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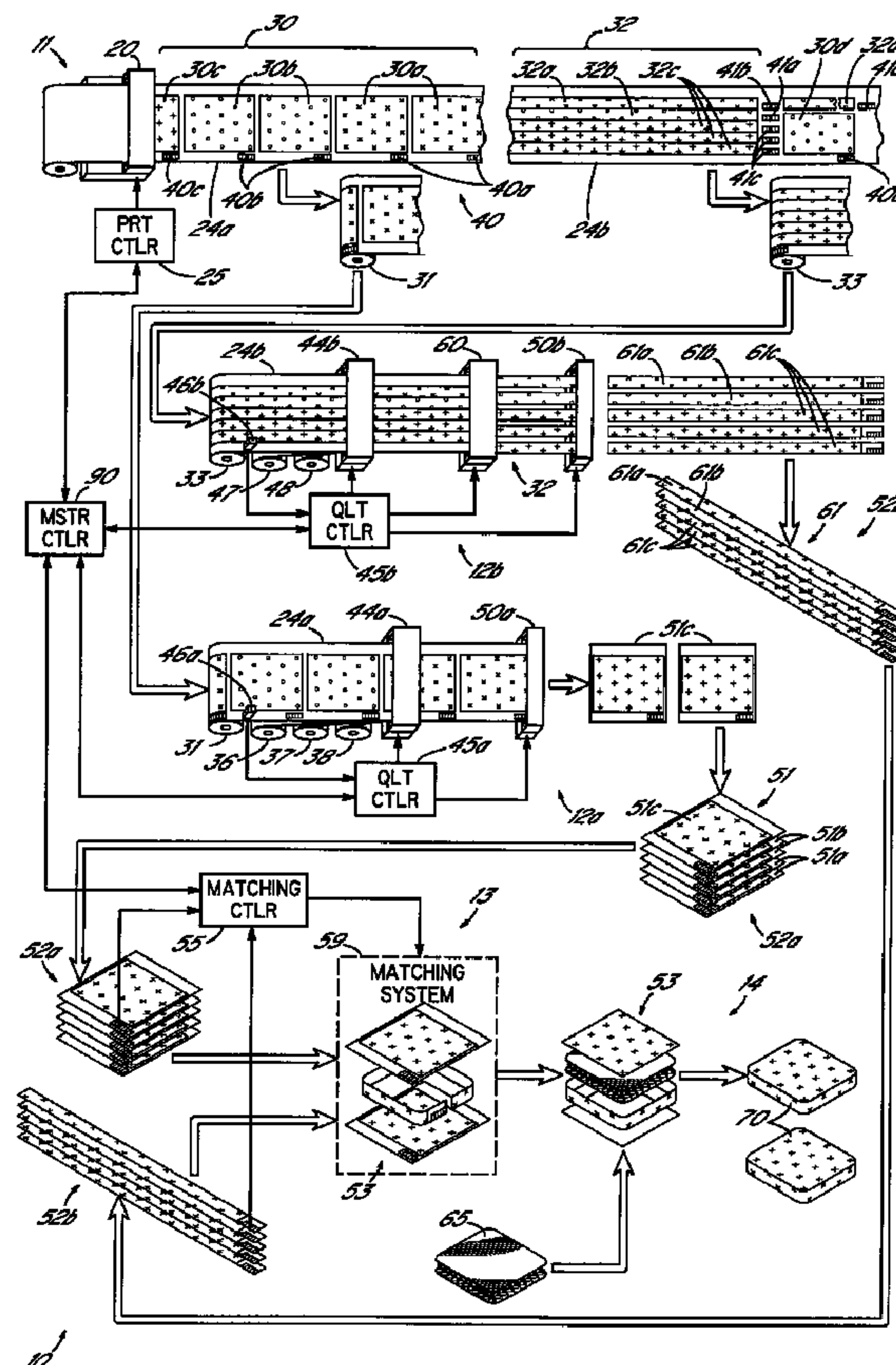
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(57) **Abrégé/Abstract:**

A quilting machine (10, 100, 200, 300, 400, 500) is provided with a printing station (20, 125, 225, 325, 425, 525) and a quilting station (44, 127, 227, 327, 427, 527). The printing station is located either in line and preferably upstream of the quilting station,

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with a conveyor (520) extending through each of the stations to convey a web of quilting material through the machine, or is off of the quilting line such that the material with a pre-applied pattern thereon is transferred, preferably in web form, to the line of the second station for the application of a pattern in registration with the first applied pattern. At the quilting station, registration longitudinal and transverse registration is measured and skewing or rotation of the material is determined. Opposite transverse sides of the material are differently adjusted to orient and register the material. A master batch controller (90, 135, 235, 335, 435, 535) assures that the proper combinations of printed and quilted patterns are combined to allow small quantities of different quilted products to be produced automatically along a material web. Ticking is preprinted with a plurality of different patterns, organized and communicated by the computer so that a print head can scan the material and print different patterns of different panels (32) across the width of a web. Identifying data (40) for matching the panels of a mattress product can be provided in data files printed on the fabric. Cutting and slitting of the panels from each other and the quilting and combining of the panels for assembly of a mattress product can be carried out manually or automatically using the data.

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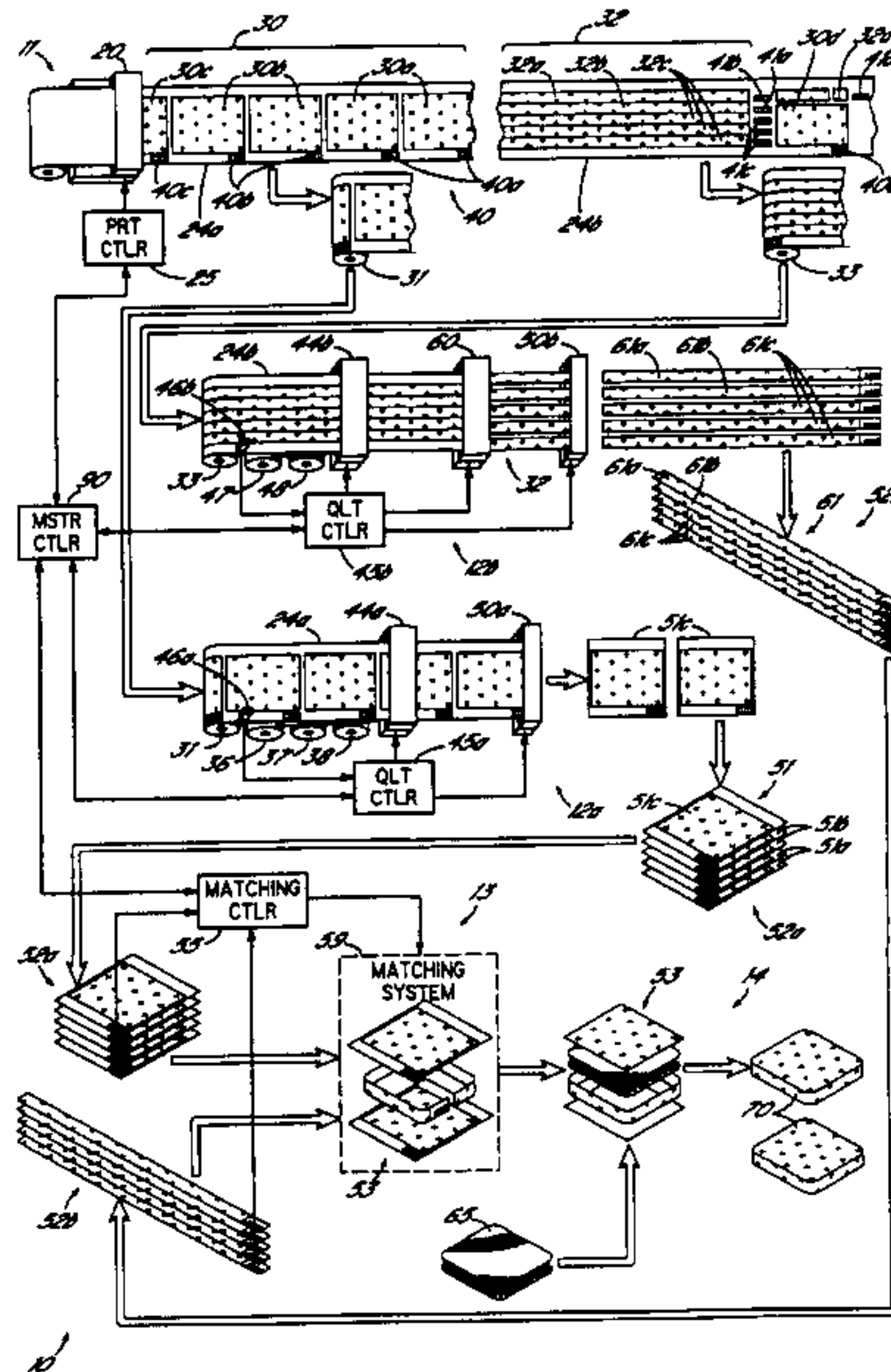
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(54) Title: PRINTING AND QUILTING METHOD AND APPARATUS



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across the width of a web. Identifying data (40) for matching the panels of a mattress product can be provided in data files printed on the fabric. Cutting and slitting of the panels from each other and the quilting and combining of the panels for assembly of a mattress product can be carried out manually or automatically using the data.

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PRINTING AND QUILTING METHOD AND APPARATUS

The present invention relates to quilting, and particularly to the quilting of pattern bearing products such as mattress covers. The invention particularly relates to the manufacture of quilted materials that bear printed patterns. The invention is particularly useful where the quilting is performed on multi-needle quilting machines, where the quilting and printing are applied to roll fed or web material or where differing products
5 are produced in small quantities and in batches.

Background of the Invention:

Quilting is a special art in the general field of sewing in which patterns are stitched through a plurality of layers of material over a two dimensional area of the material. The multiple layers of material normally include at least three layers, one a woven primary or facing sheet that will have a decorative finished quality,
10 one a usually woven backing sheet that may or may not be of a finished quality, and one or more internal layers of thick filler material, usually of randomly oriented fibers. The stitched patterns maintain the physical relationship of the layers of material to each other as well as provide ornamental qualities. In quilting, two different approaches are generally used.

Single needle quilters of the type illustrated and described in U.S. patents nos. 5,640,916 and
15 5,685,250, and those patents cited and otherwise referred to therein are customarily used for the stitching of most comforters, some bedspreads and other products from pre-formed or pre-cut rectangular panels. Some single needle quilters are used to quilt patterns on fabric that carries a pre-woven or printed pattern, with the quilting adding to or enhancing the appearance of the pattern. Such quilters require that pre-patterned material be manually positioned in the quilting apparatus so that the quilting can be registered with the pre applied
20 pattern or a complicated visual positioning system be used. With such systems, border quilting or coarse pattern quilting can be achieved but high quality outline quilting around the pre applied patterns or the quilting of pattern details of a fraction of an inch in scale are difficult to achieve. Single needle quilters are usually lock stitch machines.

Large scale quilting operations have been used for many years in the production of bedding products.
25 Mattress covers, which enclose and add padding to inner spring, foam or other resilient core structure, provide functional as well as ornamental features to a mattress. Mattress covers are typically made up of quilted top and bottom panels, which contribute to the support and comfort characteristics of a mattress, and an elongated

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side panel, which surrounds the periphery of the mattress to join the top and bottom panels around their edges to enclose the inner spring unit or other mattress interior.

Mattresses are made in a small variety of standard sizes and a much larger variety of combinations of interiors and covers to provide a wide range of support and comfort features and to cover a wide range of product prices. To provide variety of support and comfort requirements, the top and bottom panels of mattress covers are quilted using an assortment of fills and a selection of quilted patterns. To accommodate different mattress thicknesses, border panels of different widths are required with variations in the fill for border panels being less common. Border panels as well as top and bottom panels are usually made in different sizes to accommodate all of the standard mattress sizes.

Mattress covers are usually quilted on web-fed multi-needle quilters. Only one side of the quilted product need be finished for a mattress cover, so one layer of ornamental top goods or ticking is usually combined on a chain stitch quilting machine with fill and backing material to produce the mattress cover products. The ornamental characteristics of the ticking that form the outer surface of a mattress is regarded as important in the marketing of bedding products. Bedding manufacturers stock a variety of ticking materials of different colors and types, many having different sewn or printed patterns. Maintaining an adequate inventory of ticking requires the stocking of rolls of different widths of materials of different colors and patterns. The cost of such an inventory as well as the storage and handling of such an inventory contributes substantially to the manufacturing cost of bedding products.

Multiple needle quilters of the type illustrated in U.S. Patents Nos. 5,154,130 and 5,544,599 are customarily used for the stitching of mattress covers some bedspreads and other such products which are commonly formed from multi-layered web fed material. These multi-needle quilters include banks of mechanically ganged needles that sew multiple copies of a recurring pattern on the fabric. With such multi-needle machines, the combining of quilting with pre-applied printed or woven patterns in the fabric which would require registration of the quilting with the pre-applied patterns is usually not attempted. Multi-needle quilters are usually chain stitch machines. Such quilters include banks of mechanically ganged needles that sew multiple copies of a recurring pattern. Some of these quilted patterns are highly ornate and contribute materially to the appearance of the quilted products, particularly those that are of higher quality and cost, and which are made in smaller quantities. With such high-end products, the combining of quilting with pre-applied printed or woven patterns in the fabric may call for registration of the quilting with the pre-applied patterns, which is difficult to achieve with multi-needle machines. Other quilted products, such as those with simple zig-zag quilted patterns, are more functional, and rely on the varieties of the ticking material for the visual distinctiveness of the product. The varieties of ticking materials include those sewn or printed with different patterns. For such products, printed patterns are usually applied by the ticking supplier and rolls of ticking of each pattern are inventoried by the mattress cover manufacturer.

Other quilting machines and methods employing some of the characteristics of both single needle panel type quilters and web fed multi-needle quilters are disclosed in U.S. Patent No. 5,832,849 of Jeff

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Kaetterhenry, et al. issued Nov. 10, 1998 and entitled Web-fed Chain-stitch Single-needle Mattress Cover Quilter with Needle Deflection Compensation and U.S. Patent No. 6,178,903 of Bondanza et al., issued Jan. 30, 2001 and entitled Web-fed Chain-stitch Single-needle Mattress Cover Quilter with Needle Deflection Compensation. Such a machine uses one or more separately controllable single needle heads that apply chain
5 stitches to panels or webs.

The production of quilts by off-line processes, that is those involving both printing and quilting processes performed on different production lines, has included specialty product production involving the outlining or other coordinated stitching onto material on which patterns have been preprinted. Stitching in such processes is traditionally carried out with manually guided single needle quilting machines. Proposed
10 automated systems using vision systems to follow a preprinted pattern or other schemes to automatically stitch on the preprinted material have been proposed but have not proven successful. Registration of pattern stitching with preprinted patterns has been a problem. While efforts to align printing and stitching longitudinally or transversely have been made, angular orientation of the patterns has been ignored. Correction for misalignment of quilted and printed patterns by repositioning of a quilting or printing head is inadequate if multi-needle
15 quilters are to be used, particularly where angular mis-orientation is present.

Application of registration techniques to roll fed materials, where printing and quilting are best performed on material webs, presents additional problems. When using web materials, registration errors that would result if conventional techniques were applied would produce cumulative errors. This would be particularly true were angular orientation errors result due to skewing of the web as it is fed into the subsequent
20 pattern applying machine after removed from a machine in which the first pattern has been applied.

With off-line processes for applying one pattern and then another in registration with the first, one by printing and one by quilting, production of quilts in small batches is particularly a problem. Each batch can include one or a few quilted products of a common design made up of a printed pattern and a quilted pattern, with the products of different batches, preferably to be consecutively made on the same machinery, being made
25 up of a different printed pattern in combination with a different quilted pattern. As a result, the matching of the second pattern to be applied with the correct pre-applied pattern as the partially completed products are moved from a first machine or production line to a second is critical and a potential source of error as well as production delay.

For example, the outer layer of material used for mattress covers, often referred to as ticking, is
30 supplied in a variety of colors and preprinted or dyed patterns. Generally, mattress manufacturers who are the customers of the quilted mattress cover manufacturers or quilting machinery manufacturers require a wide variety of ticking material patterns to produce a variety of bedding products. Frequently, small quantities of each of the variety of products must be made to supply their customers' requirements, requiring the maintenance of inventories of a large number of different patterns of ticking material, which involves
35 substantial cost. Further, the need to constantly match patterns as well as to change ticking supply rolls when manufacturing such a variety of products in small quantities can be a major factor in reducing the throughput of a mattress making process and delaying production. These and related problems continually exist in the

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manufacture of bedspreads, comforters and other quilted products where a variety of products in small quantities is desired.

Other off-line processes may involve the loading of rolls of ticking materials commonly bearing a pre-applied pattern onto the quilting machines. Lower cost mattresses are often made by sewing generic quilted patterns onto printed pattern material. However, frequent changing of the ticking material to produce products having a variety of appearances, requires interruption of the operation of the quilting machine for manual replacement and splicing of the material. This adds to labor costs and lowers equipment productivity. Further, the spliced area of the material web which must be cut from the quilted material is wasted. Furthermore, since mattress top and bottom panels are often thicker, and vary in thickness more than border panels, border panels are sometimes quilted on quilting lines that are separate from those used to quilt the top and bottom panels. Since border panels are usually preferred to match the top and bottom panels, the changing of ticking on the top and bottom panel line is almost always accompanied by a similar change of ticking material on the border panel line. Coordination of the two production lines, as well as the matching of border panels with the top and bottom panels, requires well executed control procedures and can lead to assembly errors or production delays.

There exists a need in mattress cover manufacturing for a capability of efficiently producing small quantities of quilted fabric such as mattress covers, comforters, bedspreads and the like where different pre-applied patterns on the product are desired to be enhanced by combining the pre-applied and quilted patterns, particularly where combinations of quilted patterns and printed or other pre-applied patterns must vary with each or every few products. Further, there is a need in mattress cover manufacturing to improve the productivity and efficiency of making quilted products, particularly mattress covers, having a variety of designs without increasing, or while reducing, production costs.

Summary of the Invention:

An objective of the present invention is to provide quilt manufacturers, particularly mattress cover manufacturers, with the ability to produce quilted products having a wide variety of patterns that include both quilting and printed or other images or designs without the need to inventory material in a large number of different pre-applied designs.

A further objective of the invention is to provide for the intricate outline or other coordinated quilting of designs or patterns on multi-layered materials in a highly efficient, economical, high speed and automated manner, particularly by both applying the printed design or pattern and quilting the outline or other coordinated quilted enhancement of the printed design or pattern in sequence on the same manufacturing line.

Another objective of the present invention is to efficiently provide for customizable printed and quilted patterns on mattress covers, bedspreads and the like, which can be varied on an individual piece basis or with among items produced in small quantities. It is a particular objective of the present invention to provide flexibility in the production of mattress ticking and quilted mattress covers having patterns that can differ from product to product.

A further objective of the present invention is to reduce quilting downtime due to the need to make ticking or other material changes, pattern changes or machine adjustments. A more particular objective of the

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present invention is to provide a quilting method and apparatus with which quilted patterns and printed patterns may be applied in registration and varied on a quilting machine.

A particular objective of the present invention is to aid the production of quilted material by combining both printed patterns and quilted patterns wherein multiple copies of the quilted patterns can be simultaneously applied using a multi-needle quilter. An additional particular objective of the present invention is to facilitate accurate, coordinated application of patterns by printing and quilting to web or roll fed material. Another particular objective of the present invention is to assist in the automatic coordination of printed and quilted patterns of products produced successively in small batches of different products. These objectives are most particularly sought in systems in which a first pattern, such as a printed pattern, is applied off-line from the machine on which the second pattern, such as a quilted pattern, is to be applied in registration with the first pattern.

An additional objective of the present invention is to provide for the efficient arrangement of top, bottom and border panels of different printed patterns on one or more webs or sections of a fabric. A further objective of the invention is to coordinate the matching and assembly of the different panels that make up each of a plurality of differently patterned mattress covers or other fabric products.

According to principles of the present invention, a quilting method and apparatus are provided for the manufacture of a quilted product by a combination of printed pattern application and quilting. The process provided includes: the selecting of a print pattern to be printed on the material, the selecting of a quilt pattern to be quilted on the material, the application of the printed pattern by moving a printing head relative to the material, and the application of a quilted pattern by moving a quilting head relative to the material, with the pattern that is applied second being applied in registration with the first. Preferably the printed pattern is applied first.

According to certain embodiments of the present invention, these principles are achieved by embodiments in which printed designs and coordinated quilted patterns are applied upon multilayered material in the same production line and under the control of a common machine and pattern controller. Multiple layers of the material for the forming a quilt are supported on a frame on which a printing head and a quilting head are also mounted. A mechanism is provided to impart relative movement of the supported material relative to the quilting and printing heads. Such a mechanism can include a material conveyor that moves the material with respect to the frame, and/or head transport mechanisms that move the heads to and from the material when it is fixed relative to the frame. Either the supported material or the heads or both are moved relative to each other under the control of a programmed computer control to apply printed designs and quilted patterns to the material in mutual registration. Preferably, the printed designs are applied first onto the top layer or facing material, then a pattern is quilted in registration with the printed designs. Alternatively, printed designs can be applied after the patterns are quilted.

According to certain preferred embodiments, a quilting apparatus is provided with a supply of multiple layers of material to be quilted and printed with a combination printed design and quilt pattern. An outer or top layer is fed, preferably as a continuous web, through a series of stations. At one station, a printed design

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is applied to the top or facing layer of material. At another station, preferably downstream of the printing station, a quilted pattern is applied to the multiple layered fabric of material including the facing material layer and filler and backing material layers. Whichever pattern or design is applied second, preferably the quilted pattern, it is applied in registration with the pattern or design that has been applied first to the fabric under the control of a programmed controller. A curing station or oven may be further provided downstream or as part of the printing station to cure the dye or ink applied at the printing station.

In certain preferred machines, a printing station is provided on a frame and quilting station is located on the frame, preferably downstream from the printing apparatus. A material conveyer is provided that brings fabric printed at the printing station into the quilting station with the location of the printed pattern known so that one or more quilting heads at the quilting station can be registered with the printed pattern.

According to one preferred embodiment of the invention, the printing station includes one or more ink-jet printing or dye transfer heads moveable under computer control over the outer or facing layer of material. Additional layers of material are combined with the outer layer, preferably downstream of the printing station and after a printed pattern is applied to the outer layer at the printing station. In this embodiment, the quilted pattern is then quilted onto the material in registration with the printed pattern. Registration may be achieved by maintaining information in a controller of the location of the printed pattern on a facing material and of the relative location of the heads with respect to the facing material.

In embodiments where the material is moved on a conveyor successively through the printing and quilting stations, information of the location of the design or pattern on the facing material and of the material on the conveyor is maintained by the controller. The material may be fed in separate precut panel sections, as continuous patterns and designs along a web, or in discrete panel sections along a continuous web. Where the printed design is applied before the quilting, which is preferred, information of the exact location of the design on the facing material is maintained as the material moves from the printing station, as the filler and backing layers of material are brought into contact with the outer layer or facing material, and as the material is fed to the quilting station. For example, outline quilting the pattern in computer controlled registration with the printed pattern can be carried out, or some other quilting pattern can be applied, based on the maintained registration information of the pattern on the web moving through the apparatus.

In one preferred embodiment, exact registration between the design that is printed onto the material and the pattern that is quilted on the material is maintained by holding a panel section of the multi-layered material onto which the pattern is printed in some securing structure at and between the printing and quilting stations. The panel section can be a separate panel or a portion of a web of material, and may be secured in place on a conveyor. In such an embodiment, the registration may be maintained throughout the entire printing and quilting operation by side securements such as, for example, a pin-tentering material transport that keeps the material fixed relative to the conveyor or securing structure through the printing process and the quilting process. A programmed or process controller controls the relative movement of the fabric and printing and quilting heads, and coordinates the movement in synchronization with printing head control and quilting head control so that the printed and quilted patterns are applied in precise registration.

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In other embodiments, the pattern is applied off-line, preferably the printing process. The printed pattern may include a machine identifiable mark or other reference, such as may be achieved by the printing of selvage edge registration marks on the material that are uniquely positioned relative to the printed pattern. The printed material is then transferred to a quilting line at which a quilted pattern is applied in registration with the printed pattern. Preferably, machine readable registration information is produced on the material at more than one transversely spaced points on the material, such as on opposite selvages or side edges of the material. Separate determinations are made from the plural marks as to the relative alignment at two places on the material, such as at both of the opposite side edges. Thus, two such marks can be located when the second pattern is registered to the first, and determination can be made of the skewing or rotation of the material carrying the first or pre-applied pattern.

Adjustment to eliminate skewing or rotation of the fabric, and thereby to achieve registration of the second pattern with the first at transversely spaced locations on the material, is provided by side-to-side material position adjustment. Preferably, adjustment is provided by a split feed roll, with separately rotatable right and left components that are separately controlled in response to separate determinations of the registration of the right and left sides of the material.

Preferably, the patterns are applied to webs of material on which different products are to be quilted along the length of the material prior to the panels being separated from the web. Multi-needle quilting machines are also preferably used. Where the printing is applied to the web off-line, side-to-side registration that overcomes the effects of skewing or mis-orientation of the web achieves equally good registration of the different pattern copies being stitched simultaneously by the multiple needles and overcomes cumulative registration errors as the web is fed.

In certain other embodiments, vision systems may be employed to determine or verify the location of the printed pattern and to enhance or provide registration of the quilting with the printing. Such a vision system may be employed in addition or in the alternative to the computer control of the material transport.

Printed patterns or designs and the quilted patterns may be programmed or stored in memory and, in a programmed or operator selected manner, printed designs and quilted patterns may be combined in different combinations to produce a wide variety of composite printed and quilted patterns.

In alternative embodiments, the material may be held stationary, rather than moved relative to a fixed frame, and the printing and quilting heads of the respective printing and quilting stations may move relative to the frame and the material fixed on the frame, under the coordination of a controller, to bring a printing head or a quilting head into position over the portion of the material on which a pattern is to be applied. In most applications, quilting a pattern after applying a printed design is preferred. However, aspects of the invention can be utilized to print designs onto material after quilting the material.

Preferably, a batch control automated system keeps track of the products moving through the process. Where one pattern applying process is off-line, such as where printing is carried out on a line separate from the quilting line on which the stitched pattern is applied, the control matches the quilted pattern and the printed patterns required by each product or batch of products. This can be carried out by maintaining information in

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a control system memory that will allow for the following of the product through the system or can be assisted by automatically identifying the product on the second line, such as by reading a code, such as a bar code, applied to the product previously and correlated with the pattern that was printed onto the panel or product. Batch control systems are described in U.S. Patent No. 5,544,599 and in U.S. Patent Nos. 6,105,520, issued
5 Aug. 22, 2000, and 6,625,234, issued Sept. 23, 2003.

In the manufacture of mattress covers, printed and quilted top and bottom panels can be produced along with strips of border fabric that are to cover the border, including the sides and the head and foot, of a mattress. Such border panels can be produced with coordinated printed designs and patterns that match or correspond to the top and bottom panels. This can be achieved according to one embodiment of the invention
10 by printing and quilting a strip of fabric along a width of the same web material of which the top and bottom panels are being made. The border panel printing and quilting are carried out under the control of a programmed controller, preferably the same controller that coordinates the application of the printed designs and quilted patterns on the top and bottom panels. The border panels so made are then cut or slit from the web that carries the top and bottom panels.

As an alternative to forming border panels out of the same web as the top and bottom panels, a
15 separate but smaller machine having separate quilting and printing stations may be provided adjacent and linked to the main machine on which the mattress top and bottom panels can be applied. The separate machine is supplied with material for forming the border panels that is narrower than, but matches, the material supplied to the main machine for forming the top and bottom panels. Both machines are controlled by the same
20 controller or a controllers that are in communication with each other to coordinate the making of the mattress cover units or batches of units with matching or coordinated top, bottom and border panels. Border panels are of different widths, corresponding to mattresses of different thicknesses, and are of a length equal to the periphery of the mattress rather than the length of the mattress. In addition, border panels have thinner fill layers, being in the range of from 1/4 to 1/2 inches thick, where the top and bottom panels are usually from 1/2
25 inch to 3 or 4 inches thick. For these reasons, the embodiment using the separate border panel machine is preferred in that it provides for more efficient use of different lengths of material and provides less process complexity.

According to certain other principles of the present invention, webs of ticking or units of other fabric are printed with patterns under the control of a computer controlled printer. Such printers are typically digital
30 printers and may be referred to as digital printers, and include ink jet printers, continuous and dot-on-demand printers, and other printers that print images by dispensing ink or other printing medium in response to pattern information, which can usually vary from copy to copy, rather than from a physical mat. plate or mechanical transfer surface such as those commonly used for printing multiple copies of the same image.

In the preferred application of such principles, an ink jet printer scans a web of ticking material
35 transversely and prints on the web in response to signals from a programmed computer. In one preferred embodiment of the invention, each scan row need not necessarily print only on the same panel, but can print one or more lines of each of several panels that are arranged transversely across the web of material. Each

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panel can be printed with the same pattern, each with a different pattern or some with the same pattern and others with one or more different patterns. Top and bottom panels that match or correspond to each of the border panels can be printed on different parts of the same or a different web.

After printing, the webs of ticking are usually quilted to one or more layers of fill material and usually
5 a layer of backing material. The quilting may be applied to quilt different patterns on different panels or different sections of web containing more than one panel, or an entire web or length of web may be quilted with a generic pattern.

After the printing and after the quilting, where applicable, different panels are separated from adjacent panels of the web by longitudinal slitting or transverse cutting. The cut panels are subsequently matched with
10 other corresponding panels to form a mattress cover, which is matched with a spring interior unit and one or more layers of padding for assembly into a bedding product.

Each panel is preferably identified with a particular bedding product and may be identified with a particular item of a particular customer order. The identification and/or information relating to the properties of the panel can be contained in a computer file that is synchronized to each panel on the fabric. Such
15 information can also be printed or coded on the fabric, on or adjacent a panel, preferably in the same printing operation that applies the printed panels to the material, which coding can be in the form of either manually readable information, machine readable information or a combination of manually readable and machine readable information. Such information can be manually read for control of the quilting, the cutting and slitting and the machine of panels and assembly into bedding products. Preferably, the information is automatically
20 read and signals are then generated in response to the information to control the quilting of the printed material, the cutting and slitting of the panels from the web, and the matching of corresponding panels for assembly into bedding products.

Product labels such as those identifying the manufacturer, a retailer or a bedding product type or model, as well as describing the product, can be printed on the fabric in the same operation as the printing of
25 a panel with a pattern.

The present invention provides great flexibility in producing products of a wide variety of appearances and greatly reduces the ticking inventories of a mattress manufacturer.

The present invention also provides the ability to change printed patterns in the course of a quilting run, and to change both printed and quilted patterns to produce quilted products in a wide variety of composite
30 patterns. With the invention, the number of base cloth supplies required to provide pattern variety is greatly reduced, saving substantial costs to the quilted product manufacturer. With the invention, the appearance of the outer layer can be embellished to provide variety and detail, and outline quilting can be carried out in high quality and in close proximity to the printed design. Further, with the invention, these advantages are available with both single needle and multiple needle quilters.

35 These and other objects of the present invention will be more readily apparent from the following detailed description of the drawings.

Brief Description of the Drawings:

Fig. 1 is a diagrammatic perspective view of a one embodiment of a web-fed mattress cover quilting machine embodying principles of the present invention.

Fig. 2 is a diagrammatic perspective view of a discrete panel quilting machine which is an alternative embodiment to the machine of **Fig. 1** that is more suitable for the production of comforters.

Fig. 3 is a top view of an alternative embodiment of the web-fed mattress cover quilting machine of **Fig. 1** that includes structure for making coordinated top and bottom panels and border panels for mattress covers.

Fig. 4 is a diagrammatic perspective view of an alternative embodiment to the machine of **Fig. 3**.

Fig. 5 is a diagrammatic perspective view of an off-line alternative embodiment to the machine of **Fig. 1**.

Fig. 6 is a diagram of one embodiment of a mattress cover quilting system embodying other principles of the present invention.

Fig. 6A is a perspective view of a pattern printing portion of the system of **Fig. 6**.

Fig. 7 is a fragmentary plan view of a web of ticking being printed at the print line of the system of **Fig. 1** showing the transverse arrangement of a set of border panels bearing different patterns.

Fig. 7A is a fragmentary plan view of a web of ticking being printed at the print line of the system of **Fig. 6** showing the printing of a bedding manufacturer's label along with the printing of a pattern on a top panel of a mattress cover.

Detailed Description of the Preferred Embodiment:

Fig 1 illustrates a quilting machine 500 having a stationary frame 511 with a longitudinal extent represented by arrow 512 and a transverse extent represented by arrow 513. The machine 500 has a front end 514 into which is advanced a web 515 of ticking or facing material from a supply roll 516 rotatably mounted to the frame 511. A roll of backing material 517 and one or more rolls of filler material 518 are also supplied in web form on rolls also rotatably mounted to the frame 511. The webs are directed around a plurality of rollers (not shown) onto a conveyor or conveyor system 520, each at various points along the conveyor 520. The conveyor system 520 preferably includes a pair of opposed pin tentering belt sets 521 which extend through the machine 500 and onto which the outer layer 515 is fed at the front end 514 of the machine 500. The belt sets 521 retain the web 515 in a precisely known longitudinal position thereon as the belt sets 521 carry the web 515 through the longitudinal extent of the machine 500, preferably with an accuracy of 0 to 1/4 inch. The longitudinal movement of the belt 520 is controlled by a conveyor drive 522. The conveyor 520 may take the alternative forms including but not limited to opposed cog belt side securements, longitudinally moveable positive side clamps that engage and tension the material of the web 515 or other securing structure for holding the facing material web 515 fixed relative to the conveyor 520.

Along the conveyor 520 are provided three stations, including a printing station 525, a drying station 526, a quilting station 527 and a panel cutting station 528. The backing material 517 and filler material 518 are brought into contact with the top layer 515 between the drying station 526 and the quilting station 527

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to form a multi-layered material 529 for quilting at the quilting station 527. Preferably, the layers 517 and 518 are not engaged by the belt sets 521 of the conveyor 520 but rather are brought into contact with the bottom of the web 515 upstream of the quilting station 527 to extend beneath the web 515 through the quilting station 527 and between a pair of pinch rollers 544 at the downstream end of the quilting station 527. The rollers 544
5 operate in synchronism with the belt sets 521 and pull the webs 517 and 518 through the machine 500 with the web 515.

The printing station 525 includes one or more printing heads 530 that are transversely moveable across the frame 511 and may also be longitudinally moveable on the frame 511 under the power of a transverse drive 531 and an optional longitudinal drive 532. Alternatively, the head 530 may extend across the width of
10 the web 515 and be configured to print an entire transverse line of points simultaneously onto the web 515. The head 530 is provided with controls that allow for the selective operation of the head 530 to selectively print two dimensional designs 534 of one or more colors onto the top layer web 515. The drive 522 for the conveyor 520, the drives 531 and 532 for the print heads 530 and the operation of the head 530 are program controlled to print patterns at known locations on the web 515 by a controller 535, which includes a
15 memory 536 for storing programmed patterns, machine control programs and real time data regarding the nature and longitudinal and transverse location of printed designs on the web 515 and the relative longitudinal position of the web 515 in the machine 500.

The drying station 526 is fixed to the frame 511. The drying station may be of whatever configuration is suitable to effectively dry the dye being applied at the printing station 525. It may operate continuously or
20 be selectively controlled in accordance with the pattern, as is appropriate. While the print head 530 is preferably a digital dot printer in which the coordinates of each dot of the image printed is capable of being precisely located on the web 515 and relative to the conveyor 520, screen printed, roll printed or other types of printed images may be used while still realizing some of the advantages of the invention.

The quilting station 527 is, in this illustrated embodiment, a single needle quilting station such as is
25 described in U.S. Patent No. 5,832,849. Other suitable single needle type quilting machines with which the present invention may be used are disclosed in U.S. Patents Nos. 5,640,916 and 5,685,250. The quilting station 527 may also include a multi-needle quilting structure such as that disclosed in U.S. Patent No. 5,154,130. In Fig. 1, a single needle quilting head 538 is illustrated which is transversely moveable on a carriage 539 which is longitudinally moveable on the frame 511 so that the head 538 can stitch 360° patterns
30 on the multi-layered material 529.

The controller 535 controls the relative position of head 538 relative to the multi-layered material 529, which is maintained at a precisely known position by the operation of the drive 522 and conveyor 520 by the controller 535 and through the storage of positioning information in the memory 536 of the controller 535. In the quilting station 527, the quilting head 538 quilts a stitched pattern in registration with the printed pattern
35 534 to produce a combined or composite printed and quilted pattern 540 on the multi-layered web 529. This may be achieved, as in the illustrated embodiment by holding the assembled web 529 stationary in the quilting station 527 while the head 538 moves both transversely, under the power of a transverse linear servo drive 541,

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and longitudinally on the frame 511, under the power of a longitudinal servo drive 542, to stitch the 360° pattern by driving the servos 541 and 542 in relation to the known position of the pattern 534 by the controller 535 based on information in its memory 536. Alternatively, the needles of a single or multi-needle quilting head may be moved relative to the web 529 by moving the quilting head 538 only transversely relative to the frame 511 while moving the web 529 longitudinally relative to the quilting station 527, under the power of conveyor drive 522, which can be made to reversibly operate the conveyor 520 under the control of the controller 535.

In certain applications, the order of the printing and quilting stations 525 and 527 can be reversed, with the printing station 525 located downstream of the quilting station 527, for example the station 550 as illustrated by phantom lines in **Fig. 1**. When at station 550, the printing is registered with the quilting previously applied at the quilting station 527. In such an arrangement, the function of the curing station 526 would also be relocated to a point downstream of both the quilting station 527 and printing station 550 or be included in the printing station 550, as illustrated.

The cutoff station 528 is located downstream of the downstream end of the conveyor 520. The cutoff station 528 is also controlled by the controller 535 in synchronism with the quilting station 527 and the conveyor 520, and it may be controlled in a manner that will compensate for shrinkage of the multi-layered material web 529 during quilting at the quilting station 527, or in such other manner as described and illustrated in U.S. Patent No. 5,544,599 entitled Program Controlled Quilter and Panel Cutter System with Automatic Shrinkage Compensation. Information regarding the shrinkage of the fabric during quilting, which is due to the gathering of material that results when thick filled multi-layer material is quilted, can be taken into account by the controller 535 when quilting in registration with the printed pattern 534. The panel cutter 528 separates individual printed and quilted panels 545 from the web 538, each bearing a composite printed and quilted pattern 540. The cut panels 545 are removed from the output end of the machine by an outfeed conveyor 546, which also operates under the control of the controller 535.

Fig. 2 illustrates an embodiment 100 of the invention that which employs a single needle frame supported discrete panel quilting machine such as those described in U.S. patent no. 5,832,849. Other machines of that type are disclosed in U.S. patents nos. 5,640,916 and 5,685,250. These single needle quilting machines apply patterns to precut panels and are useful for manufacturing comforters, for example. The machine 100 has an operator accessible stack 116 of preformed panels from which the panel 129 is taken and loaded into the machine 100. A conveyor or conveyor system 120 moves a set of panel supporting edge clamps or other edge securements 121 to bring the panel 129 into a fixed position for application of a combination pattern by printing onto the outer top layer 115 of the multilayered fabric 129 and by quilting the multilayered fabric 129.

In the embodiment 100, a printing station 125, which includes a combined drying station 126 and a quilting station 127 are provided on moveable tracks 119 that are fixed relative to the machine frame 111. The printing station 125 includes one or more printing heads 130 that are transversely moveable across on the moveable station 125 across the frame 111 under the power of a transverse drive 131 and is longitudinally

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moveable under the power of a longitudinal drive 132. The head 130 is provided with controls that allow for the selective operation of the head 130 to selectively print two dimensional designs 134 of one or more colors onto the top layer 115. The drive 122 for the conveyor 120, the drives 131 and 132 for the print heads 130 and the operation of the head 130 are program controlled to print designs or patterns at known locations on the facing material 115 by a controller 135, which includes a memory 136 for storing programmed patterns, machine control programs and real time data regarding the nature and longitudinal and transverse location of printed designs on the material 115 and the relative position of the panel 129 in the machine 100. The drying station 126 may be moveable with the printing station 125, independently moveable on the frame 111, or fixed to the frame 111 in a position at which it can operate to cure the print medium applied by the printing head 130 without interfering with the printing station 125 or quilting station 127.

The quilting station 127 is, in this embodiment 100, is preferably a single needle quilting station such as is described in U.S. patent no. 5,832,849. The quilting station 127 has a single needle quilting head 138 which is transversely moveable on a carriage 139 which is longitudinally moveable on the frame 111 so that the head 138 can stitch 360° patterns on the multi-layered material 129. This is achieved, in the embodiment 100, by holding the panel 129 stationary while the quilting head 138 moves both transversely, under the power of a transverse linear servo drive 141, and the station 127 moves longitudinally on the frame 111, under the power of a longitudinal servo drive 142, to stitch the 360° pattern.

The controller 135 coordinates the motion and operation of the printing station 125 and the quilting station 127 to that one applies a pattern or design panel 129 and then the other applies a coordinated pattern or design in registration. The machine 100 can apply either the printed design first and then register the quilted pattern to it, which is the preferred order, or can apply the quilted pattern first and then register the printed design to the quilted pattern. The controller 135 controls the operation of these stations.

Fig. 3 illustrates an embodiment 200 that is similar to the machine 500 of **Fig. 1** but further includes the capability to apply combination patterns to different areas of a wide multilayered fabric 229 to produce top or bottom panels 251 with matching border panels 252 of a mattress cover. The machine is provided with supplies 218 and 219 of filler material of different thicknesses at different positions across the width of the facing material 215. The machine 200 is also provided with a slitting station 253 adjacent cutoff station 228, to slit the border panels 252 from the top and bottom panels 251.

Fig. 4 illustrates an alternative and preferred embodiment 300 for producing matching top and bottom panels and border panels for mattress covers. The embodiment 300 includes a machine 310a of the type similar to the machine 500 described in connection with **Fig. 1** above in combination with a similar narrower version of a machine 310a. The machine 310a produces the top and bottom panels from multilayered fabric 329a that is dimensioned according to the specification for such panels, including a relatively thicker filler layer 118a of mattress size width and length. The machine 310b produces the matching or coordinated border panels from multilayered 329b that is dimensioned according to the specification for border panels, including a relatively thin filler layer 118b and narrower width that corresponds to the thickness of a mattress but greater length that corresponds to the perimeter of the border of the mattress. The matching of the combination

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patterns applied to the fabric 329a,329b is controlled either by a single controller, by a master controller 335 (as illustrated) which controls separate similar machine controllers 335a,335b of respective machines 310a,310b, with separate controllers of the machines 310a,310b linked together such that they work in unison or such that the controller of one machine 310a,310b controls the other. The controller 335a controls
5 the operation of the machine 310a to produce combination printed designs and quilted patterns on the top and bottom panels of a mattress with printing head 325a and quilting head 327a, respectively, as with the machine 500 described above. Controller 335a controls the operation of the machine 310b to produce matching combination printed designs and quilted patterns on border panels for the same mattress with printing head 325b and quilting head 327b, respectively. Master controller 335 coordinates the operation of the two
10 controllers 335a and 335b.

In the embodiment of **Fig. 5**, a quilt printing and quilting system 400 is provided, which includes separate print and quilting lines such as print line 401 and quilt line 402. Quilt line 402 is preferably a multi-needle quilting machine such as that described in U.S. Patent No. 5,154,130. The print line 401 includes a printing station 425, preferably of the jet printing type, and a curing station 426, usually an oven but which may
15 be a UV light curing station or such other station as will cure the type of ink being used. Mattress ticking or some other facing sheet of material 416 is provided, preferably in web form, and fed successively through the printing station 425 and curing station 426. The printing station 425 applies patterns to the web of material 416 in accordance with pattern programs controlled by a print line controller 431 on one or more successive panel lengths 432 along the web. The patterns may be changed from panel to panel in accordance with a batch
20 controller 435 which supplies product information to the printing controller 431. The print line 401 produces a plurality of printed panels preferably on a web 429 of the facing material from the supply 416.

In the preferred embodiment, the printing performed at the printing line 401 prints, in addition to a series of panel patterns, a series of registration marks 450. The registration marks 450 are preferably printed on the opposite selvages or side edges of web and are configured, for example in a Z-shape, to provide
25 information so that, when detected, both longitudinal and transverse positioning of the respective edge of the web 429 can be determined. The opposite marks 450 are preferably aligned with each other and include one opposed pair of marks for each panel, although more than one pair per panel may be used for added accuracy.

After printing, the web of preprinted material 429 is preferably re-rolled and transported to the quilting machine 402 into which it is loaded and on which it is combined with a backing liner web 417 and one or more
30 filler material webs 418. The combined webs 429, 417 and 418 are engaged by front feed rolls 460 from which they are advanced through a quilting station 427 of the multi-needle type at which a plurality of pattern components are quilted onto the previously printed web 429 in registration with the patterns printed thereon. In lieu of feed rolls 460, other types of separately controllable feed elements that can feed or otherwise move the material in a way that will rotate or redirect the material to adjust the skew of the material can be used.

35 The quilting machine 402 has, immediately upstream of the quilting station 427, a pair of sensors 451, one over the right edge of the web 429 and one over the left edge of the web 429. The sensors 451 may be photo electric detectors that are capable of sensing the respective positions of the marks 450 so that a controller

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437 of the quilting machine 402 can calculate the positions of the opposite edges of the web 429. The controller 437 is programmed to determine the longitudinal and transverse positions of the marks 450 and to derive therefrom the location of the printed patterns so that quilted patterns can be registered with the printed patterns. The program of the controller 437 also calculates any rotation of the panel or skewing of the web 429 relative to the coordinates of the machine 402.

The machine is provided with a split feed roll 460 upstream of the quilting station 427. The split feed roll 460 includes a left half 460a and a right half 460b, each of which is separately driven by a servo motor 461a, 461b. The controller 437 differently drives the servo motors 461a, 461b in response to skewing of the web 429 that is calculated as a result of the analysis by the controller 437 of the outputs of the sensors 451 so as to adjust the transverse position of the web 429 to eliminate the skew. As a result, multiple needles of the quilting station can maintain equal alignments with their respectively corresponding printed patterns. The skew correction in combination with the longitudinal and transverse adjustment of the web 429 results in high accuracy registration of the quilting needles with the printed patterns.

Fig 6 illustrates a mattress cover manufacturing system 10 according to other aspects of the present invention. The system 10 can be divided into four subsystems or production lines, including at least one print line 11, at least one, and preferably two or more, quilting lines 12, illustrated as two quilting lines 12a and 12b, a mattress cover combining a line 13 and a mattress assembly line 14. These production lines 11-14 may be located at a single bedding manufacturing facility or distributed among different facilities of the same or different companies.

The printing line 11 includes an ink jet printing station 20 illustrated in more detail in **Fig. 6A**. The printing station 20 is operable to print an image from a memory, or otherwise in accordance with a programmed controller, onto mattress cover material. By so printing, the image can be controlled and varied from product to product along the material or from one portion of the material to another. Such printing may be referred to as digital or custom printing, although the control signals need not necessarily be, but preferably will be, digital signals, that determine the patterns and images to be printed.

At the printing station 20, a print head carriage 21 is preferably provided having one or more print heads 22 thereon. The carriage 21 is moveable transversely on a bridge 23, which is rigidly mounted to a frame 26 and spans the width of the printing line 11, which is wide enough to accommodate a print head path that traverses the width of the widest expected web 24 of mattress ticking, which may be nominally wider than the width of the king size mattress, which is 80 inches. The carriage 21 is preferably driven by a linear motor 27, which, along with the operation of the print heads 22, are controlled by a print line controller 25 to selectively print a dot pattern image on the web 24. The print heads, in the illustrated embodiment, scan individual lines across the entire transverse extent of the web 24 to print line-by-line along the length of the web 24, although the print heads 22 may be controlled to scan in different x-y paths to also print patterns in area-by-area or otherwise.

The printing station may include a UV curing station 26, at which UV curable ink is cured with ultraviolet light and/or a drying oven 28, which can further cure or dry UV inks or solvent based inks. A

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suitable printing station and method are described in the commonly assigned U.S. Patent No. 6,312,123, issued Nov. 6, 2001.

The print line controller 25 includes a digital memory in which may be stored a plurality of pattern data files. Pattern and other data from these files, and/or from a master system controller or computer 90, can be printed at selected locations on the web 24. The master controller 90, in certain preferred embodiments, sends commands to the print line controller 25 to coordinate the printing of different mattress cover patterns onto the web 24 that are grouped together in batches that will be quilted in the most efficient sequence on the same quilting line 12, with a minimum of needle changes, material changes or other adjustments or operator interventions. Typically, this would mean that the top and bottom panels of a mattress cover would be grouped separate from the border panels, because the top and bottom panels are usually thicker, having more fill, than the border panels. Furthermore, top and bottom panels vary more in thickness from one mattress product to another while border panels often are of the same thicknesses for many different mattress products.

In Fig. 6, for example, patterns for a series of king size top and bottom panels 30 are shown printed along a length 24a of the web 24. These include: two panels 30a, a top panel and a bottom panel of a first printed pattern; two panels 30b, a top panel and a bottom panel of a second printed pattern to be printed; and a panel 30c of the next pattern to be printed. These patterns are shown as changing from one product to another for illustration purposes. More typically, several products of each pattern will be printed in succession according to an order schedule. These patterns 30 are printed under the batch control of the master controller 90 according to a schedule that assigns orders for products bearing the patterns of panels 30a-c to a particular print line 11, or to a particular series to be printed on the web section 24a. The grouping of the products to be made of the panels 30a-c to the same section of web 24a is assigned by the master controller 90 making the determination that these panels are to be quilted with similar quilted patterns and with the same fill components, so that they can be run on the same quilt line 12 without interruption to make machine adjustments or material or needle changes, for example. When all panels 30 that are to be quilted consecutively on the same quilting line 12 are printed on the web section 24a, the web section 24a is preferably cut and separately wound in a roll 31 for transfer to a quilting line 12a for quilting.

The controller 90 then batches border panels 32 for printing. These border panels 32 may be printed on the same or a different print line 11 on which the top and bottom panels 30 were printed. The border panels are long narrow strips typically 10 to 20 inches wide, but which may be wider or narrower, and usually in the range of from 18 to 27 feet long in order to surround the perimeter of a mattress, although they may be formed in shorter strips and later sewn together. The border panels 32 will be printed to match the top and bottom panels 30 that are printed onto the web section 24a and rolled in the roll 31. The border panels 32 may include, for example, a border panel 32a, which is printed of the same pattern as, or one matching, the pattern of the panel 30a. Similarly, patterns 32b may be printed with patterns corresponding to the pattern printed for the panels 30b, and patterns 32c may be printed with patterns corresponding to the pattern printed for panels 30c. The corresponding patterns can be printed in the same or a different orientation or size. These border panels

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32 are printed on a web section 24b to be rolled into a roll 33 for transfer to the quilting line 12b, which is set up for the quilting of border panels.

In the quilting of border panels 32, the long narrow panels 32 are arranged to most efficiently use the area of the web section 24b. For example, five 16 inch border panel strips can be printed across the width of an 80 inch web section 24b, as illustrated in **Fig. 7**. For this arrangement, the print head 22 is controlled by the print line controller 25 to scan the entire transverse width of the web, line-by-line, to print one row of dots of the different patterns of each of the five panels across the width of the web section 24b, then to print another row of dots, and so forth, until each consecutive row of dots is printed similarly as the web section 24 advances in one direction through the printing station 20. Alternatively, the print heads 22 can be moveable in a plane relative to the material and can be controlled to print selected areas of different patterns in various orders, as may be convenient. The patterns on the border panels across the width of the web 24b may be the same or each may be different, as illustrated. Cut lines 29 may also be printed to indicate where the panels 32 are to be slit or transversely cut from one another.

The arrangement of the patterns are printed on the web groups of the panels such that those having similar quilting parameters are grouped together. Panels having the same quilted patterns and that call for the same needle settings can be arranged contiguously on the material. Border panels, for example, of different products usually, but not necessarily, have the same fill characteristics. Panels of similar characteristics can be grouped together, and particularly if they have the same quilt patterns, can be arranged side-by-side. Where possible, the arrangements of the printed patterns on the material is carried out to minimize material waste and production inefficiency. Pattern arrangements can be made automatically by a batch mode controller or scheduling computer that is programmed to implement some arranging criteria.

In addition to border panels 32, top and bottom panels 35 can also be arranged on the web section 24b, which may be desirable where such top and bottom panels are to be quilted to the same thickness as that of the border panels 32. In such a case, a top or bottom panel 30c, for example, of a full rather than king size mattress, may be printed with the matching border panel 32c for the same mattress fit in along side of the top and bottom panels 35.

Further, manufacturer or retailer labels, such as a retailer label 70, can be printed directly on the bedding products by the print heads 21 at the printing station 20, as illustrated in **Fig. 7A**. Heretofore, labels have been sewn onto bedding products. The retailer's label 70 can, instead, be printed along with the pattern on the print line 11 at, for example, the corner or edge of top panel 30a, as the carriage 22 scans the print head 21 across the web 24 to print the pattern for the panel 30a of a mattress identified to a specific order. Where a bedding manufacturer makes bedding for a number of retailers, labels can be customized to designate different store brands or product models. Even individual retail customer names can be applied for custom mattress orders. This can be done on a batch or piece-by-piece basis, as products for various retailers are batched for quilting. Such labels can be printed on a panel along with the pattern at the printing station 20. The labels can include machine readable information such as bar code encoded information identifying or describing the product, customer or order.

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With the batch mode scheduling provided by the controller 90, provision is made for the communication of information to the quilting lines 12, the combining line 13 and the assembly line 14 so that the top and bottom panels are correctly matched with border panels 32 and the resulting mattress cover is matched with the correct inner spring unit. This may be carried out by generating information records, which
5 can be done in any of several ways. One method of coordinating information, and one of the more reliable, is by attaching information records to the mattress cover panels. This can be achieved by printing product codes at the printing station 20 along with the printing of the patterns 30, 32. Such printed records can be in the form of bar codes or other machine readable records.

Bar code labels are illustrated as areas 40 and 41 in the drawings. The codes 40 are, for example,
10 shown in Fig. 6 as codes 40a-d, which contain information identifying the products for which top and bottom panels 30a-d belong, with bar codes 41a-d identifying the products to which border panels 32a-d belong. These codes are then read by sensors at subsequent stations so that subsequent operations can be automatically carried out that are appropriate for the particular products. In addition, or in the alternative, to the printing of machine readable indicia or codes, the printer can also print manually readable information that can be used by a quilting
15 machine operator, by those manually matching components in a mattress cover or mattress assembly, or by others in subsequent operations.

Rather than employ codes 40,41 printed on the material to identify the patterns, electronic files containing identifying information can be synchronized among the controllers of the various lines through the master computer 90. For example, the printing of patterns at the print line 11 can cause information as to where
20 and what was printed to be passed by the print line controller 25 to the master controller 90. The master controller 90 then transmits the printed pattern information along with information tracking the location of the printed patterns through the system 10 to the various controllers of the lines 12,13,14 controlling and keeping track of each product component in the flow through the system 10.

For the quilting part of the operation, the roll 31 bearing the top and bottom printed panels 30 on the
25 web 24a of ticking is loaded onto the quilting line 12a, where the web 24a is combined with, for example, two layers of fill 36, 37 and one web of backing material 38. The layers are advanced through a quilting station 44a at which the layers are quilted together with, for example, a generic quilted pattern, such as a plurality of side-by-side continuous zig-zag patterns. Typical patterns, as well as a multi-needle quilting machine suitable
30 for use as the quilting station 44a, are illustrated and described in U.S. Patent No. 5,154,130. The quilting station 44a is controlled by a controller 45a which controls the quilting of the patterns under the control of the master controller 90 which selects the proper pattern for the product to which the patterns of the panels 30 relate. Coordination between the printed and quilted patterns may be accomplished, for example, by a sensor 46a which reads the printed codes 40, or by signals from the controller 90, communicated to the quilting station controller 45a.

35 The quilting line 12a also includes a panel cutting station 50, which may also be operated by the quilting station controller 45a or a cutter on the panel cutter in response to coordinating signals from a master controller, the quilting station controller or from codes read from the product such as by independently reading

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a bar code on the product. The cutter at the cutting station 50a uses coordination information from the controller 45a to determine where to sever the individual panels 30. Different panels may be cut to different lengths in accordance with product size information from batch control product parameter data through the controller 90. The cutting of the panels may be controlled to accommodate for "shrinkage" that occurs as the material dimensions change in the quilting process. The cutting produces completed individual rectangular top and bottom mattress cover panels 51, which include, for example, one pair of top and bottom panels 51a bearing the printed patterns 30a, one pair of panels 51b bearing the printed patterns 30b and a series of panels 51c bearing the printed patterns 30c. Panel cutters are illustrated and described in U.S. Patent No. 5,544,599 and in U.S. Patent No. 6,237,517, issued May 29, 2001. These cut panels are then placed in a stack 52 and transferred to an area, referred to as a matching subsystem 59 of the combining line 13, at which the corresponding top and bottom panels are matched with corresponding border panels to make up the mattress cover sets 53 for each of the products. The matching may be coordinated manually or with the batch mode control by the system controller 90, directly, or through a separate matching controller or computer 55.

Similarly, the roll 33 bearing the printed border panels 32 on the web 24b of ticking is loaded onto the quilting line 12a, where the web 24b is combined with, for example, one layer of fill 47 and one web of backing material 48. The layers are advanced through a quilting station 44b at which the layers are quilted together with, for example, the same generic quilted pattern or patterns as applied at the quilting station 44a of the line 12a. The quilting station 44b is also controlled by a controller 45b which also controls the printing of the patterns under the control of the master controller 90 which selects the proper pattern for the product to which the patterns of the panels 32 relate. Coordination between the printed and quilted patterns at the quilting line 12 may be accomplished, for example, by a sensor 46b which reads the printed codes 40, or by signals from the controller 90, communicated to the quilting station controller 45b.

The quilting line 12b also includes a panel cutting station 50b, which is also operated by the quilting station controller 45b, and is similar to the cutting station 50a of the quilting line 12a. The cutting station 50a can be controlled by the quilting line controller, through a master controller or independently by reading codes, such as bar codes, printed on the panels with the pattern. The cutter at the cutting station 50b uses coordination information from the controller 45b to determine where to transversely sever one set of transversely adjacent border panels 32 from another set. This transverse cutting may take place before or after the individual border panels are slit to separate one border panel from another. The cutting and slitting processes produce completed individual rectangular border panel strips. The top and bottom mattress cover panels 51, which include, for example, one pair of top and bottom panels 51a bearing the printed patterns 30a, panels 51b bearing the printed patterns 30b, and panels 51c bearing the printed patterns 30c, are similarly cut from the material. These cut panels are then placed in a stack 52b and transferred to the matching subsystem 13 for matching with corresponding top and bottom panels as described above.

Provision for the slitting of transversely arranged panels is made by equipping one or all of the quilting lines 12 with a slitting station 60 for longitudinally separating panels 30, 32 or other panels one from another.

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or to trim the selvage or other material from the edges. Such a slitting station is illustrated in the quilting line 12b, where it is shown located between the quilting station 44b and the cutting station 50b. The slitting station 60 has a plurality of transversely adjustable and selectively operable slitting or trimming elements or knife assemblies (not shown), which can be positioned and operated to selectively slit the web 24b. In the
5 embodiment shown, the knives can be operated to longitudinally slit the web 24 in four places to separate the five border panels 32 from each other. The completed border panels 61, so separated by slitting and transverse cutting, are then set in stack 52b for transfer to the matching station 13. The separate individual rectangular border panel strips 61 include, for example, border panel 61a bearing the printed patterns matching top and bottom panels 51a, border panel 61b bearing the printed patterns matching top and bottom panel 51b, and
10 border panels 61c bearing the printed patterns matching top and bottom panels 51c. These cut panels are then placed in a stack 52b and transferred to the matching subsystem 13 for matching with corresponding top and bottom panels as described above.

Trimming knife assemblies may be made selectively operable and transversely moveable by motors or actuators under control of the quilting line controller 45b. Registration of the cutting and slitting station
15 elements with the printed patterns is carried out at the quilting lines 12 or can be carried out on independent cutting lines on which the printed and quilted material is placed for cutting and trimming. Techniques described in the parent applications for achieving registration between printing and quilting may be used for registration between cutting and/or slitting and printing. Information for activating and/or positioning the trimming knives, as well as the transverse cutting knives, may be communicated via electronic files from the
20 master controller 90 to the quilting and cutting line controllers 45a, 45b, or may be contained in coded information and/or separation lines 29 printed on the ticking with the patterns at the print line 11. The registration techniques and web alignment techniques of the parent applications identified above for registering the quilted and printed patterns may also be used for registering and aligning the cutting and slitting operations with the patterns printed on the web of ticking material. In locating the cuts and slits automatically, direct
25 sensing of printed cut lines or calculated shrinkage compensation along with precise tracking of the material through the system should be employed.

After matching of the completed border panels 61 with the top and bottom panels 51 at the matching subsystem 59 of the combining line 13, the components of a mattress cover set 53 are assembled onto an inner spring unit 65 in a conventional manner on the mattress assembly line 14 to form the finished mattress products
30 70. The matching of the mattress cover sets 53 with the proper inner spring units 65 are also carried out under the control of the master controller 90. For proper matching, the inner spring units 65 as well as the mattress cover sets 53 may be provided with sensor readable coded labels or may be coordinated with electronic files by controller 90. The resulting products 70 may then include mattresses having covers and inner springs specified by product description parameters in data files processed by computer 90. Examples of such files
35 are described in U.S. Patent No. 6,105,520, issued Aug. 22, 2000.

The above description is representative of certain preferred embodiments of the invention. For example, while described in the context of a mattress manufacturing, the certain aspects of the method of

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arranging the printing of different patterns on mattress covers can be used for other applications where fabrics are printed, such as in the production of upholstery, bedspreads and comforters, and other textile and patterned fabric production. Those skilled in the art will further appreciate that various changes and additions may be made to the embodiments described above without departing from the principles of the present invention.

- 5 The above description is representative of certain preferred embodiments of the invention. Those skilled in the art will appreciate that various changes and additions may be made to the embodiments described above without departing from the principles of the present invention.

Claims

1. A quilting method comprising:
feeding a fabric in web form through a printing station having a computer controllable printer thereat;
communicating data of a plurality of different patterns to the printer at the printing station;
at the printing station, scanning a web of the fabric with a print head of the printer and printing with the print head a plurality of panels on the web each with one of the patterns in accordance with the communicated data;
moving the web of fabric having the plurality of panels respectively printed thereon with the patterns from the printing station to a quilting station;
combining the web of fabric having the plurality of panels respectively printed with the patterns with at least one layer of fill material; and
at the quilting station, quilting the plurality of panels of the web with at least one layer of fill material at the quilting station.
2. The method of claim 1 wherein:
the quilting station and the printing station are assembled along the same production line.
3. The method of claim 1 wherein:
the quilting station is located on a quilting line;
the printing station is located on a printing line that is separate from the quilting line;
and
the moving of the web of fabric includes transferring the web having the plurality of panels respectively printed thereon with the patterns from the printing line to the quilting line.
4. The method of claim 1 wherein the fabric is ticking material and the method further comprises the step of:
scheduling said printing by grouping border panels of different mattress covers for

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printing on a section of a web of the ticking material and grouping top and bottom panels of said different mattress covers for printing on a different section of the same or a different web of the ticking material;

the feeding of the ticking material includes separately feeding the web sections of the ticking material through the printing station; and

the printing onto the web includes printing onto one web section a plurality of border panels, each with one of the plurality of the different patterns in accordance with the communicated data and separately printing onto a different web section a plurality of top or bottom panels with patterns respectively corresponding to each of the patterns printed onto the border panels.

5. The method of claim 4 wherein:

the web sections are different longitudinal sections of the same contiguous web of ticking material;

the feeding of the ticking material includes sequentially feeding the web sections of the ticking material through the printing station of a print line; and

the printing onto the web includes printing first onto one web section and then onto the other web section at a printing station on the same print line.

6. The method of claim 5 further comprising:

severing the web section having border panels printed thereon from the web section having the top or bottom panels printed thereon; and

the moving of the web of ticking material includes separately transferring severed web sections of ticking material to different quilting lines at which the combining of the quilting of border panels and the quilting of top and bottom panels are respectively carried out.

7. The method of claim 4 further comprising:

cutting each of the panels from other panels of the same web sections; and

matching a cut border panel with corresponding cut top and bottom panels to form a matching set of panels of a mattress cover.

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8. The method of claim 7 further comprising:
combining each mattress cover with a mattress interior to form a mattress product.
9. The method of claim 8 wherein:
the printing of patterns includes the printing of product identifying information on the ticking material identifying a product to which each panel corresponds;
the cutting includes cutting the panels from the other panels of the web sections along with their corresponding product identifying information; and
the matching of the panels and the combining of the mattress covers with the mattress interiors is carried out in response to a comparison of the product identifying information printed with the panels and associated with the mattress interiors.
10. The method of claim 8 wherein:
the printing includes printing product identifying information on the ticking material identifying the product to which each panel corresponds;
the cutting includes cutting the panels from the other panels of the web sections along with their corresponding product identifying information; and
the matching of the panels is in response to a comparison of the product identifying information printed with the panels.
11. The method of claim 10 wherein:
the product identifying information is manually readable.
12. The method of claim 10 wherein:
the product identifying information is machine readable code; and
the matching includes automatically reading the code and matching the panels in response to the reading of the code.
13. The method of claim 7 further comprising:
generating electronic records for coordinating the printing, quilting and matching of the panels; and

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controlling the printing, quilting and matching of the panels in response to the generated records.

14. The method of claim 4 further comprising:

generating electronic records for coordinating the printing and quilting of the panels;
and

controlling the printing and quilting of the panels in response to the generated records.

15. The method of claim 4 wherein:

the grouping of border panels of different mattress covers for printing includes arranging border panels side-by-side on transversely spaced areas of a web section.

16. The method of claim 15 wherein:

the printing of the plurality of border panels includes printing different ones of the plurality of the different patterns on different ones of the transversely spaced areas of the web section.

17. The method of claim 4 wherein:

the grouping of the border panels of different mattress covers for printing includes arranging the border panels side-by-side on transversely spaced areas of the web section;
and

the method further comprises slitting the web section to separate the border panels on the transversely spaced areas one from another.

18. The method of claim 1 wherein:

the scanning and printing include printing different ones of the plurality of the different patterns side-by-side on different transversely spaced areas of the fabric; and

the method further comprises longitudinally slitting the fabric to separate the transversely spaced areas one from another.

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19. The method of claim 18 wherein:
the scanning and printing include printing longitudinal lines between adjacent different transversely spaced areas of the fabric; and
the longitudinal slitting of the fabric is carried out in reference to the printed lines.
20. The method of claim 18 wherein:
the longitudinal slitting includes automatically registering a slitting element with printing applied to the fabric at the printing station and slitting the fabric with the registered slitting element.
21. The method of claim 20 wherein:
the longitudinal slitting includes automatically aligning the web with the slitting element.
22. The method of claim 1 further comprising:
cutting each of the panels from the other panels of the respective web sections; and
matching a cut panel to a bedding product.
23. The method of claim 22 further comprising:
the printing includes printing product identifying information on the fabric identifying the product to which each panel corresponds;
the cutting includes cutting the panels from the other panels of the web sections along with their corresponding product identifying information; and
the matching of the panels to the bedding product is in response to the product identifying information printed with the panels.
24. The method of claim 23 wherein:
the product identifying information is manually readable and the matching is carried out by a manual reading of the printed product identifying information.
25. The method of claim 23 wherein:
the product identifying information is machine readable code; and

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the matching includes automatically reading the code and matching the panels in response to the reading of the code.

26. The method of claim 23 further comprising:

generating electronic records for coordinating the printing, quilting and matching of the panels; and

controlling the printing, quilting and matching of the panels in response to the generated records.

27. The method of claim 1 wherein:

the printing includes printing a product label on the panel along with the pattern.

28. A quilting apparatus comprising:

a printing station having a computer controllable printer thereat;

a computer programmed to communicate data of a plurality of different patterns to the printer;

the printer includes a print head operable to scan a web of fabric at the printing station and printing a plurality of panels across the web each with one of the patterns in response to the communicated data; and

to a quilting station operable to combine and quilt together the web of fabric having the plurality of panels respectively printed with at least one layer of fill material.

29. The apparatus of claim 28 comprising a single quilt manufacturing line that includes the computer, the printing station and the quilting station.

30. The apparatus of claim 28 comprising two independently controllable production lines including a print line that includes the printing station and the computer and a quilt line that includes the quilting station.

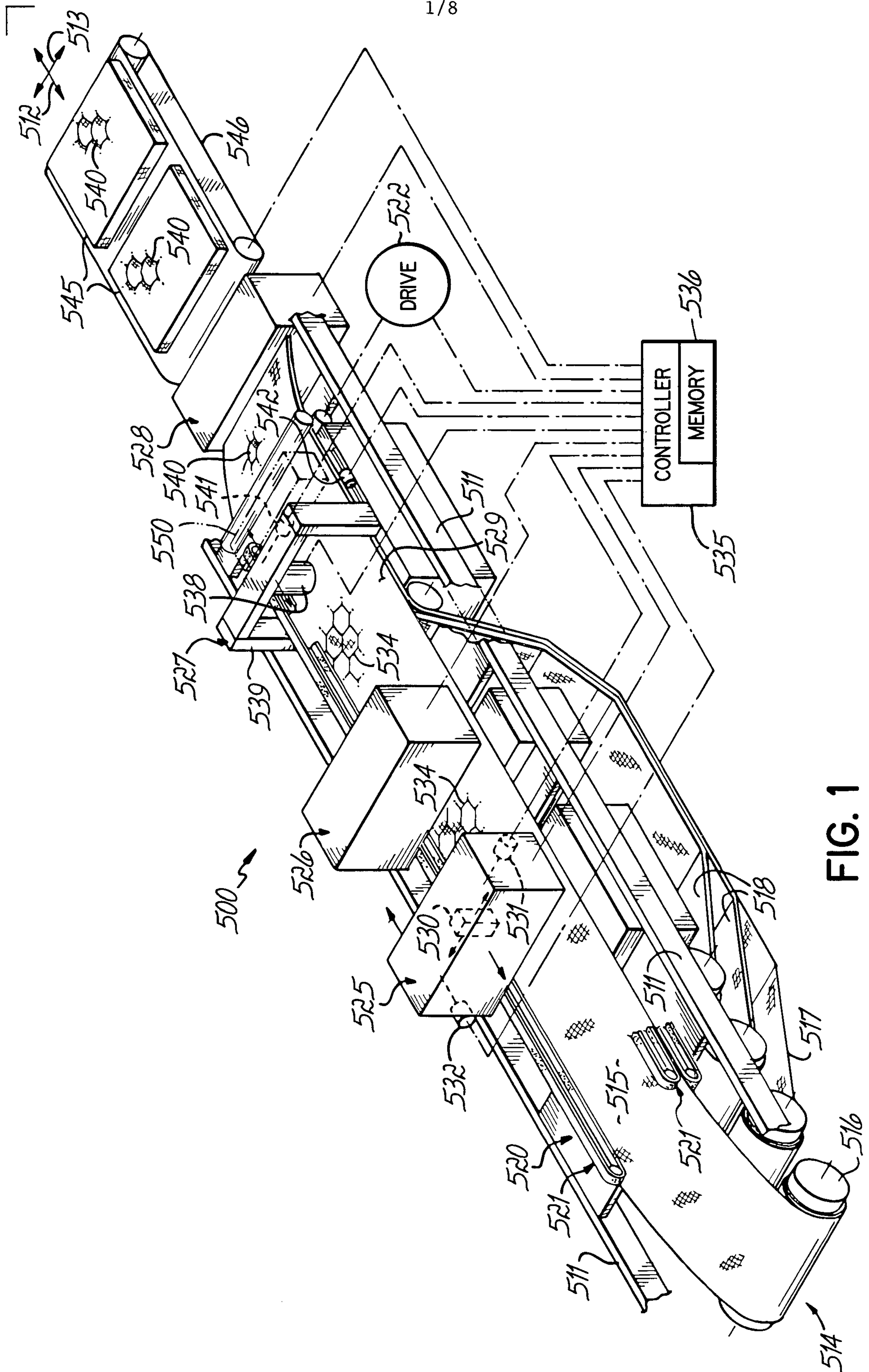


FIG. 1

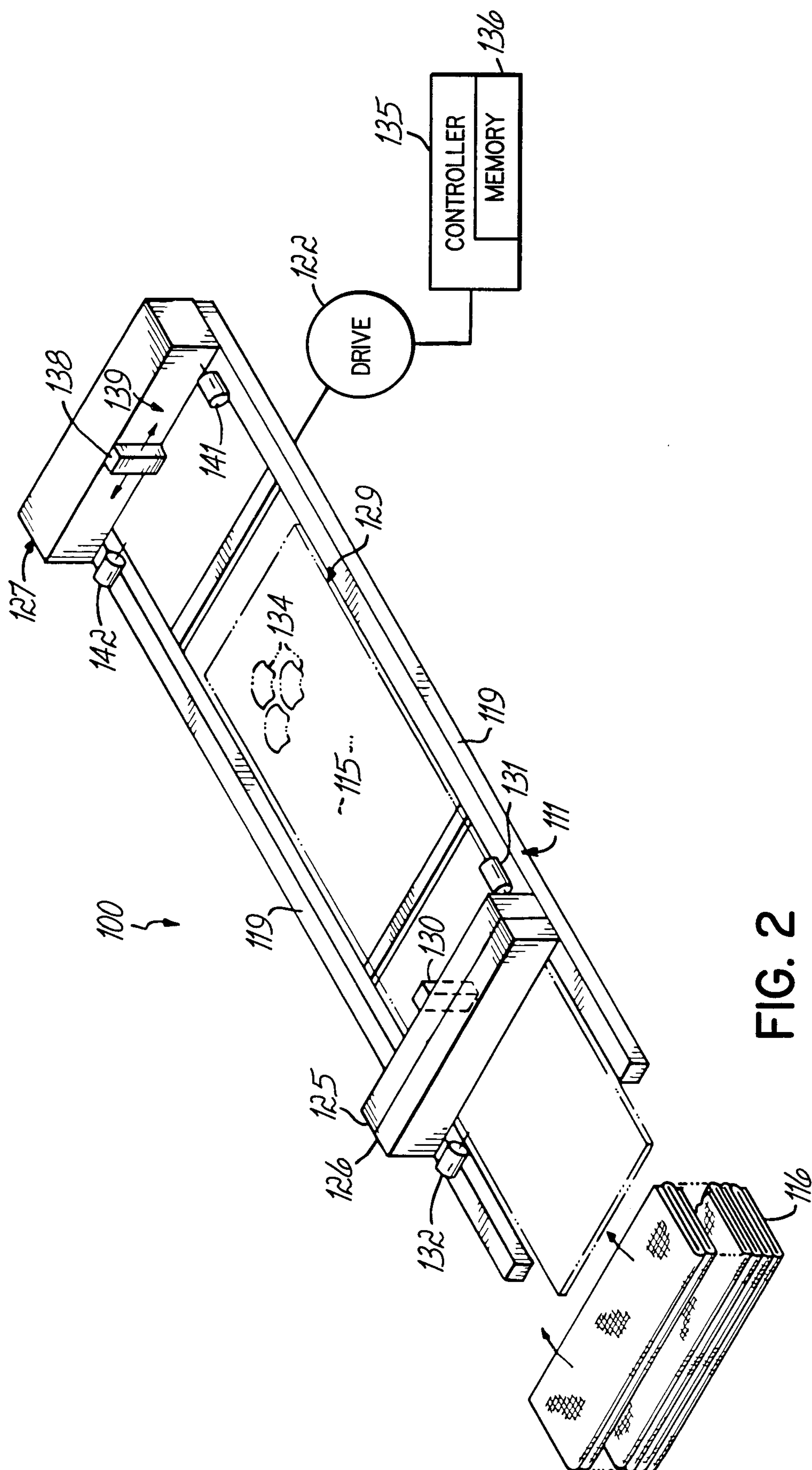


FIG. 2

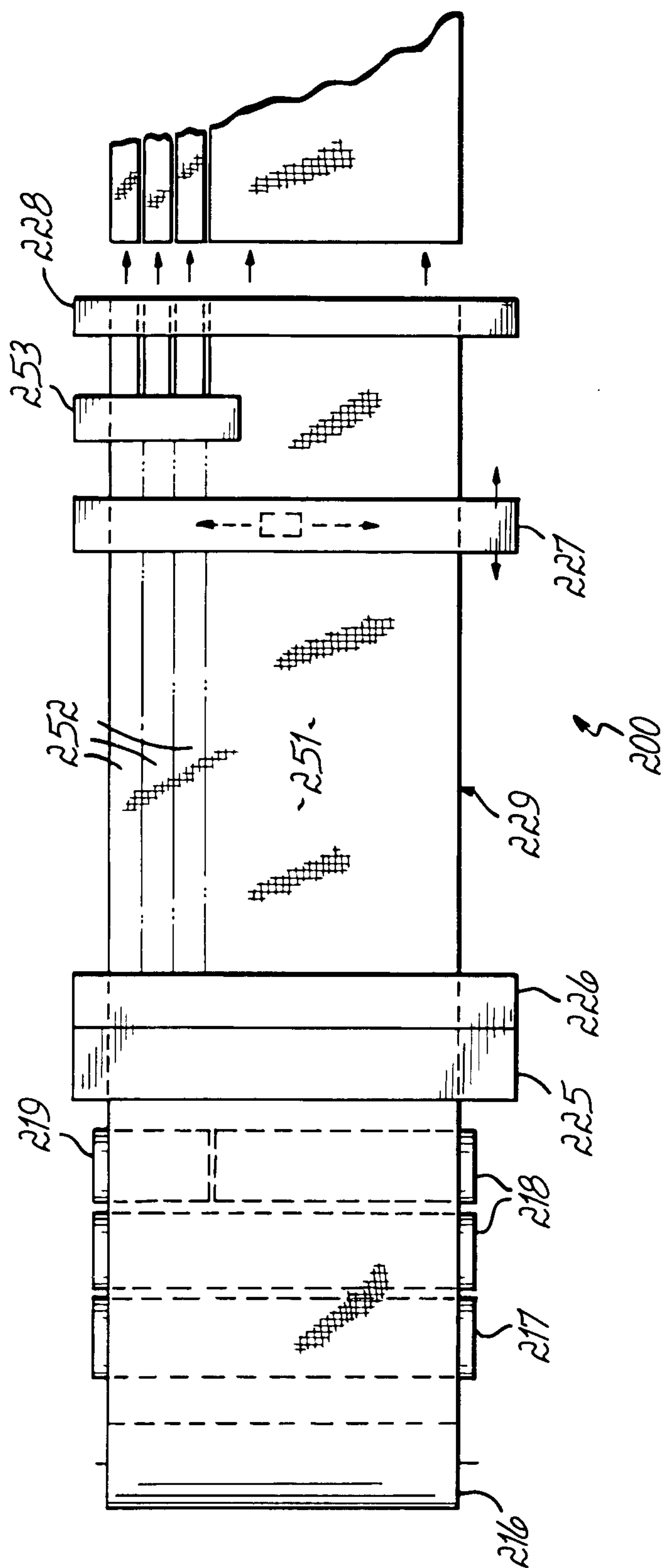


FIG. 3

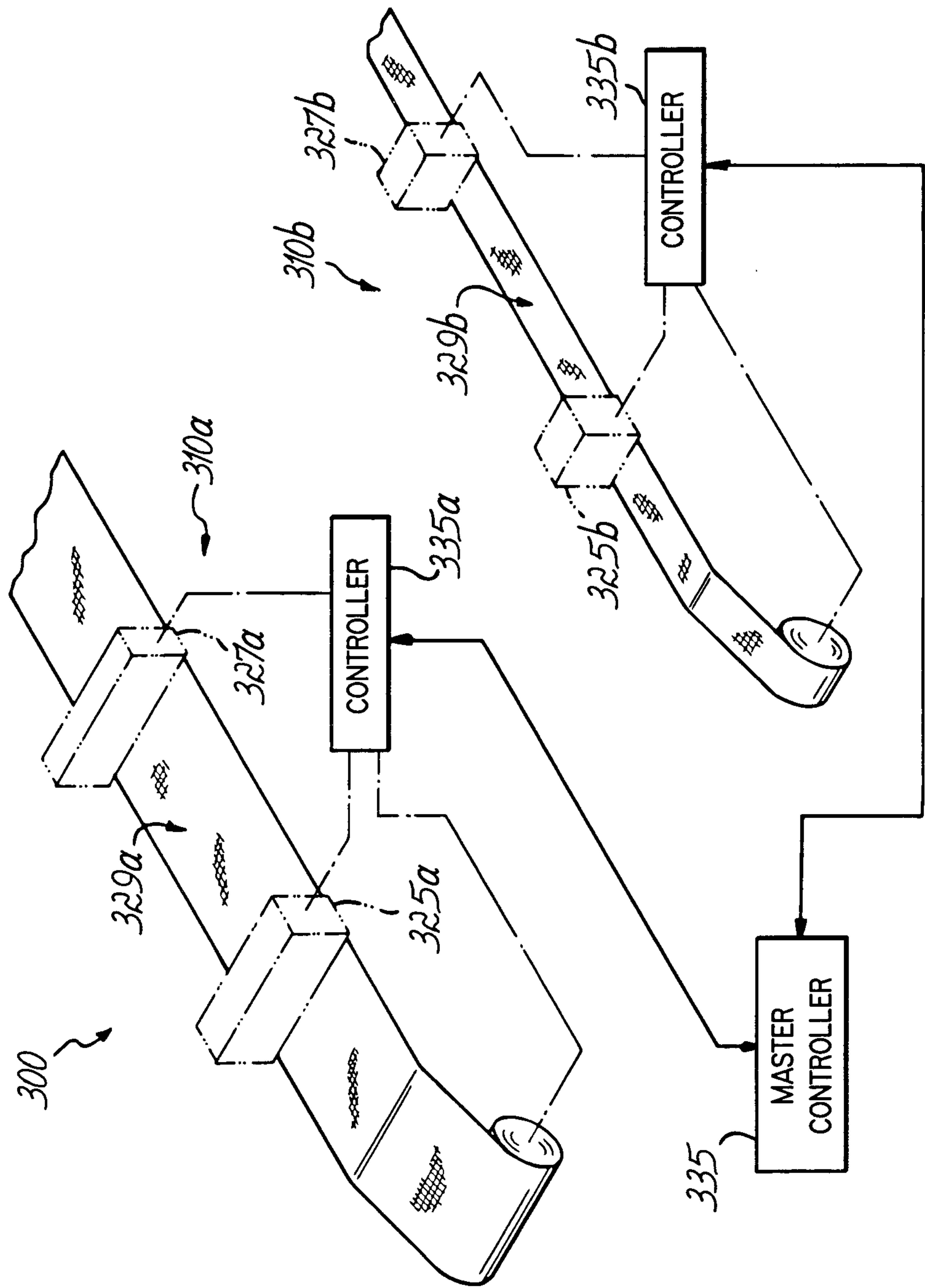
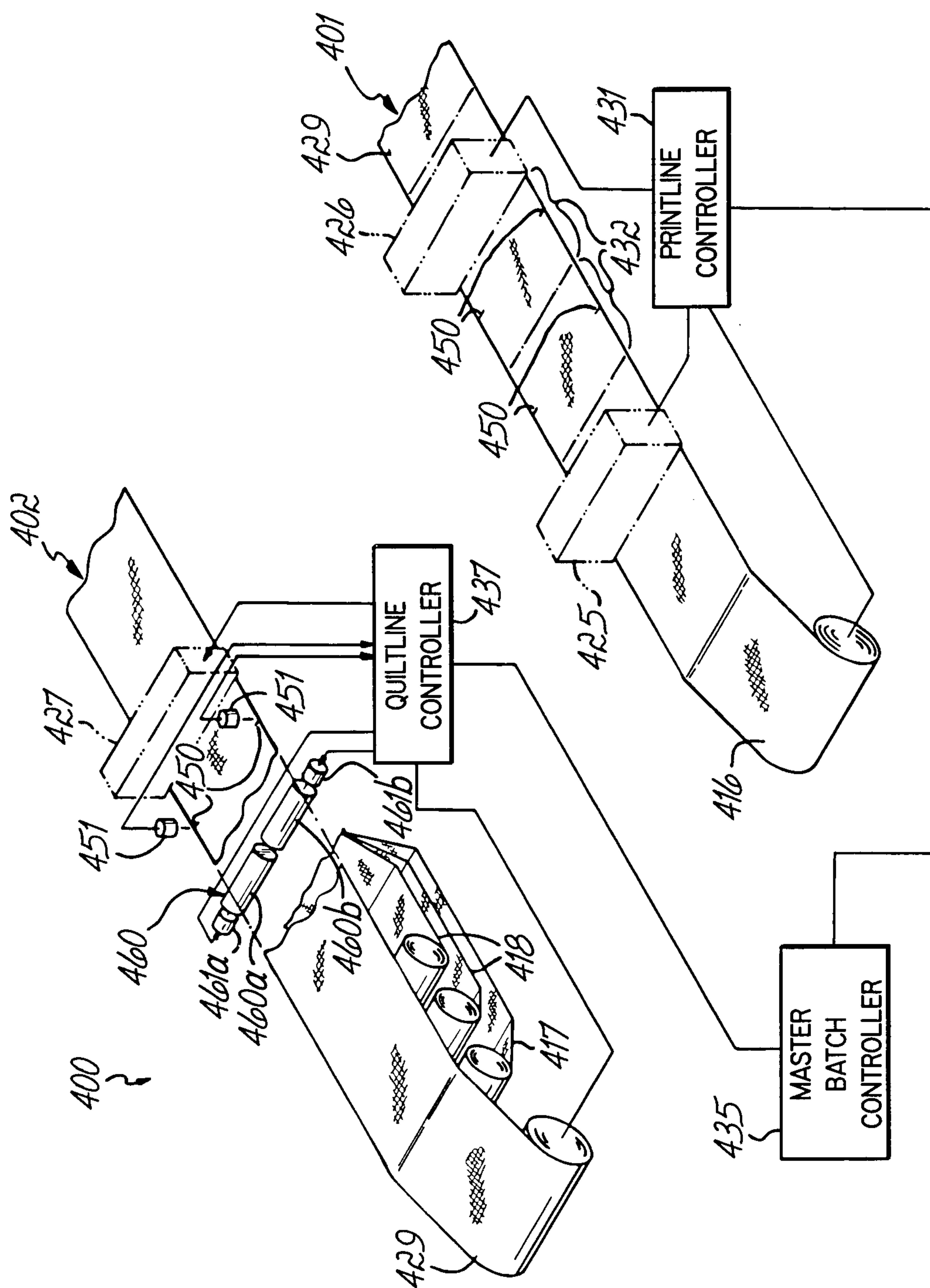


FIG. 4



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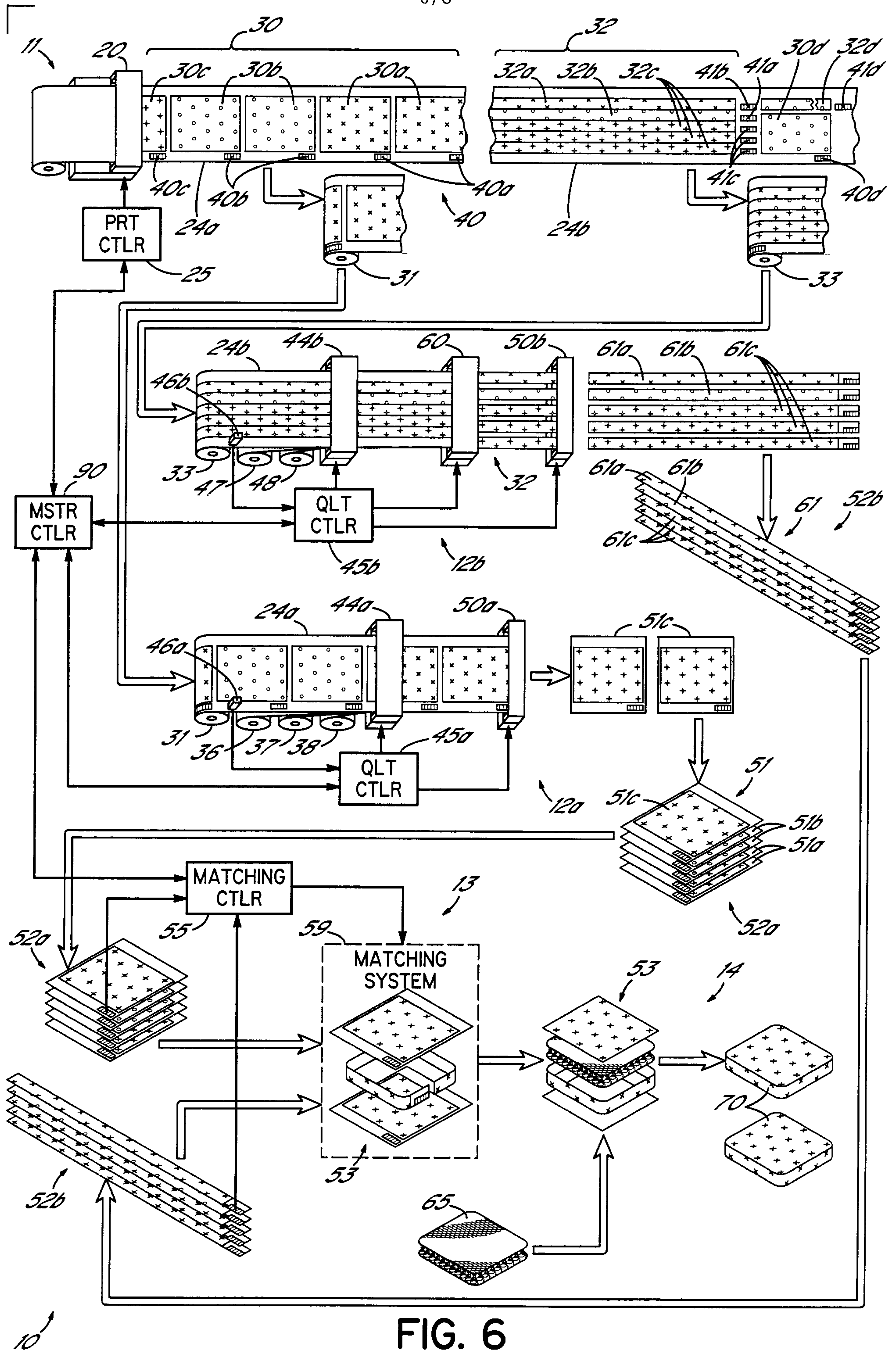


FIG. 6

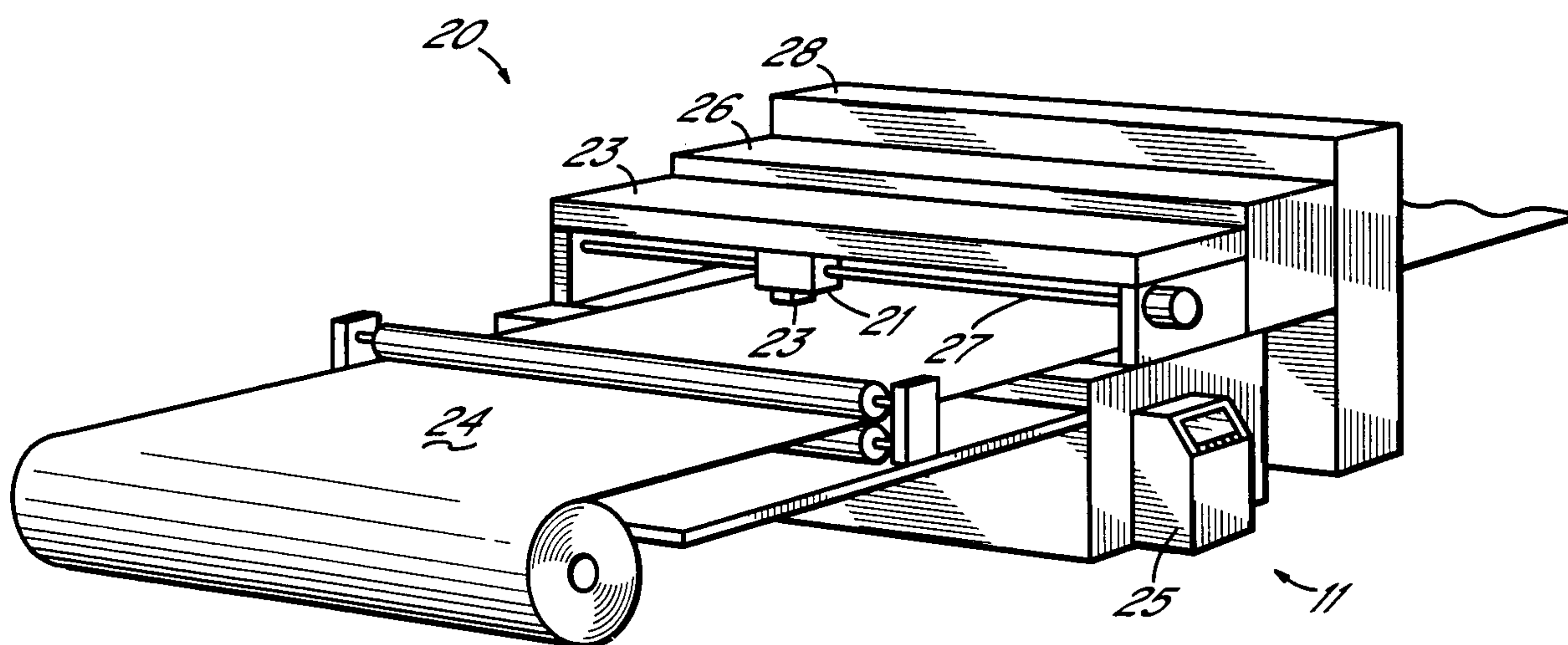


FIG. 6A

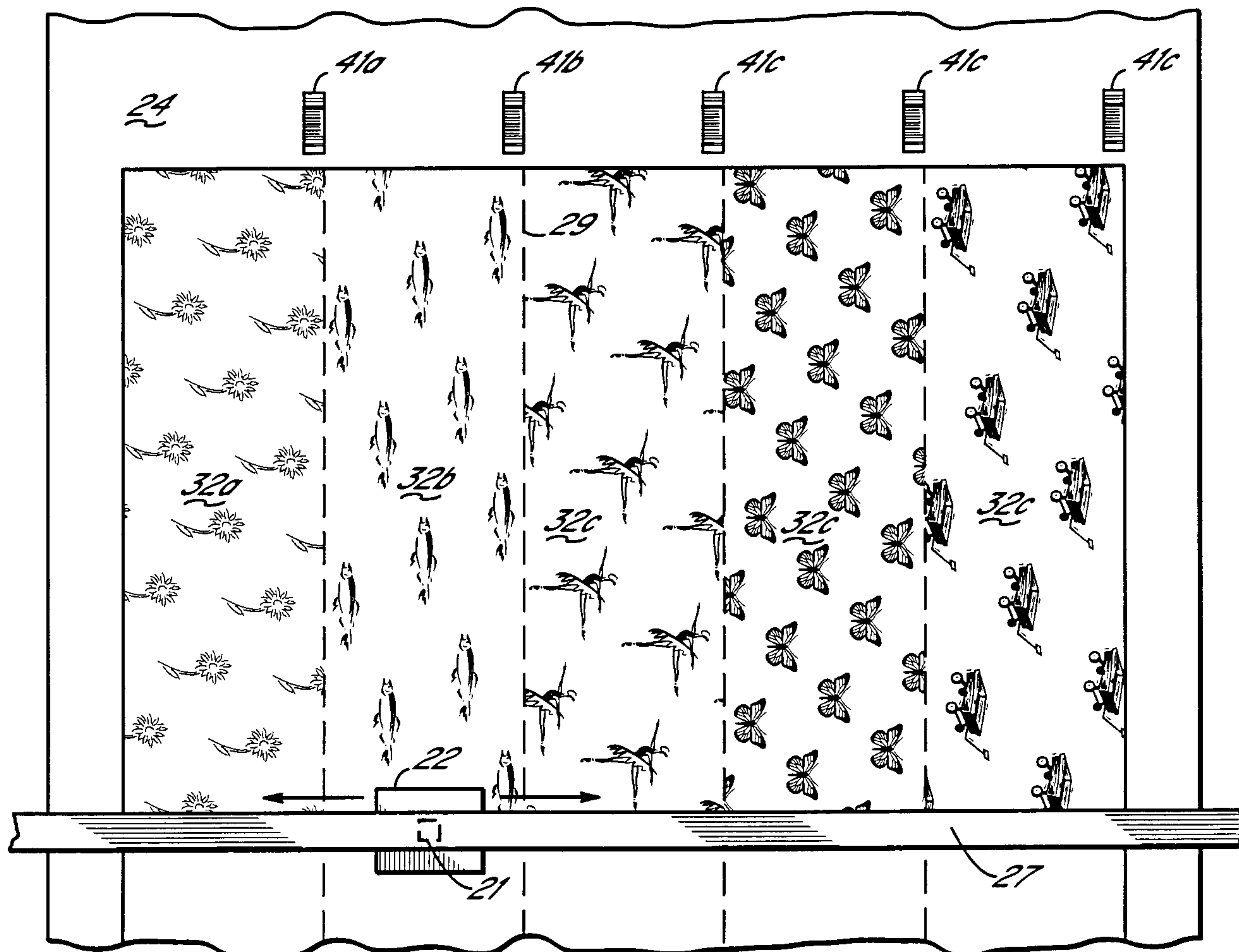


FIG. 7

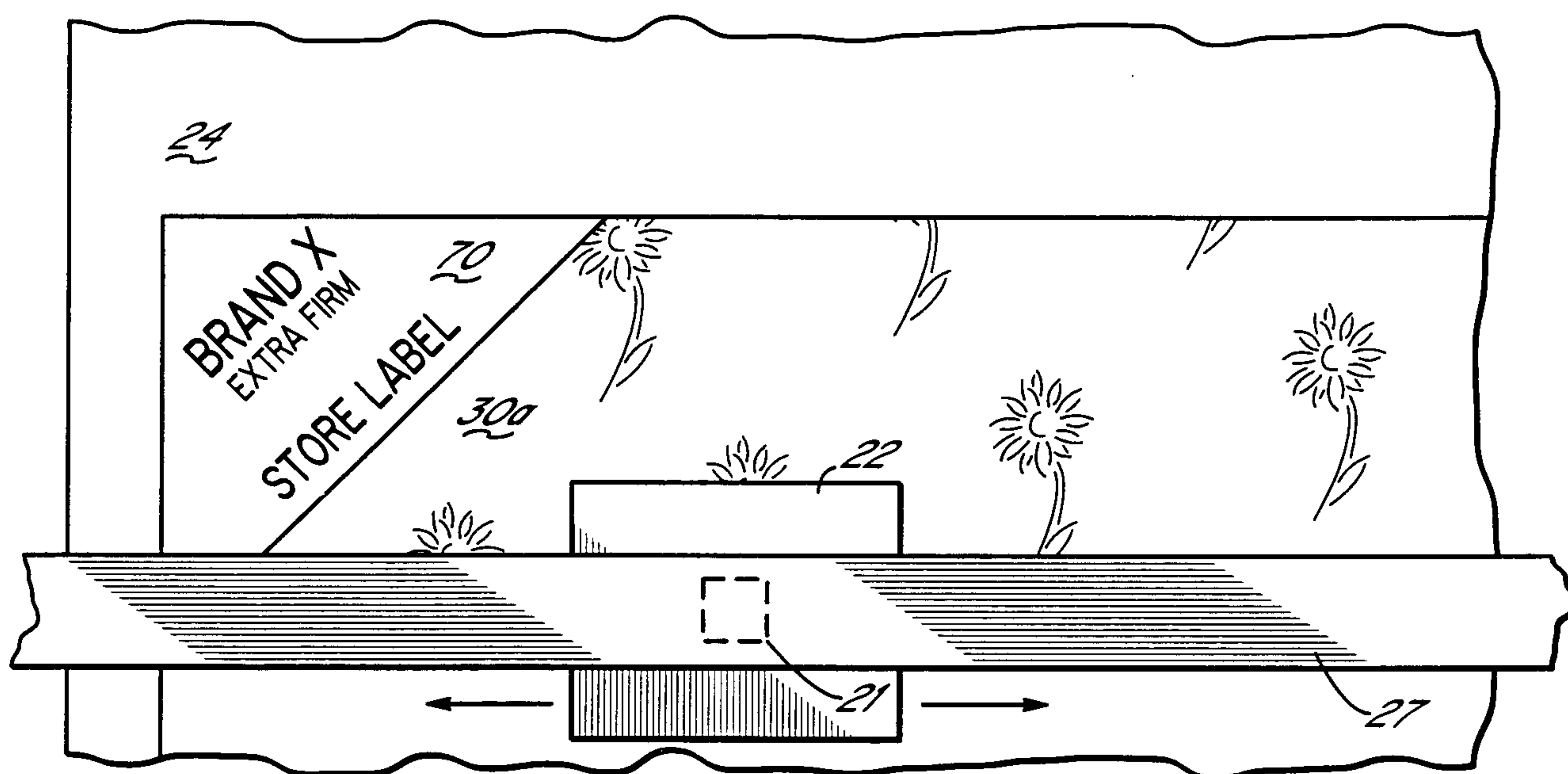


FIG. 7A

