Sept. 22, 1942. L. CAMPBELL 2,296,420

YARN PACKAGE

Original Filed May 1, 1940 5 Sheets-Sheet 1

Fig. 4.

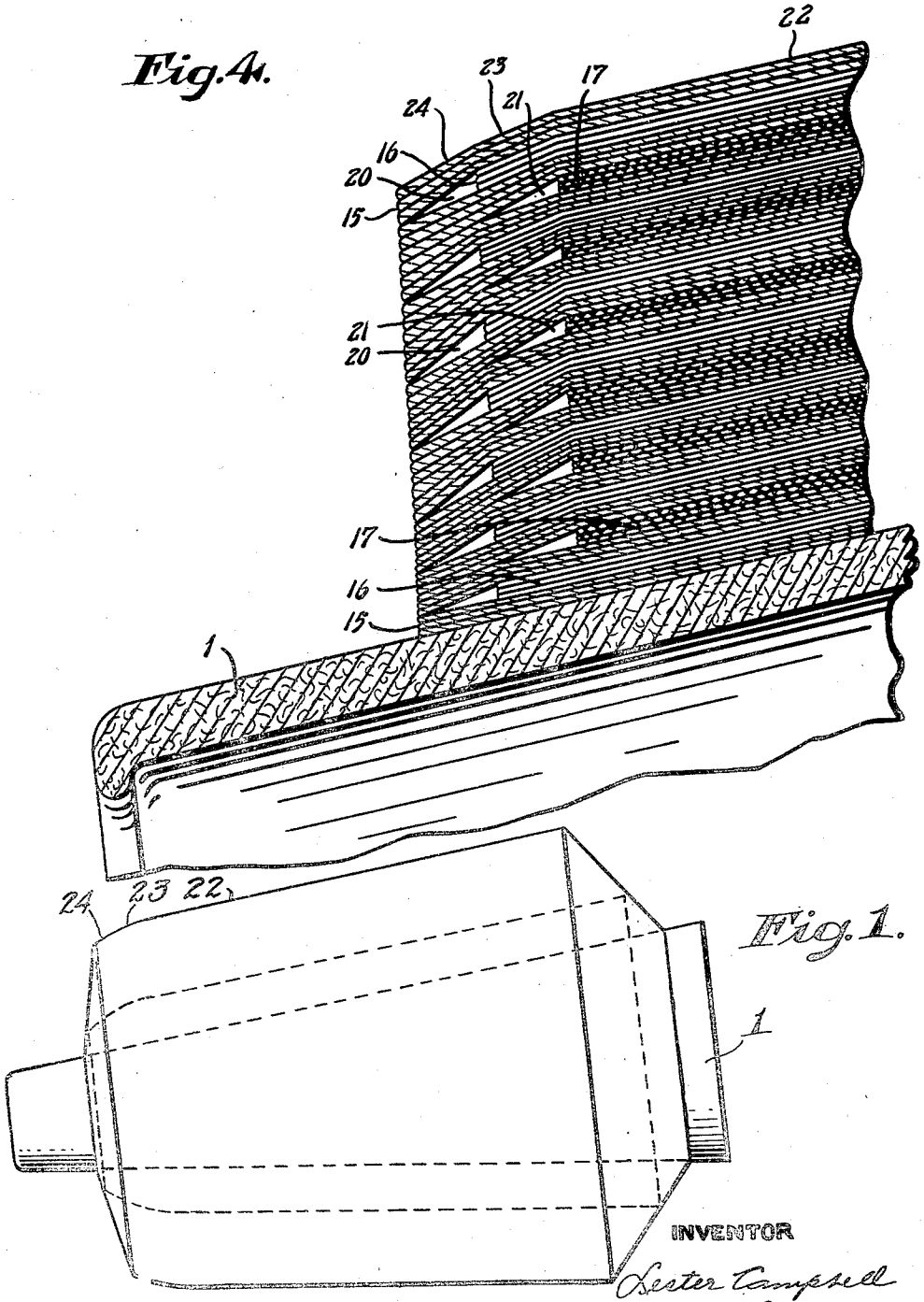


Fig. 1.

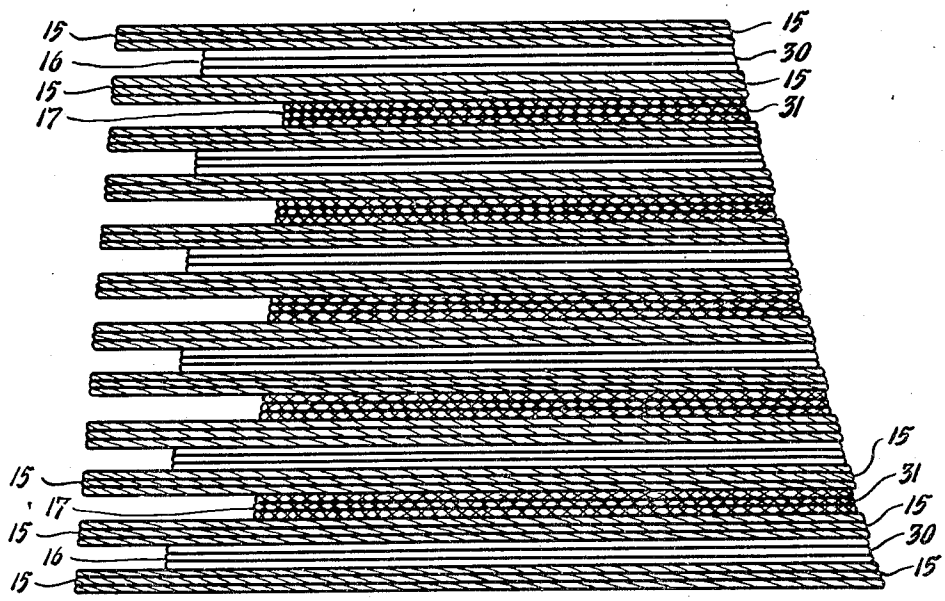
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Sept. 22, 1942. L. CAMPBELL 2,296,420

YARN PACKAGE

Original Filed May 1, 1940 5 Sheets-Sheet 2

Fig. 5.



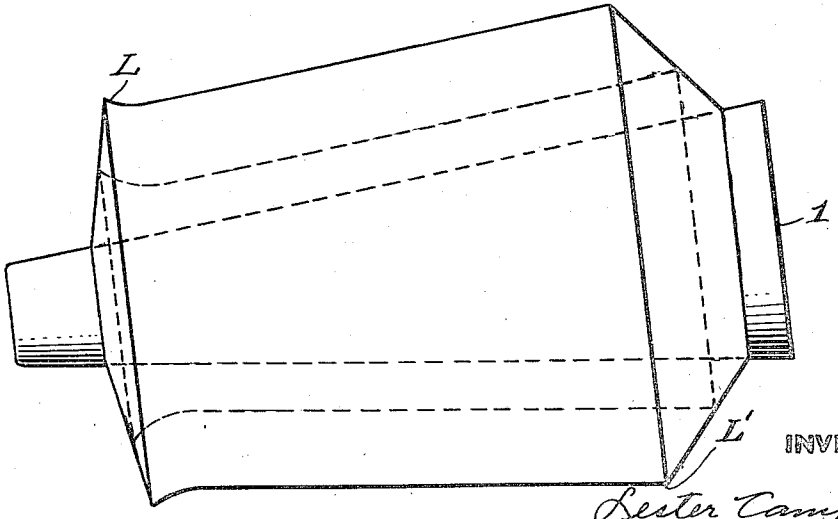


Fig. 2.

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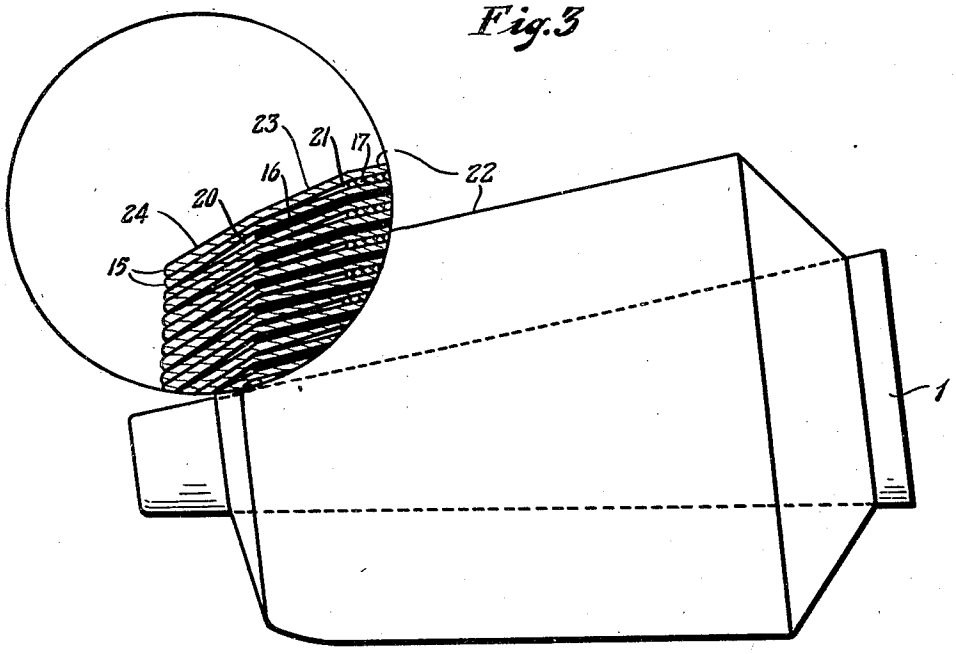
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Sept. 22, 1942. L. CAMPBELL 2,296,420

YARN PACKAGE

Original Filed May 1, 1940 5 Sheets-Sheet 3

Fig. 3



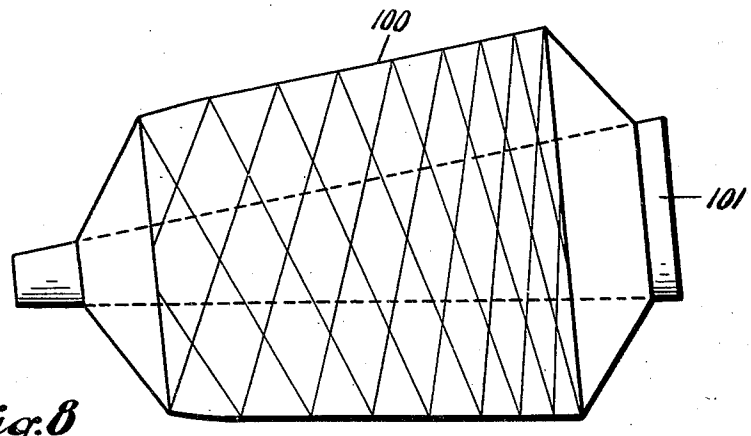


Fig. 8

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Sept. 22, 1942. L. CAMPBELL 2,296,420

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Original Filed May 1, 1940 5 Sheets-Sheet 4

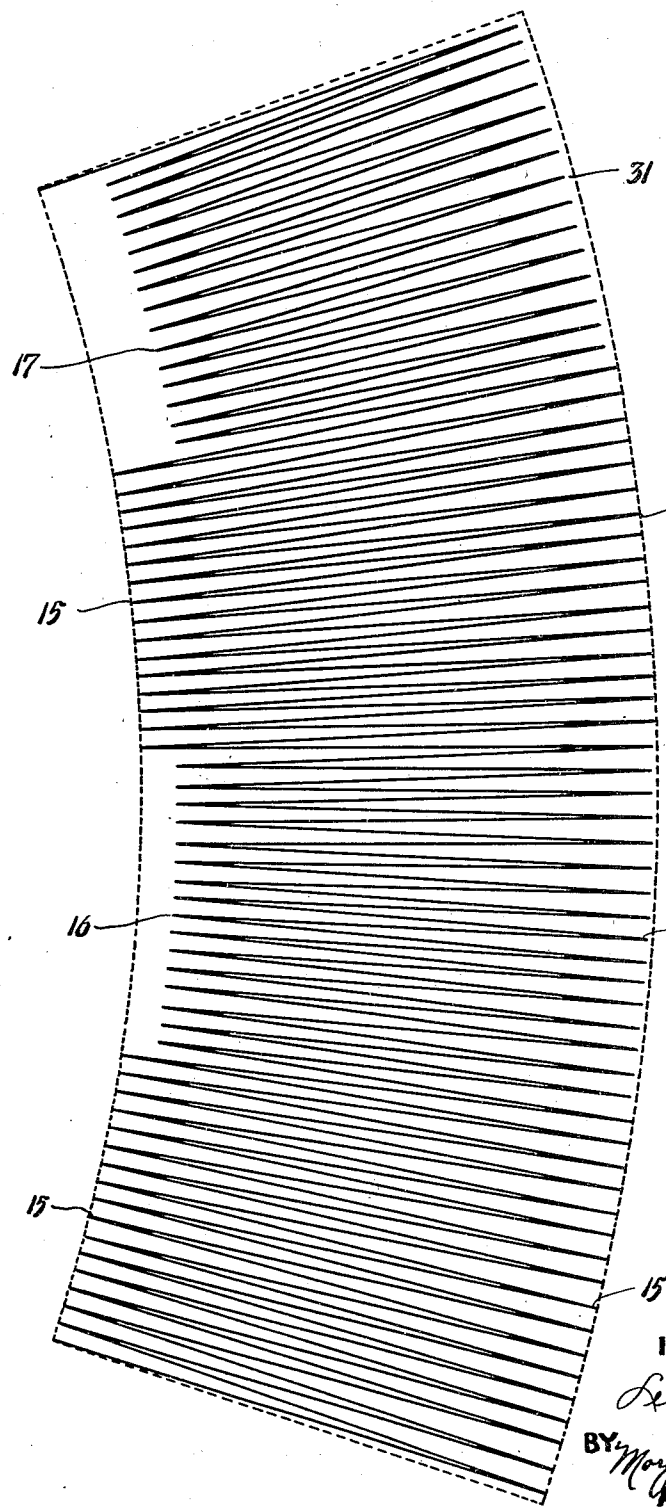


Fig. 6

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Original Filed May 1, 1940 5 Sheets-Sheet 5

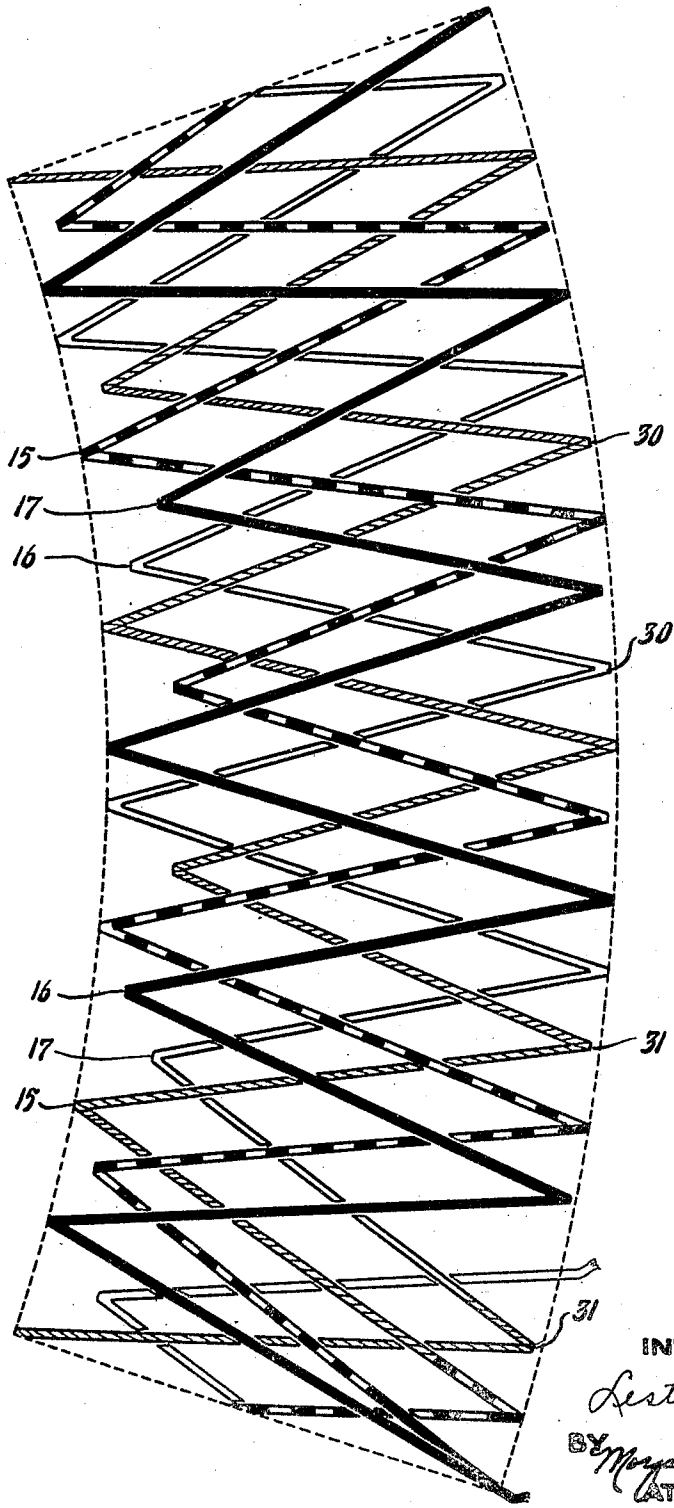


Fig. 7

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Patented Sept. 22, 1942

2,296,420

UNITED STATES PATENT OFFICE

2,296,420

YARN PACKAGE

Lester Campbell, Westfield, Mass., assignor to Foster Machine Company, Westfield, Mass., a corporation of Massachusetts

Original application May 1, 1940, Serial No. 332,724. Divided and this application May 1, 1940, Serial No. 332,723

13 Claims. (Cl. 242—159)

The invention relates to improvements in yarn or thread packages and to a novel and useful method of winding the same.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, constructions, arrangements, combinations and improvements herein shown and described.

The accompanying drawings, referred to herein and constituting a part hereof, illustrate embodiments of the invention, and together with the description, serve to explain the principles of the invention.

Of the drawings:

Fig. 1 is a diagrammatic side elevation of a yarn cone or package embodying my invention;

Fig. 2 is a similar view of a yarn cone showing the lip or ridge defect which is eliminated by my invention;

Fig. 3 is a view similar to Fig. 1 with an encircled portion enlarged and sectioned to show the detailed structure of the improved package at the nose end;

Fig. 4 is an enlarged fragmentary section of the nose end of a cone package embodying another form of the invention; and

Fig. 5 is a view similar to Fig. 4 showing the lay of the yarn during the winding operation at both ends of the cone;

Fig. 6 is a diagrammatic view showing a plurality of traverse outlines in a sequence embodying the invention;

Fig. 7 is a diagrammatic showing of the relative positions of the bends of yarn at the ends of the package; and

Fig. 8 is a diagrammatic side elevation of a package wound to a uniform density.

Objects of the invention are to provide improved yarn packages of the self-sustaining type wound on cores, especially conical cores, where the wind is a quick traverse wrapping the strand in helices of relatively great angularity. The novel cone package provided by my invention is one from which the yarn may be drawn with substantially uniform tension and without the formation of loops or breakage of the yarn. The invention also comprises a novel method of forming or winding said improved package.

In particular, my improved package and method of winding same are designed to eliminate the formation of the so-called lip or ridge which is found to form at the ends of so-called "pineapple" conical yarn packages under present methods of winding. The formation of such lip or ridge constitutes a serious inherent defect in cone packages, having numerous detrimental effects during the use of the package in knitting machines or the like. The shape and location of such lip or ridge, as found in the present type conical packages, is diagrammatically indicated at L in Fig. 2, appearing as it does in its most aggravated form at the nose or small diameter of the cone. A similar but less pronounced lip L' is formed at the base of the cone. Such lips L and L' are the result of the winding operation as now practiced, being caused by the overlapping or accumulation of bends in the yarn at the point of reversal of the traverse, as will be hereinafter more fully described. In the hosiery trade, for example, the use of conical packages having said undesirable lip formations results in the production of large quantities of so-called second quality hose which, because of the high cost of silk, has become a very costly factor in hosiery manufacture.

In the knitting of hose the strand of yarn or thread is drawn off over the nose end of the cone in the knitting machine, the cone being held stationary while the strand is drawn off in helices away from the base and over the small or nose end. Thus the strand tends to free itself from the base but tends to pull into and catch in and on the projecting ridge or lip L at the nose. Numerous detrimental effects are caused thereby. Primarily there are resultant variations in the tension of the drawn-off strand which in turn produces uneven lengths of loops in the knitting stitch thus causing unevenness in the texture and appearance of the hose. Also, from handling of the package, the lips or ridges L and L' frequently become rolled over on themselves, tending to bind the strand in and under the lips and at times causing direct breaks in the strand. At other times the bound-in strand snaps out from its pinched position causing a sudden looseness and twist in the strand so that a loop may be formed and catch on the knitting machine and break. In knitting stockings on a full fashioned knitting machine, a broken thread requires the discontinuance of the knitting operation on that particular stocking which is then pressed off the machine by the operator and either entirely discarded or reclaimed at additional expense.

There are several cumulative causes for the

formation of the lip L in the winding of cone packages. It is well known in the art that yarn piles more at the small nose end of a tapered conical package than its large base end. This is particularly true and appears more prominently on cones that are spindle driven as compared to those which are surface driven. In the winding of the cone, the tendency of the strands is to pile upon themselves toward the nose end because of the slope of the cone toward that end, while at the base end the opposite inclination tends to spread out the threads. Thus the tendency to form a lip or ridge at the nose end is considerably greater than at the base and unfortunately the presence of the lip at the nose end is particularly detrimental for the reasons previously described. Piling at the ends is also caused by the tendency of the strand to dwell or linger momentarily at either end of the traverse due to the sudden change in direction. This tendency becomes more pronounced as the traverse cams and other parts wear, causing more and more dwell at the ends of the traverse stroke.

Formation of the lips or ridges L and L' also results from the bends in the yarn which take place when the traverse of the thread is reversed at either end of the cone. In the bending of the strand of yarn an action takes place similar to that in bending a round bar of metal, for example. The outer surface of the bar tends to stretch and the inner surface squeezes together and, because there is no confining means, the material squeezes out or bulges wider than its normal diameter at the bend. The accumulation of these bulges causes the raised lips or ridges at the ends of the cone. It will be clear also that the tendency of the bulges to pile up and form a ridge or lip is more prevalent at the nose than at the base of the cone because of the smaller perimeter at the nose, whereby the same number of bends at the nose of the cone will be closer together than at the base. Also the angle of bends at the nose end is sharper than the base, and the more acute angle causes a bigger bulge.

In winding the improved package of my invention, I so wind the helices of the strand as to eliminate or prevent the formation of the lips or ridges L and L' and to form in place thereof a somewhat rounded or beveled edge at the nose in which the accumulations of bends or bulges in the reversed strands does not exist. In the preferred form of my invention I so control the traverse of the yarn being wound as to form a series of cavities or void spaces at the nose of the cone, said void spaces being disposed between layers of yarn traverses of the maximum length so that the accumulation of bulges from the bends in the yarn at the nose of the cone is prevented, such accumulations being automatically distributed over a zone recessed from the nose whereby the nose of the cone tends to curve inwardly in a direction reverse to that of the lip formation objected to in the present type of cone. The package so formed therefore has no lip or ridge at the nose of the cone and the beveled or rounded nose formed by my invention eliminates all of the disadvantages heretofore found in connection with said lip or ridge. Broadly described, I provide for distributing the strands of yarn in a series of layers at the nose of the cone whereby each traverse or group of traverses of full length are interspersed with traverses or groups of traverses of predetermined shorter lengths.

In some cases the traverses may all extend to the base of the cone, the variations in traverse length being confined to the nose of the cone as stated. In other cases, however, to prevent formation of the relatively smaller lip L' at the base, the traverses are intermittently shortened to a lesser degree than at the nose, to provide a stepping back of the base but without any cavities or overlap as at the nose. This is sufficient to prevent formation of such lip L' as would occur at the base but avoids the undesirable effect of cavities at the base.

Another object of the invention is to provide a package of substantially uniform density from nose to base. Such a uniform-density package is disclosed but not claimed in my prior copending application Serial No. 304,499 filed November 15, 1939, now Patent No. 2,281,747, and in that respect the present application constitutes an improvement thereof.

Aside from the general shape and lay of the yarn, the density of the wound package is very important and there is a growing demand for a more uniform density throughout the package. Heretofore there has always been a tendency for cone packages to be of greater density in the smaller nose portion of the package and softer in the larger base portion. The combination of an accelerated traverse of the strand of yarn toward the nose of the cone and a decelerated traverse toward the base of the cone package counteracts this defect and results in a package of more even density and when the traverses of the yarn are of various lengths of traverse and operate at various time periods the package is built without the aforesaid lips and of even density. The uniform density of package is in itself desirable and the production of such a package is one feature of my invention, while the combination thereof with the lip eliminating features provides a package which is superior in both respects.

It will be understood that the foregoing general description and the following detailed description as well are exemplary and explanatory of the invention but are not restricted thereof.

Referring now in detail to the present preferred embodiment of the invention illustrated by way of example in the accompanying drawings, it will be understood that the invention is particularly and preferably applicable to the winding of "pineapple" type packages on conical cones, although it may also be applied to other forms of packages such as standard cones, tubes, etc. In the drawings the conical paper core 1 provides the base upon which the helical winding of the thread or yarn takes place, said winding being effected by the rotation of the core through an axial drive at a uniform speed, for example, 1300 R. P. M. During the continuous rotation of the tapered or conical core the thread being wound thereon is traversed axially of the core to effect a helical winding of substantial angularity. The traversing of the thread is performed once during several rotations of the core, for example, a single traverse and reversal to five and seven rotations of the core are common. The winding of such conical packages by the quick traverse method is well known in the art and many machines for performing said operation are to be found, as for example, in the mechanism disclosed in my co-pending application Serial No. 304,499.

Referring particularly to Figs. 3 to 7, the first series or course in the cycle of windings is pref-

erably composed of helical coils of strand material extending the maximum length of yarn traverse, then reversing and going back and forth forming bends at the ends of the package. In accordance with the invention, after a predetermined number of layers of yarn **15** have been wound at the full length traverse, the traverse of the yarn is shortened at the nose end of the package to lay one or more layers of yarn **16** spaced a few yarn diameters from the end of the package, for example, five yarn diameters back. Thereafter a second series of windings at the full length traverse **15** is again performed so that a cavity or recess in the end of the cone is formed between the space bounded by the ends of the yarn layers **15** and **16**, said cavity being of a length or axial extent of five diameters in the illustrative case given and of a height or radial extent equal to the number of layers of yarn in the traverse.

As shown in Fig. 3 the alternate layers or courses of different length traverse may be one thickness of yarn more or less while in Figs. 4 and 5 said layers are shown as of three thicknesses. Above the second full length traverse **15** a series of still shorter traverses **17** are then wound, their ends being spaced, for example, at 10 diameters from the end of the cone, that is twice as far from the end as the traverses **16**. Thereafter a series of full length traverses **15** are again wound to form a second series of cavities of greater length beyond the end of the traverses **17**. Thereafter a series of alternating traverses is built up as previously described, each short traverse **16** being succeeded by a full length traverse **15** and thereafter by the shorter traverse **17** and so on. Thus a series of cavities is formed at the end or nose of the cone, said cavities assuming a triangular cross-section **20** and **21** as appears in Figs. 3 and 4 as the ends of the longest traverses curve inwardly or are drawn toward the center of the cone overlapping the shorter traverses, and thereby providing a beveled or generally rounded nose for the cone. As clearly appears in Figs. 3 and 4 the nose of the cone slopes inwardly from the general conical inclination **22** to overlie first the inner cavities **21** with a steeper inclination **23** and thence with a still steeper inclination **24** to overlie the outer cavities **20**. It will be understood that in general the original taper of the conical core is maintained throughout the length of the package, the beveled or rounded nose **23**, **24** being a relatively short portion of the length of the package and in Figs. 3 and 4 is exaggerated for purpose of illustration. In fact it will be generally found that my construction of package eliminates the lip or ridge effects L and L' as shown in Fig. 2 and results in a package of generally uniform conical contour along the sloping surface **22**.

At the base end of the cone operations similar to those at the nose are preferably performed, but to a lesser extent. As shown in Figs. 5, 6 and 7 the traverses **16** and **17** are slightly shortened also at the base to provide a slight stepping back at **30** and **31** respectively. The result is that any lip L' at the base is eliminated, but the recessing effected by the shortened layers of yarn is insufficient to effect any overlap on the part of the longer or full length traverses **15**. That is, no cavities are provided at the base of the cone, which at that end would be detrimental to the unwinding operation.

In the formation of cavities as heretofore described, it is desirable to control their length, breadth, and height and their allocation in the package in accordance with the particular wind of the package and in accordance also with the nature of the yarn or thread material being wound. With respect to the strand material being wound, it is found, in general, that for finer or smaller diameter strands, less magnitude of void or cavity is required, while the coarser or larger diameter strands require cavities or voids of greater magnitude to effect the desired diminution or elimination of the lips L and L'.

To prevent the maximum accumulation or piling on of the bulged reversals or bends of the yarn, the spacing of the shortened traverses and the numbers of layers thereof will be determined by the ratio of the wind and the relation thereof to the speed of rotation of the core spindle. For example, in a spindle speed of 1300 R. P. M., a common traverse ratio is 7:1 plus or minus a fraction, that is, a traverse going along the length of the package, reversing and returning to the starting point once during each seven rotations thereof. Actually, the ratio of traverse to rotation is usually a fractional amount over or under the whole number of traverses, for example, 7¼:1, in which case the increment of ¼ is called the gainage of the winding ratio. It has been found from experience to be desirable to produce the length of the cavity or space a few diameters of the strand, for example, five diameters back from the extreme nose end of the conical package; and the occurrence of reversals of the traverse at that point five diameters back is continued as many times as the amount of the gainage is contained in the circumference of the winding package.

So if the ratio gainage should be, say 7¼:1, it would mean that to one turn of the traverse cam, the spindle would turn seven and one-quarter times, therefore $4 \times \frac{1}{4}$ equals one complete turn or one series of circumferential bends. Now repetition of the same series of circumferential bends would be undesirable because the yarn would be laid on top of the former helices and cause piling all through the entire winding, so instead of as great a fractional increment or decrement, or gainage or lossage respectively, a lesser fractional circumferential division of the wind either added to or substracted from the number of the wind referred to as 7:1 or 5:1 (or any other equal ratio wind) is used to completely fill in the entire circumferential spaces and produce a completed flat mat or layer of yarn over the entire cone surface (Fig. 7).

This process is repeated again and again until the entire package has been built up to any predetermined diameter or weight.

In order to prevent the piling on the ends, particularly the nose end, the number and extent of the fractional divisions is an element to consider when determining the number of strand diameters that form the spaces or cavities (already referred to) also the frequency of their occurrence.

So there are three determining factors in my invention of producing wound packages with series of spaces or voids or cavities:

1. The diameter of the strand material.

2. The time element which is effective in three dimensional features providing for the formation of the cavities in (*a*) length, (*b*) breadth, and (*c*) height.

3. The fractional increment or decrement of the equal wind ratio.

While I have referred to 5 and 10 diameters

of the strand for lengths of the spaces and seven as the number of reversals or bends around the package, they have been used for illustrative purposes only and I do not intend to be limited, first, to any lengths of spaces, or second, times of their occurrence, or third, the duration of the length of time used for either or all of the series in the cycle of winding. Many combinations of these three elements composing a series of space formings may be determined to meet any required result.

While theoretically and to meet the most exacting conditions it may be necessary to determine a series of very specific requirements, in general it has been found that some series will meet the requirements covering many different sizes of strand material.

Referring now to the provision of a package of uniform density, such a package is shown in Fig. 8. As shown, the conical package 100 is wound on a conical core 101 so that the coils of thread are closer together near the base of the package and relatively widely spaced near the nose. Such winding is effected by accelerating the traverse of the yarn strand toward the nose of the cone and decelerating it toward the base. This causes the thread to be gradually wound with an increasing pitch as the yarn in the traversing thread guide moves toward the nose and with a gradually decreasing pitch as it moves toward the base. By suitably calibrating the rate of movement with respect to the angle of inclination of the elements of the cone to its axis it will be clear that the variations in density usually caused by the slope of the cone can be compensated for by the variation in pitch of the wind along the cone, thereby producing a package of uniform density throughout its length. As shown, the uniform-density package so produced is also preferably provided with the lip-eliminating traverse variations hereinbefore described.

It will be understood that the term "yarn" or "strand" as employed in the specification and claims is used in a general sense to designate any filar material such as fibers, threads, filament and other strands of silk, rayon, cotton, linen, wool or any other material.

It will be understood that the method and package herein disclosed may be formed by any suitable mechanism or even by hand and that the particular means for effecting said operations is no necessary part of the present invention. A preferred and novel form of mechanism for producing my improved package and for practicing the method of forming same is disclosed and claimed in my co-pending application Serial No. 332,724, filed as of even date herewith, of which this case is a division.

The invention in its broader aspects is not limited to the specific mechanisms shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What I claim is:

1. An improved yarn package comprising a body of yarn wound in crossed helices about a core to form a self-sustaining package, at least one end of the package being formed by a series of yarn traverses extending to and being in aligned relationship at that end and regularly interspersed by a series of courses of slightly shorter traverses terminating short of and adjacent that end to provide cavities at that end, said cavities extending in from said end of the package a sufficient distance so as to prevent a lip formation at said end of the package.

2. An improved yarn package comprising a body of yarn wound in crossed helices about a core to form a self-sustaining package, at least one end of the package having a plurality of annular recesses or cavities, said cavities being formed by a series of shortened yarn traverses at said end of the package alternately disposed between a series of traverses extending to said end, said cavities extending in from said end of the package a sufficient distance so as to prevent a lip formation at said end of the package.

3. An improved yarn package comprising a body of yarn wound in crossed helices about a core to form a self-sustaining package, an end of the package having a plurality of annular recesses or cavities, said cavities being formed by shortened yarn traverses at said end of the package alternately disposed between traverses extending to said end, the numbers of layers of yarn composing the radial extent of any of said shortened traverses being substantially equal to those in the traverses of full length.

4. An improved yarn package comprising a body of yarn wound in crossed helices about a core to form a bevel-ended self-sustaining package, an end of the package having a plurality of sets of annular recesses or cavities at different radial distances from the core, one set of said cavities being formed by shortened yarn traverses lying between traverses extending to the end and another set of said cavities being formed by still shorter traverses lying between traverses extending to the end.

5. An improved yarn package comprising a body of yarn wound in crossed helices about a core to form a bevel-ended self-sustaining package, an end of the package having a plurality of sets of annular recesses or cavities, one set of said cavities being formed by shortened yarn traverses lying between traverses extending to the end and another set of said cavities being formed by still shorter traverses lying between traverses extending to the end, the number of layers of yarn composing the radial extent of either set of shortened traverses being substantially equal to those in the traverses of full length.

6. An improved yarn package comprising a conical body of yarn wound in crossed helices about a conical core to form a self-sustaining package, at least one end of the package being formed by a series of yarn traverses extending to and being in aligned relationship at said end and regularly interspersed by a series of courses of slightly shorter traverses to provide cavities at said end and thereby prevent the formation of a lip or ridge at said end, the traverses being otherwise uniform throughout the length of the package so as to provide a lipless package which is solid throughout its body, said cavities extending in from said end of the package a sufficient distance so as to prevent a lip formation at said end of the package.

7. An improved yarn package comprising a conical body of yarn wound in crossed helices about a conical core to form a bevel-ended self-sustaining package, the smaller end of the package having a plurality of annular recesses or cavities, said cavities being formed by shortened yarn traverses at said end of the package, said traverses being terminated at substantially equal distances short of said end and being alternately disposed between traverses extending to said end.

8. The method of winding a yarn package which comprises the steps of laying the yarn in crossed helices on a rotating axial support in a course having a traverse extending from one end of the package to the other to form a bevel-ended package, shortening the traverse at at least one end of the package to lay a course terminating slightly short of said end, then laying a course again to the end of the package similar to the first course and repeating said operations as aforesaid to provide at one end of the package a series of annular cavities and thereby preventing the formation of a lip or ridge at said end, the traverses at said end being shortened an amount sufficient to eliminate the lip or ridge which would otherwise form at said end.

9. An improved yarn package comprising a body of yarn wound in crossed helices about a conical core, the longitudinal elements of said package decreasing progressively with their radial distance from the core so that both ends are beveled outwardly to form a self-sustaining "pineapple" package which is unwound in use by withdrawing the yarn over the smaller or nose end of the package while holding the core stationary, the inclination of the surface elements of said package between the beveled ends being substantially parallel to those of the core except at the nose end of the package, said nose end being inclined slightly toward the axis of the core.

10. An improved yarn package comprising a body of yarn wound in crossed helices about a conical core and having either end beveled to form a self-sustaining package which is unwound in use by withdrawing the yarn over the smaller or nose end of the package while holding the core stationary, the inclination of the surface elements of said package being substantially parallel to those of the core except at the nose end of the package, said nose end being rounded slightly toward the axis of the core, said rounding of the nose end being formed by the presence of a series of annular cavities caused by the interspersing of a plurality of shortened traverses of yarn at said end.

11. An improved yarn package comprising a body of yarn wound in crossed helices about a conical core and having its ends beveled toward the ends of the core to form a self-sustaining package, the inclination of the surface elements of said package being substantially parallel to those of the core, and the pitch of the helices decreasing progressively from the nose end to the base end of the package to form a package of substantially uniform density, and the nose end of the package being inclined slightly toward the axis of the core.

12. An improved yarn package comprising a body of yarn wound in crossed helices about a core to form a self-sustaining package, at least one end of the package being formed by a series of yarn traverses extending to and being in substantial alignment at that end and regularly interspersed by courses of slightly shorter traverses terminating short of and adjacent that end to form cavities thereat to thereby prevent the formation of a lip or ridge at said end, said cavities extending in from the end of the package a distance substantially equal to that occupied by the lip which would otherwise be formed thereon.

13. An improved conical yarn package comprising a body of yarn wound in crossed helices about a conical core to form a bevel-ended self-sustaining package, both ends of said package being formed by yarn traverses extending to said ends and interspersed by courses of slightly shorter traverses terminating short of said full-length traverses at both ends, the shortening of said traverses at the smaller end of the package being greater than at the larger end thereof.

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