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(54) METHOD OF MOUNTING A FLEXOGRAPHIC PRINTING PLATE TO AVOID BANDING

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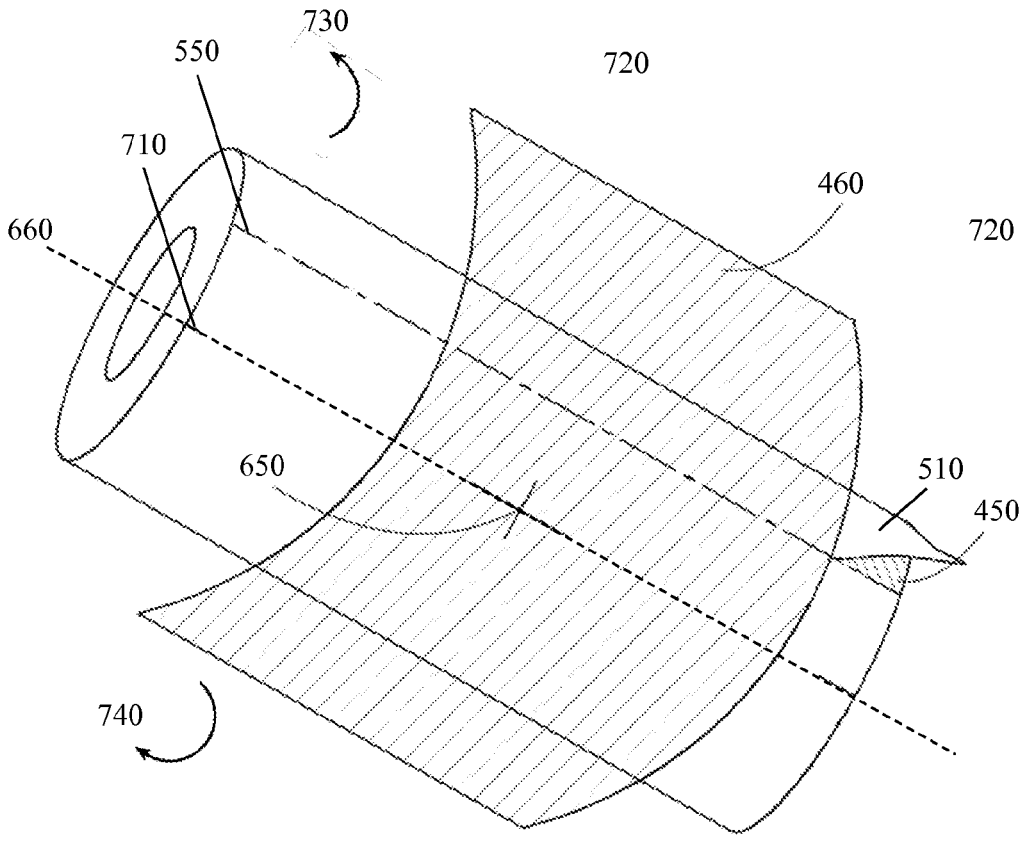
CPC *B41M 1/04* (2013.01)
USPC **101/142**; 156/185

(57) **ABSTRACT**

A method of mounting a flexographic printing plate includes disposing a backing tape on a printing plate cylinder forming a taped printing plate cylinder. A transverse center of the flexographic printing plate is attached to the taped printing plate cylinder at a mount line offset relative to a scribe line of the printing plate cylinder. A first portion of the flexographic printing plate is wrapped around a first portion of the taped printing plate cylinder from the mount line outward in a first direction away from the mount line. A second portion of the flexographic printing plate is wrapped around a second portion of the taped printing plate cylinder from the mount line outward in a second direction away from the mount line. The mount line is offset relative to the scribe line at a distance that ensures banding occurs in a non-patterned non-printing area of the flexographic printing plate.



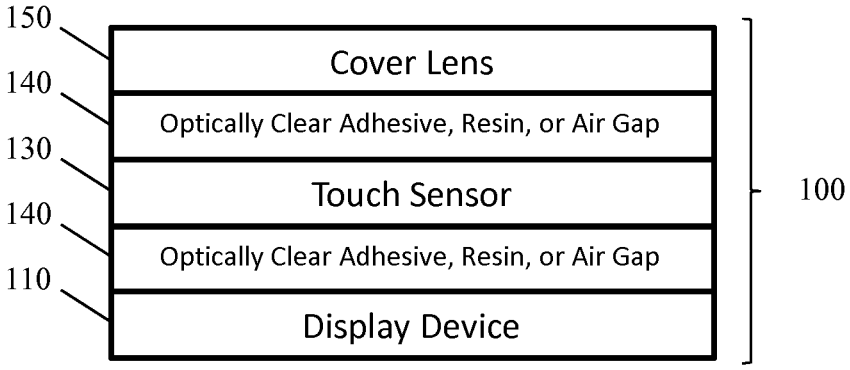

150
Cover Lens
140
Optically Clear Adhesive, Resin, or Air Gap
130
Touch Sensor
140
Optically Clear Adhesive, Resin, or Air Gap
110
Display Device
100

FIG. 1

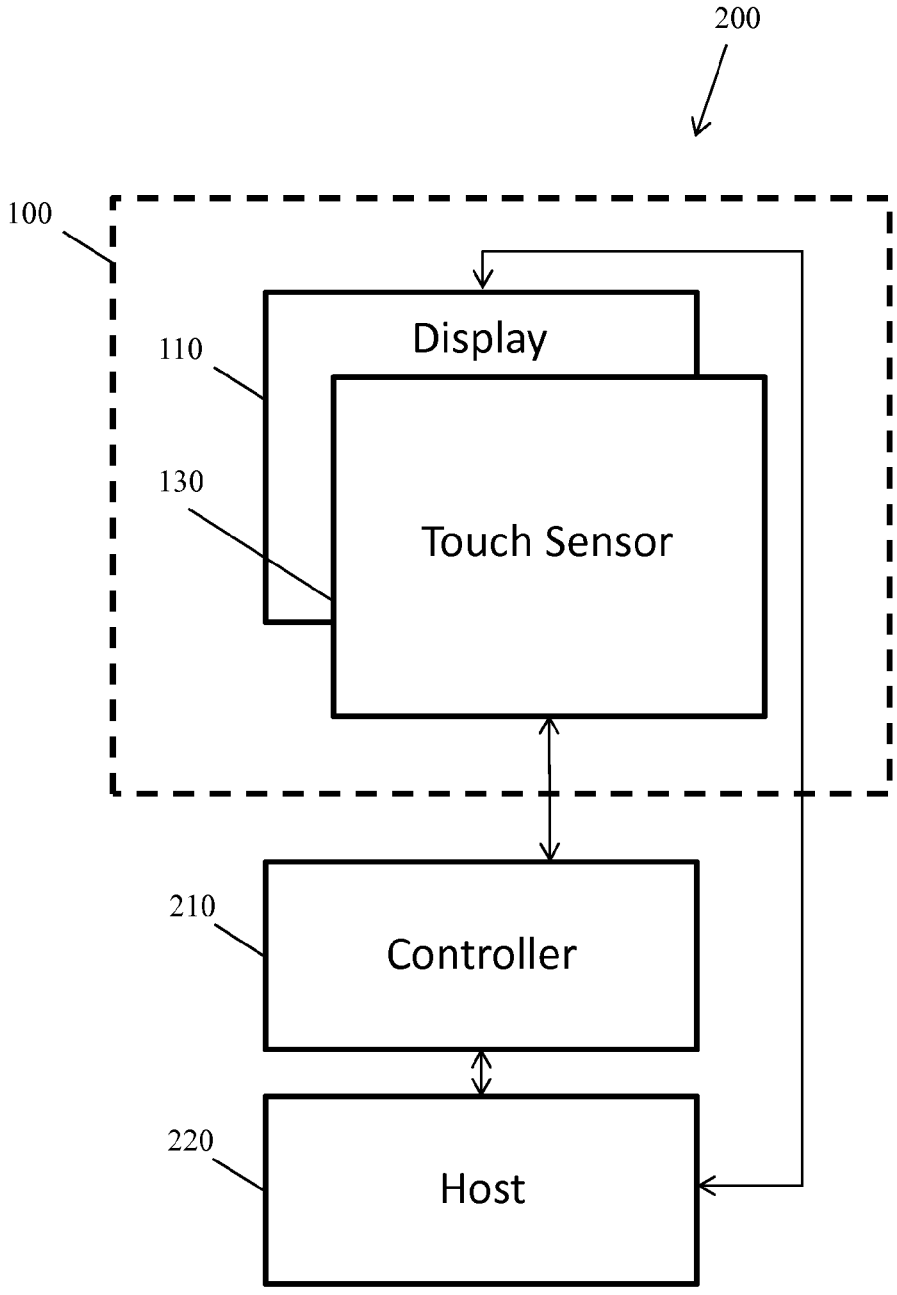

200
100
110
Display
130
Touch Sensor
210
Controller
220
Host

FIG. 2

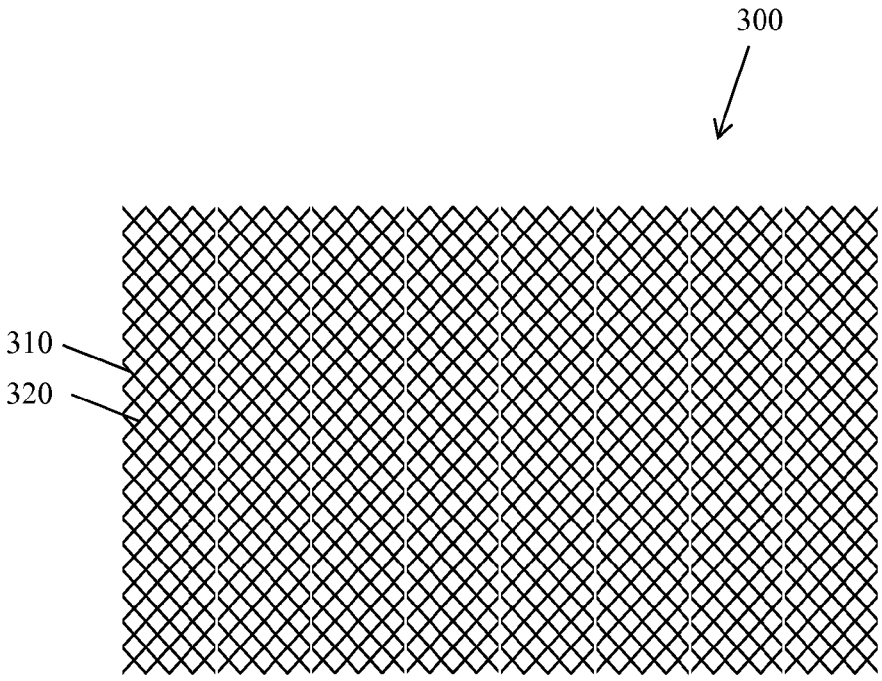


FIG. 3

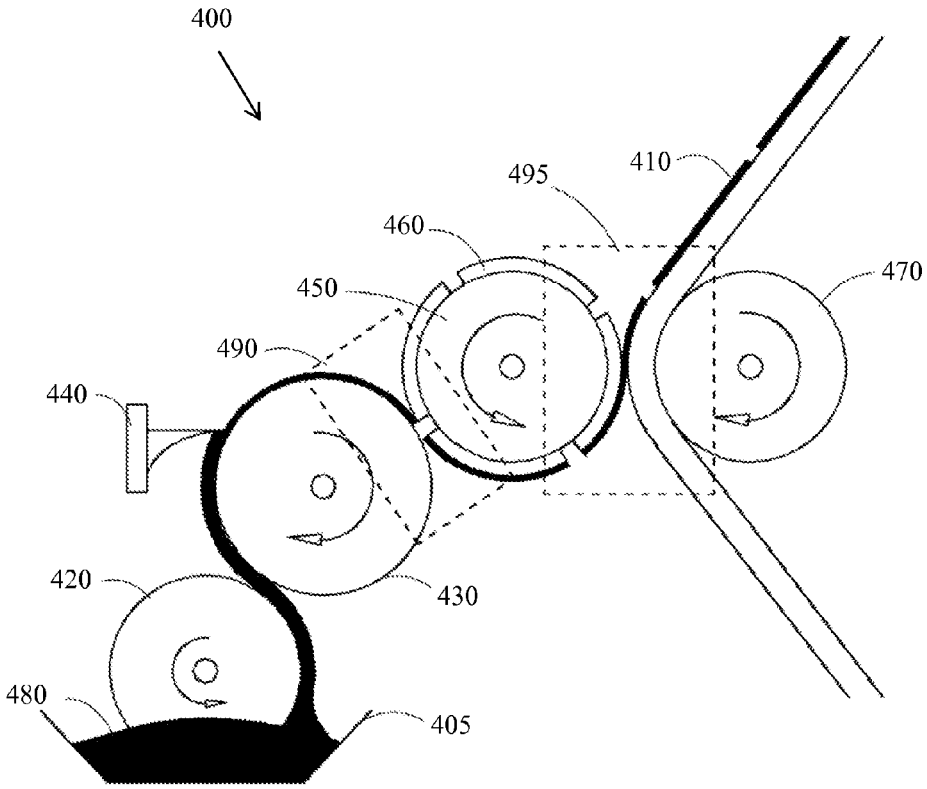


FIG. 4

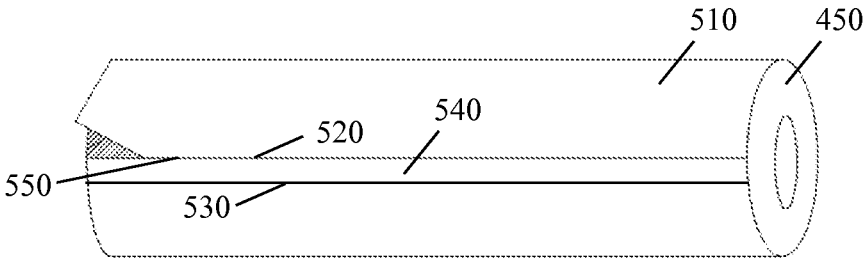


FIG. 5

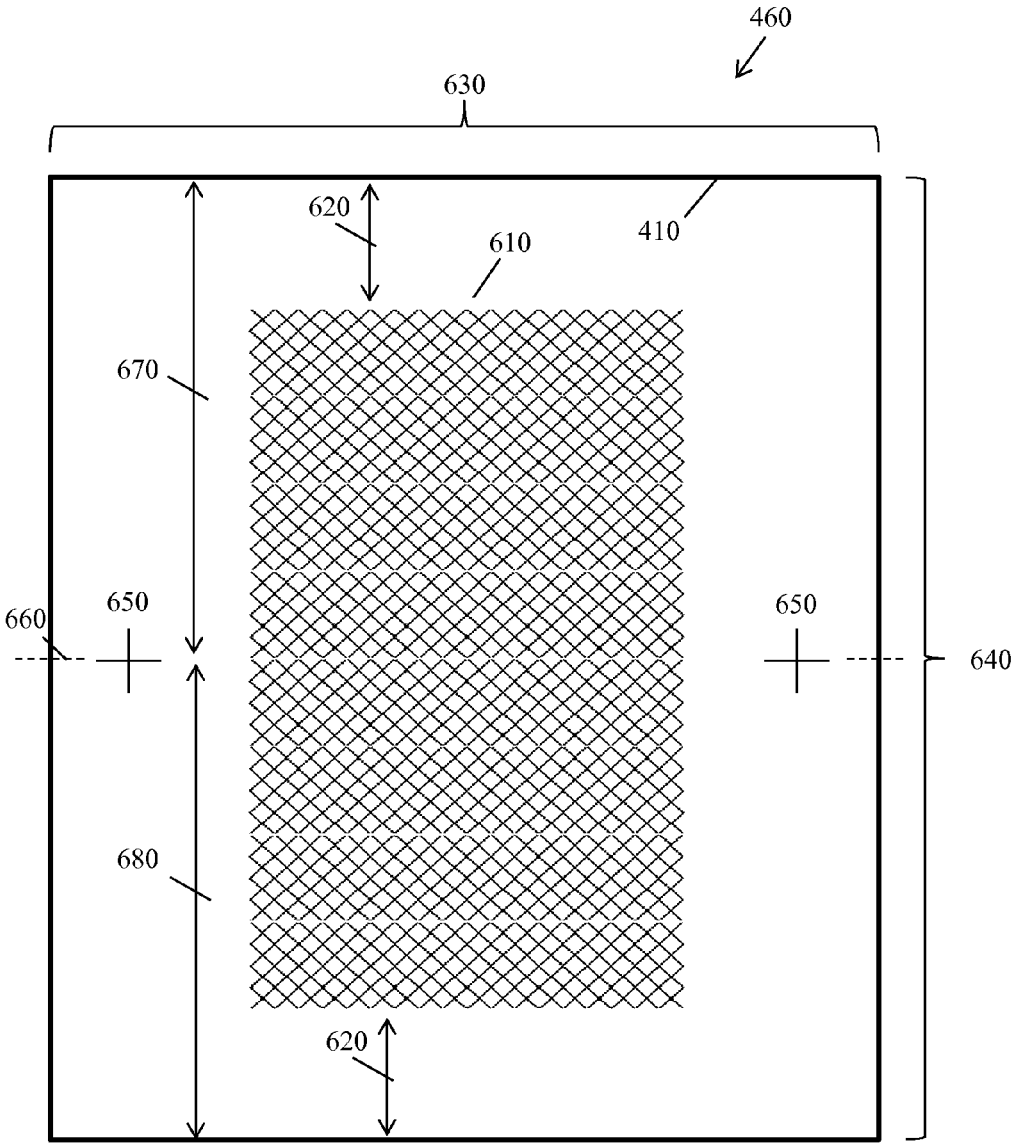


FIG. 6

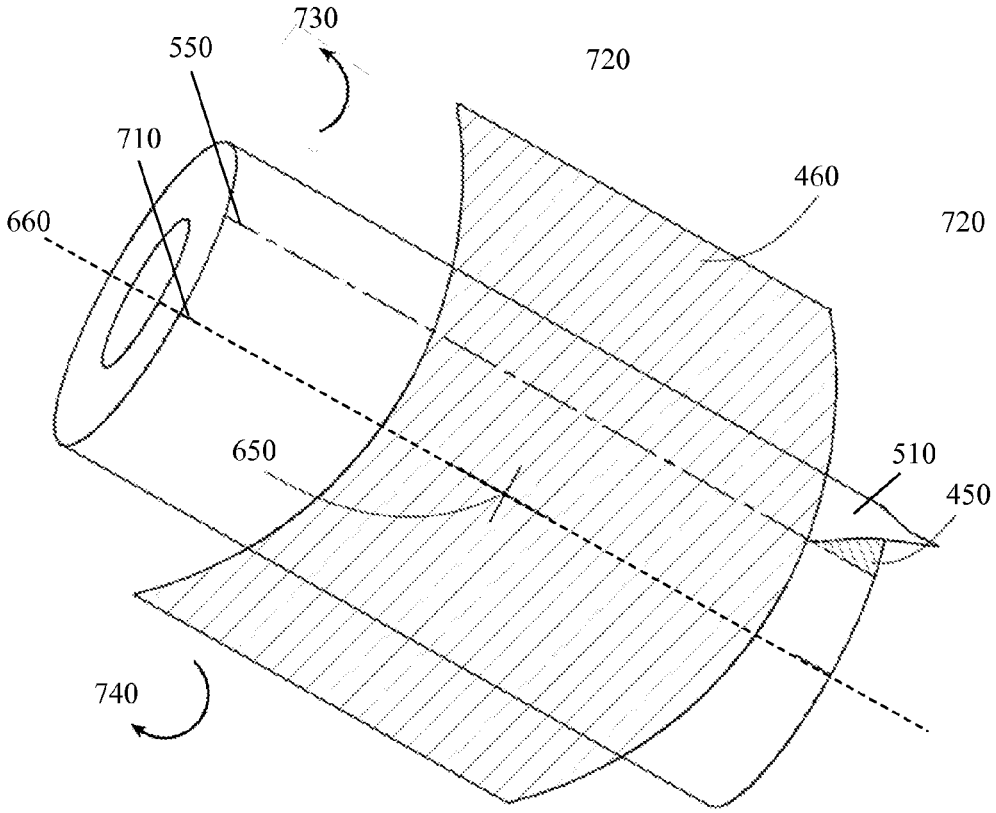


FIG. 7

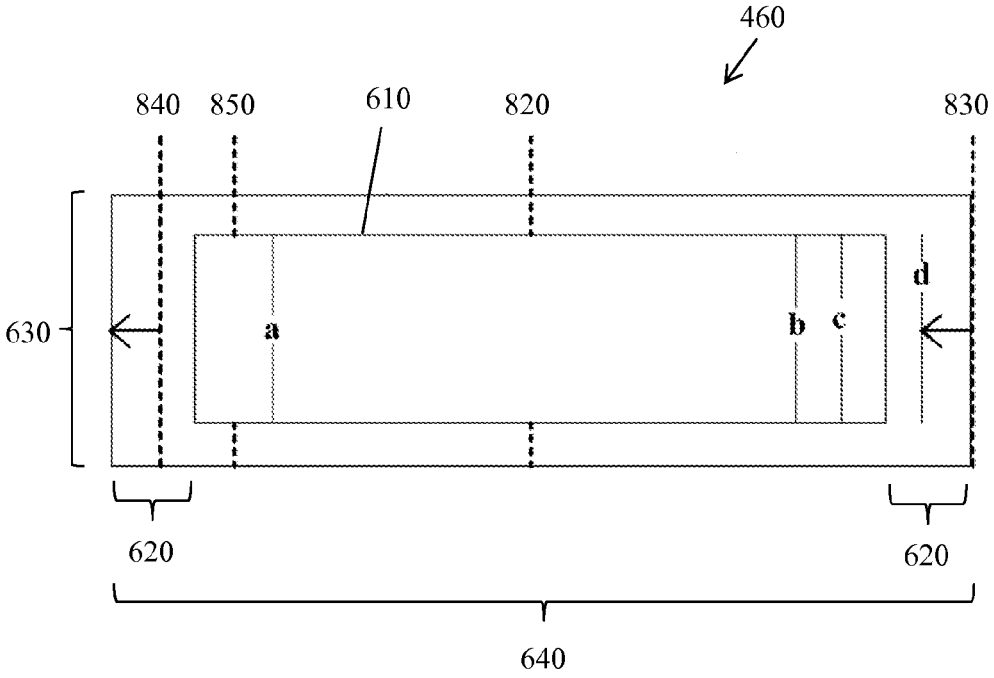


FIG. 8

METHOD OF MOUNTING A FLEXOGRAPHIC PRINTING PLATE TO AVOID BANDING

CROSS-REFRENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. patent application Ser. No. 13/784,765, filed on Mar. 4, 2013, which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] A touch screen enabled system allows a user to control various aspects of the system by touch or gestures. For example, a user may interact directly with objects depicted on a display device by touch or gestures that are sensed by a touch sensor. The touch sensor typically includes a pattern of conductive lines disposed on a substrate configured to sense touch.

[0003] Touch screens are commonly found in consumer systems, commercial systems, and industrial systems including, but not limited to, smartphones, tablet computers, laptop computers, desktop computers, printers, monitors, televisions, appliances, kiosks, copiers, desktop phones, automotive display systems, portable gaming devices, and gaming consoles.

BRIEF SUMMARY OF THE INVENTION

[0004] According to one aspect of one or more embodiments of the present invention, a method of mounting a flexographic printing plate includes disposing a backing tape on a printing plate cylinder forming a taped printing plate cylinder. A transverse center of the flexographic printing plate is attached to the taped printing plate cylinder at a mount line offset relative to a scribe line of the printing plate cylinder. A first portion of the flexographic printing plate is wrapped around a first portion of the taped printing plate cylinder from the mount line outward in a first direction away from the mount line. A second portion of the flexographic printing plate is wrapped around a second portion of the taped printing plate cylinder from the mount line outward in a second direction away from the mount line. The mount line is offset relative to the scribe line at a distance that ensures banding occurs in a non-patterned non-printing area of the flexographic printing plate.

[0005] According to one aspect of one or more embodiments of the present invention, a flexographic printing station includes a printing plate cylinder that includes a scribe line, a backing tape disposed on the printing plate cylinder forming a taped printing plate cylinder, and a flexographic printing plate disposed on the taped printing plate cylinder. The flexographic printing plate is disposed on the taped printing plate cylinder by a process that includes attaching a transverse center of the flexographic printing plate to the taped printing plate cylinder at a mount line offset relative to the scribe line, wrapping a first portion of the flexographic printing plate around a first portion of the taped printing plate cylinder from the mount line outward in a first direction away from the mount line, and wrapping a second portion of the flexographic printing plate around a second portion of the taped printing plate cylinder from the mount line outward in second direction away from the mount line. The mount line is offset relative to the scribe line at a distance that ensures banding occurs in a non-patterned non-printing area of the flexographic printing plate.

[0006] Other aspects of the present invention will be apparent from the following description and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** shows a cross section of a touch screen in accordance with one or more embodiments of the present invention.

[0008] FIG. **2** shows a schematic view of a touch screen enabled computing system in accordance with one or more embodiments of the present invention.

[0009] FIG. **3** shows a conductive pattern disposed on a transparent substrate as part of a touch sensor in accordance with one or more embodiments of the present invention.

[0010] FIG. **4** shows a flexographic printing station in accordance with one or more embodiments of the present invention.

[0011] FIG. **5** shows a printing plate cylinder with backing tape in accordance with one or more embodiments of the present invention.

[0012] FIG. **6** shows a flexographic printing plate with a patterned printing area and a non-patterned non-printing area in accordance with one or more embodiments of the present invention.

[0013] FIG. **7** shows a method of mounting a flexographic printing plate to avoid banding in accordance with one or more embodiments of the present invention.

[0014] FIG. **8** shows a plurality of mount lines and the corresponding locations of banding in accordance with one or more embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0015] One or more embodiments of the present invention are described in detail with reference to the accompanying figures. For consistency, like elements in the various figures are denoted by like reference numerals. In the following detailed description of the present invention, specific details are set forth in order to provide a thorough understanding of the present invention. In other instances, well-known features to one of ordinary skill in the art are not described to avoid obscuring the description of the present invention.

[0016] FIG. **1** shows a cross-section of a touch screen **100** in accordance with one or more embodiments of the present invention. Touch screen **100** includes a display device **110**. Display device **110** may be a Liquid Crystal Display ("LCD"), Light-Emitting Diode ("LED"), Organic Light-Emitting Diode ("OLED"), Active Matrix Organic Light-Emitting Diode ("AMOLED"), In-Plane Switching ("IPS"), or other type of display device suitable for use as part of a touch screen application or design. In one or more embodiments of the present invention, touch screen **100** may include a touch sensor **130** that overlays at least a portion of a viewable area of display device **110**. In certain embodiments, an optically clear adhesive or resin **140** may bond a bottom side of touch sensor **130** to a top, or user-facing, side of display device **110**. In other embodiments, an isolation layer, or air gap, **140** may separate the bottom side of touch sensor **130** from the top, or user-facing, side of display device **110**. A cover lens **150** may overlay touch sensor **130**. Cover lens **150** may be composed of glass, plastic, film, or other material. In certain embodiments, an optically clear adhesive or resin **140**

may bond a bottom side of cover lens **150** to a top, or user-facing, side of touch sensor **130**. In other embodiments, an isolation layer, or air gap, **140** may separate the bottom side of cover lens **150** and the top, or user-facing, side of touch sensor **130**. A top side of cover lens **150** faces the user and protects the underlying components of touch screen **100**. In one or more embodiments of the present invention, touch sensor **130**, or the function that it implements, may be integrated into a display device **110** (not independently illustrated). One of ordinary skill in the art will recognize that touch sensor **130** may be a capacitive, resistive, optical, acoustic, or any other type of touch sensor technology capable of sensing touch.

[0017] FIG. **2** shows a schematic view of a touch screen enabled computing system **200** in accordance with one or more embodiments of the present invention. Computing system **200** may be a consumer computing system, commercial computing system, or industrial computing system including, but not limited to, smartphones, tablet computers, laptop computers, desktop computers, printers, monitors, televisions, appliances, kiosks, automatic teller machines, copiers, desktop phones, automotive display systems, portable gaming devices, gaming consoles, or other applications or designs suitable for use with touch screen **100**. Computing system **200** may include one or more printed or flex circuits (not shown) on which one or more processors (not shown) and system memory (not shown) may be disposed. Each of the one or more processors may be a single-core processor (not shown) or a multi-core processor (not shown) capable of executing software instructions. Multi-core processors typically include a plurality of processor cores disposed on the same physical die (not shown) or a plurality of processor cores disposed on multiple die (not shown) disposed within the same mechanical package (not shown). Computing system **200** may include one or more input/output devices (not shown), one or more local storage devices (not shown) including solid-state memory, a fixed disk drive, a fixed disk drive array, or any other non-transitory computer readable medium, a network interface device (not shown), and/or one or more network storage devices (not shown) including network-attached storage devices and cloud-based storage devices.

[0018] In certain embodiments, touch screen **100** may include touch sensor **130** that overlays at least a portion of a viewable area of display device **110**. In other embodiments, touch sensor **130**, or the function that it implements, may be integrated into display device **110** (not independently illustrated). Controller **210** electrically drives at least a portion of touch sensor **130**. Touch sensor **130** senses touch (e.g., capacitance, resistance, optical, or acoustic) and conveys information corresponding to the sensed touch to controller **210**. In typical applications, the manner in which the sensing of touch is measured, tuned, and/or filtered may be configured by controller **210**. In addition, controller **210** may recognize one or more gestures based on the sensed touch or touches. Controller **210** provides host **220** with touch or gesture information corresponding to the sensed touch or touches. Host **220** may use this touch or gesture information as input and respond in an appropriate manner. In this way, the user may interact with computing system **200** by touch or gestures on touch screen **100**. In certain embodiments, host **220** may be the one or more printed or flex circuits (not shown) on which the one or more processors (not shown) are disposed. In other embodiments, host **220** may be a subsystem or any other part of computing system **200** that is configured to interface with display device **110** and controller **210**.

[0019] FIG. **3** shows a conductive pattern **300** disposed on a transparent substrate as part of a touch sensor (**130** of FIG. **1**) in accordance with one or more embodiments of the present invention. In certain embodiments, a conductive pattern **300** may include a mesh formed by a plurality of parallel conductive lines oriented in a first direction **310** and a plurality of parallel conductive lines oriented in a second direction **320** that are disposed on a side of a transparent substrate (not independently illustrated). One of ordinary skill in the art will recognize that the number of parallel conductive lines oriented in the first direction **310** and/or the number of parallel conductive lines oriented in the second direction **320** may vary based on an application or design. One of ordinary skill in the art will also recognize that a size of conductive pattern **300** may vary based on an application or a design. In other embodiments, conductive pattern **300** may include any other shape or pattern formed by one or more conductive lines or features (not independently illustrated). One of ordinary skill in the art will recognize that a conductive pattern is not limited to parallel conductive lines and may be any one or more of predetermined orientations of line segments, random orientations of line segments, curved line segments, conductive particles, polygons, or any other shape(s) or pattern(s) comprised of electrically conductive material (not independently illustrated) in accordance with one or more embodiments of the present invention.

[0020] In certain embodiments, one or more of the plurality of parallel conductive lines oriented in the first direction **310** and one or more of the plurality of parallel conductive lines oriented in the second direction **320** may have a line width less than approximately 5 micrometers. In other embodiments, one or more of the plurality of parallel conductive lines oriented in the first direction **310** and one or more of the plurality of parallel conductive lines oriented in the second direction **320** may have a line width in a range between approximately 5 micrometers and approximately 10 micrometers. In still other embodiments, one or more of the plurality of parallel conductive lines oriented in the first direction **310** and one or more of the plurality of parallel conductive lines oriented in the second direction **320** may have a line width in a range between approximately 10 micrometers and approximately 50 micrometers. One of ordinary skill in the art will recognize that the shape and width of one or more of the plurality of parallel conductive lines oriented in the first direction **310** and one or more of the plurality of parallel conductive lines oriented in the second direction **320** may vary based on an application or a design in accordance with one or more embodiments of the present invention.

[0021] FIG. **4** shows a flexographic printing station **400** in accordance with one or more embodiments of the present invention. Flexographic printing station **400** may include an ink pan **405**, an ink roll **420** (also referred to as a fountain roll), an anilox roll **430** (also referred to as a meter roll), a doctor blade **440**, a printing plate cylinder **450**, a flexographic printing plate **460**, and an impression cylinder **470**. Flexographic printing plate **460** may include a patterned printing area (not shown) and a non-patterned non-printing area (not shown). The patterned printing area may comprise a pattern to be printed on substrate **410**. The non-patterned non-printing area may be the area other than the patterned printing area that is not used to print on substrate **410**.

[0022] In operation, ink roll **420** transfers ink **480** from ink pan **405** to anilox roll **430**. In certain embodiments, ink **480** may be a precursor ink, a catalytic ink, or a catalytic alloy ink that serves as a plating seed suitable for metallization by electroless plating, immersion, and/or other buildup processes. In other embodiments, ink **480** may be any other conductive ink or material. In still other embodiments, ink **480** may be non-conductive ink or material. One of ordinary skill in the art will recognize that the composition of ink **480** may vary based on an application or a design. Anilox roll **430** is typically constructed of a steel or aluminum core that may be coated by an industrial ceramic whose surface contains a plurality of very fine dimples, also referred to as cells (not shown). Doctor blade **440** removes excess ink **480** from anilox roll **430**. In transfer area **490**, anilox roll **430** meters the amount of ink **480** transferred to flexographic printing plate **460** to a uniform thickness. Printing plate cylinder **450** is typically constructed of a metal such as steel or the like. Flexographic printing plate **460** may be mounted to printing plate cylinder **450** by an adhesive or backing tape (not shown). One or more substrates **410** move between printing plate cylinder **450** and impression cylinder **470**. Impression cylinder **470** is typically constructed of metal that is coated with an abrasion resistant coating. Impression cylinder **470** applies pressure to printing plate cylinder **450**, transferring an ink **480** image of the patterned printing area (not shown) from flexographic printing plate **460** onto substrate **410** at transfer area **495**. The rotational speed of printing plate cylinder **450** is synchronized to match the speed at which substrate **410** moves through flexographic printing station **400**. The speed may vary between 20 feet per minute to 750 feet per minute.

[0023] In certain touch sensor embodiments, the patterned printing area may comprise at least a portion of an image of a conductive pattern (e.g., conductive pattern **300**). One or more flexographic printing stations **400** may be used to dispose a precursor ink, a catalytic ink, or a catalytic alloy ink **480** image (not independently illustrated) of one or more conductive patterns (e.g., conductive pattern **300**) on one or more sides of one or more substrates **410**. Subsequent to flexographic printing, the precursor ink, the catalytic ink, or the catalytic alloy ink image (not shown) may be metallized by one or more of an electroless plating process, an immersion bathing process, and/or other buildup processes, forming one or more conductive patterns (e.g., conductive pattern **300**) on one or more sides of one or more substrates **410**. In other embodiments, one or more flexographic printing stations **400** may be used to directly print a conductive pattern (e.g., conductive pattern **300**) comprised of conductive ink or material **480** on one or more sides of one or more substrates **410**. In one or more embodiments of the present invention, substrate **410** may be transparent. Transparent means capable of transmitting a substantial portion of visible light through the substrate. In certain embodiments, substrate **410** may comprise polyethylene terephthalate ("PET"), polyethylene naphthalate ("PEN"), cellulose acetate ("TAC"), cycloaliphatic hydrocarbons ("COP"), bi-axially-oriented polypropylene ("BOPP"), polyester, polycarbonate, glass, or combinations thereof. In other embodiments, substrate **410** may comprise any other material suitable for use as a touch sensor substrate. One of ordinary skill in the art will recognize that the composition of substrate **410** may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0024] In certain non-touch sensor embodiments, the patterned printing area may comprise an image of any other pattern suitable for flexographic printing. One or more flexographic printing stations **400** may be used to print an ink **480** image (not independently illustrated) of one or more patterns (conductive or non-conductive) on one or more sides of one or more substrates **410**. In certain embodiments, when the image is printed on substrate **410** as part of a non-touch sensor embodiment, substrate **410** may be transparent or opaque depending on an application or design. One of ordinary skill in the art will recognize that, in addition to the transparent substrates discussed above, any opaque substrate suitable for use in a flexographic printing process may be used in accordance with one or more embodiments of the present invention.

[0025] When a flexographic printing station **400** is used to print a patterned printing area (not independently illustrated) on substrate **410**, a number of issues may arise that affect the quality of the printed pattern. For example, a backing tape (not independently illustrated) disposed on printing plate cylinder **450** may have a gap or otherwise imperfect seam. The flexographic printing plate **460** attached to the taped printing plate cylinder **450** may have a gap or otherwise imperfect seam. When anilox roll **430** rotates, one or more of these gaps may result in anilox roll **430** bumping flexographic printing plate **460** during flexographic printing operations. When anilox roll **430** bumps flexographic printing plate **460**, flexographic printing plate **460** may transfer ink or other material **480** to substrate **410** in a non-uniform manner. A bump may also result in banding during flexographic printing operations. When anilox roll **430** bumps flexographic printing plate **460**, flexographic printing plate **460** may transfer unintended ink or other material **480**, that are not part of patterned printing area, to substrate **410**. When the banding is in the patterned printing area, the unintended ink or other material **480** may degrade the printed pattern on substrate **410**. In touch sensor embodiments, banding may cause electrical shorts, electrical opens, and other failure modes. These issues and others are exacerbated when the feature size, such as the width, of lines or features of the patterned printing area are micrometer-fine.

[0026] In one or more embodiments of the present invention, a method of mounting a flexographic printing plate prevents banding in a patterned printing area.

[0027] FIG. **5** shows a printing plate cylinder **450** with backing tape **510** in accordance with one or more embodiments of the present invention. In certain embodiments, printing plate cylinder **450** may be an 18⅞-inch circumference, 151-tooth drum-type printing plate cylinder. In other embodiments, printing plate cylinder **450** may be a 24-inch circumference, 192-tooth drum-type printing plate cylinder. In still other embodiments, printing plate cylinder **450** may be a 12-inch circumference, 96-tooth drum-type printing plate cylinder. In still other embodiments, printing plate cylinder **450** may have a size in a range between approximately 12 inches and approximately 24 inches and a tooth count in a range between approximately 96 teeth and approximately 192 teeth. One of ordinary skill in the art will recognize that a circumference and a number of teeth of printing plate cylinder **450** may vary based on an application or design in accordance with one or more embodiments of the present invention. A double-sided backing tape **510** may be disposed on printing plate cylinder **450** forming a taped printing plate cylinder **450**. A first side of backing tape **510** may adhere to

printing plate cylinder **450** and a flexographic printing plate (**460** of FIG. **4**) may then adhere to a second side of backing tape **510**.

[0028] In one or more embodiments of the present invention, backing tape **510** may be disposed on at least a portion of, and in some cases all of, a circumferential surface of printing plate cylinder **450** by attaching a first end **520** of backing tape **510** to printing plate cylinder **450** at a scribe line **550**. Scribe line **550** is an indentation along a longitude of printing plate cylinder **450** that may be used to locate a longitudinal center of printing plate cylinder **450** and make a clean cut. Backing tape **510** is then wrapped around at least a portion of, and in some cases all of, a circumferential surface of printing plate cylinder **450**. A second end **530** of backing tape **510** may be cut at a cut line (not independently illustrated). In certain embodiments, the cut line may be scribe line **550** such that the second end **530** of backing tape **510** is cut along scribe line **550** forming a seam (not independently illustrated) with the first end **520** of backing tape **510**. The seam may be imperfect. In other embodiments, the cut line may be offset from the scribe line **550** such that there is a gap **540** between the first end **520** of backing tape **510** and the second end **530** of backing tape **510**. The exposed portion of printing plate cylinder **450** in gap **540** may not be level with backing tape **510**.

[0029] In one or more embodiments of the present invention, backing tape **510** may be disposed on at least a portion of, and in some cases all of, a circumferential surface of printing plate cylinder **450** by attaching a first end **520** of backing tape **510** to printing plate cylinder **450** at an offset line (not shown) that is offset from the scribe line **550**. Backing tape **510** is then wrapped around at least a portion, but sometimes the entire, circumferential surface of printing plate cylinder **450**. A second end **530** of backing tape **510** may be cut at a cut line (not independently illustrated). In certain embodiments, the cut line may be the offset line such that the second end **530** of backing tape **510** is cut along the offset line forming a seam (not shown) with the first end **520** of backing tape **510**. The seam may be imperfect. In other embodiments, the cut line may be offset from the offset line such that there is a gap (not shown) between the first end **520** of backing tape **510** and the second end **530** of backing tape **510**. The exposed portion of printing plate cylinder **450** in gap **540** may not be level with backing tape **510**. One of ordinary skill in the art will recognize that other techniques for mounting backing tape **510** to printing plate cylinder **450** may be used in accordance with one or more embodiments of the present invention.

[0030] In certain embodiments, backing tape **510** may comprise ChannalBAC™ structured patterned backing tape commercially available from Controlled Displacement™ Technology LLC of Parkland, Fla. ChannalBAC™ differs from cellular foam in that ChannalBAC™ completely separates the air and elastomeric components by forming solid elastomeric channels separated by channels of air within its membrane. As such, ChannalBAC™ cannot be crushed like cellular foam and resists fatigue and deformation in a spring-like manner. Because of the more uniform density and resistance when compared to cellular foam, ChannalBAC™ provides a more uniform and consistent transfer of ink (**480** of FIG. **4**) from a flexographic printing plate (**460** of FIG. **4**) to substrate (**410** of FIG. **4**). In other embodiments, backing tape **510** may comprise a cellular foam backing tape. One of ordinary skill in the art will recognize that a type of backing tape **510** may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0031] FIG. **6** shows a flexographic printing plate **460** with a patterned printing area **610** and a non-patterned non-printing area **620** in accordance with one or more embodiments of the present invention. In one or more embodiments of the present invention, flexographic printing plate **460** may be comprised of a base layer (not independently illustrated) such as, for example, PET and a photo-sensitive polymer layer (not independently illustrated) disposed on top of the base layer. A plurality of lines or features (not independently illustrated) may be formed in a portion of the photo-sensitive polymer layer forming a patterned printing area **610**. A portion of the photo-sensitive polymer layer in the area other than patterned printing area **610**, such as non-patterned non-printing area **620**, may be removed during fabrication of flexographic printing plate **460**. As such, flexographic printing plate **460** includes non-patterned non-printing area **620** and patterned printing area **610** that has distal ends, or contact surfaces (not shown), onto which ink or other material (**480** of FIG. **4**) may be deposited during flexographic printing operations. In this way, flexographic printing plate **460** may print an ink (**480** of FIG. **4**) image of patterned printing area **610** on a substrate (**410** of FIG. **4**) when used with a flexographic printing station (**400** of FIG. **4**).

[0032] Flexographic printing plate **460** may be substantially rectangular having a width **630** and a length **640**. In certain embodiments, flexographic printing plate **460** may have a width **630** of approximately 14 inches. In other embodiments, flexographic printing plate **460** may have a width **630** of approximately 17 inches. In still other embodiments, flexographic printing plate **460** may have a width **630** in a range between approximately 3 inches and approximately 90 inches. In certain embodiments, flexographic printing plate **460** may have a length **640** of approximately 18⅞ inches. In other embodiments, flexographic printing plate **460** may have a length **640** of approximately 24 inches. In still other embodiments, flexographic printing plate **450** may have a length **640** of approximately 12 inches. In still other embodiments, flexographic printing plate **460** may have a length **640** in a range between approximately 12 inches and approximately 24 inches. One of ordinary skill in the art will recognize that a size of flexographic printing plate **460** may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0033] The patterned printing area **610** may comprise one or more lines, features, shapes, or patterns. The patterned printing area **610** may be disposed anywhere within the boundaries of flexographic printing plate **460**. In certain embodiments, patterned printing area **610** may comprise an image of a conductive pattern (e.g., conductive pattern **300**). In other embodiments, patterned printing area **610** may comprise an image of a non-conductive pattern. In still other embodiments, patterned printing area **610** may comprise one or more of lines, features, shapes, or patterns. One of ordinary skill in the art will recognize that a pattern or design of patterned printing area **610** may vary based on an application or design in accordance with one or more embodiments of the present invention.

[0034] One or more registration marks **650** may be formed in flexographic printing plate **460** along a transverse center **660** line that traverses a width **630** of flexographic printing plate **460**. The transverse center **660** line may or may not be

formed in flexographic printing plate **460**. In one or more embodiments of the present invention, a location of transverse center **660** along a length **640** of flexographic printing plate **460** may vary based on an application or design. The transverse center **660** may be viewed as partitioning flexographic printing plate **460** into a first portion **670** and a second portion **680**. In certain embodiments, the first portion **670** and the second portion **680** may be the same size. In other embodiments, the first portion **670** and the second portion **680** may not be the same size. One of ordinary skill in the art will recognize that the relative size of the first portion **670** and the second portion **680** may vary based on an application or design in accordance with one or more embodiments of the present invention. One of ordinary skill in the art will also recognize that the role of the first portion **670** and the second portion **680** may be reversed in certain applications or designs. The one or more registration marks **650** may be a cross hair pattern used to assist in the alignment of flexographic printing plate **460** to taped printing plate cylinder **450**. One of ordinary skill in the art will recognize that the number and the location of the one or more registration marks **650** may vary in accordance with one or more embodiments of the present invention.

[0035] FIG. **7** shows a method of mounting a flexographic printing plate **460** to avoid banding in accordance with one or more embodiments of the present invention. A backing tape **510** may be disposed on printing plate cylinder **450** forming a taped printing plate cylinder **450** as discussed above with reference to FIG. **5**. In certain embodiments, a transverse center **660** of flexographic printing plate **460** may be attached to taped printing plate cylinder **450** at a mount line **710** of printing plate cylinder **450** that may be offset relative to a scribe line **550** of printing plate cylinder **450**. Because backing tape **510** is tacky, when a portion of flexographic printing plate **460** makes contact with backing tape **510**, the portion of flexographic printing plate **460** in contact with backing tape **510** may be secured in place. Mount line **710** is a virtual line that traverses a longitude of printing plate cylinder **450** and is parallel to scribe line **550**. Mount line **710** may be used to align flexographic printing plate **460** to printing plate cylinder **450**. One or more registration marks **650** may be used to assist in aligning the transverse center **660** of flexographic printing plate cylinder **460** to taped printing plate cylinder **450** along mount line **710**. The one or more registration marks **650** may be used with a camera system to ensure alignment of one or more registration marks **650** of flexographic printing plate **460** to mount line **710** of taped printing plate cylinder **450**. In other embodiments, a transverse center **660** of flexographic printing plate **460** may be attached to taped printing plate cylinder **450** at a mount line **710** that may be the scribe line **550** of printing plate cylinder **450**.

[0036] Once the transverse center **660** of flexographic printing plate **460** is attached to taped printing plate cylinder **450** at mount line **710**, a first portion (**670** of FIG. **6**) of flexographic printing plate **460** may be wrapped around a first portion of a circumferential surface of taped printing plate cylinder **450** from mount line **710** outward in a first direction **730** away from mount line **710**. A second portion (**680** of FIG. **6**) of flexographic printing plate **460** may be wrapped around a second portion of the circumferential surface of taped printing plate cylinder **450** from mount line **710** in a second direction **740** away from mount line **710**. The first direction **730** and second direction **740** may be perpendicular to mount line **710** about the circumference of taped printing plate cylinder **450**. A size of the first portion (**670** of FIG. **6**) of flexographic printing plate **460** and a size of the second portion (**680** of FIG. **6**) of flexographic printing plate **460** may vary based on a location of transverse center **660**. After mounting flexographic printing plate **460** to taped printing plate cylinder **450**, flexographic printing plate **460** may be used in a flexographic printing station (**400** of FIG. **4**) as part of flexographic printing operations.

[0037] FIG. **8** shows a plurality of mount lines (**710** of FIG. **7**) and the corresponding locations of banding **810** in accordance with one or more embodiments of the present invention. In certain embodiments, for purposes of illustration, flexographic printing plate **460** may be mounted to an 18⅞-inch, 151-tooth drum-type printing plate cylinder **450** at a mount line (**710** of FIG. **7**). Flexographic printing plate **460** may have a width **630** of approximately 14 inches and a length **640** of approximately 18⅞ inches suitable for mounting to an 18⅞-inch, 151-tooth drum-type printing plate cylinder **450**. One of ordinary skill in the art will recognize that the size and shape of flexographic printing plate **460** and printing plate cylinder **450** may vary based on an application or design. A patterned printing area **610** may be disposed on flexographic printing plate **460**. Because patterned printing area **610** may vary in shape and/or size, an offset of a mount line (**710** of FIG. **7**) may vary to ensure that banding occurs in a non-patterned non-printing area **620** on substrate (**410** of FIG. **4**). As such, an offset of the mount line (**710** of FIG. **7**) may vary based on an application or design in accordance with one or more embodiments of the present invention. For purposes of illustration, patterned printing area **610** may be represented by a rectangle within which a pattern is disposed to be printed on substrate (**410** of FIG. **4**). One of ordinary skill in the art will recognize that the patterned printing area **610** may vary in shape and/or size based on an application or design in accordance with one or more embodiments of the present invention. A non-patterned non-printing area **620** may be the area other than the patterned printing area **610** that is not used to print on substrate (**410** of FIG. **4**).

[0038] When a mount line (**710** of FIG. **7**) is offset relative to a scribe line (**550** of FIG. **5**), banding may occur on substrate (**410** of FIG. **4**) at a location that may be determined by the offset. In one or more embodiments of the present invention, a mount line (**710** of FIG. **7**) may be offset relative to a scribe line (**550** of FIG. **5**) at a distance that ensures banding occurs on substrate (**410** of FIG. **4**) in an area corresponding to the non-patterned non-printing area **620** of flexographic printing plate **460**. For example, a mount line (**710** of FIG. **7**) offset **820** approximately 9 inches from an edge of flexographic printing plate **460** (as measured from left to right) relative to a scribe line (**550** of FIG. **5**) results in banding on substrate (**410** of FIG. **4**) in an area corresponding to location a of patterned printing area **610** of flexographic printing plate **460**. Banding at location a may comprise a transverse line approximately 4.375 inches from an edge of flexographic printing plate **460** as measured from left to right. As such, during flexographic printing operations, anilox roll (**430** of FIG. **4**) may bump flexographic printing plate **460** resulting in an unintended band on substrate (**410** of FIG. **4**) in patterned printing area **610**, negatively impacting the ability to print micrometer fine lines or features in patterned printing area **610**. For example, the banding may cause shorts, opens, or other failure modes.

[0039] Continuing the example, a mount line (**710** of FIG. **7**) offset **830** approximately **18** inches from an edge of flexo-

graphic printing plate **460** (as measured from left to right) relative to a scribe line (**550** of FIG. **5**) results in banding on substrate (**410** of FIG. **4**) in an area corresponding to location b of patterned printing area **610** of flexographic printing plate **460**. Banding at location b may comprise a transverse line approximately 13.25 inches from an edge of flexographic printing plate **460** as measured from left to right. As such, during flexographic printing operations, anilox roll (**430** of FIG. **4**) may bump flexographic printing plate **460** resulting in an unintended band on substrate (**410** of FIG. **4**) in patterned printing area **610**, negatively impacting the ability to print micrometer fine lines or features in patterned printing area **610**. For example, the banding may cause shorts, opens, or other failure modes.

[0040] Continuing the example, a mount line (**710** of FIG. **7**) offset **840** approximately 1 inch from an edge of flexographic printing plate **460** (as measured from left to right) relative to a scribe line (**550** of FIG. **5**) results in banding on substrate (**410** of FIG. **4**) in an area corresponding to location c of patterned printing area **610** of flexographic printing plate **460**. Banding at location c may comprise a transverse line approximately 14.25 inches from an edge of flexographic printing plate **460** as measured from left to right. As such, during flexographic printing operations, anilox roll (**430** of FIG. **4**) may bump flexographic printing plate **460** resulting in an unintended band on substrate (**410** of FIG. **4**) in patterned printing area **610**, negatively impacting the ability to print micrometer fine lines or features in patterned printing area **610**. For example, the banding may cause shorts, opens, or other failure modes.

[0041] However, a mount line (**710** of FIG. **7**) offset **850** approximately 4 inches from an edge of flexographic printing plate **460** (as measured from left to right) relative to a scribe line (**550** of FIG. **5**) results in banding on substrate (**410** of FIG. **4**) in an area corresponding to location d of non-patterned non-printing area **620** of flexographic printing plate cylinder **460**. Because banding occurs in the non-patterned non-printing area **620**, the banding does not negatively impact the patterned printing area **610** or the corresponding image of the patterned printing area **610** printed on substrate (**410** of FIG. **4**). In embodiments using an 18⅞-inch, 151-tooth drum-type printing plate cylinder **450**, banding may lead a scribe line (**550** of FIG. **5**) by approximately 4.7 inches. As such, in certain embodiments, a mount line **710** may be offset relative to a scribe line (**550** of FIG. **5**) at a distance of approximately 4.7 inches to ensure banding occurs in non-patterned non-printing area **620**. In other embodiments, mount line **710** may be offset relative to scribe line (**550** of FIG. **5**) at a distance that ensures banding occurs in non-patterned non-printing area **620**.

[0042] While the above noted examples are based on an example of a patterned printing area **610**, one of ordinary skill in the art will recognize that patterned printing area **610** may vary in shape and/or size. In addition, one of ordinary skill in the art will recognize that an offset of mount line (**710** of FIG. **7**) may vary based on the shape and/or the size of the patterned printing area **610**. For example, a small patterned printing area **610** may have a larger non-patterned non-printing area **620** and an offset of mount line (**710** of FIG. **7**) may vary as a result. Advantageously, in one or more embodiments of the present invention, a mount line (**710** of FIG. **7**) may be offset relative to a scribe line (**550** of FIG. **5**) at a distance that ensures banding occurs in a non-patterned non-printing area of a flexographic printing plate **460**.

[0043] Advantages of one or more embodiments of the present invention may include one or more of the following:

[0044] In one or more embodiments of the present invention, a method of mounting a flexographic printing plate to avoid banding improves mounting precision.

[0045] In one or more embodiments of the present invention, a method of mounting a flexographic printing plate to avoid banding ensures banding occurs in a non-patterned non-printing area of a flexographic printing plate. In this way, the banding may be hidden in the non-functional or otherwise unimportant area of the substrate.

[0046] In one or more embodiments of the present invention, a method of mounting a flexographic printing plate to avoid banding allows for the flexographic printing of micrometer-fine lines or features on a substrate.

[0047] In one or more embodiments of the present invention, a method of mounting a flexographic printing plate to avoid banding allows for more uniform ink transfer when printing micrometer-fine lines or features on a substrate.

[0048] In one or more embodiments of the present invention, a method of mounting a flexographic printing plate to avoid banding improves yield when printing fine lines or features on substrate.

[0049] In one or more embodiments of the present invention, a method of mounting a flexographic printing plate to avoid banding reduces wear and tear on flexographic printing station components.

[0050] In one or more embodiments of the present invention, a method of mounting a flexographic printing plate to avoid banding reduces manufacturing expense, manufacturing time, and manufacturing complexity.

[0051] In one or more embodiments of the present invention, a method of mounting a flexographic printing plate to avoid banding is compatible with existing flexographic printing processes.

[0052] While the present invention has been described with respect to the above-noted embodiments, those skilled in the art, having the benefit of this disclosure, will recognize that other embodiments may be devised that are within the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the appended claims.

What is claimed is:

1. A method of mounting a flexographic printing plate comprising:

disposing a backing tape on a printing plate cylinder forming a taped printing plate cylinder;

attaching a transverse center of the flexographic printing plate to the taped printing plate cylinder at a mount line offset relative to a scribe line of the printing plate cylinder;

wrapping a first portion of the flexographic printing plate around a first portion of the taped printing plate cylinder from the mount line outward in a first direction away from the mount line; and

wrapping a second portion of the flexographic printing plate around a second portion of the taped printing plate cylinder from the mount line outward in a second direction away from the mount line,

wherein the mount line is offset relative to the scribe line at a distance that ensures banding occurs in a non-patterned non-printing area of the flexographic printing plate.

2. The method of claim **1**, wherein the patterned printing area comprises a plurality of micrometer-fine lines.

3. The method of claim 1, wherein the patterned printing area comprises a mesh formed by a plurality of parallel lines oriented in a first direction and a plurality of parallel conductive lines oriented in a second direction.

4. The method of claim 1, wherein the offset is approximately 4.7 inches.

5. The method of claim 1, wherein disposing the backing tape on the printing plate cylinder comprises:

attaching a first end of the backing tape to the printing plate cylinder at the scribe line;

wrapping the backing tape around the printing plate cylinder; and

cutting a second end of the backing tape at a cut line.

6. The method of claim 5, wherein the cut line is the scribe line.

7. The method of claim 5, wherein the cut line is offset from the scribe line forming a gap between the first end of the backing tape and the second end of the backing tape.

8. The method of claim 1, wherein the backing tape comprises a structured patterned backing tape.

9. The method of claim 8, wherein the structured patterned backing tape comprises ChannalBAC™.

10. The method of claim 1, wherein attaching the transverse center of the flexographic printing plate to the taped printing plate cylinder comprises:

aligning the transverse center of the flexographic printing plate to the mount line; and

disposing the transverse center of the flexographic printing plate on the backing tape.

11. A flexographic printing station comprising:

a printing plate cylinder comprising a scribe line;

a backing tape disposed on the printing plate cylinder forming a taped printing plate cylinder; and

a flexographic printing plate disposed on the taped printing plate cylinder,

wherein the flexographic printing plate is disposed on the taped printing plate cylinder by a process comprising:

attaching a transverse center of the flexographic printing plate to the taped printing plate cylinder at a mount line offset relative to the scribe line,

wrapping a first portion of the flexographic printing plate around a first portion of the taped printing plate cylinder from the mount line outward in a first direction away from the mount line, and

wrapping a second portion of the flexographic printing plate around a second portion of the taped printing plate cylinder from the mount line outward in second direction away from the mount line,

wherein the mount line is offset relative to the scribe line at a distance that ensures banding occurs in a non-patterned non-printing area of the flexographic printing plate.

12. The flexographic printing station of claim 11, wherein the patterned printing area comprises a plurality of micrometer-fine lines.

13. The flexographic printing station of claim 11, wherein the patterned printing area comprises a mesh formed by a plurality of parallel lines oriented in a first direction and a plurality of parallel conductive lines oriented in a second direction.

14. The flexographic printing station of claim 11, wherein the offset is approximately 4.7 inches.

15. The flexographic printing station of claim 11, wherein the backing tape is disposed on the printing plate cylinder by a process comprising:

attaching a first end of the backing tape to the printing plate cylinder at the scribe line;

wrapping the backing tape around the printing plate cylinder; and

cutting a second end of the backing tape at a cut line.

16. The flexographic printing station of claim 15, wherein the cut line is the scribe line.

17. The flexographic printing station of claim 15, wherein the cut line is offset from the scribe line forming a gap between the first end of the backing tape and the second end of the backing tape.

18. The flexographic printing station of claim 11, wherein the backing tape comprises a structured patterned backing tape.

19. The flexographic printing station of claim 18, wherein the structured patterned backing tape comprises ChannalBAC™.

20. The flexographic printing station of claim 11, wherein attaching the transverse center of the flexographic printing plate to the taped printing plate cylinder comprises:

aligning the transverse of the flexographic printing plate to the mount line; and

disposing the transverse center of the flexographic printing plate on the backing tape.

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