

[54] SEWING METHOD

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[51] Int. Cl. **D05b 3/12**

[58] Field of Search 112/104, 105, 262,
112/265, 266, 65, 70, 77, 76; 2/265, 266

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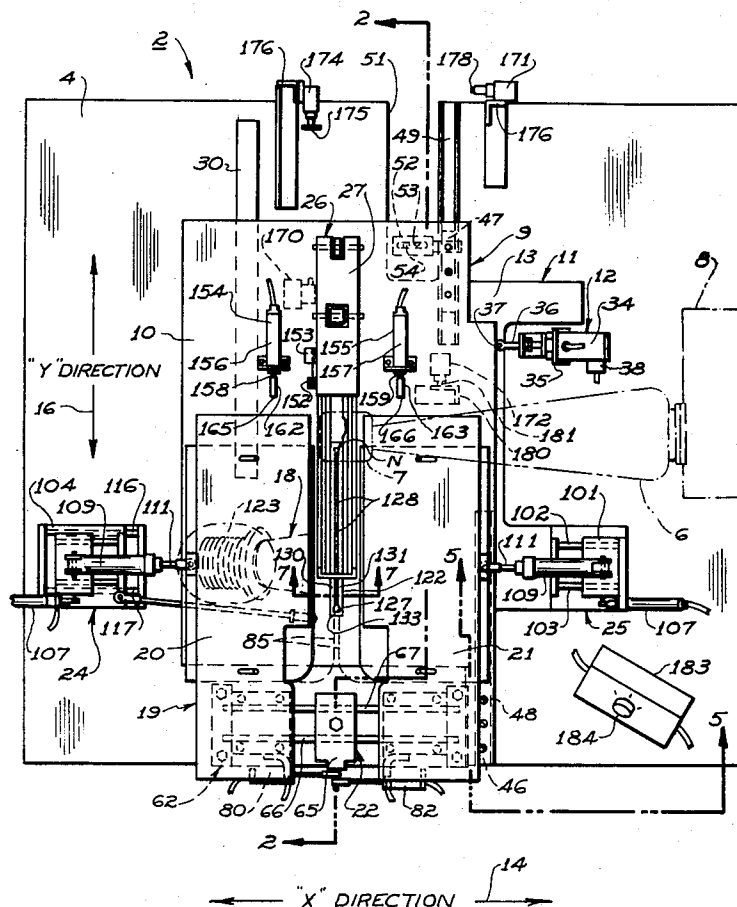
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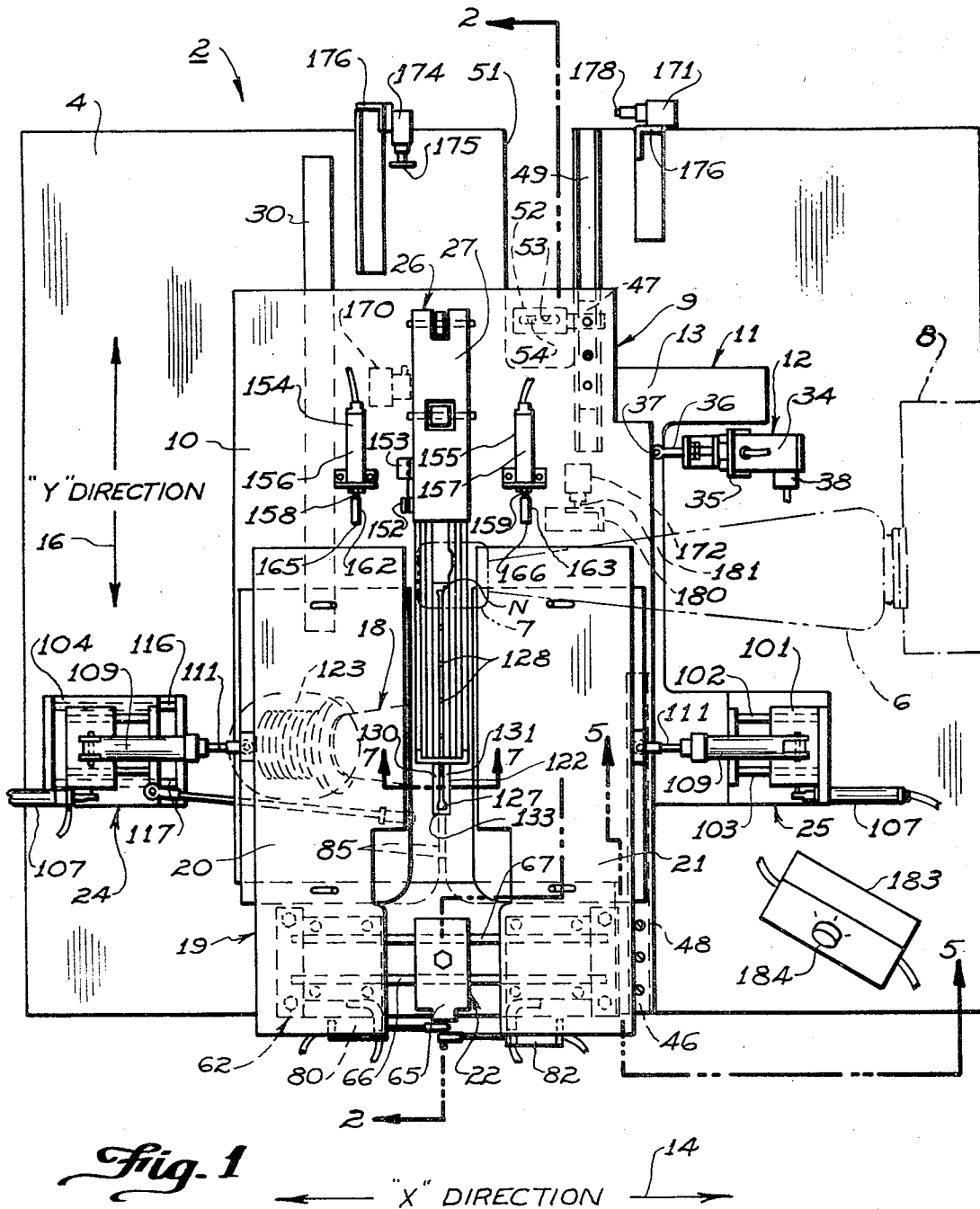
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[57] **ABSTRACT**

A sewing apparatus and method for securing a fastener between opposed fabric edge portions which automatically transfers and guides the fabric and fastener, as a unit, relative to a relatively stationary sewing machine and needle to form a predetermined generally linear stitching line pattern for securement to the fastener, and in which each edge portion is held in folded and tensioned condition, and in spaced-upon relation to itself during selective portions of the operation to effect precise, uniform stitching.

12 Claims, 13 Drawing Figures





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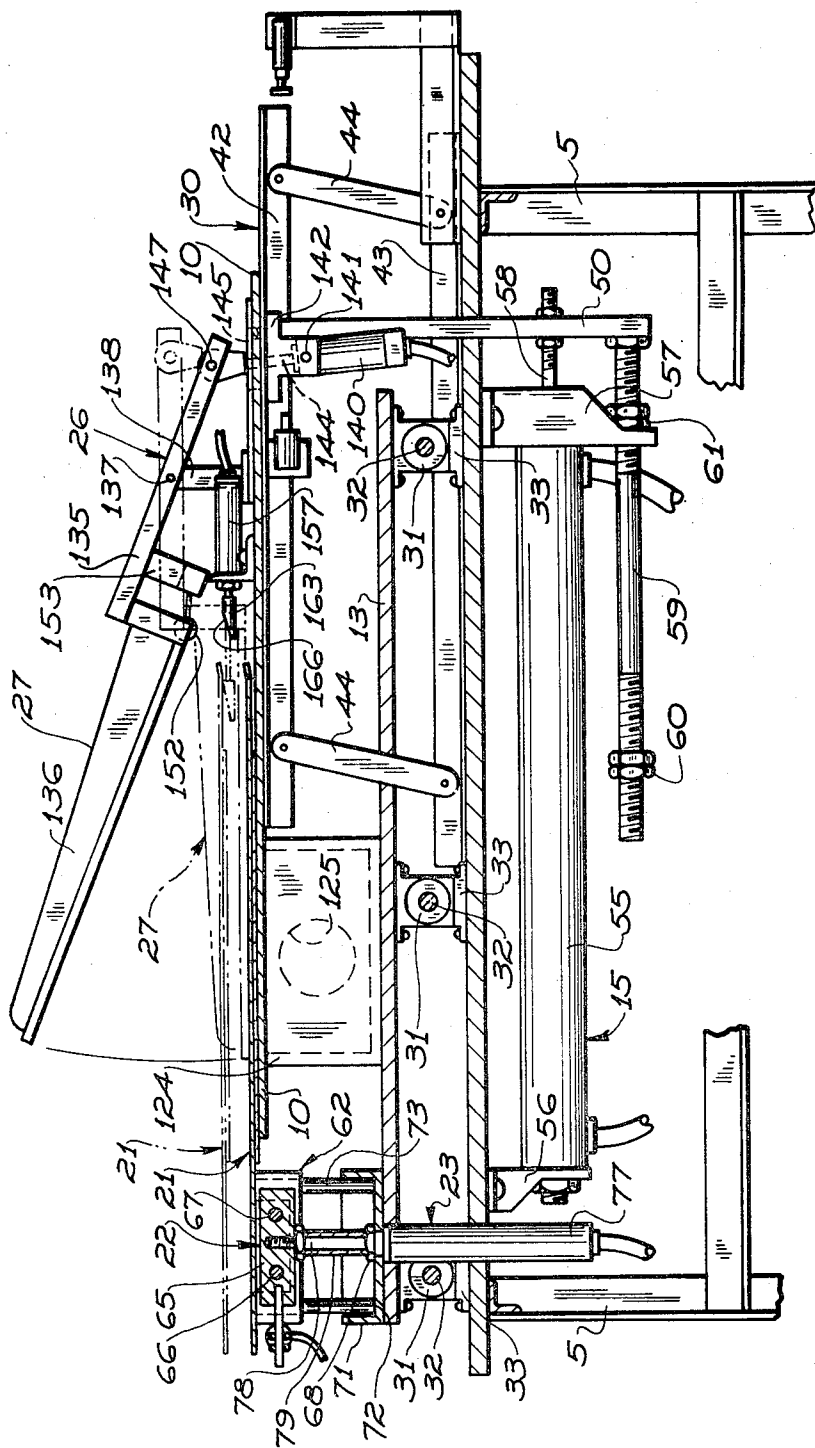


Fig. 2

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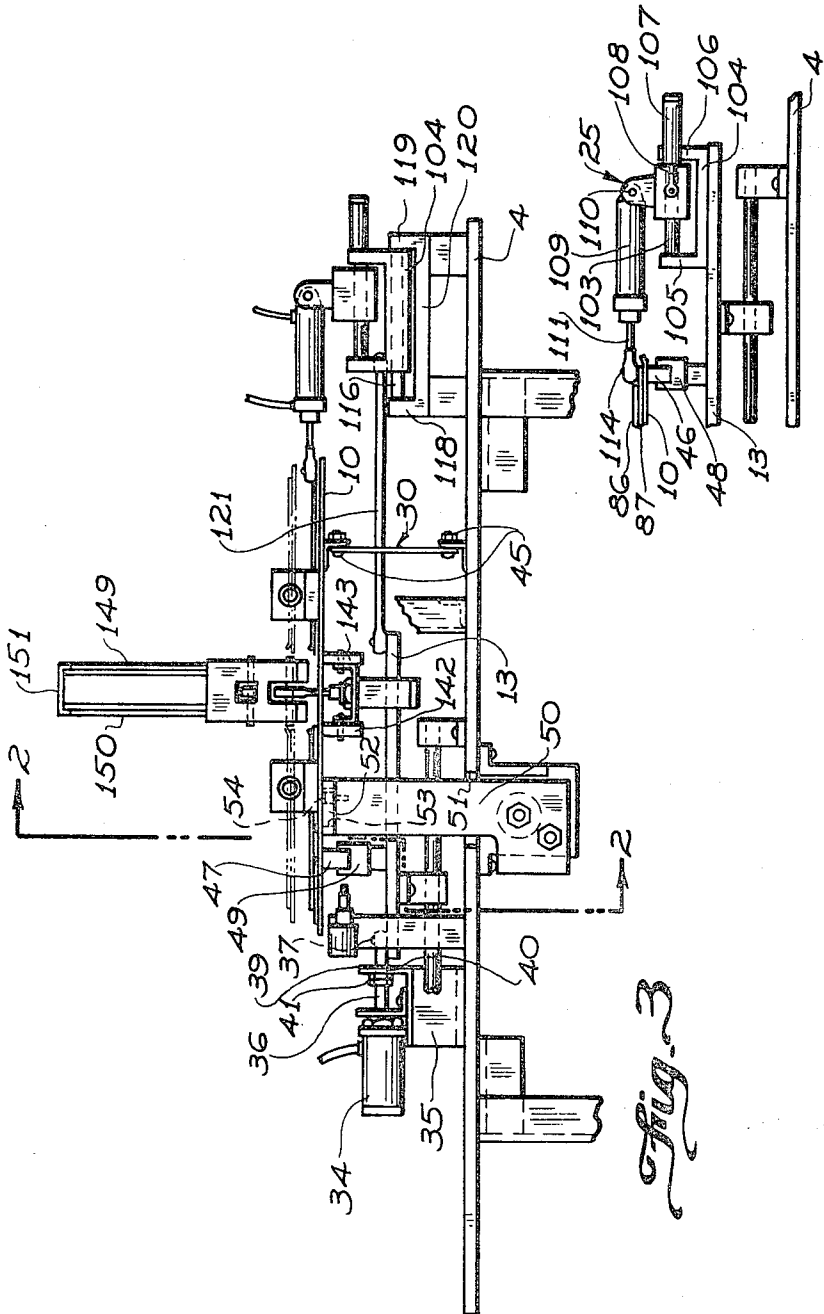


Fig. 5

Fig. 3

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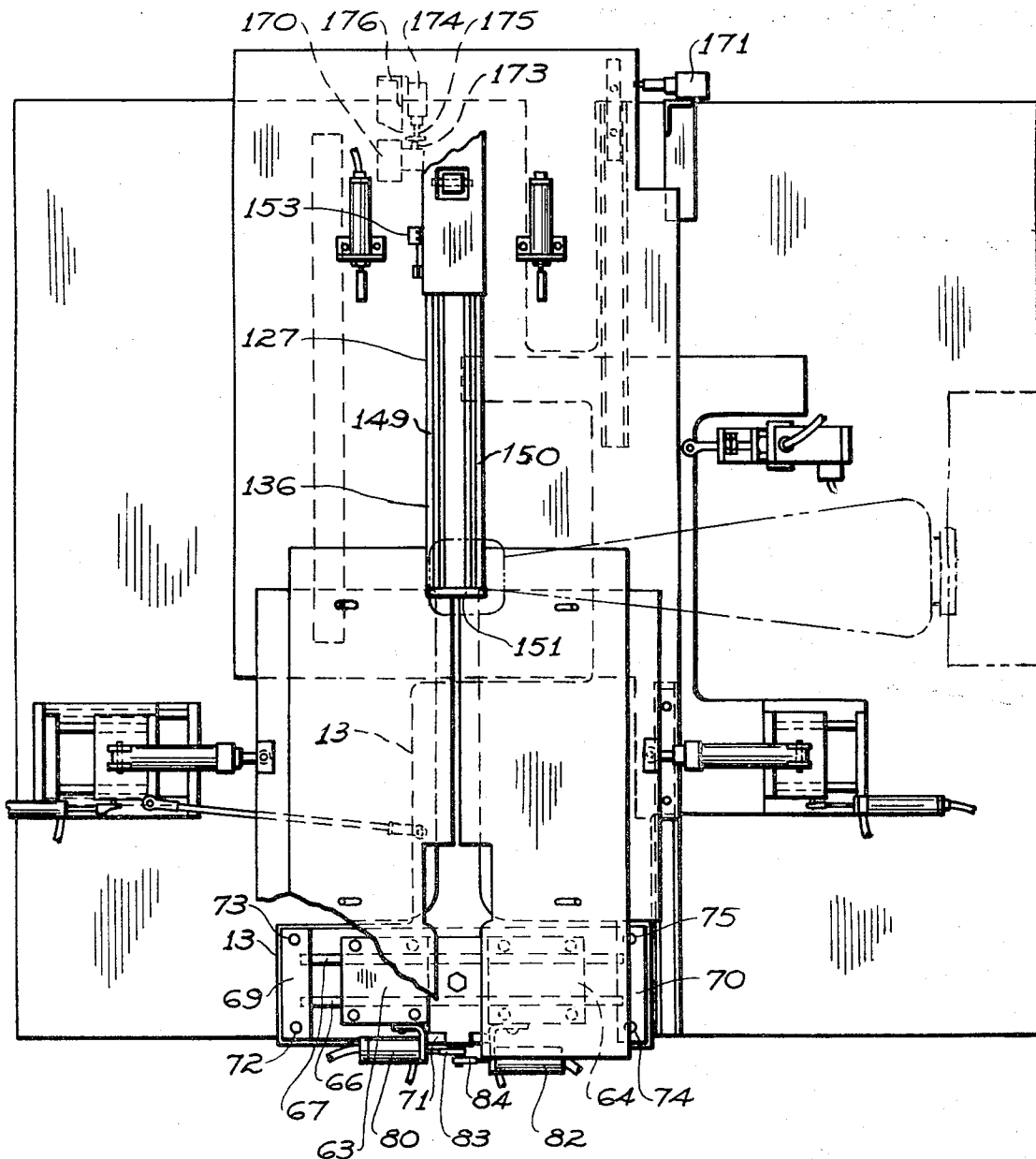


Fig. 4

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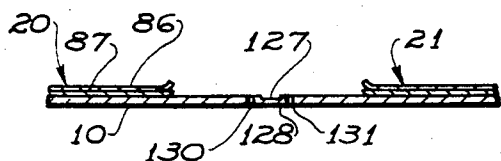


Fig. 7

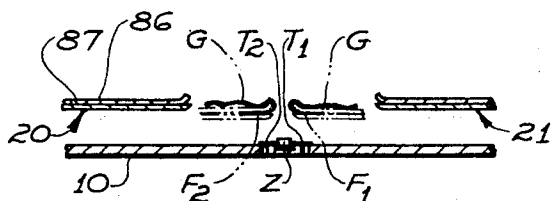


Fig. 8

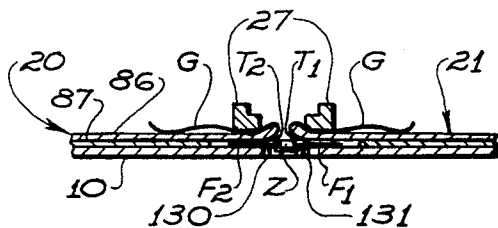


Fig. 9

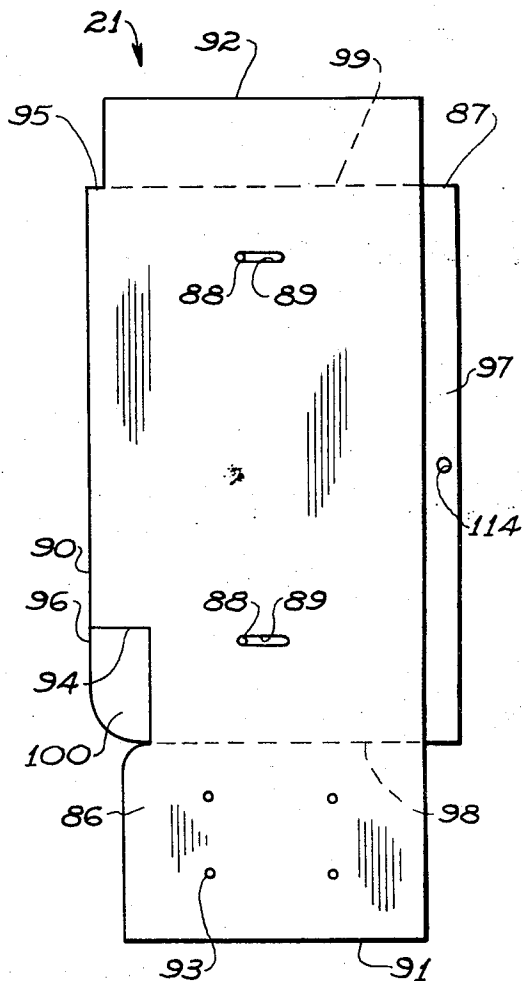


Fig. 6

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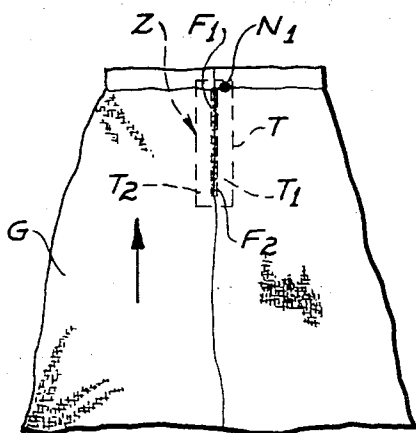


Fig. 10

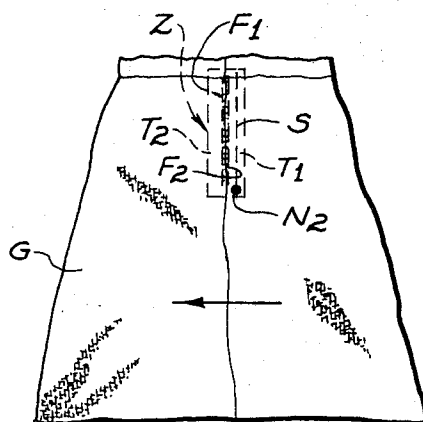


Fig. 11

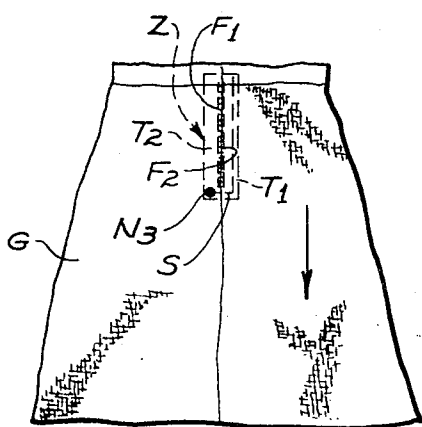


Fig. 12

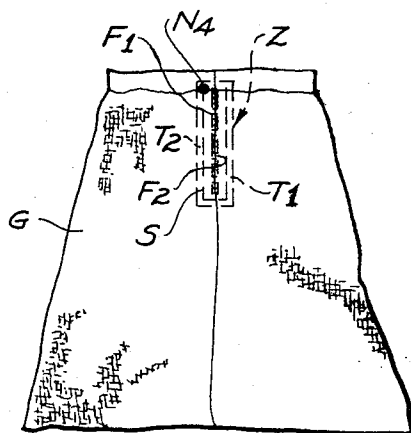


Fig. 13

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SEWING METHOD

BACKGROUND OF THE INVENTION

The present invention relates to sewing apparatus, and more particularly, to sewing apparatus for attaching a fastener, such as a zipper, to a fabric garment, such as a skirt, a dress or the like.

Conventionally, the typical double-lap slot style zipper includes a pair of flexible, fabric tab portions which project outwardly from a centrally disposed, lengthwise extending row of interlocked teeth which are carried and adapted to secure the respective tab portions together. These tab portions are adapted to be attached to a garment, such as by stitching, lengthwise along one of the seams thereof. Normally, the seam to receive the zipper is left unsewn adjacent one end thereof providing opposed, spaced fabric edges for connection to the respective tab portions of the zipper.

Heretofore, numerous methods and apparatus have been employed for attaching zippers to garments. These former methods and apparatus have been, for the most part, manual operations requiring well trained operators. In one such operation, it was necessary for the operator to open the zipper by moving the zipper slide approximately one-half the length of the zipper, and then placing one tab of the zipper under the foot of the sewing machine head. The operator would then fold under one of the opposed fabric edges adjacent the unsewn end of the seam of the garment and place the folded edge portion on top of the zipper under the foot of the sewing machine. After properly aligning the zipper with the folded fabric edge, a stitch would then be made lengthwise of the zipper tab down to the zipper slide. At this time, the operator would then lift the foot of the sewing machine head, move the zipper slide back to its original closed position, and then, finish stitching to the opposite end of the zipper tab. With the needle in the down position and the foot in a lifted position, it was necessary for the operator to turn the garment and zipper, as a unit, at an angle of approximately 90° with respect to the previously made stitch, and then stitch across the lower end of the zipper tabs to attach the zipper to the already sewn portion of the seam. With the needle in the down position, the foot is then lifted to enable the operator to again turn the garment and zipper. The foot is then lowered and a stitch is made along a predetermined lengthwise portion of the opposite tab. Maintaining the needle in a down position, the foot is lifted and the zipper slide is again opened to a position beyond the foot to enable a stitch to be applied to the remaining portion of the zipper tab. The garment is then removed from the sewing machine and the zipper slide is moved to the closed position.

As can be seen, such an operation requires well trained, highly skilled operators capable of producing a high quality finished product while maintaining acceptable production rates. Due to rapidly rising labor costs, lack of skilled labor, and the extremely high cost of training operators to perform skilled jobs, it has become most desirable to develop improved, essentially automatic apparatus capable of being operated by little trained or virtually unskilled labor, and which apparatus can reduce the production time for attaching a zipper to a garment while improving the uniformity of the end product.

SUMMARY OF THE INVENTION

The present invention contemplates providing an improved sewing apparatus and method for securing a fastener, such as a zipper or the like, between opposed fabric edge portions of a garment, such as a skirt, a dress or the like. The sewing apparatus comprises a support member for supporting a sewing machine thereon. A work transferring assembly is mounted on the support member, being adapted for moving the zipper and garment relative to the sewing machine. The work transferring assembly includes a loading mechanism movably mounted on the support member for supporting the zipper thereon. A garment aligning mechanism is operably associated with the loading mechanism for aligning the garment with the zipper. A clamping means is carried by the loading mechanism and clampingly coacts with the garment aligning mechanism to clamp the garment on the work transferring assembly to enable movement of the garment and zipper, as a unit, relative to the garment aligning mechanism upon movement of the loading mechanism. The work transferring assembly includes a shifter assembly movably mounted on the support member having a selectively actuatable means operably connected thereto for moving the loading mechanism in one direction relative to the sewing machine. The loading mechanism includes a loading platform having a zipper holding device operably connected thereto for holding the zipper thereon. A selectively actuatable means is operably connected to the loading platform for moving the garment and zipper in another direction relative to the sewing machine. The garment aligning mechanism includes folding means having a pair of oppositely disposed folder units adapted for movement toward and away from one another. Each of the folder units includes a folder member and a caresser member adapted for clamping coaction with one another for supporting the opposed fabric edges in aligned relation for performing the sewing operation. Each of the caresser members is slidably mounted adjacent the underside of a respective folder member, being adapted for lateral movement with respect thereto. A selectively controlled fluid actuatable means is operably associated with each of the folder units for moving a respective one of the caresser members a predetermined distance with respect to an associated folder member for clampingly engaging a respective one of the opposed fabric edges therebetween.

In accordance with the foregoing, there is provided an improved apparatus and method for securing a zipper between the opposed fabric edge portions of a garment which has numerous advantages over heretofore known equipment and modes of operation. The invention contemplates an apparatus and method which provides for quick and easy loading and properly aligning the opposed fabric edge portions of the garment with the respective tab portions of the zipper. Further, the apparatus and method provides for automatically moving the garment and zipper, as a unit, in one lengthwise direction relative to a fixed stitching point for stitching one of the fabric edge portions to the zipper, then moving the garment and zipper, as a unit, in a transverse direction relative to the fixed stitching point, and then, moving the garment and zipper, as a unit, in a direction opposite to the aforementioned lengthwise direction

and relative to the stitching point for stitching the other edge portion of the garment to the zipper.

As can be seen, there is provided an improved apparatus and method for essentially automatically attaching a zipper to a garment. Further, the method and apparatus are capable of being operated and performed by little trained or virtually unskilled labor, and which apparatus is capable of reducing production time for attaching a zipper to a garment while improving the uniformity of the end product.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of the sewing apparatus of the present invention showing the loading platform in the forwardmost position;

FIG. 2 is a side elevation view taken along the lines 2—2 of FIGS. 1 and 3;

FIG. 3 is a rear elevation view of the sewing apparatus of the invention as seen from the top of FIG. 1;

FIG. 4 is a top plan view of the sewing apparatus of the present invention showing the loading platform in the rearwardmost position;

FIG. 5 is a front elevation view taken along the line 5—5 in FIG. 1;

FIG. 6 is an enlarged, top plan view of one of the folder units of the present invention;

FIG. 7 is a fragmentary, cross-sectional view taken on the line 7—7 in FIG. 1, and showing the folder units of the present invention in the open, unloaded condition;

FIG. 8 is a view of the folder units shown in FIG. 7 in the raised, loaded condition;

FIG. 9 is a view of the folder units in FIG. 8 showing the zipper and garment in the clamped, loaded condition; and

FIGS. 10 to 13 are a diagrammatic representation in top plan of a garment shown at various stages of the sewing operation of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The sewing apparatus of the present invention is illustrated in FIG. 1, generally at 2, being adapted to attach a zipper, as at Z (FIG. 10) to the opposed edges F1 and F2 of a fabric garment G, such as a skirt, a dress or the like (FIG. 10). The apparatus is shown as including a main work table 4 which may be supported on a suitable framework 5 as shown in FIG. 2. Referring again to FIG. 1, a sewing machine (indicated by the dotted lines at 6) may be mounted on the main work table 4 being adapted to be driven by a suitable drive mechanism (indicated by the dotted lines at 8). The sewing machine includes a head 7 which operably supports a stitching needle N. A work transferring assembly 9 is shown as being mounted on the work table 4 being adapted to support and move the garment and zipper, as a unit, in a predetermined path during the sewing operation. As shown, the work transferring assembly 9 includes a loading platform 10 moveably mounted on the main work table 4 being adapted to support the zipper and garment thereon during the sewing operation. A shifter assembly 11 is moveably mounted on the main work table and is operably connected to the loading platform for imparting predetermined directional movement to the garment and zipper relative to the sewing machine 6. The shifter assembly 11 includes a shifter plate 13 supported above the main work table 4 for movement to the left and right, as indicated by the

arrow 14, and hereinafter referred to as the X-direction. A selectively controlled fluid actuatable unit 12 is mounted on the work table 4 being operably connected to the shifter plate 13 to impart selective reciprocating movement thereto in the aforementioned X-direction. The loading platform 10 is disposed in overlying relation above the shifter plate 13 being adapted for movement therewith, as a unit, in the X-direction upon actuation of the fluid actuatable unit 12. Referring again to FIG. 1, a selectively controlled fluid actuatable unit 15 is shown attached to the main work table 4 being operably connected to the loading platform for selectively moving the latter between a forward loading position (FIG. 1) and a rearward position (FIG. 4) as indicated by the arrow 16, and hereinafter referred to as the Y-direction. A zipper holding device 18 is operably associated with the loading platform 10 being adapted to support the zipper in proper alignment with respect to the sewing machine needle N during the sewing operation. A garment aligning mechanism 19 is shown as being mounted on the shifter assembly 11 and including oppositely disposed folder units 20 and 21 adapted to grippingly engage and align respective ones of inwardly extending fabric edges F1 and F2 of the garment with a respective one of the tabs T1 and T2 of the zipper preparatory to performing the stitching portion of the operation (FIGS. 7, 8 and 9). The garment aligning mechanism 19 includes a lifter assembly 22 being adapted to move the folder units 20 and 21, as a unit, between a raised loading position, as shown by dotted line 21 in FIG. 2, and a lowered operating position, shown by the solid lines 21 in FIG. 2. A selectively controlled fluid actuatable unit 23 is operably connected to the lifter assembly 22 to raise and lower the folder units 20 and 21, as aforesaid. Folder actuator assemblies 24 and 25 are shown as being operably associated with the lifter assembly 22 for moving the folding units 20 and 21, respectively, between an open loading position (FIGS. 1 and 7) and a closed garment holding position (FIGS. 4 and 9). A clamping mechanism 23 is shown mounted on the loading platform 10 being adapted to clamp the garment G in position relative to the zipper Z (FIG. 9). The clamping mechanism 26 includes a clamp arm 27 adapted for pivotal movement in a generally vertical plane between a raised loading position, as indicated by the solid lines 27 in FIG. 2, and a lowered clamping position, indicated by the dotted lines 27 in FIG. 2. By the foregoing arrangement and referring to FIGS. 10 to 13, a zipper and garment are clamped into position on the loading platform 10 having the top of one tab T1 of the zipper disposed beneath the needle of the sewing machine 6, as at N1 (FIG. 10). The selectively actuatable unit 15 is then operated to move the loading platform 10 rearwardly in the Y-direction, as indicated by the arrow in FIG. 10, to attach one of the zipper tabs T1 to a respective one of the fabric edges F1. When the lower end of the zipper reaches the needle, as at N2, the selectively actuatable unit 15 is deactuated and the selectively actuatable unit 12 is actuated to move the garment and zipper, as a unit, in the X-direction, as indicated by the arrow in FIG. 11, to attach the lower end of the zipper to the garment. After movement of the loading platform a predetermined distance in the X-direction and the needle is aligned with the other tab T2, as at N3, the selectively actuatable unit 12 is deactuated and the unit 15 is actuated in the reverse direction to move the load-

ing platform 10 forwardly in the opposite Y-direction, as indicated by the arrow in FIG. 12, for attaching the opposite fabric edge F2 to the tab T2 of the zipper. The loading platform 10 and sewing machine 6 are stopped when the top of the zipper reaches the needle, as at N4, 5 and the garment is removed from the apparatus.

Referring now to FIGS. 2 and 3, the shifter plate 13 is shown as being disposed between the main work table 4 and the loading platform 10. In the form shown, the shifter plate 13 is mounted on ball bushings 31 10 connected adjacent the underside thereof being adapted to sliding movement along guide rods 32. The guide rods 32 may be rigidly supported adjacent their respective outer ends by pillow blocks 33 mounted on the main work table 4.

To impart movement to the shifter plate 13 in the X-direction, the fluid actuating unit 12 includes a fluid cylinder 34 adapted for connection to a source of pressurized fluid, such as air or the like. As shown, the fluid cylinder 34 is supported on a bracket member 35 20 mounted on the main work table 4. The fluid cylinder 34 includes a piston rod 36 which is connected to the shifter plate, as at 37 (FIG. 3) being adapted to selectively reciprocate the shifter plate 13 in the X-direction. Preferably, the fluid cylinder 34 is of the double-acting type being operably connected to a suitable flow control device, such as at 38, to control the feed rate of the shifter plate. In the form shown, the bracket member 35 is provided with a generally upright arm 39 including an opening 40 therein adapted to receive the piston rod 36 therethrough. A stop element 41 is carried on the piston rod 36 being adapted for abutting engagement with the arm 39 to limit the throw of the piston rod 36, and thus, control the lateral shifting movement of the shifter plate 13, such as to the left when viewing FIG. 1.

The loading platform 10 is shown as being generally polygonal in configuration, such as rectangular, being made of a sheet material, such as steel or the like. The loading platform 10 may be supported on one side by an adjustable bracket member 30. The bracket member 30 is shown as including generally parallel upper and lower bars 42 and 43, respectively, which may be connected together by pivotal links 44 (FIG. 2). Referring to FIG. 3, the upper and lower ends of the links 44 45 may be connected to the bars 42 and 43 by suitable fasteners, as at 45, which may be tightened to lock the bars 42 and 43 in fixed relation with respect to one another, and thus, position the loading platform at a predetermined distance above the main work table 4. As shown, the lower bar 43 may be secured to the main work table 4, whereas, the loading platform 10 is slidably mounted on the upper arm 42. Preferably, the loading platform 10 rests by gravity on the upper arm to enable the loading platform to move both in the X-direction and Y-direction thereon. The loading platform 10 is shown as being supported on the opposite side by means of track followers 46 and 47 disposed adjacent the front (FIG. 5) and rear (FIG. 3), respectively. The track followers 46 and 47 may be connected by suitable fasteners to the underside of the loading platform being mounted for sliding movement within trackways 48 and 49 to enable the loading platform 10 to move, back and forth, in the Y-direction. The trackways 48 and 49 are rigidly connected to the shifter plate 13 for cam-like contact with the track followers 46 and 47 to cause movement of the loading platform

back and forth in the X-direction upon movement of the shifter plate 13, as aforesaid.

To impart movement to the loading platform 10 in the Y-direction, an elongated, generally vertically-oriented drive arm 50 is provided which is operably connected at its upper end to the loading platform 10 and at its lower end to the fluid actuated unit 15. As shown in FIG. 1, the main work table 4 includes an elongated slot 51 which extends inwardly from the rear end thereof being adapted to receive the drive arm 50 therethrough and thus, to enable the drive arm to be moved back and forth in the Y-direction. Referring to FIGS. 1 and 3, a block-like trackway 52 is mounted adjacent the underside of the loading platform being moveably connected to the upper end of the drive arm 50. As shown, the trackway 52 includes an elongated slot 53 which extends in the X-direction being adapted to receive a nut-like track follower 54 in sliding relation therein. By this arrangement, the loading platform 10 may move freely back and forth in the X-direction, whereas, the track follower 54 will coast with the trackway 52 to move the loading platform 10 in the Y-direction upon actuation of the fluid actuated unit 15.

As shown in FIG. 2, the fluid actuated unit 15 includes a fluid cylinder 55 which is shown as being supported adjacent the underside of the main work table 4 by mounting bracket 56 and 57. The fluid cylinder 55 includes a piston rod 58 which is rigidly connected to the drive arm 50 for imparting movement to the loading platform 10, as aforesaid. In addition, an elongated rod 59 is rigidly connected to the outer end of the drive arm 50 including stop elements 60 and 61 thereon adapted for abutting engagement with the mounting bracket 57 for limiting the stroke of the piston rod 58, and thus, the travel of the loading platform in the Y-direction for a reason which will be discussed more fully hereinafter. Preferably, the fluid cylinder 55 is of the "Cyl -Chek" type as manufactured by the Allenaire Corporation of Mineola, New York, which is a trade name for a fluid cylinder of the hydraulically driven, electrically controlled type to provide smooth, precise uniform feed of the loading platform in the Y-direction. The fluid cylinder 55 may be of the double-acting type being adapted for connection to a suitable flow control device (not shown) to control the rate of flow of fluid to the cylinder 55, and thus, control the rate of travel, such as approximately 150 inches per minute, of the loading platform back and forth in the Y-direction.

Referring now to FIGS. 1 and 2, the lifter assembly 22 includes a main carriage 62 adapted for moving the folding units 20 and 21 between the lowered operating position and raised loading position, as aforesaid. As shown, the main carriage 62 includes a central mounting block 65 having a pair of generally parallel guide rods 66 and 67 mounted thereon. Each of the guide rods 66 and 67 extend outwardly from the opposite sides of the mounting block 65 in the X-direction. As best shown in FIG. 4, the rods 66 and 67 are supported adjacent their opposite ends by a pair of carriage-like abutment blocks 69 and 70 being mounted for sliding movement on generally, vertically-extending guide posts 72, 73 and 74, 75, respectively. The guide posts 72, 73, 74 and 75 are connected to and extend generally upwardly from a box-like base 71 mounted on the shifter plate 13, and thus, being moveable therewith to move the folding units 20 and 21, as a unit, upon lateral shifting movement of the shifter plate 13.

To impart vertical movement to the main carriage 62, and as shown in FIG. 2, a fluid actuated unit 23 may be provided including a fluid cylinder 77 mounted on the shifter plate 13 and being adapted to receive fluid under pressure, such as air or the like. The fluid cylinder 77 is shown as being rigidly attached to the base 71, such as by a nut 68, and includes a generally vertically extending piston rod 78 projecting upwardly therefrom being adapted for selective reciprocating movement, such as up and down in a generally vertical direction. The fluid cylinder 77 may be of the single-acting, spring-return type having the upper end of the piston rod 78 thereof rigidly connected at its upper end, such as by threading or the like, to the central mounting block 65. A spacer element 79, such as a sleeve or the like, may be slidably disposed circumferentially about the piston rod 78 being held in position adjacent the upper end thereof, such as by the nut 68, to limit the downward movement of the mounting block 65, and thus, the main carriage 62 to properly orient the folding units 20 and 21 in overlying relation with respect to the loading platform 10.

Referring now again to FIG. 4, the main carriage 62 includes a pair of laterally moveable sub-carriages 63 and 64 being adapted for movement toward and away from one another. As shown, the sub-carriages 63 and 64 are each slidably mounted on the rods 66 and 67 being adapted for movement between an inward position adjacent the central mounting block 65 (FIG. 4) and an outward position adjacent the abutment blocks 69 and 70 (FIG. 1), respectively. In the form shown, the folding units 20 and 21 are connected to the sub-carriages 63 and 64, respectively, being adapted for movement therewith.

To move the carriages 63 and 64, fluid cylinders 80 and 82 are provided being mounted on the carriages 77 and 78, respectively. Preferably, each of the fluid cylinders 80 and 82 is of a double-acting type being adapted to receive fluid under pressure, such as air or the like. In the form shown, the fluid cylinders 80 and 82 include piston rods 83 and 84, respectively, which are rigidly connected to the central mounting block 65, such as by a pin 85. By this arrangement, the carriages 63 and 64, and thus, the folding units 20 and 21, will be moved away from one another (FIGS. 1 and 7) upon actuation of the fluid cylinders 80 and 82, and likewise, will be moved toward one another upon deactuation of the fluid cylinders 80 and 82, respectively (FIGS. 4 and 8), in a manner to be more fully described hereinafter.

Referring now to FIGS. 1 and 2, the folder units 20 and 21 are rigidly connected at one end to the carriages 63 and 64, respectively, and extend rearwardly in overlying relation with respect to the loading platform 10. As the folding units 20 and 21 are essentially identical in configuration, only one, such as 21, will be described in detail hereinafter with like parts of the folder unit 20 being designated by like numerals. Referring now to FIG. 6, the folder unit 21 includes an upper folder plate 86 and a lower caresser plate 87 which is moveably attached in sliding relation adjacent the underside of the folder plate 86, such as by rivets 88 or the like. As shown, the folder plate 86 includes elongated slots 89 being adapted to receive the rivets 88 in sliding relation therethrough. The slots 89 are arranged so as to have their lengthwise axis extending in the X-direction to enable the caresser plate 87 to be moved relative to the

folder plate 86, such as in the X-direction, for a reason which will become more apparent hereinafter.

Each of the folder plates 86 is of a generally rectangular construction in top plan view (FIG. 1) being made of a sheet material, such as metal or the like. Each of the folder plates 86 includes a generally linearly extending inner edge 90 which extends in the Y-direction, and generally parallel front 91 and rear 92 edges. As shown, apertures 93 are provided adjacent the front edge 91 of each of the folder plates being adapted to receive suitable fasteners therein for attachment of the folder plates to the carriages 63 and 64, as aforesaid. A cutout portion 94 is provided in each of the folder plates 86 adjacent to and extending inwardly from the inner edge 90 to facilitate loading of the garment into the apparatus. The cut-out portion 95 is provided adjacent the inner 90 and rear 92 edges of each of the folder plates to provide clearance to enable the sewing machine needle to contact the garment and zipper when performing the sewing portion of the operation.

Each of the caresser plates 87 is also shown as being of a generally rectangular configuration when viewed in top plan (FIG. 6), being made of a sheet material, such as metal or the like. As shown, each of the caresser plates 87 includes a generally linearly extending inner edge 96 disposed in generally parallel relation with respect to the inner edge 90 of the folder plate 86 and an outer edge 97 adapted for connection to the folder actuator assembly 25, as at 114. The caresser plates 87 include front 98 and rear 99 edges spaced inwardly from the front 91 and rear 92 edges of the folder plates 86, respectively. In the form shown, the caresser plates 87 project outwardly from beneath the folder plates 86 adjacent the cut-out portions 94 providing platform-like guide surfaces for inserting the turned under portions of the edges F1 and F2 of the garment between the respective folder plates 86 and caresser plates 87, as at 100.

Referring now to FIGS. 1 and 4, the inner edges 90 of the respective folder plates 86 are disposed in laterally-spaced, generally parallel relationship when in the mounted position being adapted to be brought into closely-spaced relationship upon closing of the folding units 20 and 21 with the space therebetween, indicated by the dotted lines 88 in FIG. 1, being preferably somewhat greater than the thickness of the garment material to enable the turned under edges to be easily slid there-through upon rearward movement of the loading platform. In addition, the inner edges 96 of the caresser plates 87 are disposed in generally parallel relationship with respect to the inner edges 90 of the folder plates 86, and to one another. Further, the inner edges 96 of the caresser plates 87 are vertically aligned with the respective inner edges 90 of the folder plates 86 (FIG. 7) being adapted to be temporarily maintained in such alignment upon movement of the folder units 20 and 21 into the closed position as shown in FIG. 8.

Referring particularly to FIG. 1, the folder actuator assemblies 24 and 25 are provided to selectively control the movement of the caresser plates 87 relative to the folder plates 86. As each of the folder actuator assemblies 24 and 25 are essentially identical, only one, such as 25, will be described in detail with like parts of the assembly 24 being described by like numerals. Assembly 25 is shown as including a carriage-like base 101 adapted for sliding movement on rods 102 and

103. As shown in FIG. 5, the rods 102 and 103 are mounted on a bracket 104 which includes generally upright support arms 105 and 106. The rods 102 and 103 extend between and have their opposite ends rigidly secured to the support arms 105 and 106. A fluid actuated cylinder 107 may be fixedly mounted on the bracket 104 having a piston rod 108 operably connected to the base 101 to impart selective movement thereto between the arms 105 and 106. In the form shown, a fluid actuated cylinder 109 is pivotally connected at one end to the base 101, as at 110, and includes a piston rod 111 which is pivotally connected to a respective one of the caresser plates, as at 114, to impart movement to a respective one of the folder units, such as 21. The fluid cylinders 107 and 109 are preferably of the double-acting type being adapted for connection to a source of pressurized fluid, such as air or the like. By the arrangement shown, the fluid cylinders 107 and 109 may be actuated independently of or simultaneously with one another so that the caresser plates 87 may move inwardly, as a unit, with the folder plates 86, as shown by the dotted lines in FIG. 8, and may be withdrawn outwardly from beneath the folder plates 86 when the folding units are in the loaded position, as shown in FIG. 9. In the form shown, the arm 105 provides an abutment to limit the throw of the piston rod 111, and thus, position the respective inner edges 90 of the folder plates 86 in the aforementioned closely-spaced relationship. Further, the throw of the piston rod 111 is pre-set to move the inner edge 96 of the respective caresser plates 87 outwardly away from the respective inner edges 90 of the folder plates 86 a sufficient distance, such as in the range of one-half to three-quarters of an inch, to maintain gripping contact with the respective turned under edges of the garment, and thus, pull the fabric taut for commencement of the sewing operation.

As shown in FIG. 5, the folder actuator assembly 25 is mounted directly on a shifter plate 13, whereas, the bracket 104 of the folder actuator assembly 24 is of a carriage-like construction (FIG. 3) being mounted for movement on a sub-carriage assembly 115. As shown in FIGS. 1 and 3, the carriage-like bracket 104 is slidably mounted on guide rods 116 and 117. The guide rods 116 and 117 extend between and are supported at their opposite ends by generally upright walls 118 and 119 of a support bracket 120 mounted on the main work table 4. A connecting rod 121 may be provided to innerconnect the carriage-like bracket 104 of the actuator assembly 24 to the shifter plate 13 so that upon movement of the shifter plate 13, the folder actuator assembly 24 will move, as a unit, with the folder actuator assembly 25.

As shown in FIG. 1, 2 and 7, the zipper holding device 18 includes an elongated receptacle 122 provided in the loading platform 10 and being adapted for fluid communication with a suitable vacuum source, as at 123. More particularly, a box-like enclosure 124 is mounted beneath the loading platform 10, and includes an inlet 125 which is adapted for connection to the vacuum source 123. The receptacle 122 includes an elongated recess 127 having its lengthwise dimension extending in the Y-direction and being adapted to receive the teeth of the zipper therein. The recess 127 may be provided with laterally spaced openings or apertures 128 extending lengthwise thereof to provide an outlet for the enclosure 124, and thus, create a suction adja-

cent the upper surface of the loading platform 10 to firmly hold the zipper in position during the sewing operation. Elongated slots 130 and 131 are provided in the loading platform 10 and extend in generally parallel, spaced relationship along opposite sides of the recess 127. A shorter slot 133 extends transversely between, such as in the X-direction, and in communication with the slots 130 and 131 adjacent the forward ends thereof. Spacing between the slots 130 and 131 is less than the maximum transverse width of the zipper so that the opposed zipper tabs T1 and T2, respectively, will lie in overlying relation with respect thereto (FIG. 9) when the teeth of the zipper are disposed within the recess 127. By this arrangement, the slots 130, 131 and 133 provide openings in the loading platform to receive the needle of the sewing operation.

Referring now to FIG. 2, the clamping assembly 26 is mounted adjacent the rear end of the loading platform 10 and includes a clamp arm 27 having a base portion 135 and an elongated clamping portion 136. The base portion 135 is mounted for pivotal movement, as at 137, to a generally upright bracket 138 which is secured to the loading platform 10. The clamping portion 136 is connected adjacent the front end of the base portion 135 and projects forwardly and outwardly therefrom in overlying relation with respect to the receptacle 122. The opposite or rear end of the base portion 135 is operably connected to a fluid actuated cylinder 140 being adapted to impart pivotal movement in a generally vertical plane to the clamp arm 27 upon actuation thereof. The fluid cylinder 140 is shown as being pivotally connected, as at 141, between spaced brackets 142 and 143 which are mounted adjacent the underside of the loading platform 10. The fluid cylinder 140 is preferably of the double-acting type, and includes a piston rod 144 which extends upwardly through an opening 145 in the loading platform 10 and being pivotally connected; as at 147 to the rear end of the base portion 135. By this arrangement, the fluid cylinder 140 is free to swing about the pivotal connection 141 while imparting pivotal movement to the clamp arm 27 upon actuation thereof.

Referring now to FIG. 4, the clamping portion 136 includes a pair of oppositely disposed arm-like strut members 149 and 150 which extend in laterally-spaced, generally parallel relationship with respect to one another being rigidly connected together at one end to the base portion 135 and at their opposite front end to a cross piece 151. In the form shown, the minimum transverse distance between the struts 140 and 150 is slightly greater than the maximum transverse distance between the slots 130 and 131. As shown in FIGS. 4 and 9, the folder plates 86 are turned upwardly adjacent the inner ends 90 so as to extend in overlying relation with respect to the zipper teeth when disposed in the slot 127. As shown, the turned up inner edges 90 of the folder plates 86 are positioned above and between the slots 130 and 131 and between the arms 149 and 150 when the clamping portion 136 is brought into engagement with the folder plates 86 as shown in FIG. 9. Referring now to FIG. 2, a limit switch 153 is mounted on the base portion 135 including roller-like contact 152 adapted for engagement with the loading platform 10. Preferably, the limit switch 153 is operably connected to the fluid cylinder 109 to cause retraction of the piston rod 111, and thus, the respective caresser plates 87. Preferably, the contact 152 is posi-

tioned to engage the loading platform 10 just prior to engagement of the clamping portion 136 with the folder plates 86 so that the caresser plates 87 will be withdrawn just prior to contact of the clamp arm with the garment.

Referring again to FIGS. 1 and 2, selectively controlled, fluid actuable units 154 and 155 are mounted on the loading platform adjacent the rear ends of the folder plates 86 being adapted to support the latter upon actuation thereof. In the form shown, the units 154 and 155 comprise fluid actuated cylinders 156 and 157 including piston rods 158 and 159 adapted for selective movement in a generally horizontal, forward direction for engagement with the rear ends of the respective folder plates 86. Wedge-shaped cam members 162 and 163 are mounted adjacent the forward end of the piston rods 158 and 159 and include cam surfaces 165 and 166. The cam surfaces 165 and 166 are inclined downwardly in a forward direction being adapted for camming coacting engagement with the rear edges 92 of the folder plates 86. As shown, the rear edges 92 of the folder plates 86 extend beyond the rear edges 99 of the caresser plates 87, and thus, the cam members 162 and 163 will engage the underside of the folder plates 86 and not interfere with the caresser plates upon retraction thereof when the folder units are moved to the closed loading position.

Referring now to FIGS. 1 and 4, limit switches 170, 171 and 172 are provided to terminate movement of the loading platform rearwardly, to the right (when viewing FIG. 1), and forwardly, respectively. Referring now particularly to FIG. 4, the limit switch 170 may be provided with a spring loaded contact pin 173 adapted for engagement with a stationary contact actuator 174 mounted adjacent the rear end of the work table 4. As shown in FIG. 2, the contact actuator includes an adjustable contact element for making minor adjustments to the travel distance of the loading platform. The contact actuator 174 is mounted adjacent the upper end of a generally upright stanchion 176 supported on the work table 4 to position the contact element 175 in alignment with the contact pin 173. As it is necessary for the folder units 20 and 21 to be moved outwardly away from one another in order to accomplish sewing in the X-direction, the limit switch 170 is arranged to actuate the fluid cylinders 80, 82 and 107, and thus, move the folder units to the open or spread position. As shown in FIG. 1, the limit switch 171 may include a spring loaded contact pin 178 adapted for engagement with the track follower 47 upon movement of the shifter plate 13 in the X-direction, such as to the right when viewing FIG. 1. As shown, the limit switch 171 may be positioned atop a generally upright stanchion 176 to position the contact pin 178 in alignment with the track follower 47. Referring again to FIG. 1, limit switch 172 may be mounted adjacent the underside of the loading platform 10 being adapted for contact with a contact actuator 180 mounted on and extending generally upwardly from the shifter plate 13. As stated, the stop elements 60 and 61 carried by the rod 59 provide a safety feature to limit the travel of the loading platform 10, back and forth, in the Y-direction and prevent damage to the limit switches 170 and 172. By this arrangement, movement of the loading platform in the rearward direction will cause the contact element 175 to engage the contact pin 173 and provide a signal to stop the rearward movement of the piston rod 58 of the

fluid cylinder 55. The fluid cylinder 34 is actuated to substantially simultaneously commence movement of the loading platform in the X-direction, such as to the right, when viewing FIG. 1. Upon movement of the loading platform a predetermined distance in the X-direction, the track follower 47 will contact the contact pin 178 to deactuate the fluid cylinder 34, and thus, stop movement of the loading platform in the X-direction. Simultaneously, the fluid cylinder 55 will be reactuated causing fluid to flow therethrough in the reverse direction, and thus, move the loading platform 10 forwardly in the return Y-direction, such as downwardly when viewing FIG. 1. Forward travel of the loading platform 10 will terminate upon contact of the contact pin 181 with the contact element 180. Upon completion of movement in the return Y-direction, a suitable time delay device (not shown) may be provided to enable a time delay, such as 0.5 to 1.5 seconds, to allow the needle to be raised and the thread to be severed before beginning the next cycle.

It is to be understood, that any suitable flow control apparatus, as at 183 (FIG. 1), may be provided, as well known in the art, to control the operation of the various aforementioned fluid actuated cylinders in timed sequence to perform the sewing operation. Such device may be of the electro-mechanical and/or pneumatic/hydraulic type adapted to selectively connect the respective fluid cylinders to a source of pressurized fluid, such as either pneumatic or hydraulic. The flow control may be equipped with a main control switch, as at 184, including an "on" position, "start" position and "stop" position, and such switch may be of the manual and/or automatic-sequence type, as desired.

In a typical operation, the main control switch 184 is turned to the "on" position causing the apparatus to be connected to the source of pressurized air, the drive mechanism of the sewing machine 6 to be energized, and a suction to be applied at the receptacle 122 of the zipper holding device 18. Further, the fluid cylinder 34 is activated to extend the piston rod 36 and to place the needle N of the sewing machine in alignment adjacent the rear end of the slot 131 as shown in FIG. 1. At the same time, fluid under pressure is applied to the fluid cylinders 80 and 82 to extend the piston rods 83 and 84, respectively, and move the folder units 20 and 21 away from one another to the open position (FIGS. 1 and 7). Simultaneously, fluid pressure is applied to the fluid cylinder 77 to extend the piston rod 78, and thus, move the main carriage assembly 62 and the folder units 20 and 21 upwardly to the raised loading position (FIGS. 2 and 8). As the fluid cylinder 77 is actuated, the fluid cylinders 155 and 156 will also be actuated to extend the piston rod 158 and 159, and thus, move the wedge-shaped support elements 162 and 163 forwardly into camming coacting engagement with the underside of the folder plates 68 preparatory to loading a garment thereon (FIG. 2). The zipper Z is then loaded into the recess 127, being held in place by suction applied thereto by the vacuum source 121 and having the upper end of the tab T1 positioned beneath the needle, as at N1 (FIG. 10).

At this time, the fluid cylinders 80 and 82 are actuated in the reverse direction to cause the piston rods 83 and 84 to be retracted. When this occurs, the carriages 63 and 64, and thus, the folder plates 20 and 21, respectively, are moved inwardly into the closed position as indicated by the dotted lines 85 in FIG. 1. The fluid

cylinders 107 are actuated simultaneously with the actuation of the fluid cylinders 80 and 82 to move the carriages 101 inwardly, and thus, move the caresser plates 87 inwardly, as a unit, with the folder plates 86 (FIG. 8). While in the position, a garment is then loaded into the apparatus and the garment edges folded under and slid between the inner ends of the folder and caresser plates. Then, the fluid cylinder 77 is deactuated to lower the folder units 20 and 21 into overlying engagement with the loading platform 10 and the fluid cylinder 140 is actuated to extend the piston rod 144 to move the clamping portion 136 of the clamp arm 27 downwardly into clamping engagement with the folder units 20 and 21 to clamp the garment G in aligned position with the zipper Z (FIG. 9). Just prior to engagement of the clamp portion 136 with the garment and folder units 20 and 21, the roller-like contact 152 of the limit switch 153 will contact the loading platform 10 to cause actuation of the cylinders 109, and thus, retract the piston rods 111 to withdraw the caresser plates outwardly away from one another, and thus, pull the turned under edges F1 and F2 of the garment G into a taut condition, as best seen in FIG. 9.

With the apparatus components in the aforementioned positions, the sewing portion of the operation may be commenced. The main control switch 184 is now placed in the "start" position causing the drive mechanism 8 to be operably connected to the sewing machine 6 and to actuate the fluid cylinder 55. As fluid is supplied to the fluid cylinder 55, the piston rod 58 will be extended at a predetermined rate, as aforesaid, causing the loading platform 10 to be moved rearwardly at a constant speed, and thus, the needle of the sewing machine will stitch along the slot 131 in the Y-direction. As the loading platform 10 moves rearwardly, the garment G will be pulled therewith, as a unit, with the zipper Z while the turned under edges F1 and F2 are held in clamped sliding relation between the respective folder plates 86 and the loading platform 10. The loading platform 10 will continue to travel rearwardly until the contact pin 173 engages the contact element 175, and simultaneously actuate the fluid cylinders 80 and 82. At this time, the needle of the sewing machine will be positioned at the juncture of the slots 131 and 133 and adjacent the lower end of the zipper, as at N2 (FIG. 11).

To enable the sewing machine needle to sew along the slot 133 in the X-direction, such as to the left when viewing FIG. 1, the fluid cylinders 80 and 82 are actuated to cause the piston rods 83 and 84 to be extended. The extending of the piston rods 83 and 84 will cause the fluid cylinders 80 and 82 to move outwardly away from one another, and thus, move the carriages 63 and 64 outwardly away from one another. After the folder units 20 and 21 have been moved to the open position, the fluid cylinder 34 is actuated to retract the piston rod 36. As the piston rod 36 begins to retract, the shifter plate 30, and thus, the loading platform 10, will begin to travel transversely in the return X-direction, such as to the right when viewing FIG. 4. The shifter plate 30 and loading platform 10 will continue to move to the right at a predetermined speed, such as 150 inches per minute, until the track follower 47 engages the contact pin 178 of the limit switch 171. Upon contact of the track follower 47 with the contact pin 178, the fluid supply to the fluid cylinder 34 is cut-off, positioning the needle of the sewing machine at the jun-

ture of the slots 130 and 133 and adjacent the lower end of the tab T2, as at N3 (FIG. 12). At the same time, the fluid supply to the fluid cylinder 55 is turned on in the reverse direction to cause the piston rod 58 to be retracted, and thus, cause the loading platform to begin movement in the return Y-direction. During this movement, stitches will be applied to the garment and zipper along the slot 130.

The loading platform 10 will continue to be retracted until contact pin 181 of the limit switch 172 contacts the contact element 180. At this time, the fluid supply to the fluid cylinder 55 will be shut-off terminating the forward travel of the loading platform 10 with the needle position in aligned relation with the upper end of the slot 130 and adjacent the upper end of the tab T2, as at N4 (FIG. 13). Simultaneously, the fluid cylinders 77 and 140 will be actuated and deactuated, respectively, to raise the clamping portion 136 out of clamping engagement with the garment G. At this time, a suitable time delay, such as 0.5 to 1.5 seconds, to enable the needle to be raised and the thread to be severed. Then, the fluid cylinder 34 is actuated to extend the piston rod 36, and shift the loading platform in the X-direction, such as to the left when viewing FIG. 1, to position the needle of the sewing machine in alignment with the slot 131 to begin the next sewing cycle.

We claim:

1. A method of securing a fastener between opposed fabric edge portions comprising,
 - providing a sewing apparatus having a relatively fixed stitching point,
 - positioning a fastener on said sewing apparatus in one lengthwise direction,
 - folding the opposed fabric edge portions in a direction away from one another to form opposed folds, moving said fabric and fastener as a unit, in one lengthwise direction relative to said stitching point for stitching one of said fabric edge portions to said fastener,
 - moving said fastener, as a unit, in a transverse direction relative to said stitching point,
 - moving said fabric and fastener, as a unit, in a direction opposite to said lengthwise direction and relative to said stitching point for stitching the other edge portion of said fabric to said fastener.
2. A method of securing a fastener between opposed fabric edge portions comprising,
 - providing a sewing apparatus having a relatively fixed stitching point,
 - positioning a fastener on said sewing apparatus in one lengthwise direction,
 - folding the opposed fabric edge portions in a direction away from one another to form opposed folds, applying tension to said fabric adjacent said folds of said edge portions in the direction of folding thereof,
 - moving said fabric and fastener, as a unit, in one lengthwise direction relative to said stitching point for stitching one of said fabric edge portions to said fastener,
 - moving said fabric and fastener, as a unit, in a transverse direction relative to said stitching point, and
 - moving said fabric and fastener, as a unit, in a direction opposite to said lengthwise direction and relative to said stitching point for stitching the other edge portion of said fabric to said fastener.

3. A method of securing a fastener between opposed fabric edge portions comprising,
 providing a sewing apparatus having a relatively fixed stitching point,
 positioning a fastener on said sewing apparatus in one lengthwise direction,
 aligning the opposed fabric edge portions adjacent the lengthwise dimension of said fastener,
 applying tension to the opposed fabric edge portions in a direction away from said fastener,
 clamping said fastener and said opposed fabric edge portions together in said aligned relation,
 moving said fabric and fastener, as a unit, in one lengthwise direction relative to said stitching point for stitching one of said fabric edge portions to said fastener,
 moving said fabric and fastener, as a unit, in a transverse direction relative to said stitching point,
 moving said fabric and fastener, as a unit, in a direction opposite to said lengthwise direction and relative to said stitching point for stitching the other edge portion of said fabric to said fastener.

4. A method of securing a fastener between opposed fabric edge portions comprising,
 providing a sewing apparatus having a relatively fixed stitching point,
 positioning a fastener on said sewing apparatus in one lengthwise direction,
 moving said fabric and fastener, as a unit, in said one lengthwise direction relative to said stitching point for stitching one of said fabric edge portions to said fastener,
 moving said fabric and fastener, as a unit, in a transverse direction to said one lengthwise direction and relative to said stitching point,
 moving said fabric and fastener, as a unit, in a direction opposite to said one lengthwise direction and relative to said stitching point for stitching the other edge portion of said fabric to said fastener, and
 applying tension on said opposed fabric edge portions in a direction away from said fastener while moving said fastener and fabric, as a unit, in at least said one lengthwise direction.

5. A method in accordance with claim 4, including maintaining the lengthwise dimension of said fastener in said one lengthwise direction when moving said fabric and fastener in said transverse direction.

6. A method in accordance with claim 4, including aligning the opposed fabric edge portions adjacent the lengthwise dimension of said fastener.

7. A method in accordance with claim 4, wherein the application of tension includes,
 imparting a frictional drawing action on one of the exposed surfaces of each fold in a direction away from said fastener.

8. A method in accordance with claim 6, including folding the opposed fabric edge portions in a direction away from one another to form opposed folds prior to applying tension thereto.

9. A method in accordance with claim 8, including clamping said fastener and said opposed fabric edge portions together in said aligned relation after folding said opposed fabric portions.

10. A method in accordance with claim 9, wherein the application of tension includes,
 imparting a frictional drawing action on one of the exposed surfaces of each fold in a direction away from said fastener.

11. A method in accordance with claim 10, including maintaining the lengthwise dimension of said fastener in said one lengthwise direction when moving said fabric and fastener in said transverse direction.

12. A method of securing a fastener between opposed fabric edge portions comprising,
 providing a sewing apparatus having a relatively fixed stitching point,
 positioning a fastener on said sewing apparatus in one lengthwise direction,
 turning each of said opposed portions over into folded relation while maintaining the confronting surfaces of each fold out of contact with one another,
 applying tension to said fabric adjacent each of the fold areas in the direction of folding,
 moving said fabric and fastener, as a unit, in one lengthwise direction relative to said stitching point for stitching one of said fabric edge portions to said fasteners,
 moving said fabric and fastener, as a unit, in a transverse direction relative to said stitching point, and
 moving said fabric and fastener, as a unit, in a direction opposite to said lengthwise direction and relative to said stitching point for stitching the other edge portion of said fabric to said fastener.

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