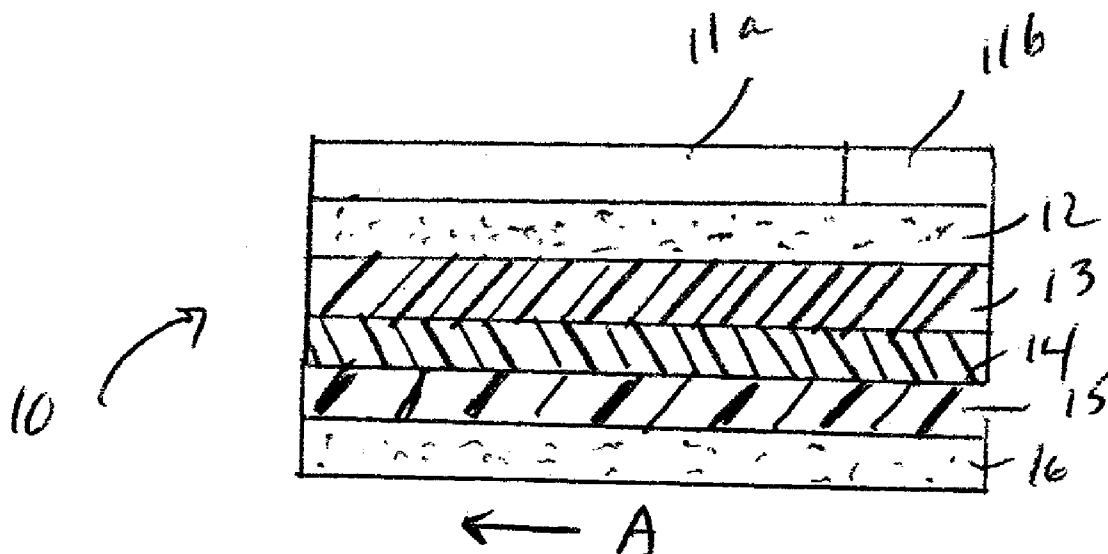




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Manteufel(10) **Pub. No.: US 2008/0087370 A1**(43) **Pub. Date: Apr. 17, 2008**(54) **SPLICING TAPE****Publication Classification**(75) Inventor: **Todd L. Manteufel**, Union Grove,
WI (US)(51) **Int. Cl.**
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ROCKFORD, IL 61107(52) **U.S. Cl. 156/157; 428/41.8**(57) **ABSTRACT**

A splicing tape for making a running splice is disclosed. A running splice is needed for web-fed type continuous processes involving rolls of material. Materials are typically paper or thermoplastic rolls to be printed or coated. The layered splicing tape includes three central layers or films with a controlled breaking force that allows better control over the force required to separate the central layers and allow a replacement roll to be fed into the web on the tail of the roll that has almost been consumed. Pressure-sensitive or other adhesives adhere the splice to the roll and the cohesive failure of the splice then enables the splice to be made without stopping the process.

(73) Assignee: **Custom Adhesive Products, LLC**,
Racine, WI (US)(21) Appl. No.: **11/870,773**(22) Filed: **Oct. 11, 2007****Related U.S. Application Data**(60) Provisional application No. 60/829,427, filed on Oct.
13, 2006.

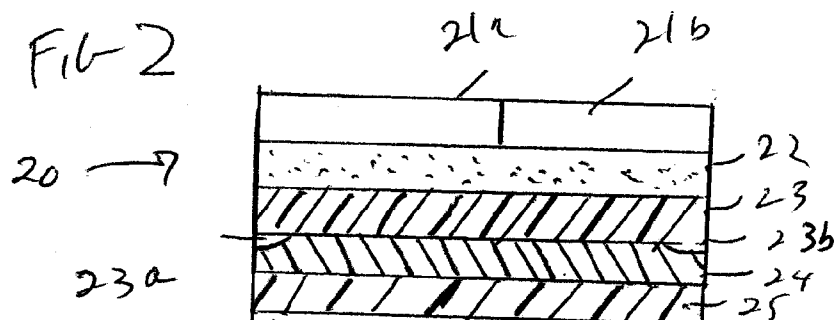
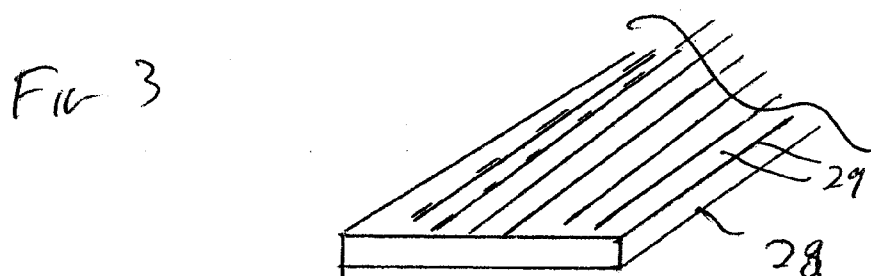
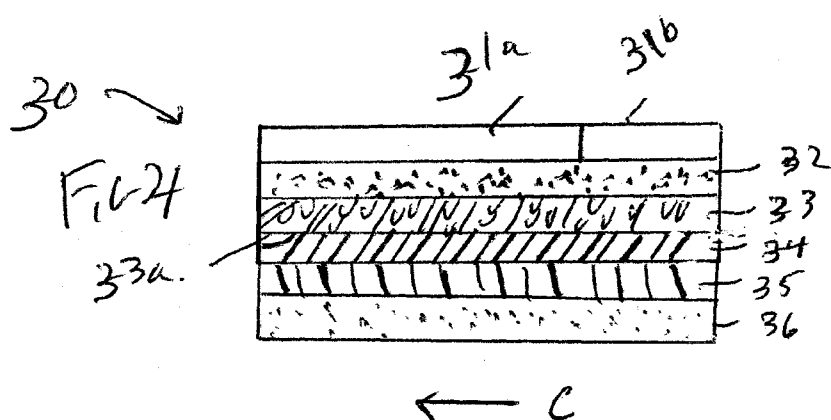
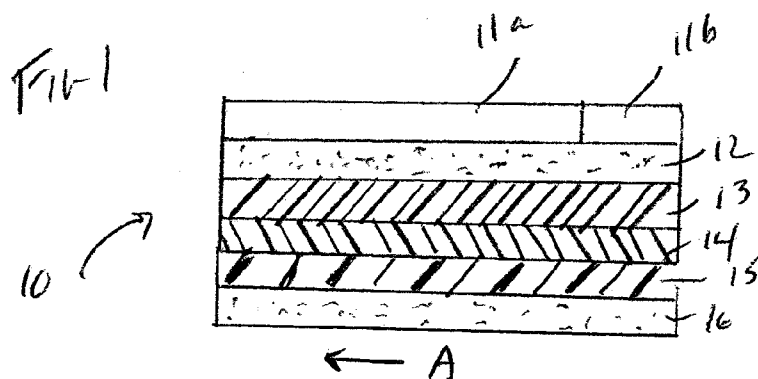


Fig. 5

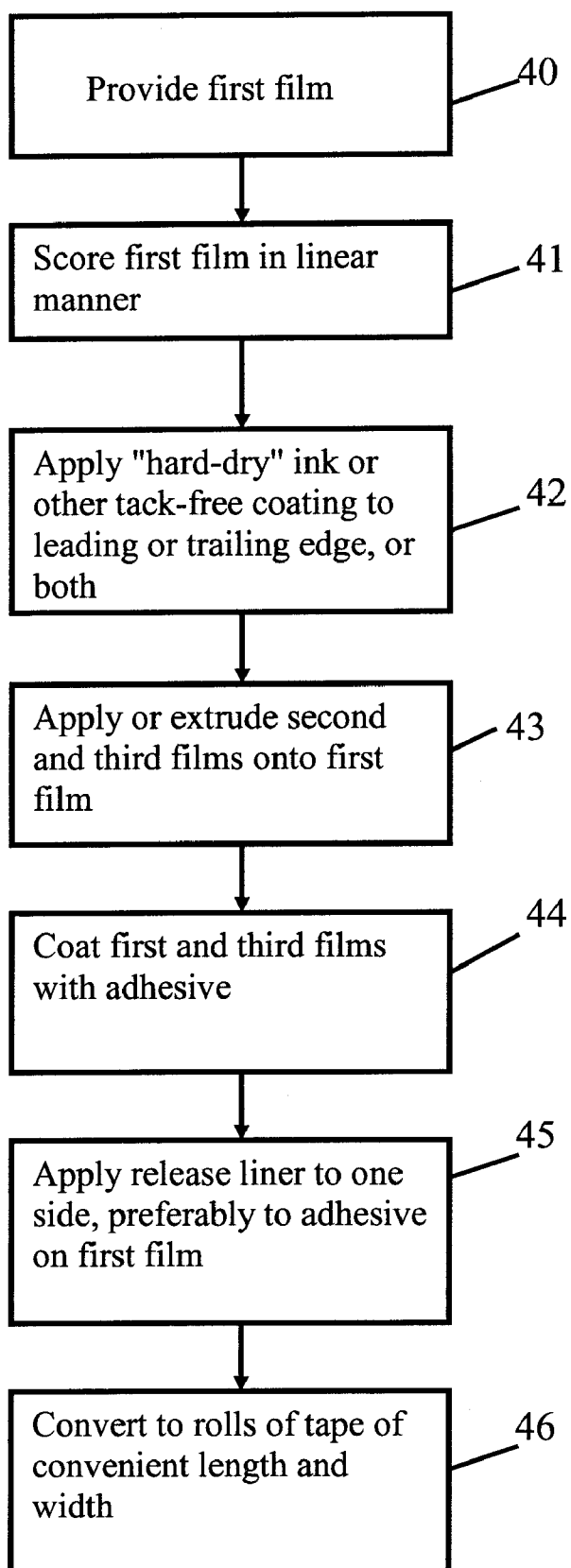
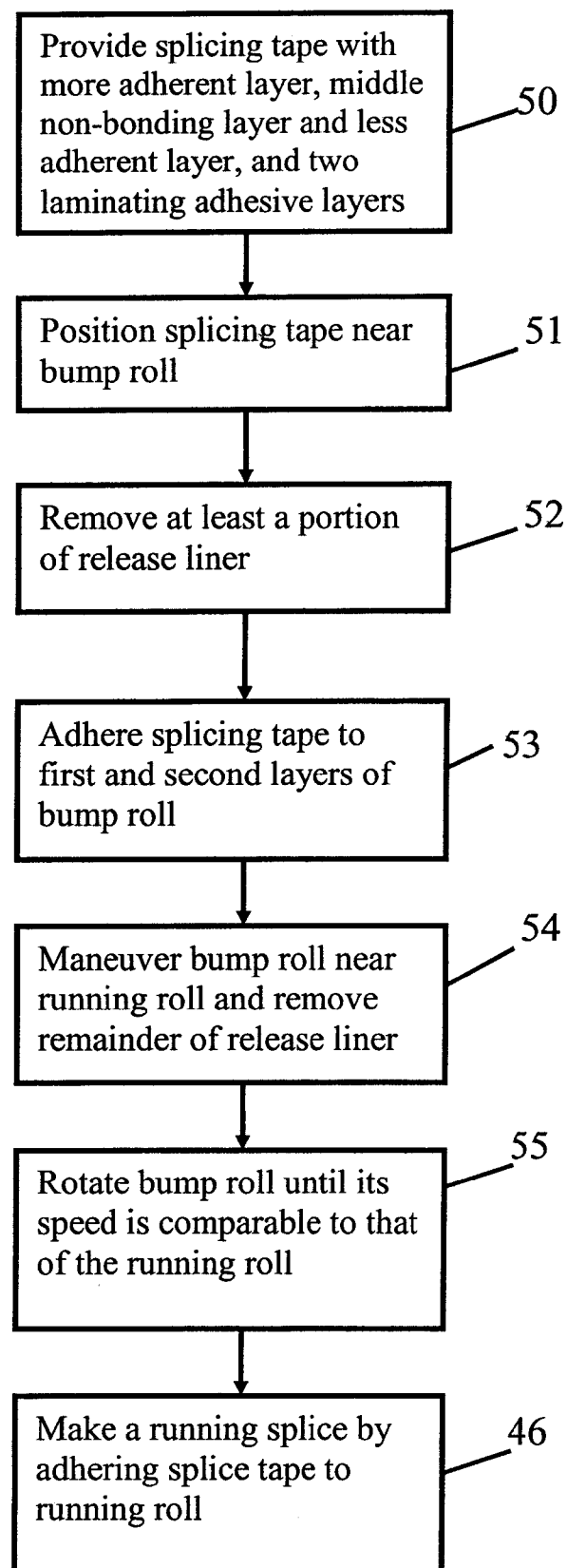


Fig. 6



SPLICING TAPE

CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

[0001] This patent application claims the benefit of U.S. Provisional Patent Application No. 60/829,427, filed Oct. 13, 2006, the entire disclosure of which is incorporated by reference in its entirety herein.

FIELD OF THE INVENTION

[0002] This invention generally relates to pressure sensitive adhesive systems and polymeric films, and the application of pressure sensitive adhesives and polymeric films to on-the-fly splices for industrial web processes.

BACKGROUND OF THE INVENTION

[0003] There are many continuous web-fed processes, in which paper or thin plastic film is unwound from a roll and fed into a printer or coating machine to print or coat the incoming material. Such processes are preferably run in a continuous, uninterrupted manner, even though the feed rolls will eventually be consumed. To keep the presses or coaters running, it is desirable that a splice be made from the roll already in the process to the next roll. A splice may be an adhesive that joins the present roll to the replacement roll. The splice is desirably made so quickly that there is no noticeable interruption in the feed. It has been estimated that about 2% of the material on each roll is wasted because of the technical requirements for making even these splices. Accordingly, making proper splices is important for economical functioning of printing, coating, or other web-based processes.

[0004] There have been a number of prior art attempts to achieve this ideal. An early attempt, U.S. Pat. No. 5,702,555, uses a seven layer symmetrical adhesive tape having a central layer which is cleavable. The inner layer is a cleavable paper, surrounded on either side by a pressure-sensitive adhesive, a release coating, and an outer release layer. The cleavable layer has an internal bond strength of from 2 to 20 inches per inch of width. This does not sufficiently control the strength of the cleavable layer, and the adhesive tape may break before the paper cleaves, and no splice is achieved.

[0005] In another example, U.S. Pat. Nos. 5,901,919 and 5,916,651 use a multi-layered adhesive tape. A first adhesive layer adheres to the replacement roll, and there is a backing between the first adhesive layer and a second adhesive layer, which is intended to adhere to the roll that is being processed. A release liner protects the second adhesive layer until it is time for adherence to the roll being processed. This adhesive tape is not ideal because the backing layer, which is cleavable, is not sufficiently controlled and the force required may vary from splice to splice.

[0006] Another example is disclosed in U.S. Pat. No. 6,756,101. This patent uses a multi-layer structure, in which the lower portion comprises an adhesive and a breakaway coating releasably secured to an upper portion. The upper portion includes a release coating, a preferably paper substrate, a second layer of adhesive, and an upper release liner. In use, there may be quite a bit of variation in the force required to separate the release coating from the breakaway coating. This leads to unpredictability in the breakaway and makes this product more difficult to use,

[0007] U.S. Pats. No. 6,595,461 and 6,817,567 disclose an unsymmetrical structure in a double-sided adhesive tape intended for making splices on the fly. The products depicted in these patents include a top layer of adhesive and a film substrate, rather than paper. There is a much shorter layer of film secured to the bottom of the substrate with a second layer of adhesive; a third layer of adhesive secures the second layer of film to the replacement roll. The second and third layers of adhesive and the second layer of film are about the same length, much shorter than the top layer of adhesive and film. The second and third layers of adhesive and the film are located far back from the leading edge of the top layers, and are also located a short distance (offset) from the trailing edge. The success of the splice is very sensitive to the amount of the offset.

[0008] Another tape uses a breakable paper layer and actual perforations in the layer. U.S. Pat. Nos. 6,899,933 and 7,037,397 disclose a layered system that include a base paper layer, upper and lower layers of pressure-sensitive adhesive, and a top release liner. The force required to break the paper layer and achieve separation is adjusted by selecting the length and frequency of the perforations, as well as the longitudinal separation of one row of perforations from the next. In addition, the bottom adhesive layer is split into two portions, for a leading edge and a trailing edge, so that breakaway is more easily achieved. While this process works, it is expensive to have perforations and two separate layers of adhesive on the bottom portion.

[0009] Embodiments of the present invention provide a less expensive and more reliable way to achieve on-the-fly splices. These and other advantages of the invention, as well as additional inventive features, will be apparent from the description of the invention provided herein.

BRIEF SUMMARY OF THE INVENTION

[0010] One embodiment is a splicing tape for making a running splice. The splicing tape includes a release liner, a first layer of a pressure sensitive adhesive adjacent the release liner, a first film adjacent the first layer of pressure sensitive adhesive, the first film having a relatively high surface energy, a second film adjacent the first film, the second film comprising a polymer or non-adhesive blend of polymers, optionally comprising an additive to prevent bonding, a third film adjacent the second film, the third film having a relatively low surface energy, and a second layer of a pressure sensitive adhesive adjacent the third film, wherein the second film is configured to break away from the first film and the third film is configured to break away from the second film.

[0011] Another embodiment is a method of making a running splice. The method includes steps of furnishing a splicing tape comprising a release liner, a first layer of a laminating adhesive adjacent the release liner, a first film having a relatively high surface energy, the first film adjacent the first layer of laminating adhesive, a second film having a relatively low surface energy, the second film adjacent the first film, the second film comprising a polymer or non-adhesive blend of at least two polymers, a third layer of film, and a second layer of a laminating adhesive adjacent the third film, wherein the second film is configured to break away from the first film or the third film. The method also includes steps of positioning the splicing tape, removing the release liner, adhering the splicing tape to a replacement roll, maneuvering the replacement roll to a position near a

running roll, and making a running splice by adhering the splicing tape to the running roll, whereby the splicing tape splits between the first film and the second film, or between the second film and third film, and the replacement roll takes a position of the running roll. A longitudinal split in the splice means an in-plane split of one layer from another, e.g., a split between the first film and the second film, whereby the first film and the first adhesive layer above go in one direction (with the leading edge of the replacement roll) and the second film and the second adhesive layer below go in the opposite direction (with the second layer of the replacement roll).

[0012] Another embodiment is a splicing tape for making a running splice. The splicing tape includes a release liner, a first layer of a laminating adhesive adjacent the release liner, a first polymeric film having a high surface energy adjacent the first layer of laminating adhesive, a second film comprising a polymer or a non-adhesive blend of polymers, the second film adjacent the first film, a third film having a lower surface energy adjacent the second film, and a second layer of a laminating adhesive adjacent the third film, wherein the second film is configured to break away from the first film, and the third film is configured to break away from the second film, when a running splice is made.

[0013] Another embodiment is a method for forming a splicing tape for use between two rolls. The method includes steps of furnishing a first film having a high surface energy, applying a second film to the first film, said second film configured as a polymeric film, applying a third film to the second film, said third film having a low surface energy, applying an adhesive coating to exposed surfaces of the first and third films, and applying a release liner to the splicing tape, wherein the first film splits easily from the second film, or the second film splits easily from the third film, when a splice is made between the two rolls.

[0014] Other aspects, objectives and advantages of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The accompanying drawings incorporated in and forming a part of the specification illustrate several aspects of the present invention and, together with the description, serve to explain the principles of the invention. In the drawings:

[0016] FIG. 1 is a side view of a first embodiment of a splicing tape;

[0017] FIGS. 2 and 4 are side views of additional embodiments of a splicing tape;

[0018] FIG. 3 is a perspective view of a scored film;

[0019] FIG. 5 is a flowchart for a method of making a splice tape; and

[0020] FIG. 6 is a flowchart for a method for making a splice using embodiments as described herein.

[0021] While the invention will be described in connection with certain preferred embodiments, there is no intent to limit it to those embodiments. On the contrary, the intent is to cover all alternatives, modifications and equivalents as

included within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

[0022] Web-fed processes may run at speeds of greater than 1200 meters per minute (about 4000 feet per minute). Continuous, reliable production demands that the process, usually a printing or a coating process, run uninterrupted for as long a period of time as possible. Running at such high speed also means that it may be both difficult and essential to change from the running roll to a replacement roll with virtually no interruption, as described above.

[0023] The process for making the change generally takes place with embodiments of the invention as follows. A replacement roll is readied for its place in the line by placing a splicing tape between its top layer and its second layer. The bottom layer of the splice is adhered to the second layer of the roll, and a portion of the release liner of the splice, the portion nearer the trailing edge, is removed. The top layer of the replacement roll is adhered to the exposed portion of the adhesive. When the end of the running roll nears, the portion of the release liner near the leading edge is removed, and the replacement roll is maneuvered into position, typically underneath the running roll. The replacement roll is then rotated until the speed of the top layer is close to the web speed. The splice is made by raising the replacement roll into contact with the web. The web “grabs” the exposed adhesive and the replacement roll begins to unwind at about the speed of the web. The force of the unwinding causes separation of the layers of the splice, and the splice is made. The replacement roll then becomes the running roll, and the process is repeated as often as desired. The layers in embodiments of the present invention are explained below.

[0024] It should be noted that embodiments are intended for use with replacement rolls that are “spun-up” by either an external outer arm that rotates the replacement roll by contact with its outer surface, or by a core-drive mechanism that rotates the replacement roll by contact with its core layer or with the edges of its core layer. Another technical detail concerns the edges of the splicing tape. The splicing tape itself is produced via a web-based process, and the tape is then wound onto a roll. In use, a short length of the tape will be cut or removed from the roll and used to make a splice. The tape is placed cross-wise on a replacement roll, i.e., the leading edge of the splice tape is actually the left or right side of the tape as produced in roll form. Usually, the release liner is scored closer to one edge than the other (left or right edge), for easy removal. One portion of the release liner is typically removed to secure the splice tape to the replacement roll: this will be the trailing edge. After the trailing edge is secured to the replacement roll, the other portion of the release liner is removed (on the leading edge) to ready the replacement roll for making the splice. Thus, the left and right sides of the tape as produced are actually the leading and trailing edges of the splice tape as used.

[0025] A first embodiment of a splicing tape 10 is depicted in FIG. 1. Web feed is in the direction of arrow A, to the left. The top layer is a split release liner, 11a, 11b, in which 11a is in the leading edge while 11b is in the trailing edge. First adhesive layer 12 is a pressure sensitive adhesive, preferably made from an acrylic, rubber, or silicone polymer. Layer 13 is a first layer, preferably but not necessarily polymeric, chosen for its excellent adhesion to first adhesive layer 12.

Layer 13 is preferably polyethylene terephthalate (PET), commonly referred to in the industry as "polyester." Layer 13 may instead be made from other convenient and useful polymers, such as polyvinyl chloride, polyethylene, polypropylene, and so forth. Layer 14 is a second film that is adjacent first film 13. Layer 14 is a polymer or a non-adhesive blend of polymers. Layer 14 may include an additive, preferably laid in a pattern. Layer 14 results in virtually zero bonding force to layer 13 and also to lower layer 15. Layers 13-15 are available from Exact Products, LLC, Mason Ohio, as Part No. 336-A, in which the middle layer is a non-adhesive blend of polymers. Layer 14 may be applied to layer 13 in one or more of many ways. Layer 14 may be a separate roll that is merely laid adjacent layer 13, i.e., layer 14 is unrolled simultaneously and pressed upon layer 13. Alternately, layer 14 may be extruded as a thin film upon layer 13 preferably with cooling to encourage formation of the final, thin configuration of the layered structure. Layer 15 is a second, preferably polymer film, on the other side of layer 14. Layer 15 may also be a separate roll that is merely laid adjacent layer 14, i.e., unrolled simultaneously and pressed upon layer 14. Alternately, layer 15 may be extruded as a thin film upon layer 14 preferably with cooling to encourage formation of the final, thin configuration of the layered structure. Final layer 16 is a second layer of pressure sensitive adhesive. As will be recognized by those skilled in the art, layers 12, 16 of adhesive may be applied at the same time.

[0026] Pressure sensitive adhesives (PSA) and contact adhesives adhere to most surfaces with very slight pressure. They are available in solvent and latex or water based forms. Pressure sensitive adhesives and contact adhesives are often based on non-crosslinked rubber adhesives, acrylics or polyurethanes. Pressure sensitive adhesives form viscoelastic bonds that are aggressively and permanently tacky; adhere without the need of more than a finger or hand pressure; and require no activation by water, solvent or heat. Pressure sensitive adhesives are often based on non-crosslinked rubber adhesives in a latex emulsion or solvent-borne form. PSAs are preferred, but other adhesives may also be used, such as heat-activated adhesives, or others, as desired.

[0027] Pressure sensitive adhesives are available in a wide variety of chemical compositions or systems. Pressure sensitive adhesives do not cure or cross-link, but derive their bonding strength from contact or pressure on the adherends. Some of the most common types of systems include acrylic and methacrylate adhesives, rubber-based pressure sensitive adhesives, styrene copolymers (SIS/SBS), and silicones. Acrylic adhesives are known for excellent environmental resistance and fast-setting time when compared with other resin systems. Acrylic pressure sensitive adhesives often use an acrylate system. Ethylene ethyl acrylate (EEA) or ethylene methyl acrylate (EMA) copolymers are used to form hot melt PSA adhesives. Natural rubber, synthetic rubber or elastomer sealants and adhesives can be based on a variety of systems such as silicone, polyurethane, chloroprene, butyl, polybutadiene, isoprene or neoprene. Rubber and elastomers are characterized by their high degree of flexibility and elasticity (high reversible elongation). Styrene-isoprene-styrene (SIS) and styrene-butadiene-styrene (SBS) copolymers are commonly applied in pressure sensitive adhesive applications. Silicone is produced through the hydrolysis and

polymerization of silanes and siloxanes. All pressure-sensitive adhesives, also known as contact adhesives, are meant to be included.

[0028] The key to the performance of the improved splicing tape is the nature of the bond between the film layers 13, 14 and 15. Upper film 13 is chosen for excellent adhesion and may be treated to increase its surface energy so as to bondably receive pressure sensitive adhesive layer 12. Other surface treatments may also be applied, e.g., exposing the film to oxidized air or chemically treating the film, such as by exposing the film surface to caustic soda (sodium hydroxide) or other oxidizing agents, such as sodium hypochlorite (bleach) or other oxidizing treatments. For instance, PET film may be flame treated, corona treated or plasma treated to increase its surface energy for better bonding. In one embodiment, the surface energy of the film may be about 45-55 dynes/cm. This insures a good bond to pressure sensitive adhesive layer 12. On the other side, lower film layer 15 is chosen for its inability to bond well to layer 14. Thus, the lower film layer is preferably made from a polymer with a lower surface energy, preferably less than 40 dynes/cm, more preferably less than 35 dynes/cm, such as polypropylene or one of the polyethylene polymers. Other substrates and polymers with low surface energy, such as latex or polystyrene, may also be used. Fluoropolymers would be very desirable because of their low surface energy and poor bonding, but would only be chosen for premium-priced versions of the splicing tape. Surface energy of an adherend is sometimes referred to as surface tension; the meaning is the same in this context, that a solid with a higher surface energy or surface tension is more easily bonded to another material.

[0029] Optionally, film 15 may include substances to control the adhesion between film 15 and film 14. For instance, slip agents, such as long-chain primary amides, may be included as part of the film 15. Examples include stearamide, erucamide, and oleamide, typically applied at a level from about 100 to about 4000 ppm. Other levels may be used. As noted above, the bond between layers 14 and 15 is poor, so that the layers will quickly split when the splice is made. Whether or not a slip agent is used, and without being bound by any particular theory, it is believed that films 13, 14 and 15 adhere to each other with only minimal forces, such as those resulting from electrostatic attraction or Van der Waal's forces, rather than direct stronger bonds, such as those provided by adhesives.

[0030] The overall splicing tape 10 is preferably no more than about 5 mils thick, 0.005 inches (about 0.13 mm). The upper pressure sensitive layer is preferably about 1 to 3 mils (0.025 to about 0.076 mm) thick, but may range from 0.5 to 7 mils thick (0.013 mm to about 0.18 mm). Preferred adhesives include Aroset numbers 414, 1845-z-45, and 1920 from Ashland Chemical Co., Covington, Ky. Also useful are Duro-Tak 80-1058 and 80-1068 from National Starch and Chemical Co., Bridgewater, N.J., and S8510 from Avery Denison Performance Polymers, Mill Hall, Pa., U.S.A.

[0031] The upper film, as stated, is preferably polyethylene terephthalate, but may instead be made from another material, so long as it will adhere to the upper pressure sensitive layer. The upper polymeric film is preferably about 0.75 mils thick to about 2.50 mils thick (about 0.019 mm to about 0.064 mm), but may vary from about 0.4 to about 8.0 mils (about 0.010 mm to about 0.20 mm). Middle film 14 is thin, preferably from about 0.1 to about 0.5 mils (about

0.004 to about 0.020 mm), but it may be even thinner or may also be thicker. Lower film **15** is preferably polypropylene, from about 0.5 mils to about 2.50 mils (0.013 mm to about 0.064 mm). The lower level of pressure sensitive material is preferably about 0.75 mils thick to about 2.50 mils thick (about 0.019 mm to about 0.064 mm), but may vary from about 0.25 to about 5 mils thick (about 0.006 mm to about 0.13 mm thick). Other thicknesses may be used for any of the layers, and English units are definitive. Preferred adhesives are those adhesives listed above for the upper polymeric film. The force of separation is preferably about 20 g/linear inch of splice.

[0032] The middle layer, the blend of polymers, is preferably made from two polymers or other substances with low surface energy and thus poor bonding ability to adjacent layers. The polymers in the blend may include at least two of polyethylene, low density polyethylene, linear low density polyethylene, high density polyethylene, polypropylene, polybutene, polyoctene, polystyrene, and others. In other embodiments, the middle layer may be a single polymer, of low surface energy, rather than a blend of two polymers. In addition, the middle layer may include additives to help prevent adhesion to other films. These additives may include slip agents, as discussed above, inert fillers, and particles or mechanical additives, such as clay particles or calcium carbonate fillers, such as Camel Wite® (ground marble additive).

[0033] Another embodiment of a splicing tape is shown in FIG. 2. This embodiment is very similar to that of FIG. 1, but in this embodiment, lower layer **25** has an additional coating layer **23a**, used only at the leading edge, and additional coating layer **23b**, used only at the trailing edge, of splicing tape **20**. Additional coating layers **23a**, **23b** virtually prevent adhesion of middle film **24** to upper film **23**. The direction of web feed is in the direction of arrow B. The remainder of the layers include release layer **21a**, **21b**, preferably split as shown for easier use in connecting splicing tape **20** to a replacement or bump roll. First pressure sensitive layer **22** may be a silicone, rubber, or acrylic-based adhesive, and is preferably thicker than second PSA layer **26**. First polymeric layer **23** preferably has a high surface energy surface for bonding to adhesive layer **22**. Middle film **24** is preferably a low surface energy polymeric film, such as a non-adhesive blend of polymers, as described above. Lower film **25** is preferably also a low surface energy polymeric film, such as polypropylene. Other films or substrates may be used. The preferred thicknesses of the layers in FIG. 2 are similar to those discussed above for FIG. 1.

[0034] The extent of additional coating layers **23a**, **23b** may be short, i.e., only one-eighth to one inch long, and preferably about one-quarter inch long, extending in the direction of feed, or arrow B, along the width of the splice tape (extending into the paper). In addition, only one of these layers may be used, i.e., either the leading edge layer **23a** or the trailing edge layer **23b**. The leading edge is preferred for a snappy, controlled split of the splicing tape when the transition is made from the running roll to the replacement roll. The additional coating layers are believed to provide a "lift edge," making separation easier.

[0035] The coating used for additional coating layers **23a**, **23b**, may be any coating or adhesive that dries or cures to form a tack-free surface. They adhere to the upper film **23** but do not adhere to middle film **24**, and thus insure a quick and reliable split of the splice in operation. Examples of

coatings that suffice are the Marathon Relay "hard dry" inks from the Kohl & Madden division of Sun Chemical Co., Fort Lee, N.J. The 725 brand inks from Kohl & Madden also dry hard with minimal tack. Other inks may also be used so long as they dry to a tack free condition. Acrylic adhesives, such as the Permabond® line from Permabond, Bridgewater, N.J., U.S.A., dry to a tack-free condition and may be used, as do urethane coatings and adhesives for Soluol, Inc., West Warwick, R.I., U.S.A. Even though some of these chemicals may be "adhesives," they are used to prevent adhesion of one layer to another, and thus do not function as adhesives in these applications. Other coatings and adhesion-prevention members may also be used, such as a coating that leaves particles of a size effective to prevent contact, and thus adhesion, between the layers. Examples would include a barrier coating with tiny cured particles of SIS/SBS, rubber, talc or other particles.

[0036] Another embodiment of a splicing tape is shown in FIG. 4. This embodiment is very similar to that of FIG. 3, but in this embodiment, additional coating layer **33a** is used only at the leading edge of splicing tape **30**. Additional coating layer **33a** virtually prevents adhesion to the middle film **34**. The direction of web feed is in the direction of arrow C. The remainder of the layers include release layer **31a**, **31b**, preferably split as shown for easier use in connecting splicing tape **30** to a replacement or bump roll. First adhesive layer **32** may be a silicone, rubber, or acrylic-based adhesive, and is preferably thicker than second adhesive layer **36**. First film layer **33** preferably has a high surface energy surface for bonding to layer **32**. First film layer **33** may be made from paper, cellulosic material, or other thin, filmy material. Middle film **34** is a preferably a blended, non-bonding, low surface energy layer as discussed above. Lower film **35** is preferably a low surface energy polymeric film, such as polypropylene. Other films or substrates may be used. The preferred thicknesses of the layers in FIGS. 3-4 are similar to those discussed above for FIG. 1. As noted, other embodiments of middle film **34**, and thus other embodiments of the splicing tape, may include only a single polymer rather than a blend.

[0037] A method of making the splicing tape is depicted in FIG. 5. A first film or layer is provided **40**, preferably in roll form. As noted above, the first film is preferably polyethylene terephthalate, commonly known as "polyester" in the industry. However, this first film may be virtually any polymeric film or other continuous type sheet, such as paper or cellulosic material. The film may then be scored **41**, i.e., run through a die or roller that leaves small raised tracks in the material, for easier later separation of the first film from a second film. Note that FIG. 3 depicts a layer or film **28** with score marks **29** as described here. A coating may then be applied **32** to the film, such as to the leading or trailing edge, or both. The coating could be applied to the entire surface of the film, but it is preferred to apply the coating only to the leading edge, for ease of separation of the film layers. As noted, the coating is meant to prevent or minimize adhesion of the layers to each other, and the coating is preferably a hard-dry ink or other barrier to adhesion.

[0038] A second layer and a third layer is then applied **43** to the first film or layer. The second layer is preferably a non-adhesive blend of polymers utilized with or without an additional additive laid in a pattern resulting in a zero bond lift area. By a zero bond lift area is meant that when the second layer is assembled to the first and third layers, at least

one of the first and third layers has virtually zero bonding to the second layer. One product sold by Exact Products, LLC, Mason, Ohio, U.S.A., Part Number 336-A, is a laminate of a first outer layer of polyethylene terephthalate, one layer of a non-adhesive blend of polymers with or without an additive laid in a pattern resulting in a zero bond lift area, and a second outer layer of polypropylene on the opposite side of the laminate.

[0039] The polymer or non-adhesive polymer blend may also be simply a polymer or blend that yields virtually no bonding to the first and third layers. For instance, polymers with low surface energy will work well, such as a single polymer, or two or more polymers, preferably but not necessarily selected from the group consisting of polyethylene, low density polyethylene, linear low density polyethylene, polypropylene, polybutene, polyoctene, and polystyrene (polystyrene preferably in blends only). The non-adhesive polymer or blend preferably has a surface energy of 35 dynes/cm or less. The blend may include one or more additives, such as a slip agent, small particles, or fillers as mentioned above, pigment particles, or other additive to achieve a virtually a zero bond area when laminated to the first layer.

[0040] The second layer is applied to the first layer in one of several ways. The second layer may be extruded, pressed on as a dry film, or roller-coated onto the first layer. One method of extruding is disclosed in U.S. Pat. App. Publ. 2005/0266194, which is hereby incorporated by reference as though each word and figure of this application were set forth herein in their entirety. An extrusion process is preferred, with cooling, to control the thickness and application of the second layer. Alternatively, the second layer may be fabricated as a roll of polymeric film, and then laminated to the first layer by one or more nip rolls or pinch rolls. If the rolls have a pattern with high and low spots, the pattern will help prevent bonding to the second layer. Alternatively, the second layer may be formed by first preparing one or more polymers in a solvent and coating the second layer onto the first layer, for instance by roller coating or other coating process. Additives may be slurried into the coating or added by pressing onto the still-wet coating, or by any other desired method. A discontinuous coating applied in this manner, with or without additives, will prevent bonding to the third layer.

[0041] After the second film is applied, the third layer is added. One preferred method of applying the third layer is to extrude a film of polypropylene through a die onto the first and second films as the combination of the first and second film moves under the die or other apparatus. There is preferably a chill roll or water bath immediately following the extrusion die, and there may also be one or more compaction dies in series after the film is extruded and cooled onto the first film. It is not necessary that the second layer be a polypropylene film. The third layer could as well be a different polymer film, such as polyethylene, PVC, PVA, polycarbonate, nylon, nylon 6/6, ionomeric resin (such as DuPont Surlyn®), PEEK, polyphenylene sulfide, polyimide, polyethylene naphthalate (PEN), and so forth. The third layer could also be made from another material, such as a coated paper, a Kraft paper, a non-woven (preferably spun-bonded) film, or other layer. As noted, the property desired from this layer is minimal adhesion to the first two layers. If the third layer is not extruded onto the first two layers, the third layer may be applied via compaction rolls

in a continuous process. The first layer, instead of being polyethylene terephthalate, could also be a non-polymeric material, such as Kraft paper, coated paper, non-woven film, or other material. For convenience, each of these portions are referred to as a "film" or a "layer," regardless of the nature of the material used.

[0042] It is also possible to add the second and third layers, as discussed above, by a process that presses or extrudes the second and third layers sequentially and preferably simultaneously in the same production line. U.S. Pat. No. 6,110,552, discloses a process for sequential extrusion, and is hereby incorporated as though each word and figure were set forth herein in their entirety. This process has added advantages of economical efficiency, as both layers may be applied in a single step, and the finished tape or roll is complete at the end of the processing line. The extrusion takes place with cooling after each extrusion step. Alternatively, the two layers may be applied with sequential nip rolls, and then rolled into a roll of splicing tape at the end of the line.

[0043] After the three layers have been joined, the outer sides of the layers are coated **44** with an adhesive, preferably a pressure-sensitive adhesive. A release liner is then applied **45** to the exposed adhesive that is adjacent the first layer. Finally, the formed splice-tape is converted **46** to more convenient-sized rolls of tape. For example, the process for forming the tape may be conducted using a web that is about 3 to 5 feet (about 1 to 1.5 meters) across. The formed web may be converted by running the web through a converter or slit to form rolls of tape that are about 3 to 6 inches (about 0.075 to 0.15 meters) wide. This size is more convenient for use.

[0044] A method of making a splice is depicted in the flowchart of FIG. 6. The method includes a step **50** of furnishing a splice tape as described above, the splice tape including two polymeric layers with different properties and a pressure sensitive adhesive on one side of each layer, and a middle layer as outlined above. The method includes positioning **51** the splice tape near the replacement or bump roll, and removing **52** at least a portion of the release liner on the top surface of the splice tape. The splice tape is then adhered **53** to the first and second layers of the bump roll. The top surface of the splice tape, from which the release liner was removed, is adhered to the leading edge of the bump roll. The bottom surface of the splice tape is adhered to the second layer of the bump roll. The bump roll is then maneuvered **54** into position near the line and the remainder of the release liner is removed. The bump roll is then rotated **55** until it is at or near the speed of the running roll. The running splice is then made **56** by maneuvering the bump roll and the exposed top adhesive layer into position so that the exposed top adhesive layer contacts and adheres to the moving web.

[0045] All references, including publications, patent applications, and patents cited herein are hereby incorporated by reference to the same extent as if each reference were individually and specifically indicated to be incorporated by reference and were set forth in its entirety herein.

[0046] The use of the terms "a" and "an" and "the" and similar referents in the context of describing the invention (especially in the context of the following claims) is to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms "comprising," "having," "including," and

“containing” are to be construed as open-ended terms (i.e., meaning “including, but not limited to,”) unless otherwise noted. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise clearly contradicted by context. The use of any and all examples, or exemplary language (e.g., “such as”) provided herein, is intended merely to better illuminate the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention. [0047] Preferred embodiments of this invention are described herein, including the best mode known to the inventors for carrying out the invention. Variations of those preferred embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend for the invention to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

What is claimed is:

1. A splicing tape for making a running splice, the splicing tape comprising:

- a release liner;
- a first layer of a pressure sensitive adhesive adjacent the release liner;
- a first film adjacent the first layer of pressure sensitive adhesive, the first film having a relatively high surface energy;
- a second film adjacent the first film, the second film comprising a non-adhesive polymer or blend of polymers, optionally further comprising an additive to prevent bonding;
- a third film adjacent the second film, the third film having a relatively low surface energy; and
- a second layer of a pressure sensitive adhesive adjacent the third film, wherein the second film is configured to break away from the first film and the third film is configured to break away from the second film.

2. The splicing tape according to claim 1, wherein the tape is configured to break at an applied force of about 20 g/inch.

3. The splicing tape according to claim 1, wherein the release liner is cut into two portions across the tape.

4. The splicing tape according to claim 1, wherein the first and second layers of pressure sensitive adhesive comprise acrylic, rubber, or silicone pressure sensitive adhesive.

5. The splicing tape according to claim 1, wherein the first and third films are selected from the group consisting of polyethylene terephthalate (PET), polypropylene, and polyethylene films.

6. The splicing tape according to claim 1, wherein the second film is a blend of at least two polymers selected from the group consisting of polyethylene, low density polyeth-

ylene, linear low density polyethylene, high density polyethylene, polypropylene, polybutene, polyoctene, and polystyrene.

7. The splicing tape according to claim 1, wherein the second film is a blend of at least two polymers selected from the group consisting of polyethylene, low density or high density polyethylene, linear low density polyethylene, polypropylene, polybutene, polyoctene, and polystyrene, and is configured as a non-bonding blend of at the least two polymers, and optionally comprises an additive to prevent bonding.

8. The splicing tape according to claim 1, wherein the first film is a polymeric film and the third film is selected from the group consisting of a polymeric film, a cellulosic film, and a paper.

9. The splicing tape according to claim 1, wherein the third film is a thermoplastic material and optionally comprises a slip agent or filler to help prevent adhesion.

10. The splicing tape according to claim 1, further comprising a barrier coating on an edge of the first or third film.

11. A splicing tape for making a running splice, the splicing tape comprising:

- a release liner;
- a first layer of a laminating adhesive adjacent the release liner;
- a first film having a high surface energy adjacent the first layer of pressure sensitive adhesive;
- a second film comprising a polymer or non-adhesive blend of polymers, said second film adjacent the first film;
- a third film having a lower surface energy adjacent the second film; and
- a second layer of a laminating adhesive adjacent the third film, wherein the second film is configured to break away from the first film, and the third film is configured to break away from the second film, when a running splice is made.

12. The splicing tape according to claim 11, wherein the first film comprises a layer of polyethylene terephthalate with a thickness from about 0.0004 inches to about 0.0025 inches.

13. The splicing tape according to claim 11, wherein the first film comprises a layer of polyethylene terephthalate treated to have a surface energy of about 45-55 dynes/cm.

14. The splicing tape according to claim 11, wherein the third polymeric film comprises a layer of polyethylene or polypropylene with a surface energy less than about 40 dynes/cm.

15. The splicing tape according to claim 11, further comprising a tack-free coating on the first layer or the third layer.

16. The splicing tape according to claim 11, wherein the second film is a blend of a least two polymers having a surface energy less than about 40 dynes/cm.

17. A method of making a running splice, the method comprising:

- furnishing a splicing tape comprising a release liner, a first layer of a laminating adhesive adjacent the release liner, a first film having a relatively high surface energy, the first film adjacent the first layer of laminating adhesive, a second film having a relatively low surface energy, the second film adjacent the first film, the second film comprising a polymer or non-adhesive blend of at least two polymers, a third layer of film, and

a second layer of a laminating adhesive adjacent the third film, wherein the second film is configured to break away from the first film or the third film; positioning the splicing tape; removing the release liner; adhering the splicing tape to a replacement roll; maneuvering the replacement roll to a position near a running roll; and making a running splice by adhering the splicing tape to the running roll, whereby the splicing tape splits between the first and second film, or between the second film and the third film, and the replacement roll takes a position of the running roll.

18. The method of claim **17**, wherein the splicing tape is configured to split under a load of about 20 g/inch.

19. The method of claim **17**, further comprising holding the replacement roll closed after the step of adhering the splicing tape to the replacement roll.

20. A method of forming a splicing tape for use between two rolls, the method comprising:

providing a first film having a high surface energy; applying a second film to the first film, said second film configured as a polymeric film; applying a third film to the second film, said third film having a low surface energy;

applying an adhesive coating to exposed surfaces of the first and third films; and

applying a release liner to the splicing tape, wherein the first film splits easily from the second film, or the second film splits easily from the third film, when a splice is made between the two rolls.

21. The method of claim **20**, further comprising treating the first film to have a high surface energy or treating the second film to have a low surface energy.

22. The method of claim **20**, wherein the second film is applied to the first film, or the third film is applied to the second film, by extruding a thermoplastic material onto the first film.

24. The method of claim **20**, wherein the second film is applied to the first film by a method selected from the group consisting of extruding, pressing, and coating.

25. The method of claim **20**, wherein the third film is applied to the second film by a method selected from the group consisting of extruding and pressing.

26. The method of claim **20**, further comprising applying a barrier coating to at least a portion of the first film.

27. The method of claim **20**, wherein the second film is configured as a non-adhesive blend of at least two polymers.

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