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2,746,696

ADHESIVE TAPE SUPPLY ROLL

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FIG. 1

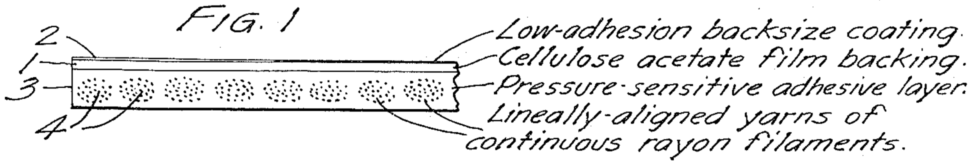


FIG. 2

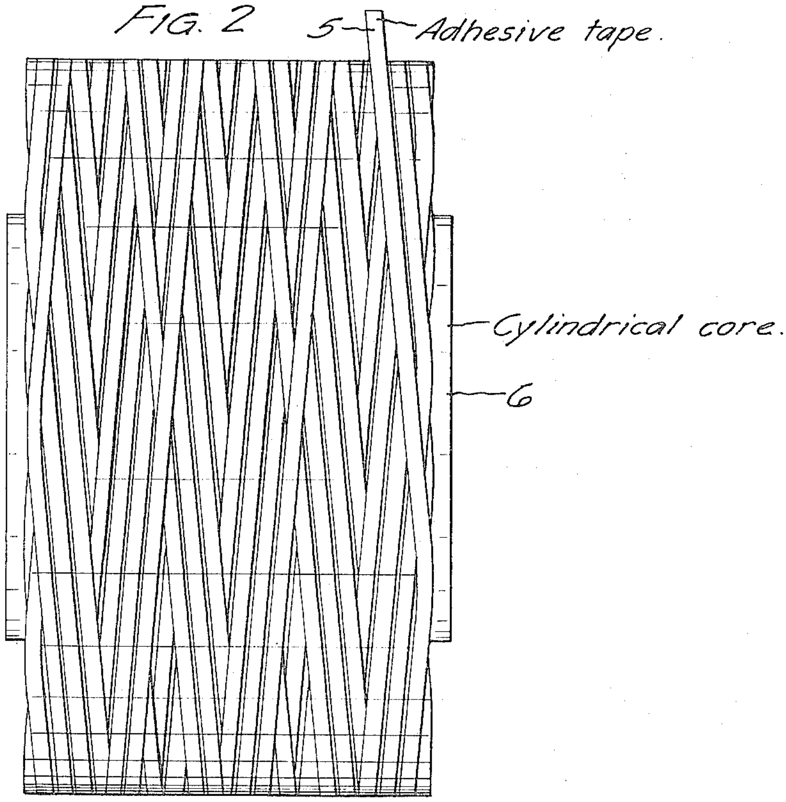
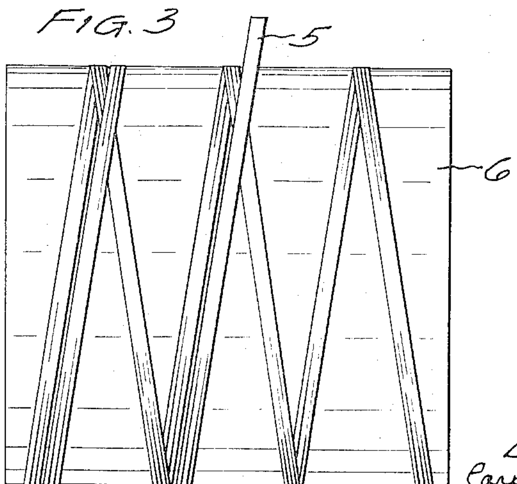


FIG. 3



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ADHESIVE TAPE SUPPLY ROLL

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3 Claims. (Cl. 242—159)

This invention relates to a novel article of manufacture consisting of an extremely long length of narrow-width filament-reinforced pressure-sensitive adhesive tape wound on a core in such a manner as to permit of convenient use in automatic tape-applying machines wherein the tape is to be unwound at high rates of speed.

More particularly, the invention relates to novel supply rolls of tape which, unlike ordinary rolls of tape, carry an extremely long length of tape (1,000 to 10,000 yards) wound upon the core and the tape has a narrow width (⅛ to ¼ inch). The tape with which I am concerned is a filmbacked pressure-sensitive adhesive tape having a normally and aggressively tacky adhesive coating in which is embedded a layer of contiguous lineally-aligned yarns of continuous rayon filaments that reinforce the tape so that it has a high lengthwise tensile strength (at least 25 pounds) and high shock strength and elasticity. The backing is a cellulose acetate film.

This type of tape is capable of being employed as a "tear strip" for paperboard and fibreboard shipping cartons. Machines are available for automatically applying the tape to carton blanks so that when formed into cartons each carton has a tear strip adhered around its inner surface, one end of the strip extending out at the seam so that it can be picked off and grasped. It can then be pulled back around the carton so that it will tear through the wall and thus open the carton, dividing it in two. To reduce costs the applying machines should be operated at high speeds and it is therefore desirable that the tape be furnished in supply rolls that can be efficiently utilized and do not require highly frequent replacement.

There are a number of problems which must be overcome in a satisfactory tape supply roll for this purpose. It must be of such a nature that the aggressively tacky tape can be unwound at high speeds and without tearing or splitting. When the tape is unwound the tacky adhesive must not pick up a reinforcing yarn exposed at the edge of an underlying portion of the tape, or pick up individual filaments, as this would immediately foul up the unwinding operation. The roll must carry an extremely long length of narrow tape, yet must be compact and convenient to handle, and not undergo distortion. Rotation speed in unwinding should not be excessive or have to greatly increase during unwinding to keep up with the lineal speed of the tape being pulled off.

None of these requirements can be met by the conventional spiral-wound tape rolls wherein tape, slit from a web of adhesive sheeting, is wound spirally directly upon itself in fully overlapping relation (the width of the tape roll being the same as the width of the tape and the superimposed tape edges being in the same plane).

I have discovered that all of these requirements are satisfactorily met by the new type of tape supply roll of this invention.

In my tape supply roll, the tape is wound upon a cylindrical core surface which is much longer than the width of the tape (about 4 to 10 inches) and has a large diam-

eter (about 4 to 10 inches). The narrow tape (about ⅛ to ¼ inch width) is wound on in a "level-wound criss-cross" manner, that is, is guided so as to advance back and forth along the length of the cylindrical core as the latter rotates, with the tape of each winding being advanced during each rotation a distance equal to several times the width of the tape, leaving an open formation that is filled in by succeeding windings to fill each layer with tape. The turns of tape cross over the underlying turns at a substantial acute angle.

To avoid cut filament ends exposed along the edges of the tape, the tape can be formed by tearing the original wide web of adhesive sheeting between contiguous yarns so chosen that the tape will have the desired width; this tearing being feasible because the reinforcement consists of lineally-aligned yarns and because the backing is a cellulose acetate film that is readily and smoothly torn. The combination benefit of using a tape free from filament ends at the edges, and of having the superimposed tape edges cross each other at a substantial angle, has been found to avoid the picking up of the yarn or of filaments, when the tape is unwound, even at high speeds.

The tape backing carries a low-adhesion backsize, which reduces the force required to strip the tape from the back surface of the underlying tape in unwinding the roll and thus further facilitates high speed unwinding.

In the accompanying drawings:

Fig. 1 is a diagrammatic edge view of the tip of the pressure-sensitive adhesive tape (the relative thickness being greatly exaggerated);

Fig. 2 is a side view of a supply roll of the adhesive tape; and

Fig. 3 is a corresponding view of the supply roll showing the position of the tape when the first two windings had been applied to the core and the third winding was in process.

Referring to Fig. 1, the adhesive tape has a structure comprising a cellulose acetate film backing 1 having on the back surface an extremely thin coating 2 of a low-adhesion backsize. The backing carries on its face side a layer 3 of pressure-sensitive adhesive (normally and aggressively tacky) in which is wholly embedded a monolayer of contiguous lineally-aligned yarns 4 of continuous viscose rayon filaments (regenerated-cellulose filaments that extend continuously as distinguished from staple fibers). These yarns serve to reinforce the tape in a lengthwise direction. They also permit of tearing the individual tape strips from the wide web thereof as originally manufactured on coating equipment, the contiguous yarns between which each tear takes place serving to control the tear line. The tape resulting from this method of making is free from cut filament ends along the edges of the tape.

The tape has a width of about ⅛ to ¼ inch and is employed in lengths about 1,000 to 10,000 yards long. The low-adhesion backsize is firmly bonded to avoid delamination and serves to materially reduce the force required to strip the tape from underlying tape in a roll, as compared to the force that would be required if the adhesive layer contacted the naked surface of the cellulose acetate film backing of the underlying portion of the tape strip. Pressure-sensitive tape adhesives are well known in the art and need not be described in detail. They are aggressively and stably tacky and cause the tape to instantly adhere to surfaces against which it is pressed. Detailed descriptions of low-adhesion backsizes and of pressure-sensitive tape adhesives will be found in U. S. Patents Nos. 2,532,011 (November 28, 1950) and 2,607,711 (August 19, 1952). The former patent describes a preferred low-adhesion backsize consisting of polyvinyl N-octadecyl carbamate, made by reacting together polyvinyl alcohol and octadecyl isocyanate; and the latter patent describes a preferred example consisting of a copolymer of octadecyl acrylate and acrylic acid in a 3:2 ratio by weight.

A typical tape, useful as a "tear strip" tape, has a cellulose acetate film backing that is 1.5 mils thick, and a pressure-sensitive adhesive layer that is 10 mils thick within which is embedded a mono-layer of aligned yarns numbering 102 per inch width of the tape, each yarn being formed of 120 continuous high-strength filaments of viscose rayon, the yarn having 2½ twists per inch. The individual filaments are of 2½ denier size. A tape of this type having a width of ¼ inch has a lengthwise tensile strength of about 50 pounds and an elongation at break of 15%. Due to its streach and elasticity, it has a high shock strength.

Referring to Fig. 2, there is shown a supply roll of the tape **5** wound upon a cylindrical cardboard core **6**, which has a diameter of about 4 to 10 inches and a length somewhat greater than the distance occupied by the wound tape, which is about 4 to 10 inches. A preferred core diameter is 6 inches and a preferred length is 6¾ inches, the portion occupied by the wound tape being about 6 inches, so as to provide a margin at each end.

The tape is level-wound in a criss-cross manner on the core, being applied through a guide that moves back and forth as the core is rotated so that the tape is wrapped (tacky side down) in a cylindrical helix wherein the turns are not contiguous, the tape direction or pitch being at a substantial acute angle to a plane normal to the core axis.

As illustrated in Fig. 3, which shows the tape after the first two windings have been applied to the core and the third winding is in process, the tape **5** is advanced along the core **6** during each rotation thereof at a rate such that the turns of each winding are spaced apart a distance equal to several widths of the tape; and the number of turns in each winding is preferably not an exact integer, thereby avoiding having the terminal reversal occur at the same place, and distributing the reversal positions of successive windings around the periphery at each end. The tape of the third winding is laid down so as to parallel and lead the tape of the first winding across the core, the edges being contiguous but slightly spaced apart; then the tape of the fourth winding is laid down similarly relative to the tape of the second winding in returning along the core; and so on. Thus the contiguous tape turns of the same layer or level, that are mutually parallel and most closely approach each other in edge-to-edge fashion, supplied by different alternating successive windings of the same direction, are spaced apart a short distance (about 1/16 inch from the edge to edge being suitable), thereby preventing overlapping of edges and maintaining a flat lay of the tape.

In a typical example, having tape of ¼ inch width wound on a 6 inch diameter core, the winding distance on the core being 6¼ inches, the tape is advanced along the core in a helix such that the center-to-center distance between the turns for each rotation of the core is 2 1/16 inches, and the winding direction is reversed after slightly less than three turns.

The angle at which the tape crosses itself is twice the pitch angle of the helix, and is considerably greater than would be obtained if the tape were wound on with each turn contiguous to the preceding turn.

It will be evident from Fig. 3 that the first winding on the core does not fill the surface, and several succeeding windings of the same direction will contact the core as well as contact each other where the tape crosses itself,

so that each level or layer is finally filled by the tape from several windings which alternate with windings of the opposite direction and criss-cross. As the successive windings build up, the tape in going once around will cross over tape at different winding levels, the exposed tape surfaces that are contacted being provided by underlying criss-crossing turns that were laid down during several successive lengthwise travels. Thus when the tape is pulled from the roll in unwinding, each portion of underlying tape from which it is separated is held down by the criss-crossing intermediate portions of tape, thereby avoiding any chance of being lifted up or split during high speed unwinding.

The criss-cross arrangement would result in a tangle preventing further unwinding if the yarns or filaments at the edges of the tape could be pulled free by the tacky tape during unwinding. This untoward result is minimized by the fact that the tape crosses underlying turns at a substantial angle, but it has been found that this feature alone does not suffice. The absence of yarns that have been cut into, thereby forming filament ends available for plucking out at the edges of the tape, is equally important.

It should be noted that criss-cross winding is not obtained when tape is level-wound in a helix with each turn contiguous to the preceding turn, each layer or level being filled with tape laid down during a single end-to-end winding operation and the tape turns of each winding adhering solely to the tape turns of the preceding winding. Moreover, the crossing angle between the tape turns of successive layers would be small, owing to the narrow width of the tape relative to the core diameter. The expression "wound in a level-wound in acriss-cross manner" differentiates my tape roll products, the term "criss-cross" signifying the criss-crossing structure of tape turns that results from winding the tape in the manner I have described so that each layer or level is filled by tape from several windings.

I claim:

1. A tape supply roll comprising a core and a pressure-sensitive adhesive tape cross-wound thereon in a manner to produce adhesive contact between an outer convolution and the next adjacent inner convolutions only at the cross-points, the tape being coated on its outer surface with a low-adhesion backsize.

2. A tape supply roll according to claim 1 in which the core is of a relatively large diameter and length, and the tape is a relatively narrow filament-reinforced tape having a cellulose acetate backing.

3. A tape supply roll according to claim 2 in which the tape is free of filament ends along the edges.

References Cited in the file of this patent

UNITED STATES PATENTS

1,965,524	Melhorn	July 3, 1934
2,369,155	Marinsky	Feb. 13, 1945
2,446,618	Stephano	Aug. 10, 1948
2,607,711	Hendricks	Aug. 19, 1952

FOREIGN PATENTS

797,174	France	Feb. 8, 1936
426,449	Great Britain	Apr. 3, 1935
608,127	Great Britain	Sept. 10, 1948
680,657	Great Britain	Oct. 8, 1952