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(54) **COVER TAPE AND METHOD FOR MANUFACTURE**

(76) Inventors: **Ruben E. Velasquez Urey**, Austin, TX (US); **Laura C. Devaney**, Austin, TX (US); **David J. Vanoverbeke**, Hutchinson, MN (US); **Daniel H. Henderson**, Austin, TX (US); **Barbara L. Birrell**, Austin, TX (US)

Correspondence Address:
3M INNOVATIVE PROPERTIES COMPANY
PO BOX 33427
ST. PAUL, MN 55133-3427 (US)

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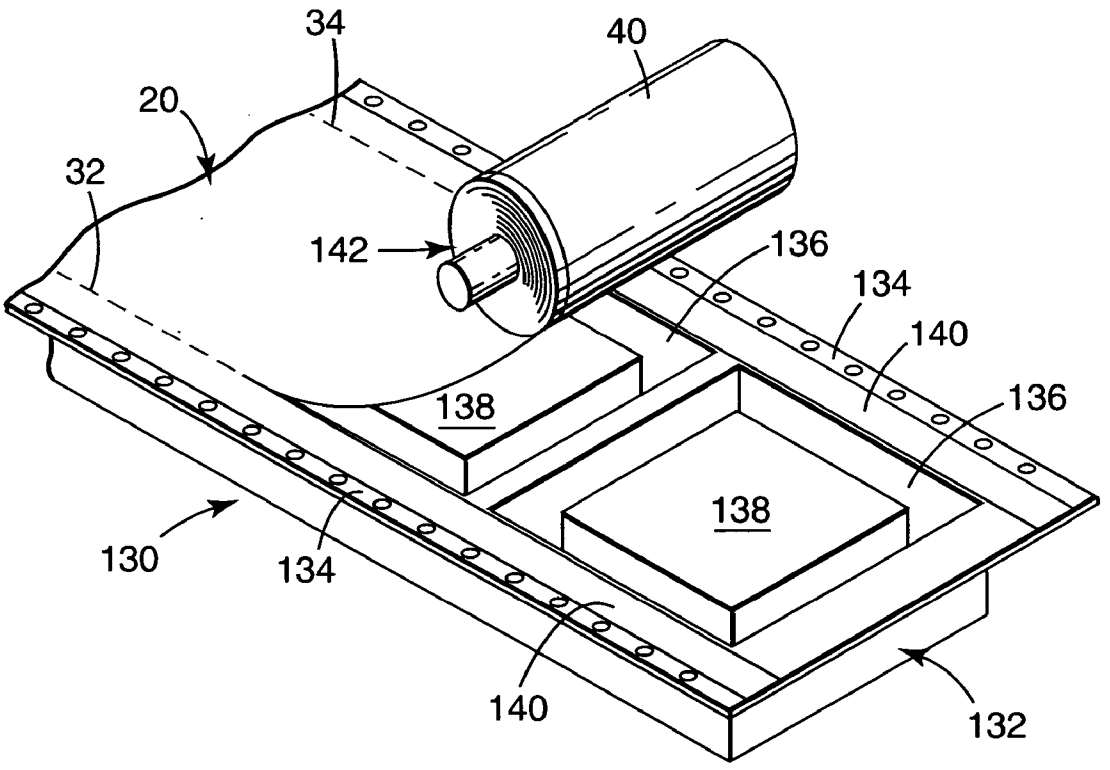
(57) **ABSTRACT**

An article includes a cover tape, which includes a base film layer, recessed areas, tear enabling features, and an adhesive. The base film layer has opposed longitudinal edges. The recessed areas extend along the longitudinal edges of the base film layer. The tear enabling features are substantially parallel to the longitudinal edges. The adhesive is disposed on the recessed areas.



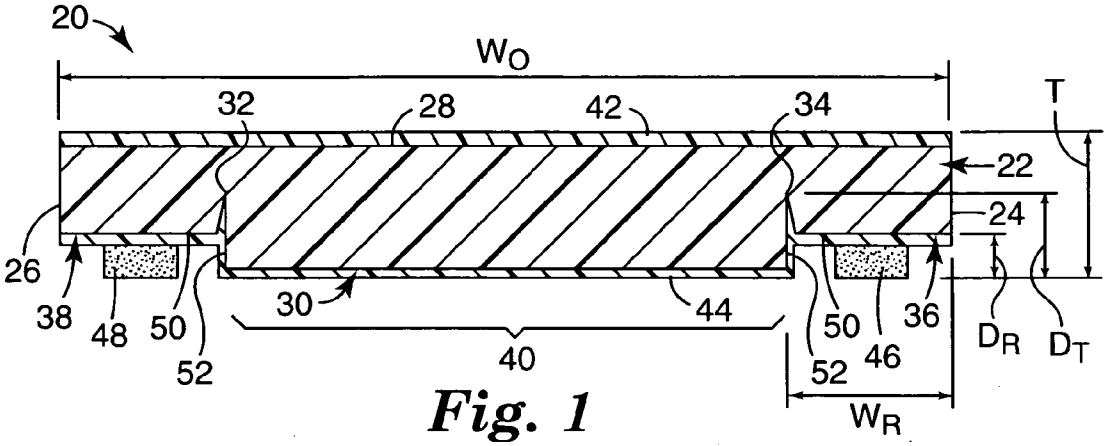


Fig. 1

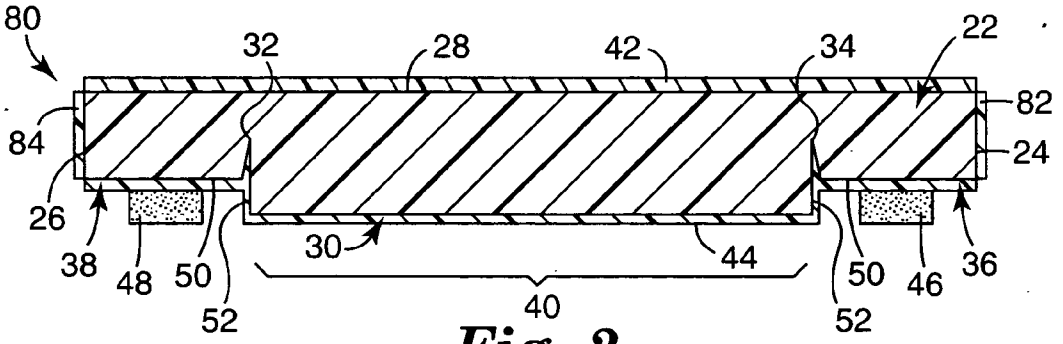


Fig. 2

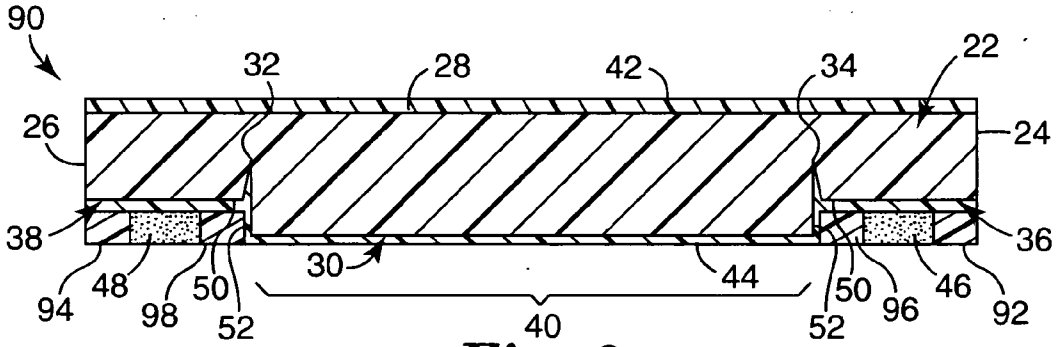


Fig. 3

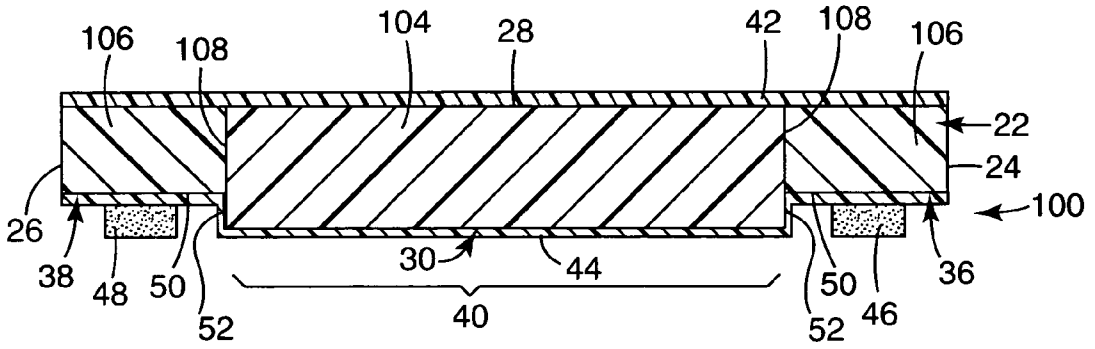


Fig. 4A

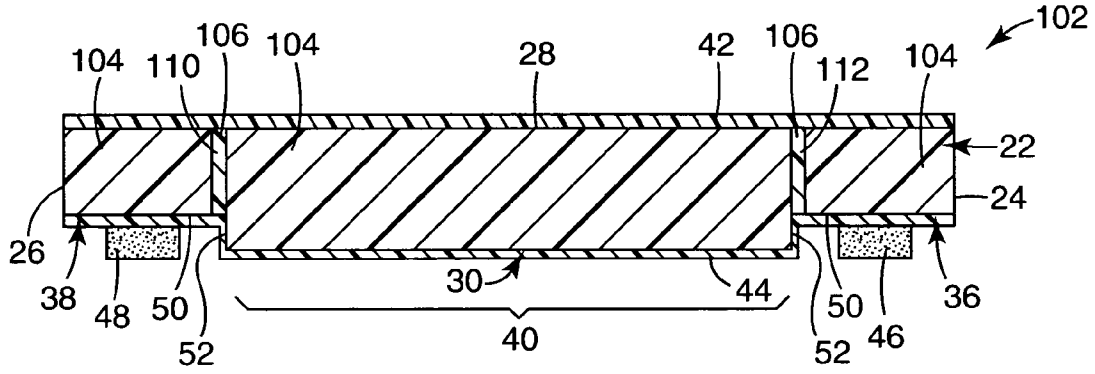


Fig. 4B

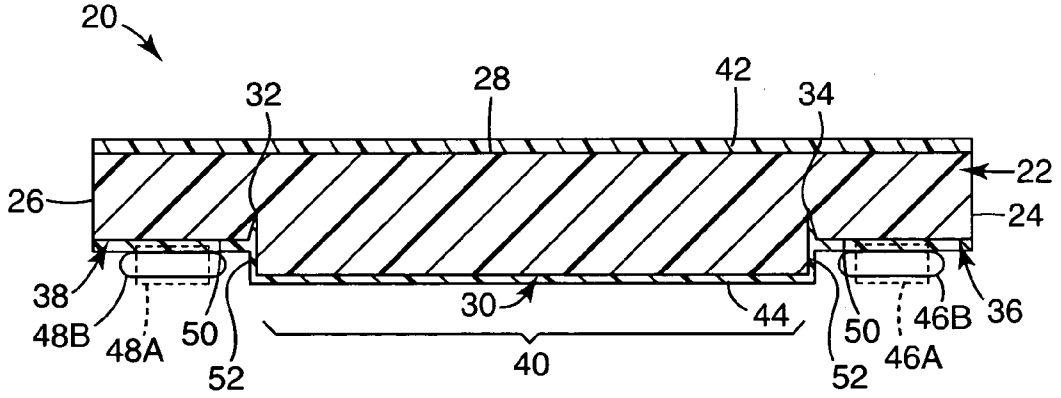


Fig. 5

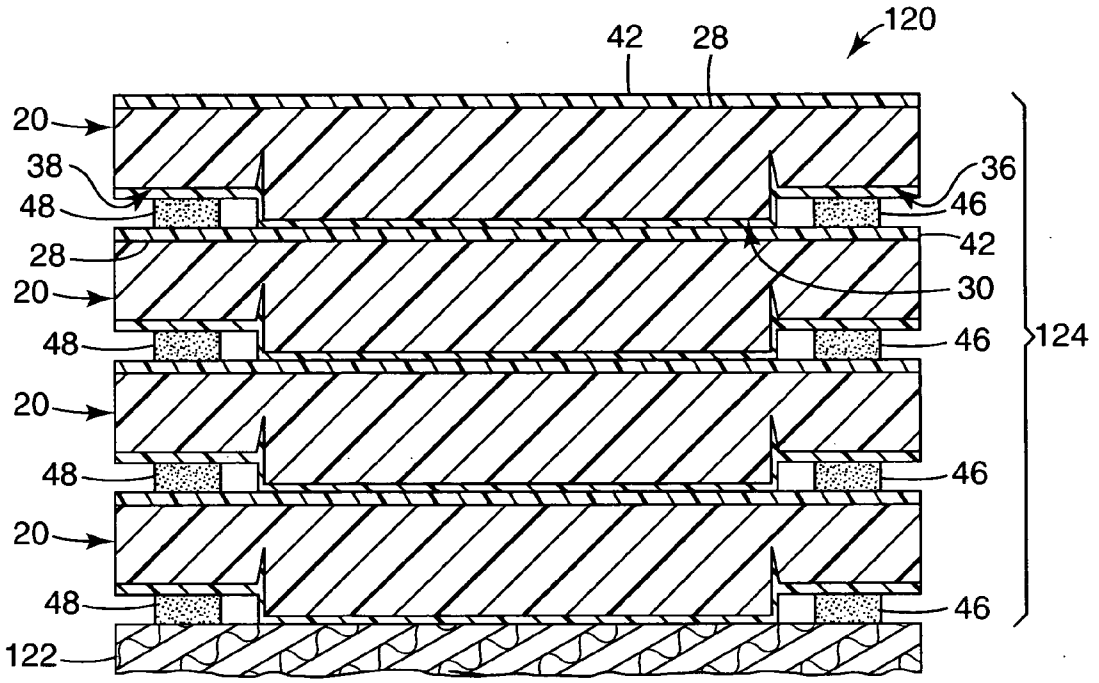

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Fig. 6

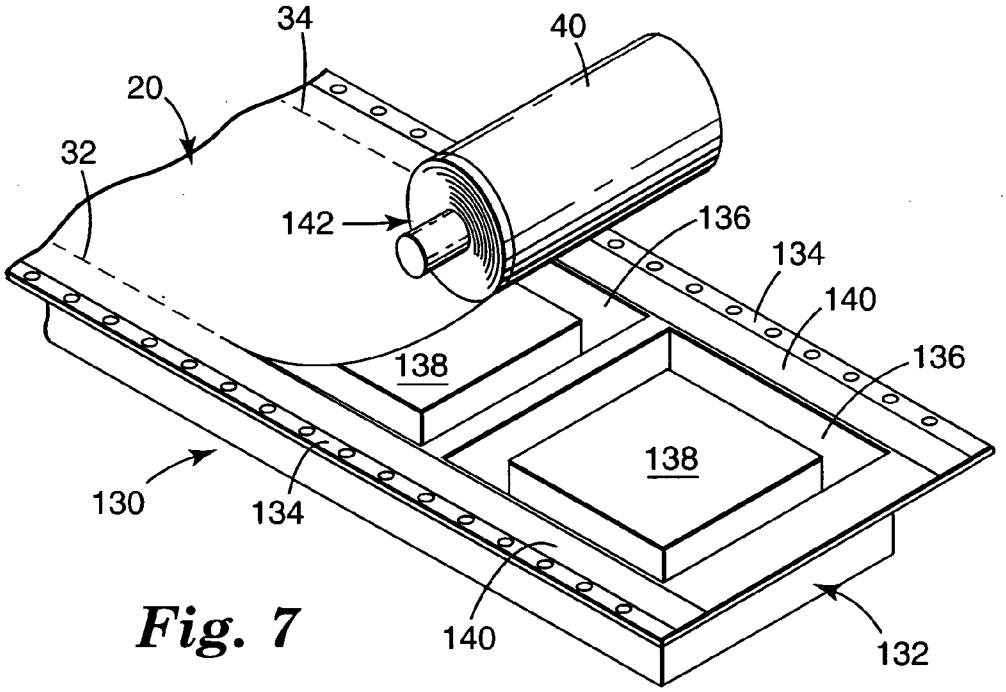
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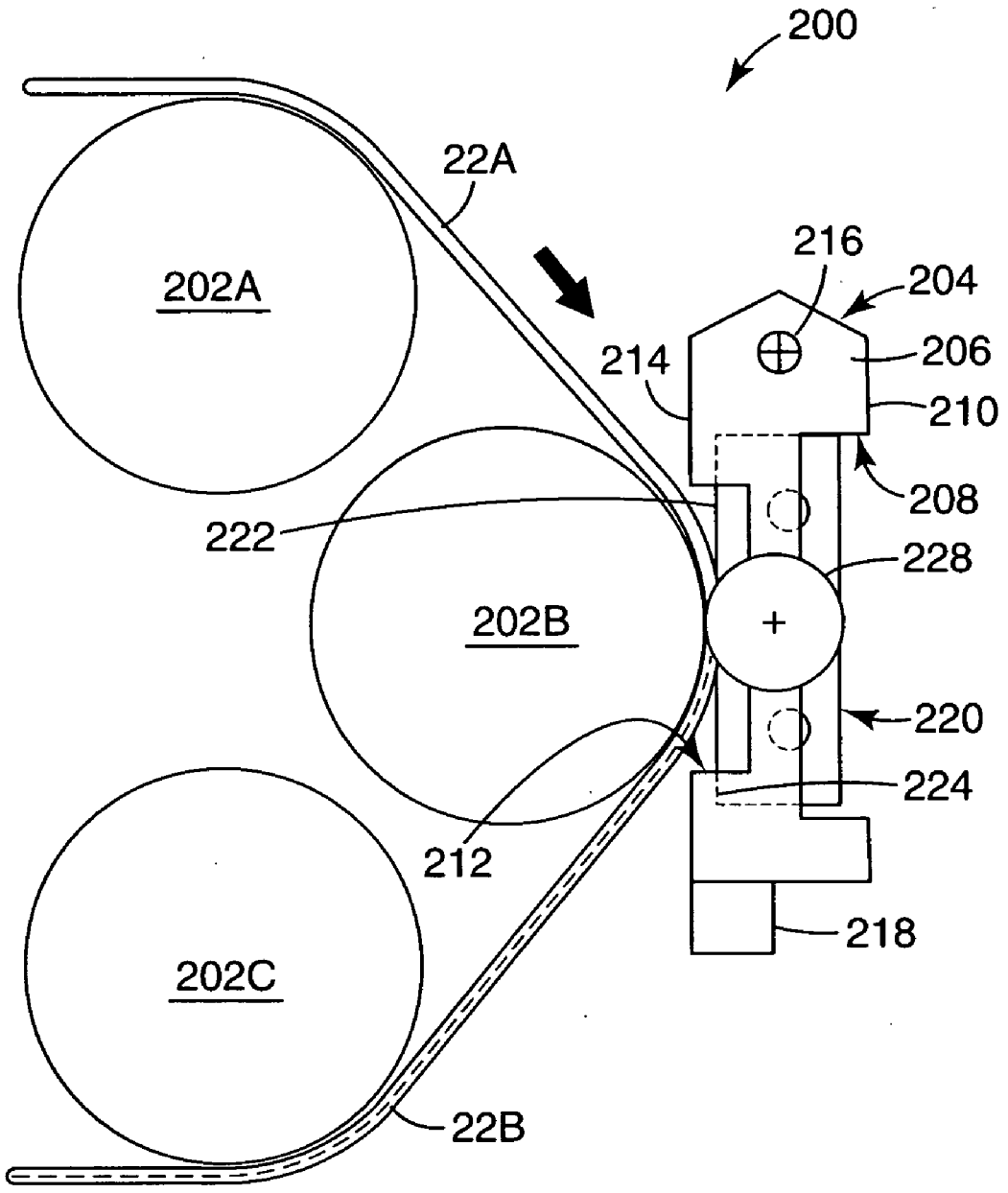
Fig. 7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22B

Fig. 8

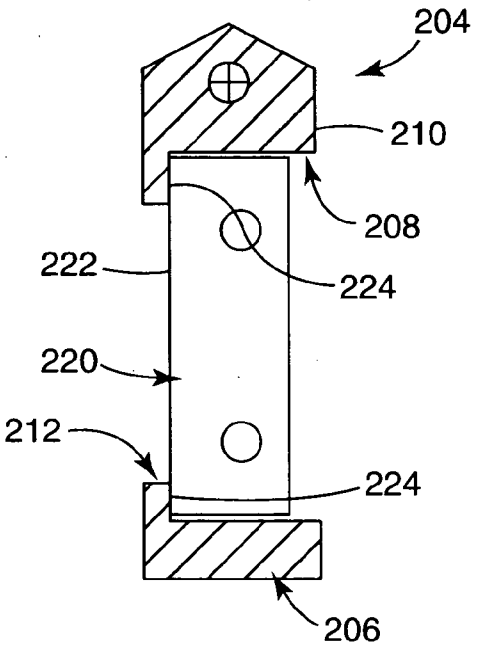
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Fig. 9

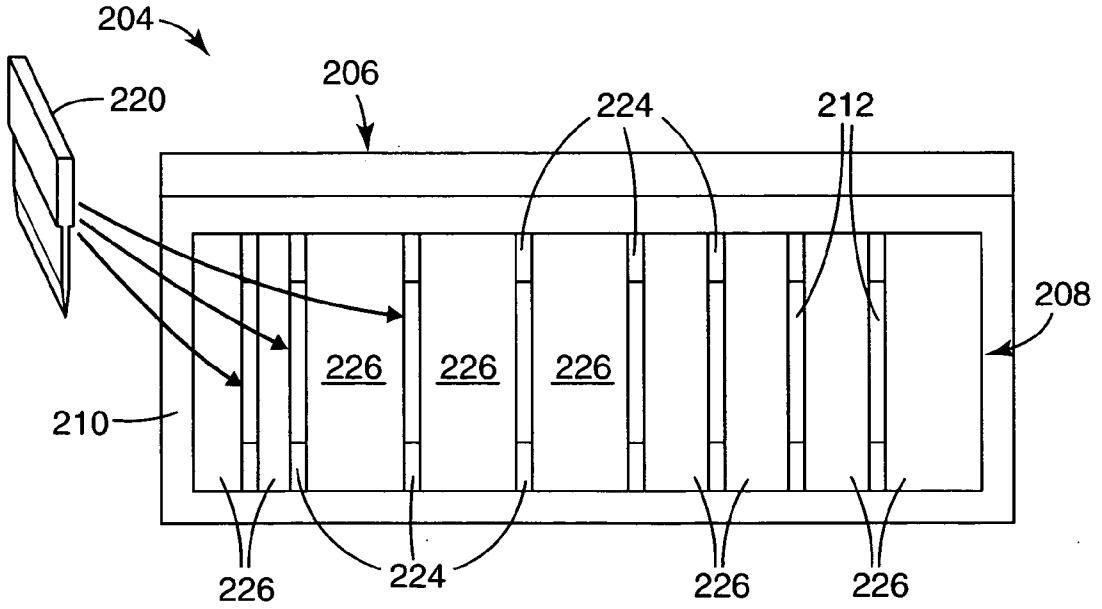
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Fig. 10

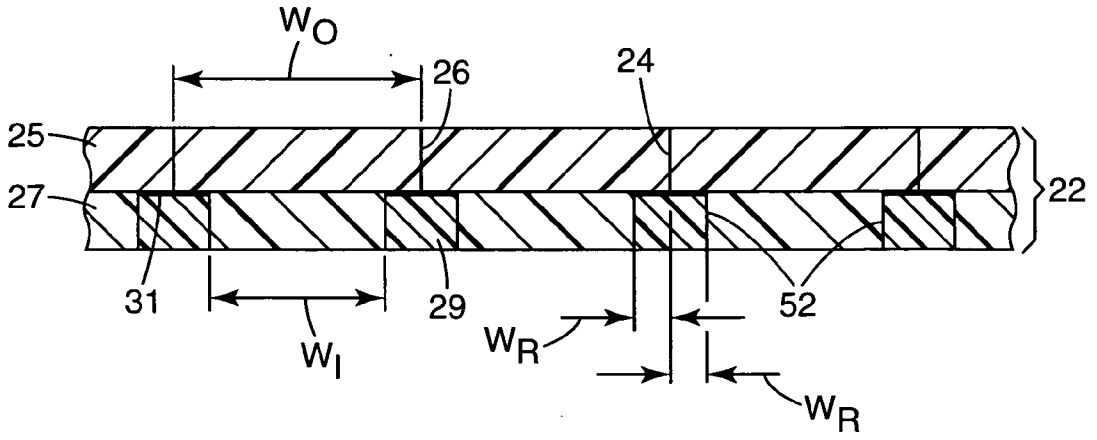

Fig. 11A

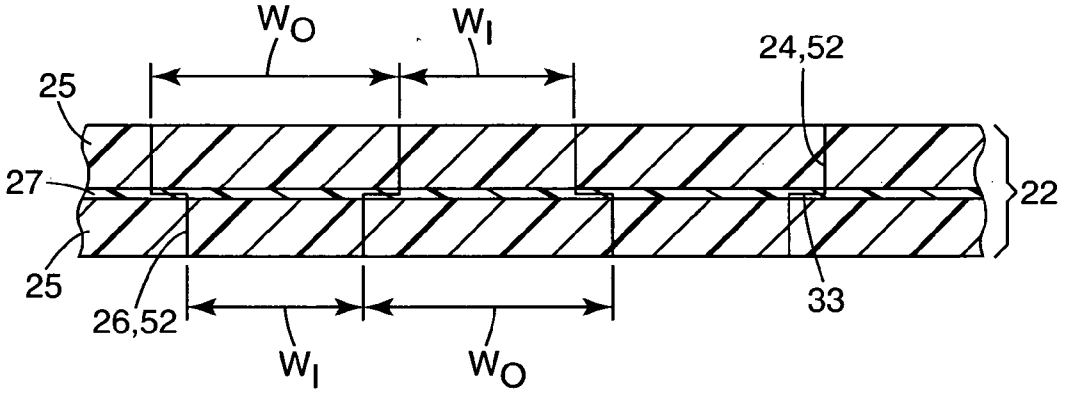

Fig. 11B

COVER TAPE AND METHOD FOR MANUFACTURE

BACKGROUND

[0001] The present invention relates to tapes for carrying components and a method and apparatus for making such tapes.

[0002] In manufacturing settings, it is often necessary to hold and transport components. For example, in the field of electronics circuit assembly, electronic components are often carried from a supply of components to a specific location on a circuit board for attachment thereto. The components may be of several different types, including surface mount components. Particular examples include memory chips, integrated circuit chips, resistors, connectors, processors, capacitors, gate arrays, etc. It is possible to transport small and delicate components using a carrier tape/cover tape system, such as that disclosed in U.S. Pat. No. 5,325,654.

[0003] The electronic industry is continually moving towards smaller devices and thus smaller components, which in turn require more delicate and precise removal of such components from the carrier tape/cover tape system. Most known cover tapes use heat activated adhesive (HAA) or pressure sensitive adhesive (PSA) to bond the cover tape to the carrier tape. Removal of the components is done by first carefully peeling or debonding the cover tape off of the carrier tape to expose the component to vacuum nozzles or other component handling equipment for safe component removal.

[0004] However, known cover tapes present several operational difficulties. For instance, peeling the cover tape from the carrier tape can create "shocky", rough, nonuniform and inconsistent peels, which cause movement of the carrier tape/cover tape that can displace the small components. Shocky peels have also been known to eject the small components out of the pocket in the carrier tape, thus causing miss-picks and eventual shut down of automated component handling equipment.

[0005] The peel force of adhesive cover tape can vary considerably depending on the width of the cover tape and the type of carrier tape used. Wider HAA cover tapes require higher heat to get secure bonds. Likewise, wider PSA cover tapes have lower peel forces and require wider adhesive exposure to get secure bonds. In addition, cover tapes that are designed for one type of carrier tape (e.g., polystyrene) do not always have good performance from other types of carrier material (e.g., polycarbonate). Even if cover tapes do nominally work with different types of carrier tapes, they may have less than optimum peel force and nonuniform peels. Moreover, HAA cover tapes also have poor stability as the peel force degrades with time and temperature.

[0006] Additionally, known cover tapes present difficulties in storing and transporting the cover tape. For instance, adhesive "squeeze-out" can occur when adhesives on a bottom surface of a tape migrate and deform under pressure and/or heat such that adhesive moves beyond the edges of the tape. This is problematic, as it can cause adhesives to adhere in undesired locations, lead to contamination, necessitate undesired cleaning, lessen aesthetic values, as well as present other problems such as undesired equipment downtime. Moreover, where a cover tape made of a flat film (i.e., a film without recesses) is wound upon itself, it can cause undesired sagging in between adhesive stripes, which leads to an unstable roll.

BRIEF SUMMARY

[0007] In one aspect of the present invention, an article includes a cover tape, which includes a base film layer, recessed areas, tear enabling features, and an adhesive. The base film layer has opposed longitudinal edges. The recessed areas extend along the longitudinal edges of the base film layer. The tear enabling features are substantially parallel to the longitudinal edges of the base film. The adhesive is disposed on the recessed areas.

[0008] In another aspect of the present invention, a method of making a cover tape includes providing a base film layer having opposed longitudinal edges, forming a recessed area extending along each longitudinal edge, forming tear enabling features substantially parallel to the longitudinal edges, and applying an adhesive on each of the recessed areas.

[0009] The above summary is not intended to describe each disclosed embodiment or every implementation of the present invention. The figures and the detailed description, which follow, more particularly exemplify illustrative embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a cross-sectional schematic view of a cover tape according to the present invention.

[0011] FIG. **2** is a cross-sectional schematic view of another embodiment of a cover tape according to the present invention.

[0012] FIG. **3** is a cross-sectional schematic view of another embodiment of a cover tape according to the present invention.

[0013] FIG. **4**A is a cross-sectional schematic view of another embodiment of a cover tape according to the present invention.

[0014] FIG. **4**B is a cross-sectional schematic view of another embodiment of a cover tape according to the present invention.

[0015] FIG. **5** is a cross-sectional schematic view of the cover tape of FIG. **1** after heat and pressure have been applied.

[0016] FIG. **6** is a cross-sectional schematic side view of a portion of a roll of cover tape according to the present invention.

[0017] FIG. **7** is a perspective view of a carrier tape/cover tape system according to the present invention, showing separation of the cover tape therefrom.

[0018] FIG. **8** is a schematic side view of a cover tape scoring apparatus according to the present invention.

[0019] FIG. **9** is a cross-sectional schematic side view of a portion of the scoring apparatus of FIG. **8**.

[0020] FIG. **10** is a schematic back view of a portion of the scoring apparatus of FIGS. **8** and **9**.

[0021] FIG. **11**A is a cross-sectional schematic view of an embodiment of a series of cover tapes according to the present invention.

[0022] FIG. **11**B is a cross-sectional schematic view of another embodiment of a series of cover tape according to the present invention.

[0023] While the above-identified drawing figures set forth several embodiments of the invention, other embodiments are also contemplated, as noted in the discussion. In all cases, this disclosure presents the invention by way of representation and not limitation. It should be understood that numerous other modifications and embodiments can be devised by those skilled in the art, which fall within the scope and spirit of the principles of the invention. The figures may not be drawn to scale. Like reference numbers have been used throughout the figures to denote like parts.

DETAILED DESCRIPTION

[0024] Aspects of the present invention relate to a cover tape, a carrier tape/cover tape system, as well as to a method and apparatus for making a cover tape. A cover tape according to the present invention can be adhered to a carrier tape, which can hold components for storage and transportation. The cover tape can cover pockets in the carrier tape that can hold components, and has a portion that can be separated from the system to expose the pockets in the carrier tape. Tear enabling features on the cover tape permit the portion of the cover tape to be separated from other portions of the cover tape (and a carrier tape to which the cover tape was adhered) with a substantially consistent and uniform separation force, which reduces the possibility of undesired movement of components held by the carrier tape during the separation process. As used herein, the term "tear" means generally controlled separation of portions of a component. In addition, the cover tape according to the present invention provides recesses along the longitudinal edges of the cover tape, which help the cover tape maintain a relatively flat profile during storage and application. The location of the adhesive is spaced from the edge of the cover tape, which helps prevent contamination of the adhesive and undesired adhesion of the adhesive to other surfaces, such as cover tape handling equipment.

[0025] FIG. **1** is a cross-sectional schematic view of a cover tape **20** suitable for use in a carrier tape/cover tape system. The cover tape **20** includes an elongate film **22** that has opposed longitudinal edges **24** and **26**, and opposed top and bottom faces **28** and **30**, respectively. The film **22** can be a polymer film, for example, polyethylene terephthalate, oriented polypropylene (e.g., biaxially oriented polypropylene), oriented polyamides, oriented polyvinyl chloride, polystyrene, polycarbonate, polyethylene, polyacrylonitrile, polyolefin and polyimide films. The film **22** can be transparent. Additionally, the film **22** can be intrinsically electrically conductive or static dissipative. Longitudinally extending tear enabling features **32** and **34** and longitudinally extending recesses **36** and **38** are located relative to the bottom face **30** of the film **22**. The tear enabling features **32** and **34** are spaced apart, and a central portion **40** of the film **22** is defined therebetween. A top coating **42** is optionally provided along top face **28** of film **22**. The top coating **42** can include a static dissipative (SD) coating, LAB (i.e., an adhesive release coating), an anti-reflective or glare-reducing coating, and other coatings and combinations of coatings. A bottom coating **44** is also optionally provided along the bottom face **30** of the film **22**, which can be a SD coating or other type of coating and can be at least partially blended with the film **22**. Longitudinally disposed adhesive stripes **46** and **48** are provided along the recesses **36** and **38**.

[0026] The recesses **36** and **38** are located at the longitudinal edges **24** and **26**, respectively, of the film **22**. The recesses **36** and **38** are each open facing the bottom face **30** and longitudinal edges **24** and **26**, respectively, of the film **22**. Alternatively, recesses may be formed on both surfaces of the cover tape. This feature would be useful, for example, if the thicknesses of the adhesive stripes are greater than depth D_R, because it would facilitate winding of the cover tape.

[0027] In the embodiment shown in FIG. **1**, a bottom portion **50** and a side portion **52** define each of the recesses **36** and **38**. The adhesive stripes **46** and **48** can be disposed on the bottom portions **50** of the recesses **36** and **38**, respectively. The bottom portions **50** of the recesses **36** and **38** can have microtexture (not shown in FIG. **1**) for better adhering the adhesive stripes **46** and **48** to the film **22**. It should be recognized that other recess shapes can be utilized, so long as the recesses **36** and **38** are open facing an adjacent elongate edge **24** or **26** of the film **22** and the bottom face **30** of the film **22**.

[0028] The film **22**, including recesses **36** and **38** and any microtextures, can be formed using processes such as scoring, extrusion, calendaring, micro-replication, laser ablation, ultrasound, die cutting, chemical etching, and stripping. In further embodiments, the recesses **36** and **38** can be formed using different processes. Moreover, the film **22** can be formed using a film that can fracture or delaminates along a centerline (i.e., a line halfway between the top and bottom faces **28** and **30** of the film **22**), and separation lines can be cut from the top and bottom to the centerline in order to form the recesses. As illustrated in FIG. **11**A, the fracture or delamination centerline can be established, for example, by laminating or co-extruding two layers of different material **25**, **27** that have a weak interface. Multiple cover tapes **20** can be formed from a single film web of the two layer material by cutting multiple separation lines across the width of the sheet. Separation lines in one layer will be a width W_0 apart. These separation lines will form opposed longitudinal edges **24** and **26** of each adjacent cover tape **20**. Separation lines in the second layer will be spaced away from the separation lines in the first layer by a width W_R. These separation lines will form side portions **52** of each adjacent cover tape, which side portions are a width W_1 apart. The portion of the second layer opposite the separation line in the first layer will be scrap material **29**. After the separation lines are cut, tapes **20** are formed by separating sections of film **22** along edges **24** and **26**, side portion **52**, and fracture line **31**. Fracture line **31** forms the interior side of scrap material **29**.

[0029] As shown in FIG. **11**B, to avoid having this scrap material, a different process may be used. In this case, both the top and bottom layers of the film web are made of the same material **25** with a thin layer of a different material **27** between these layers to allow for fracture or delamination. Preferably, the cohesive strength of material **27** is less than the adhesive strength between materials **25** and **27**. Because the top and bottom layer materials are the same, both layers

may form the wider and narrower portion of the cover tape. (This method could also be used with the top and bottom layers being different materials, but is particularly useful when it is desirable to have the top and bottom layers made of the same material.) Accordingly, adjacent cover tapes may be arranged adjacent each other top-to-bottom (i.e., arranged at a 180° angle relative to each other). Therefore, each separation line in a layer will form a longitudinal edge **24** or **26** of one cover tape and will also form side portion **52** of an adjacent tape. In other words, separation lines on each of the layers will alternately be separated by a width of W_0 and a width of W_1. In the relation of one layer to another, the distances between separation lines will alternate in opposite orders such that a width W_0 in one layer **25** will be paired with a width W_1 in the other layer **25**. After the separation lines are cut, tapes **20** are formed by separating sections of film **22** along edges **24/52**, **26/52** and fracture line **33**.

[**0030**] The adhesive stripes **46** and **48** on bottom portion **50** of recesses **36** and **38** can be, for instance, pressure sensitive adhesives (PSAs), heat activated and microencapsulated adhesives. The adhesive stripes **46** and **48** can have thicknesses greater than, less than or equal to a depth D_R of the recessed areas **36** and **38**. Typically, the thickness is less than or equal to depth D_R. The adhesive stripes **46** and **48** have widths equal to or less than widths W_R of the recessed areas **36** and **38**. Having widths less than widths D_R of recessed areas **36** and **38** provides substantially adhesive-free zones longitudinally extending along the bottom portions **50** of the recesses **36** and **38** on either side of each of the adhesive stripes **46** and **48** when the cover tape **20** is not applied to a surface (i.e., is not under tension).

[**0031**] The tear enabling features **32** and **34** are located relative to the bottom face **30** of the film **22**, and can be located adjacent the recesses **36** and **38** at the side portions **52** thereof. However, in further embodiments, the tear enabling features **32** and **34** can be located nearly anywhere along the top face **28**, bottom face **30**, or both faces of the film **22**, so long as they are each spaced from the longitudinal edges **24** and **26** of the film **22**. As shown in FIG. **1**, the tear enabling features **32** and **34** are continuous scoring lines that extend longitudinally along film **22**. Such scoring lines can be formed by cutting into the film **22** (e.g., with lasers, die cutters, and blades, for instance, according to the blade scoring procedure described below). In further embodiments, the tear enabling features **32** and **34** can be weakened regions of the film **22** (e.g., thinner regions, microperforations, etc.), a transition between two materials (e.g., a first material comprises central portion **40** of the film **22** and a second material comprises the region of the film **22** between the bottom portions **50** of the recesses **36** and **38** and the top face **28**), or other structures that facilitate tearing.

[**0032**] In one embodiment, provided by way of example and not limitation, the cover tape **20** can have the following dimensions. An overall width W_0 of the film **22** (measured between elongate edges **24** and **26**) is about 1 inch (2.54 cm). A thickness T of the film **22** is about 2 mil (0.0254 mm) (measured at the thickest portion of the central region **40** of the film **22**). The recesses **36** and **38** each have a width W_R of about 0.0393701 inch (1 mm) and a depth D_R of about 0.5 mil (0.0127 mm). The tear enabling features **32** and **34** are score lines each having a depth of about 1.5 mil (0.0381 mm) (measured from the bottom face **30** of the film **22**). It should be recognized that dimensions of the cover tape **20** can vary, as desired. For instance, a width of the central portion **40** of the film **22** can be selected such that it is at least as wide as the pockets of a carrier tape with which the cover tape **20** is used.

[**0033**] FIG. **2** is a cross-sectional schematic view of another embodiment of a cover tape **80** according to the present invention. The cover tape **80** shown in FIG. **2** is generally similar to the cover tape **20** shown and described with respect to FIG. **1**. The cover tape **80** of FIG. **2** further includes coatings **82** and **84** on elongate edges **24** and **26**, respectively of the film **22**. The coatings **82** and **84** can be LAB coatings in order to reduce the possibility of adhesive becoming attached to the elongate edges **24** and **26**, and therefore reduce the possibility of undesired stickiness, contamination, and other problems associated with exposed adhesives.

[**0034**] FIG. **3** is a cross-sectional schematic view of another embodiment of a cover tape **90** according to the present invention. The cover tape **90** shown in FIG. **3** is generally similar to the cover tape **20** shown and described with respect to FIG. **1**. The cover tape **90** of FIG. **3** further includes outer recess coatings **92** and **94** and inner recess coatings **96** and **98**. The outer recess coatings **92** and **94** are each located on the bottom portions **50** of the recesses **36** and **38**, adjacent to the adhesive stripes **46** and **48** and toward the elongate edges **24** and **26** of the film **22**. The inner recess coatings **96** and **98** are each located on the bottom portions **50** of the recesses **36** and **38**, adjacent to the adhesive stripes **46** and **48** and toward the side portions **52** of the recesses **36** and **38**. Coatings **92**, **94**, **96** and **98** can be, for example, LAB coatings or other tack-free materials that can help prevent undesired contact with adhesives by more positively constraining the adhesive stripes **46** and **48** within the recesses **36** and **38**.

[**0035**] FIG. **4**A is a cross-sectional schematic view of a further embodiment of a cover tape **100**. The cover tape **100** is generally similar to cover tape **20**; however, the film **22** includes a first material **104** and a second material **106**. With cover tape **100**, the second material **106** is located at (i.e., above) the recesses **36** and **38** and extends from elongate edges **24** or **26** to material interfaces **108**. The central portion **40** of the film **22** is defined between material interfaces **108**.

[**0036**] The material interfaces **108** exhibit weaker bonding or connection strength than internal bonding or cohesion of either the first material **104** or the second material **106**. The relative weakness of the material interfaces **108** facilitates substantially consistent and uniform tearing, that is, the separation of the first material **104** and the second material **106** at the material interfaces **108**. Thus, the material interfaces **108** can form tear enabling features.

[**0037**] The first and second materials **104** and **106** can generally be selected from the same types of materials discussed with respect to FIGS. **1-3** above. In some embodiments the first material **104** can be weaker than the second material **106**, or vice versa. In other words, one material can have weaker internal cohesive or bonding properties than the other. Moreover, the central portion **40** of the film **22** can be transparent and have high optical clarity.

[**0038**] The films **22** of cover tapes **100** can be fabricated using processes such as co-extrusion and profile extrusion.

With co-extrusion, the first and second materials **104** and **106** are extruded together in a desired arrangement. With profile extrusion, the first and second materials **104** and **106** are extruded individually in desired shapes and are joined while still molten after the initial individual extrusion process. Fabrication may result is some negligible intermingling of the first and second materials **104** and **106** at their interface (e.g., at interface **108** in FIG. **4**A). One advantage of this embodiment is that the tear enabling features do not require scoring.

[**0039**] FIG. **4**B is a cross-sectional schematic view of another embodiment of a cover tape **102**. The cover tape **102** is generally similar to cover tape **100**, and the film **22** includes a first material **104** and a second material **106**. With cover tape **102**, the second material **106** is disposed in elongate bands **110** and **112** positioned near side portions **52** of the recesses **36** and **38**, with the first material **104** disposed on either side of bands **110** and **112** of the second material **106**. The central portion **40** of the film **22** is defined between the bands **110** and **112** of the second material **106**.

[**0040**] The second material **106** is generally weaker than the first material **104**. In other words, the second material **106** has weaker internal cohesive or bonding properties than does the first material **104**. This facilitates consistent and uniform tearing of the film **22** within the bands **110** and **112** of the second material **106**. The bands **110** and **112** thus constitute tear enabling features. In some embodiments, the first material **104** can resist tearing. The second material **106** can comprise a different and weaker form of the type of material as the first material **104**, or can be an entirely different type of material. The first and second materials can generally be selected from the same types of materials discussed with respect to FIGS. **1**-**3** above. In addition, the weaker second material **106** can be made of ethylene vinyl acetate (EVA). One advantage of this embodiment is that the tear enabling features do not require scoring.

[**0041**] FIG. **5** is a cross-sectional schematic view of the cover tape **20** of FIG. **1** after heat and pressure have been applied. In use, the cover tape **20** may be placed in contact with a surface (e.g., wound upon itself) such that tensile and compressive forces act on the tape **20**. Heat and pressure can cause portions of the film **22** near the recesses **36** and **38** to deflect slightly. Heat and pressure can also cause the adhesive stripes **46** and **48** to deform and migrate. More particularly, heat and pressure can cause the adhesive stripes **46** and **48** to change from first shapes **46**A and **48**A to second shapes **46**B and **48**B. First shapes **46**A and **48**A have a generally greater thickness and generally lesser width than second shapes **46**B and **48**B. Nonetheless, even after such deformation, the adhesive stripes **46** and **48** are substantially contained within recesses **36** and **38** despite the presence of pressure and heat. In the second shapes **46**B and **48**B, the adhesive stripes **46** and **48** are generally spaced from side walls **52** of recesses **36** and **38**, and spaced from the elongate edges **24** and **26** of the film **22**. By substantially containing the adhesive stripes **46** and **48** within the recesses **36** and **38** (even when deformed by heat and/or pressure), the cover tape **20** can be securely adhered to a desired location without undesired exposure of adhesive or adhesion in undesired locations. It should be noted that the features of the recesses **36** and **38** are not limited to the particular embodiment of cover tape shown in FIG. **5**.

[**0042**] It is possible to place cover tape according to the present invention in the form of a roll. FIG. **6** is a cross-sectional schematic side view of a portion of a roll **120** of cover tape **20**. The cover tape **20** is wound upon itself on a core **122** (e.g., a substantially cylindrical cardboard core). In this configuration, the top face **28** of the cover tape **20** is substantially smooth and flat, and the roll **120** is generally stable. In addition, sides **124** of the roll **120** are generally tack-free, as adhesive generally does not protrude from the cover tape **20** along the sides **124** of the roll **120** (adhesive is spaced from the side edges of the tape within the recesses). The adhesive stripes **46** and **48** can releasably adhere to the top coating **42** of the cover tape **20**.

[**0043**] Cover tape can be placed in a roll (e.g., the roll **120** of FIG. **6**) after it has been fabricated and prior to being adhered to a carrier tape. Placing the cover tape in a roll facilitates storage and transportation, as well as automated handling of the cover tape. Coating materials on the top face of the cover tape can facilitate peeling portions of the cover tape away from the roll.

[**0044**] Cover tape can be used in a carrier tape/cover tape system. FIG. **7** is a perspective view of a carrier tape/cover tape system **130** that includes a carrier tape **132** and cover tape **20**. The carrier tape **132** has a pair of opposed elongate lip portions **134**, and one or more pockets **136**. Components **138**, such as electronic components, can be placed in the pockets **136**. After the components **138** have been placed in the pockets **136** of carrier tape **132**, as desired, cover tape **20** can be adhered to elongate lip portions **134** in order to cover the pockets **136** and contain the components **138** between the carrier tape **132** and the cover tape **20**. The cover tape **20** can be dispensed from a roll.

[**0045**] In order to expose and remove the components **138**, a portion of the cover tape **20** is separated from the system **130**. As shown in FIG. **7**, the central portion **40** of the cover tape **20**, defined between tear enabling features **32** and **34**, is torn away. Outer portions **140** of cover tape **20** remain adhered to carrier tape **132** after the central portion **40** of the cover tape **20** is torn away. After being torn away, the central portion **40** of the cover tape **20** can be wound into a roll **142** for discard or recycling.

[**0046**] The central portion **40** of the cover tape **20** is separated at the tear enabling features **32** and **34** (e.g., score lines in the embodiments shown and described with respect to FIGS. **1**-**3**). In other embodiments, separation can occur at material interfaces (e.g., material interfaces **108** as shown and described with respect to FIG. **4**A), at bands of weaker material (e.g., bands **110** and **112** of the second material **106** as shown and described with respect to FIG. **4**B), or other locations depending on the type and location of tear enabling features.

[**0047**] It is desirable to have a substantially uniform tear force when tearing away a portion of the cover tape. Although lasers or blades can be used to create scoring lines, making multiple precise scoring lines capable of less than 0.001 inch (0.0254 mm) in variation can be expensive with lasers, and is nearly impossible with known uses of blades that are hindered by variations in blade cutting edge alignment.

[**0048**] In order to achieve uniform tearing with cover tapes having scoring lines, it is desired to provide scoring

lines with very little variation in depth along the length of the cover tape as well as between distinct scoring lines. Scoring lines with substantially uniform depth can be simply and efficiently formed in a film web using the method and apparatus described below. Scoring lines are generally formed in a film web after the film has been formed with recesses; however, scoring lines can be performed at other stages of a cover tape fabrication process. For example, one possible manufacturing process includes forming a plurality of parallel, laterally spaced apart and longitudinally extending recesses in a large film web. Next, longitudinal scoring lines are formed in the large film web. Then longitudinal adhesive stripes are applied to the recesses of the film (e.g., two spaced apart stripes of adhesive, with one stripe within each recess). Finally, the large film web is cut and separated into a plurality of individual cover tape strips by cutting through each recess between the adhesive bands therein.

[0049] FIG. **8** is a schematic side view of a scoring apparatus **200** that includes web support rollers **202**A, **202**B and **202**C and a blade assembly **204**. FIG. **9** is a cross-sectional schematic side view of the blade assembly **204**. The blade assembly **204** includes a main structure **206** with a cavity **208** defined along a rear face **210** and a generally-U-shaped opening **212** defined along a front face **214**. The main structure **206** is supported by a pivot **216**. Alignment means **218** (e.g., adjustable micrometer assemblies) are provided in order to provide precise alignment of the scoring apparatus **200** relative to roller **202**B, for instance, to adjust the scoring depth. In order to maintain a substantially constant scoring depth, it is preferable to reduce the impact of variability in geometry of support roller **202**B. This can be achieved by attaching one or more scoring depth control rollers **228** to the main structure **206**. These scoring depth control rollers **228** are in direct contact with the web support roller **202**B and enable the main structure **206** to follow the contour of the web support roller **202**B, which will minimize variations in scoring depth. One or more blades **220** (e.g., conventional flat metallic blades having linear tapered cutting edges in configurations generally resembling that of a single-edged razor blade) are inserted into cavity **208** such that cutting edges **222** of the blades **220** face the front face **214** of the main structure **206** and contact a precision inner surface **224** (FIG. **9**) of the cavity **208** that defines a plane. The blades **220** are biased against the precision surface **224**, using biasing means such as ties, springs and bumpers (biasing means not shown in FIG. **8**). Generally central portions of the cutting edges **222** of the blades **220** are exposed through the opening **212** in order to permit the blades **220** to cut a film web material that contacts them.

[0050] The main structure **206** of the blade assembly **204** can be formed of any material (e.g., metal, glass, polymers, etc.) such that the precision inner surface **224** resists cutting by the blades **220**. In one embodiment, the main structure **206** is formed of a metallic material that is at least as hard as the blades **220**.

[0051] In operation, an unscored film **22**A passes between the roller **202**B and the blade assembly **204**. The cutting edges **222** of the blades **220** are adjusted with alignment means **218** relative to the roller **202**B, such that desired cutting depths are achieved. It is possible to provide different cutting depths for different blades. For instance, some blades can provide scoring while other blades can simultaneously cut apart individual cover tape strips from an article that includes a plurality of connected cover tape strips. However, cutting to separate individual cover tape strips need not be performed at the same time as scoring.

[0052] After passing the blade assembly **204**, the now scored film **22**B can be moved by the roller **202**C to other locations for further processing, and can be ultimately wound in a roll (e.g., roll **120** as shown and described with respect to FIG. **6**).

[0053] It is possible to provide a plurality of score lines in a film simultaneously using the apparatus shown and described with respect to FIGS. **8** and **9**. FIG. **10** is a schematic back view of the blade assembly **204**. In FIG. **10**, the blades have been omitted for clarity. A number of lateral spacers **226** are inserted into the cavity **208** of the blade assembly **204**. Gaps are formed between adjacent spacers such that a blade can be inserted into the gap. The spacers provide for alignment of the blades across a width of a film to be scored. In addition, the spacers provide support to the blades, which can be thin, in order to increase rigidity of the blades and promote the formation of straight and uniform scoring lines. The number, size, and arrangement of the spacers **226** will vary according to the desired scoring pattern. The spacers **226** can be formed of a metallic or polymer material.

[0054] In further embodiments, the spacers **226** can be integrally formed with the main structure **206** of the blade assembly **204**. In such embodiments, a blade alignment plane can be collectively defined by the plurality of precision surfaces **224** formed relative to each gap.

[0055] In light of the discussion above, numerous advantages and benefits of the present invention should be recognized. One advantage of the cover tape according to the present invention is that it has a very uniform removal force of the central portion of the tape, which reduces the risk of miss-picks during storage and transportation operation due to parts or components "jumping" out of the carrier pocket of the carrier tape. In addition, the cover tape can be made more cost effective by using adhesive stripes while resolving the winding issues normally encountered with adhesive stripe-coated tapes (e.g., unstable rolls with sagging problems). In addition, the cover tape of the present invention also reduces a risk of adhesive build-up on equipment due to adhesive "squeeze-out" by keeping the adhesive substantially contained in the recesses before and after tearing of the middle portion of the tape. It also has substantially tack-free side edges when wound in a roll format, which reduces a risk of contamination when the roll of cover tape is laid on a table or other surface. Further, while forming the cover tape, no cutting through adhesive is required, which may lead to more effective processing by avoiding adhesive build-up on cutting equipment.

[0056] The method and apparatus for scoring the film also present numerous advantages. Scoring can be accomplished, simply, efficiently, and in a cost-effective manner. The scoring apparatus of the present invention permits substantially uniforms scoring depth to be provided, with relatively little variation in scoring depth. By using conventional blades (e.g., blades resembling single-edged razor blades) in the manner of the present invention, the scoring apparatus is relatively simple, and the blades and apparatus are relatively inexpensive. Moreover, by aligning the blades directly at their respective cutting edges, rather than using blade ref-

erence features (e.g., notches and holes) that are spaced from the cutting edges, undesired variation in cutting or scoring depth due to individual variations in the blades can be reduced.

[0057] Although the present invention has been described with reference to several alternative embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention. For instance, various types of tear enabling features can be used according to the present invention, and those tear enabling features can have various arrangements.

1. An article comprising:

a cover tape comprising:

a base film layer having opposed longitudinal edges;

recessed areas extending along the longitudinal edges;

tear enabling features substantially parallel to the longitudinal edges; and

an adhesive on the recessed areas.

2. The article of claim 1, wherein the base film layer is composed of a material selected from the group consisting of polyethylene terephthalate, polypropylene, polyamides, polyvinyl chloride, polystyrene, polycarbonate, polyethylene, polyacrylonitrile, polyolefin and polyimide.

3. The article of claim 1, wherein the base film layer is composed of an oriented film.

4. The article of claim 1, wherein the base film layer is transparent.

5. The article of claim 1, wherein the adhesive is selected from the group consisting of pressure sensitive, heat activated and microencapsulated adhesives.

6. The article of claim 1 wherein the article is wound upon itself, and wherein prior to being wound the adhesive has a thickness less than or equal to a depth of the recessed areas.

7. The article of claim 1 wherein the article is wound upon itself, and wherein prior to being wound the adhesive has an initial thickness greater than a depth of the recessed areas, and wherein the adhesive can be displaced after being wound such that the article has a substantially flat profile.

8. The article of claim 1, wherein the adhesive has a width equal to or less than a width of the recessed areas.

9. The article of claim 1, wherein the adhesive in each recess is spaced from the longitudinal edge of the base film layer.

10. The article of claim 1, wherein the adhesive in each recess is spaced from an adjacent tear enabling feature.

11. The article of claim 1, further comprising a tack-free material on the recessed area.

12. The article of claim 1, wherein two tear enabling features are provided, and each tear enabling feature is continuous.

13. The article of claim 1, wherein each tear enabling feature comprises a weaker zone in the base film layer.

14. The article of claim 1, wherein the base film layer comprises a first material and a second material, and the tear enabling features comprise a transition between the first material and the second material.

15. The article of claim 1, wherein the tear enabling features provide a substantially consistent tear force.

16. The article of claim 1 and further comprising:

a carrier tape having compartments formed therein for holding components,

wherein the cover tape can be adhered to the carrier tape for sealing components in the compartments.

17. The article of claim 1, wherein each recessed area is open along an adjacent longitudinal edge of the base film layer.

18. A method of making a cover tape, the method comprising:

providing a base film layer having opposed longitudinal edges;

forming a recessed area in the base film layer extending along each longitudinal edge;

forming tear enabling features in the base film layer substantially parallel to the longitudinal edges; and

applying an adhesive on each of the recessed areas.

19. The method of claim 18, wherein the step of forming a recessed area comprises a process selected from the group consisting of scoring, extrusion, calendaring, micro-replication, laser ablation, ultrasound, chemical etching and stripping.

20. The method of claim 18 wherein the base film layer comprises two layers of laminated or coextruded materials that have a weak interface, and wherein the step of forming a recessed area comprises cutting each layer to the interface at offset locations, then separating sections of the two-layer base film layer from each other along the cuts and a portion of the interface.

21. The method of claim 18 wherein the base film layer comprises two outer layers of laminated or coextruded materials separated by a intermediate layer of material having a weaker cohesive force than adhesive force with the outer materials, and wherein the step of forming a recessed area comprises cutting each outer layer to the interface with the intermediate layer at offset locations, then separating sections of the three-layer base film layer from each other along the cuts and a portion of the intermediate layer.

22. The method of claim 18, wherein the step of forming tear enabling features comprises a process selected from the group consisting of scoring, extrusion, calendaring, micro-replication, laser ablation, ultrasound, die cutting, and chemical etching.

23. The method of claim 18, wherein the base film layer comprises a first longitudinal strip of a film substrate having a plurality of such longitudinal side-by-side strips, and wherein the steps of claim 18 are performed in parallel to define a plurality of side-by-side cover tapes, and further comprising:

separating adjacent cover tapes.

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