward bulging of the longer walls.

Such a package may be produced by simple inward compression, in a direction transverse to the axis of the package, a package of the type shown in the Taylor patents referred to above. This package would then have side walls of substantially the same thickness as the end walls, and would not be subject to the inward bulging referred to above. This would be because the cross-overs are substantially equally spaced around the package.

However, with many materials, it is impossible to produce a package with an oval internal opening without deforming the material to such an extent that it will not payout properly. Such compression may be possible with relatively thin wall packages containing only a limited amount of material, but is not practical with most resilient materials where the walls of the package are fairly thick, which is of course necessary if the package is to contain substantial lengths of material.

SUMMARY OF THE INVENTION

According to the present invention, the likelihood of "birds-nesting" is greatly reduced by forming the package with an axial opening having a cross section substantially in the shape of a dumb-bell or a kidney, that is, with a narrow central portion.

A further feature of the invention is the use in such a package of a payout tube which is secured in the payout opening and which has a portion extending inwardly substantially to the central plane of the package, this portion flaring outwardly from the interior wall of the package to its free end at an angle of around 30°.

A further feature of the invention lies in the winding of the package on a spindle composed of two shafts or rolls which are mounted on a common frame in parallel spaced relation, which spindle is rotated about a line equidistant between the rolls while a guide is reciprocated along the length of the rolls, the flexible material being fed in by this guide.

As a result of this arrangement, and because the curved ends of the rolls will be moving more rapidly across the guide than the central portions, the substantially flat central portions of the package so wound will have their cross-overs spaced apart by a less distance than the cross-overs of the substantially cylindrical end parts. The result of this will be that the flat side portions as the layers build up will be thicker than the end portions. If then the resulting package is enclosed in a sim-

ple container of oval cross-section with flat sides, the thicker side portions will be caused to bulge inwardly so as to produce the dumb-bell shaped interior space referred to above, whereas if pressure is exerted on the central part of only one of the side walls the interior axial space will be kidney shaped.

A further feature of the invention, of general application, is the provision of a removable part in the payout tube having a member thereon which engages the inside surface of the opposite wall of the package during shipment.

The purpose of the oval or elliptical wind is to offset certain disadvantages inherent in a circular wind when material is paid out of an air core through a radial hole in that wind, as follows:

- a. To prevent material during payout from loosening itself from the wall of the wind and going into loose circular coils immediately prior to payout exit. Nearly all material has some tendency to do this—the greater the spring characteristics relative to the weight of the material, the greater the tendency. The non-circular shape of the wind or package, plus the flat or straight sided wall of the oval wind augmented by the interior bulge, hereinafter described, work to prevent loose circular coils from forming.
- b. Reduce or eliminate the tendency of relatively stiff but kinkable material to go into a kinkable bend (below minimum bend point) before being paid out through the radial hole. Thus soft solid copper wire paying off the flat oval side of the wind into the radial hole located in that side is not encouraged or forced into the minimum bend, and because of the absence of cones used in circular wind (to also prevent coils from tangling), has room to assume the best angle of exit.
- c. Reduce the space displaced by the package by reducing the volume of the air core.
- d. Produce a package shape more useful in certain situations, for example where lacing tape packages are passed through narrow spaces, particularly where the payout hole can be placed in the circular end of the oval wind, and thus enable material to be paid out in the direction of the movement of the package.
- e. Reduce slight fluctuations in tension occurring in a circular wind by placing the payout hole in the circular end of an oval wind, thus reducing the range of angle fluctuations in the approach to the hole by the exiting line.

Accomplishment of the oval wind may be done in two ways

- (1) by pressure applied to the outside of a circular wind, transforming it into an elliptical shape and then into an oval wind
- (2) by a lesser degree of pressure applied to an elliptically wound wind, using a mandrel having semi-circular ends some distance apart. Where a true oval-shaped mandrel is attempted, most material with any degree of stiffness will tend to bulge outward on the flat sides so that an elliptical effect is produced — that is, except where the distance between the semi-circular ends is very great relative to the material used. A fully shaped elliptical mandrel may thus be the most practical for some materials.

Where the wind contains a relatively small number of layers, or a thin wall, the pressure required to transform a fully circular wind into an oval shape should be well within the limits of pressure allowable to the material, whereas a thick-walled or many-layered wind may not be so transformed without undue pressure on the material. In the latter case an oval may only be accomplished by winding on an elliptical mandrel as close as possible to the oval shape required. In addition it should be noted that stiff heavy and inflexible material such as solid copper building wire can only be pressured from a circular wind if the wall is thin, not only because of the resistance to pressure of the thick wall but because these inner coils of a thick wall might be reduced to a circular bend at the end that is smaller than the minimum bend for the material.

Where such transformation from either elliptical or spherical winds takes place, each layer progressing from the outside to the inside encloses a somewhat smaller area than the same

layer enclosed before pressure was applied. This results in one or both of the flat sides of the transformed oval buckling toward the inside to produce a slight hour-glass effect. Each inward layer tends to buckle a little more than the preceding one and thus a thick-walled wind tends to maximize this effect. In addition, the buckling or hour-glass effect is accentuated by the fact that the slower winding speed across the face of the long side of the oval tends to increase the number of cross-overs and thus increases the thickness of wall in that area. This build-up of cross-over points tends to increase in progression from the circular ends toward the center.

For very light weight materials with low spring characteristics and great flexibility the effect described in the preceding is of no benefit to payout — perhaps the reverse, since the loosening effect tends to displace relationships between contiguous coils that are light enough to effect one another by any degree of friction. Where the weight of the material is both relatively heavy and relatively springy and where flexibility or absence of spring does not increase too much relative to weight, this bulge may on the other hand be a payout advantage, since it tends to assist the oval shape in preventing loose coils from forming ahead of the payout, and since it also tends to point the lay of the line around the hold toward a position above the hole, particularly when a tube is used, and thus to ease the exit.

For materials benefiting from the oval shape from a payout viewpoint, the most flexible material can be paid out through a hole located either in the circular end or the flat side. The former may be advantageous where the whole package needs to be moved through narrow spaces and a direct exit is desirable in the direction of such movement. These same materials may benefit also by the more constant tension of the payout process through a hole thus located.

For other materials the side wall payout location will be more advantageous since the circular ends tend to restrict the space required for stiff springy and/or kinkable material to assume the bend necessary for exiting through the hole. The flat run of the material and the length of open space of the side wall also tends to be much less restrictive. By the same token the inward bulge of the layers tends to assist the flow of such material out the hole and at the same time prevent the formation of loose coils.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood from the accompanying drawings in which:

FIG. 1 shows a package produced according to the invention while still supported by the spindle on which it is wound;

FIG. 2 shows the same package removed from the spindle and enclosed in a container;

FIG. 3 shows diagrammatically a machine for producing a package according to the invention;

FIG. 4 shows the payout tube;

FIG. 5 shows a diagram of the winding of one layer of the package according to the invention;

FIG. 6 shows a modified form of package;

FIG. 7 shows in plan view the holder of FIG. 6;

FIG. 8 shows a part of a package with a stabilizing member secured in the payout tube; and

FIG. 9 shows the stabilizing member in plan view;

FIG. 10 is a diagram explaining the action of the machine of FIG. 3;

FIG. 11 is a diagrammatic showing of a modified form of machine;

FIG. 12 shows an oblong mandrel with a package thereon; and

13 shows another form of package.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIGS. 1 and 3, there is shown a spindle 2 driven by a motor 4 and carrying brackets 6 which support rolls 8. A guide 10 is reciprocated along the rolls in conjunc-

tion with the rotation of the spindle formed by the rolls 8, the drive mechanism for example being of the type shown in Taylor U.S. Pat. No. 2,767,938.

The guide makes substantially one complete reciprocation for every two turns of the spindle, but is slightly out of phase therewith so that the cross-overs progress around the spindle. This builds up a package of flexible material a typical layer of which is shown in FIG. 5, this layer being composed of a plurality of FIG.-8s. In this figure there is shown a hole 13 produced in each layer by the fact that the crossovers do not continue completely around the package. It will be noted also that the spacings 14 between the cross-overs in the portions of the package going around the rollers, one of such portions for example being located between lines 16 located at the left hand side of FIG. 5, are spaced substantially further apart than the cross-overs as at 18 in the flat side wall sections of the package. As a result, as is seen in FIG. 1, the side walls of the package build up to a greater thickness than the substantially cylindrical end wall portions.

FIG. 2 shows the package of FIG. 1 enclosed in a substantially rigid container 20 having a flat side wall and provided with a hole 22 opposite the hole 12 in the package. It will be noted from this figure that the resulting package has a dumb-bell shaped interior.

It is also desirable to use a payout tube such as shown in FIG. 4 which has a portion 24 for fitting in the hole 12 and a flaring portion 26 of funnel shape which begins at the interior wall of the original package and extends substantially to the center of the dumb-bell shaped opening. The angle between the wall and the radius of the package is preferably within the range of 15° to 40°, preferably around 30°. This flaring shape helps to lift the coils one by one away from the package wall, the portions of the coils nearest the hole being guided outwardly by contact with the sloping surface. The interior free end 28 of the flexible material is brought out through this funnel with a result that, as shown in the previously identified Taylor patent the material is fed out substantially without twist.

FIG. 1 shows a clip 30 attached to one of the rolls 8 for the attachment of the starting end of the material (indicated in broken lines in FIG. 1) during winding.

While a single FIG.-8 wind is shown in the drawing, it is to be understood that multiple FIG.-8 winds are not excluded from the scope of the invention in its broadest aspect.

FIG. 6 shows a similar coil held by a frame (see also FIG. 7) so that the interior axial opening is kidney shaped. The frame is composed of one side of two bars 32 spaced apart and engaging the package near the ends of one of the long sides, while a second bar 34 with a central ring 36 for payout engages the central part of the other longer side. These bars are connected by frame members 38.

FIG. 8 shows, in combination with the payout tube, a rod 40 of plastic material which fits fairly tightly within the payout tube part 24 and has at its end normally spreading resilient fingers 42. If the fingers are held together and the rod is inserted in the payout tube with the fingers in front, the fingers will spread apart and can engage the opposite interior wall so as to stabilize the package during shipping and handling. When the package is to be paid out, the rod 40 is withdrawn and the fingers 42 will be compressed and come out through the tube.

The inner end 28 of the material may be attached to rod 40, so that it is drawn out as the rod is removed.

Where a number of packages are to be "cascaded," that is, connected in series, the payout tubes can be dropped off as each coil is paid out if the outer end of the material is led inwardly through the radial hole on the outside of the tube and then out through the tube. To permit this without interfering with the normal payout, the tube can be provided with a groove 44 in which the outer end portion can lie during the withdrawal.

The use of a constant speed spindle results in a change in linear speed of the material being wound, forming a sine wave f.p.m. curve. The maximum speed occurs at the major diame-

ter of the shape and the minimum speed at the minimum or minor diameter. As shown in FIG. 10, where A and B are the major and minor radii, respectively:

The maximum speed per revolution $= 2 \pi B$

The minimum speed per revolution $= 2 \pi A$

The average speed per revolution $= 2 \pi [\frac{1}{2}(A^2+B^2)]^{1/2}$

The linear speed (f.p.m.) curve per revolution is generated then as a sine curve, and the cross-over points are closer together at the minor diameter on the circumference of the wind and increase in distance as the major diameter is approached, as shown in FIG. 5.

A constant linear winding speed per revolution of an oval winding form may be obtained by having the R.P.M. of the mandrel vary in a sine wave pattern. The curve generated is the same as with a constant R.P.M. mandrel with the exception that the R.P.M. varies with the linear speed (F.P.M.) constant.

A wind made in this manner results in the cross-over points being spaced in an equidistant manner on the wind circumference.

The wall thickness remains constant as contracted with a slight thickening at the minor axis on the constant R.P.M. wind caused by the closer cross-overs in this area.

With a constant tension applied to the material being wound, the tension remains constant with a constant linear speed wind. With a constant R.P.M. wind, the tension changes with the linear speed as the mandrel rotates.

As shown in FIG. 11, an oblong spindle 50 is driven by a belt 52 from a variable speed motor 54 which is controlled in such a way that the peripheral speed of the mandrel is maintained constant. The guide 56 is reciprocated by a constant speed motor, for example through cam mechanism of the type shown in the Taylor patents.

FIG. 12 shows how a package may be produced on an oval mandrel, such as the mandrel 81 of FIG. 11. The package 82 is of substantially equal thickness both at the ends and in the longer sides.

FIG. 13 shows a package which can be produced by the machine shown in FIG. 11, using a mandrel of the type shown in FIG. 3, or may be produced by winding on a round mandrel and compressing inwardly at the hole and at the opposite side.

We claim:

1. A package of flexible material comprising a plurality of layers each formed of a plurality of figure-8s having cross-overs progressing around the package, said package having an axial opening and having in cross-section perpendicular to the axis of said axial opening a substantially oval shape with elongated sides and curved ends, and having a radial opening, the

inner end of the material being led out through such opening.

2. A package as claimed in claim 1, in which the radial opening is substantially at the center of one of the elongated sides.

3. A package as claimed in claim 1 in which the interior walls of the axial opening are closer together at the central portion of the elongated sides than at the end portions.

4. A package as claimed in claim 1 in which the cross-overs in the curved ends are spaced further apart than the cross-overs in the elongated sides.

5. A package as claimed in claim 1 in which the elongated sides are thicker than the curved ends.

6. A package as claimed in claim 5 and a cover therefor substantially oval in cross-section and having flat sides engaging the elongated sides of the package whereby said sides bulge inwardly into the axial opening.

7. A package as claimed in claim 1 in which the cross-overs in the curved ends are spaced further apart than the cross-overs in the elongated sides.

8. A package as claimed in claim 1 having a payout tube with a part held in said radial opening and an outwardly flaring portion terminating at the interior wall of the package.

9. A package as claimed in claim 8 in which the outwardly flaring portion forms an angle of 15° to 40° with the longitudinal axis of the tube.

10. A package as claimed in claim 8 having a part removably secured in the tube, said part having means thereon engaging the opposite interior wall of the package.

11. A package as claimed in claim 1 in which the cross-overs are evenly spaced around the package.

12. A package of flexible material comprising a plurality of layers each formed of a plurality of figure-8s having cross-overs progressing around the package, said package having an axial opening and having a radial opening, the inner end of the material being brought out through the radial opening, a payout tube having a portion within the radial opening, and a part removably secured in the tube, said part having means thereon engaging the opposite interior wall of the package.

13. A package as claimed in claim 12 in which the payout tube has an outwardly flaring portion which forms an angle of 15° to 40° with the radius.

14. A package of flexible material comprising a plurality of layers each formed of a plurality of figure-8s having cross-overs progressing around the package, said package having an axial opening and having a radial opening, the inner end of the material being brought out through the radial opening, and a part removably secured in the radial opening having means thereon engaging the opposite interior wall of the package.

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