March 18, 1969 W. P. SMITH 3,433,355

TAPE ROLL AND METHOD OF MAKING THE ROLL

Filed June 30, 1967

FIG. 1

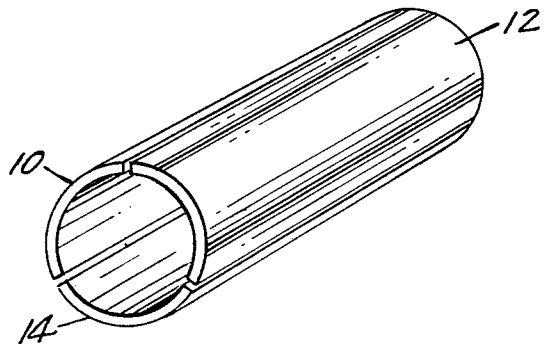

FIG. 2

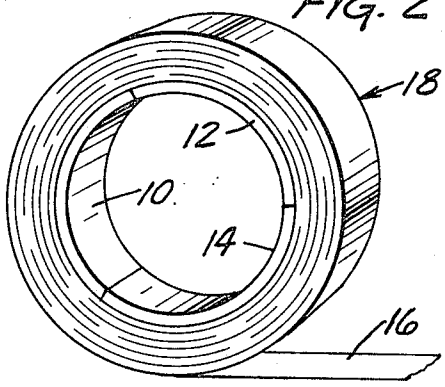

FIG. 4

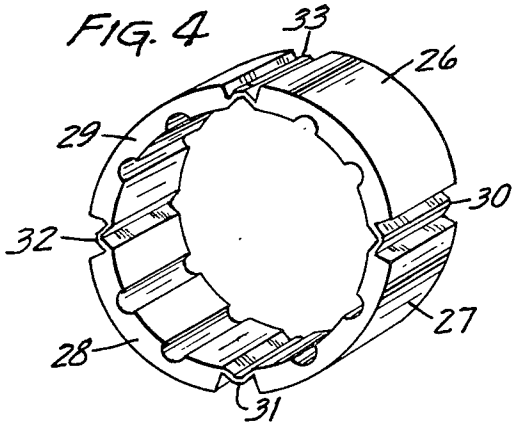

FIG. 3

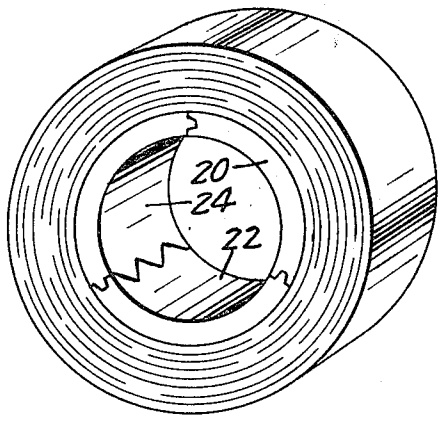

FIG. 6

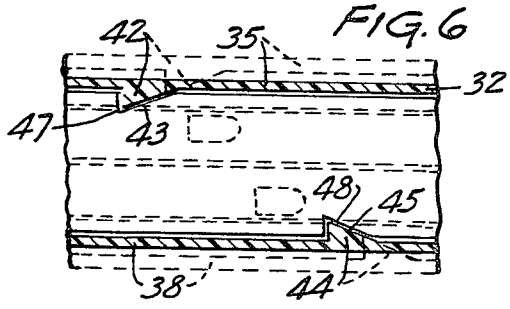

FIG. 5

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United States Patent Office 3,433,355
Patented Mar. 18, 1969

3,433,355

TAPE ROLL AND METHOD OF MAKING THE ROLL

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Filed June 30, 1967, Ser. No. 650,485
U.S. Cl. 206—59 5 Claims
Int. Cl. B65h 75/02; B65d 85/04, 85/66

ABSTRACT OF THE DISCLOSURE

A roll of flexible, stretchy, polymeric film or tape, such as a pressure-sensitive adhesive tape, wound on an annular core formed from two or more distinct arcuate segments which are expandable radially outward, for example by an expandable collapsible mandrel for winding of film thereon, radial force of film causes a predetermined amount of collapse of core, thus relieving excessive tension in wound film.

This invention relates to improved rolls of tape, including adhesive tape, wound on novel cores which reduce radial compression forces in the roll, and to a method for forming stable rolls of tape. More particularly, the invention relates to tapes or films wound on cores which contract radially a controlled, predetermined amount.

Pressure-sensitive adhesive tapes are ordinarily sold in roll form, wound upon a cylindrical core. A problem which has constantly been encountered in the winding of such tapes, particularly tapes which have a tendency to shrink upon storage or stretchy tapes which are wound under tension and which tend to shrink again after winding due to the plastic memory of the tape backing, has been the "telescoping" of rolls of film in which excessive radial compression forces were generated. Such telescoping occurs when the radial compression or squeezing causes a lateral displacement of the turns of the roll toward one side, the amount of displacement increasing outwardly from the core so that a funnel-shaped roll of tape is produced. The adhesive exposed through telescoping is easily contaminated, thereby impairing the properties of the tape. In addition telescoped tape rolls are difficult to package and cannot be used in most dispensing equipment which is designed to use tape rolls of a prescribed width, thus resulting in waste of the goods. Similar problems are also encountered in the winding of stretchy films or tapes which do not have an adhesive coating.

Various solutions have been employed in the prior art to reduce or eliminate the telescoping problem. For example, in U.S. Patent 2,350,369 (Sampair et al.) issued June 6, 1944, tape cores were disclosed in which the outermost portion was formed from corrugated material which would collapse under the radial compression caused by shrinkage of the tape, thus relieving the radial compression forces. This construction, however, does not permit holding of the cores in the expanded position during winding, and thus collapse or contraction of the core often occurs during the winding operation. Another solution to

the telescoping problem, which is successful where a relatively small amount of radial displacement is required to relieve the stresses sufficiently to prevent telescoping, is that shown in U.S. Patent 2,693,918 (Bretson et al.) issued Nov. 9, 1954. The cores of the Bretson et al. patent comprised an outer shell on which the tape is wound and inner bearing surfaces for contacting a dispensing device. These inner and outer surfaces were interconnected by spaced supporting ribs. Such constructions are capable of sufficient inward flexing to minimize telescoping. Another suggested system is that shown in U.S. Patent 3,179,245 (Bastain) issued Apr. 20, 1965, wherein a foam layer is provided on the core to allow for collapse. This construction, however, requires a separate heating step to cause the core to collapse.

The present invention provides tape wound on cores employing a new technique for relieving radial compression forces in the roll. The cores used in the present invention are particularly suitable where substantial amounts of shrinkage are desirable, as where stretchy plastic-backed tapes are wound thereon under tension. The present invention employs a segmented core which is held in an expanded position during the winding of the tapes. The segments in the expanded position are spaced apart, forming a core which has slight gaps or spaces therein between the segments. When the core with the tape wound thereon is released from the supporting mandrel, uniform radial relief is provided across the width of the core from the compressive forces caused by winding tension, variable thickness, volumetric changes in the physical size of the tape due to temperature and humidity changes, or other shrinkage forces. The core segments are forced together to form a continuous core of predetermined size. The compression of the core can be accomplished simply by removing the core with the tape wound thereon from the mandrel. The segments are held together as a stable core by means of the inward forces from the tape roll on the arch-like segments and, generally also by frictional forces between the core and the inner wrap of the tape. The cores of this invention allow a larger amount of radial contraction than previously obtainable, the amount of collapse being predetermined in each case by the length of the segments and spaces therebetween which are provided in the design of the core. Tapes wound on such cores have resulted in unexpectedly neat, uniform, and stable rolls. In embodiments of the invention the individual segments of the core can be secured together by hinged elements or an elastic sleeve. Cores in which the segments are thus secured together are as equally expandable and collapsible as those in which the segments are completely separated and are more easily handled.

The invention will be further illustrated by the accompanying drawings, wherein:

FIGURE 1 is a perspective view illustrating assembled expanded core segments prior to winding thereon of the tape and slitting;

FIGURE 2 is a perspective view of a roll of tape of this invention illustrating a core in retracted position;

FIGURE 3 is a perspective view of a roll of tape illustrating a further embodiment of the invention wherein the core is provided with dovetailed or interlocking segments;

FIGURE 4 is a side view of a core illustrating a still further embodiment of the invention wherein the core segments are hingedly interconnected;

FIGURE 5 is a perspective view of one form of mandrel which can be used for holding the cores of the invention in the expanded position during winding, and

FIGURE 6 is a cross sectional view along line **6—6** in FIGURE 5, and also shows the mandrel in expanded position with dotted lines.

The core segments **10**, **12**, and **14**, are expanded as shown in FIGURE 1 during the normal winding and/or slitting operations so that a gap exists between the segments during winding and/or slitting. An expandable and collapsible mandrel, described below, is used to hold the core segments in the expanded position.

With the core segments held in the expanded position, tape **16** is wound under tension around the core segments. The core with the tape thereon is then slit, using conventional slitting equipment to form the desired roll of tape **18** of the desired width, as shown in FIGURES 2 and 3. Alternatively the tape and the cores may be slit prior to winding, if desired.

As shown in FIGURE 3, core segments **20**, **22**, and **24** may optionally be provided with dovetailing or otherwise mating ends. Such interlocking may be desired in cases where the roll is under very low tension after contraction of the core, in order to eliminate the possibility of any endwise slippage of the core segments relative to each other.

In further embodiments of the invention the segments of the cores can be joined together by elastic or hinged elements which hold the segments together for ease of handling of the cores and to provide increased stability to the rolls. For example, the segments can be affixed to an elastic sleeve which is positioned either around or inside the segments. Such a sleeve expands and contracts with the core, and eliminates the need for handling individual core segments. If such a sleeve is positioned around the segments, a uniform surface is provided, on which the first wrap of tape can be wound.

Another means of joining the core segments together is shown in FIGURE 4. In this embodiment segments **26**, **27**, **28**, and **29** are assembled together by hinge elements **30**, **31**, **32** and **33**. The latter hinge elements retain the segments in the desired positions with relation to each other, and thus provide easy assembly of the segments over a mandrel, while at the same time allowing the desired amount of expansion and contraction of the core. The construction of FIGURE 4 admits itself readily to the formation of the hinged, segmented cores by extrusion of a plastic material in continuous lengths. The extruded tubes can then be cut to any desired shorter length.

It will be apparent to those skilled in the art that various types of expandable and collapsible mandrels can be used to hold the cores in expanded position during winding. For example, the mandrel may be expanded mechanically or by means of hydraulic or gaseous pressure. The core-supporting surface of the mandrel may, for example, consist of curved metal segments or an elastic sleeve.

The mandrel shown in FIGURES 5 and 6 for purposes of illustration employs a number of mechanically expandable sections **34**, **35**, **36**, **37** (not shown), **38**, and **39** (not shown) whcih are preferably arcuate segments of equal length. Each of the sections has a number of metal protrusions, e.g., **42** and **44**, affixed to it. Each protrusion preferably has an inclined surface **43**, **45**. The arcuate segments are assembled around a shaft **46**. Each protrusion fits into a mating depression, e.g. **47** and **48**, in shaft **46**. As the segments **34**, **35**, **36**, **37**, **38** and **39** are shifted axially on shaft **46**, the segments are forced radially outward as the protrusions **42**, **44**, ride up the inclined surfaces of the depressions **47** and **48**. The axial movement of the sections on the shaft is accomplished by turning the nuts **50** and **52** simultaneously in the same direction (clockwise or counterclockwise). The inner faces of the nuts are bored adjacent to the threads to the maximum diameter of the expanded mandrel and to a depth of ¼ to ½ inch. Bored out portion **54** of nut **52** is shown in the drawing. The segments fit into the bored out portions **54** (and a corresponding portion on nut **50**, not shown) and are thus held in position around the shaft by the nuts. When it is desired to collapse the mandrel, the nuts are simultaneously turned in the direction which causes the protrusions **42**, **44**, etc. to slide back into the depressions **47**, **48**, etc. Shaft **46** has a drive gear **60** affixed to one end to provide a means for rotating the mandrel during the tape winding operation.

The number of segments used in making a particular core is a matter of choice, as it is possible to form suitable cores having various numbers of segments. Preferably two to six segments, either entirely separate or hingedly interconnected, are used. Three segments are usually sufficient, and preferable, as this number provides uniform shrinkage around the core while at the same time providing segments of sufficient circumferential length to form arch-like elements which support the tape wound thereon better than would a larger number of circumferentially shorter segments. When a large number of segments is used it becomes more desirable to interconnect the segments either hingedly or with an elastic sleeve. It is preferred for convenience to use segments of equal length on any given core, but it will be understood that segments of different lengths may be used. The circumference of the cylinder or other annulus for making the core segments should be chosen with due regard for the final diameter desired in the final core. The size of the gaps or spaces used between the segments is then selected experimentally to best allow for the shrinkage required for the particular tape to be wound on the core under a given winding tension. The cores used in the practice of this invention can be formed from any stiff, relatively rigid, compression-resistant material such as cardboard, plastic, or the like.

The cores of this invention can be used for winding stretchy films or tapes of any composition, for example, polyvinyl chloride, polyolefin and polyester polymers, silicone rubbers, and other stretchy plastic, rubbery, or elastic materials. The tapes may be uncoated or coated with an adhesive, for example a pressure-sensitive adhesive. Such adhesives are known to those skilled in the art, and may be, for example, of the rubber-resin, acrylate, or polyvinyl ether type. Examples of adhesive tapes which may be used with the cores of the present invention are those shown in U.S. Patent Nos. Re. 23,843 (Oace et al.) issued June 29, 1954; 2,882,183 (Bond et al.) issued Apr. 14, 1959; and 3,129,816 (Bond et al.) issued Apr. 21, 1964. The cores of this invention perform particularly well with very stretchy tapes because substantially more radial displacement is possible with the cores of the present invention when compared to prior known devices.

What is claimed is:

1. A roll of pressure-sensitive adhesive tape of the type having a normally tacky adhesive coating upon a stretchy flexible backing wound upon a hollow cylindrical core, said cylindrical core being formed from discrete arcuate segments, which together form said hollow cylinder, said segments being held in position by radially compressive forces of said tape wound thereon.

2. A roll of pressure-sensitive adhesive tape of the type having a normally tacky adhesive coating upon a flexible backing wound upon an annular core formed from a stiff relatively rigid material, said core being formed from at least two separate arcuate segments which together form said annulus, said segments being held in position by radially compressive forces of said tape thereon.

3. A roll of tape according to claim **2** wherein said backing is a stretchy plastic material, and said pressure-sensitive adhesive is of the rubber-resin type.

4. A method of forming stable rolls of polymeric film material wrapped around a core which comprises

(1) providing an annular core,

(2) placing an expandable, collapsible mandrel within said core,

(3) expanding said mandrel,

(4) winding a stretchy plastic film around said core while the core is in a radially expanded position, in repeated wraps encircling said core,

(5) radially collapsing said mandrel, thereby permitting said core to contract radially under the compressive forces of said film, whereby excessive tension in said film is relieved.

5. Method according to claim 4 wherein said film is coated with a pressure-sensitive adhesive.

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MARTHA L. RICE, *Primary Examiner.*

U.S. Cl. X.R.

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