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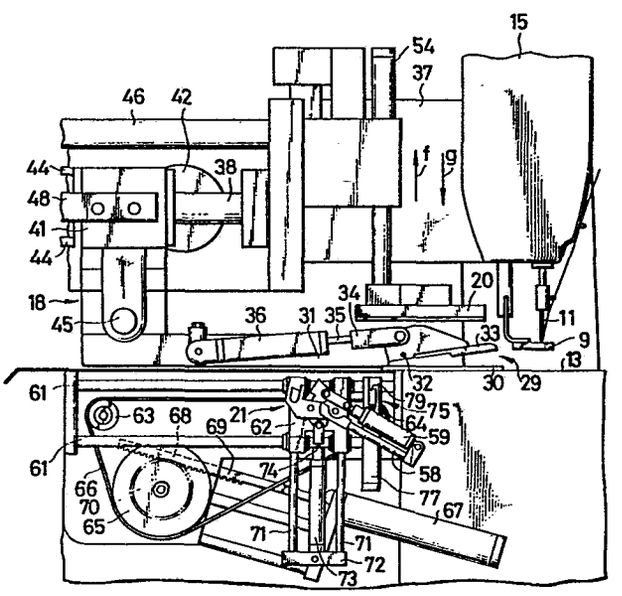
(54) Method and apparatus for sewing a slide fastener to fabric pieces.

(57) An apparatus for sewing a slide fastener (1) to a pair of fabric pieces (7, 7) is provided with a slider-moving unit (21) for coupling a pair of opposed stringers (4, 4) of the slide fastener (1) immediately after the opposed stringers (4, 4) have been sewn to the respective fabric pieces (7,7). The slider-moving unit (21) includes a slider-holding mechanism disposed downstream of a sewing station (14) and reciprocable for pulling a slider (5) on the slide fastener (1) away from the sewing station (14), and a brake (75) disposed adjacent to an upstream end of the reciprocating movement of the slider-holding mechanism for retaining a bottom end of the slide fastener (1) while the slider (5) is being pulled by the slider-holding mechanism.



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METHOD AND APPARATUS FOR SEWING A SLIDE FASTENER TO FABRIC PIECES

The present invention relates to a method of and an apparatus for sewing a slide fastener to a pair of fabric pieces, e.g. of a curtain, a tent or a lady's dress. It relates to the field of copending application for U.S. Patent, Serial No. 535,729 filed September 26, 1983.

As shown in Figures 1 and 2 of the accompanying drawings, a concealed slide fastener 1 comprises a pair of fastener stringers 4, 4, each stringer including a stringer tape 2 having an inner longitudinal edge folded on itself supporting a row of coupling elements 3 attached to the tape edge. The opposed rows of coupling elements 3, 3 are brought into and out of intermeshing engagement by a slider 5 which is slidably mounted on the rows of coupling elements 3, 3. The slider 5 has a slider body disposed on the coupling-element side of the concealed slide fastener 1 and a pull tab pivotally connected to the slider body and projecting therefrom through a seam-like

junction between the folded edges of the opposed stringer tapes 2, 2.

Conventionally, for attaching the concealed slide fastener 1 to a pair of fabric pieces 7, 7 (Figure 3), e.g. of a curtain, a tent or a lady's dress, on a sewing machine, the slider 5 is moved on the rows of coupling elements 3, 3 to a bottom end stop (not shown) to uncouple the opposed stringers 4, 4 except at their bottom end portions. The uncoupled stringers 4, 4 are simultaneously sewn to the respective fabric pieces 7, 7 with sewn stitches 12, 12 along a pair of folding line of the respective stringer tapes 2, 2, as shown in Figure 3. At that time, the folded tape edge of each stringer 4 is unfolded until the coupling elements 3 are erected with their head portions 10 directed downwardly, and the coupling elements 3 and the element-supporting tape edge of each stringer 4 are slidably received in a respective one of a pair of parallel downwardly opening grooves 8, 8 in a presser foot 9 of the sewing machine. A pair of parallel sewing needles 11,11 are reciprocable through a pair of vertical holes in the presser foot 9. Also, during this sewing, the two stringers 4, 4 are superimposed over the respective fabric pieces 7, 7 in such a manner that initially-outer (as seen in Figures 1 and 2) longitudinal edges of the opposed stringer tapes 2, 2 are directed inwardly, i.e. toward each

other.

This sewing operation continues until the sewn stitches 12, 12 reach a position immediately short of the slider 5 disposed adjacent to the bottom end stop (not shown) of the slide fastener 1. As a result, the two stringers 4, 4 have been sewn to the respective fabric pieces 7, 7, leaving the lower end portions of the stringers 4, 4 not sewn and hence floating from the fabric pieces 7, 7.

As shown in Figures 4, 5 and 6, the sewn fabric pieces 7, 7 are folded back on itself about the sewn stitches 12, 12 as the two stringers 4, 4 are progressively coupled together by moving the slider 5 from the bottom end stop (not shown) to a pair of top end stops (not shown) to close the concealed slide fastener 1. At that time, in order for their correct coupling, the two stringers 4, 4 need to assume proper twisted positions that are in mirror symmetry (Figure 5).

Practically, however, because the lower end portion of the sewn slide fastener 1 is not sewn and hence floating from the fabric pieces 7, 7, the opposed stringers 4, 4 would tend to assume an improper twisted position that is not in mirror symmetry (Figure 7), thus causing portions of the fabric pieces 7, 7 to bulge inwardly between the two stringers 4, 4 (Figure 8). The bulged portions of the fabric pieces 7, 7 can

be easily caught by the slider 5 during the coupling of the two stringers 4, 4; in such occurrence, the coupling of the stringers 4, 4 must be restarted after removing the caught fabric pieces 7, 7 from the slider 5, which is laborious and time-consuming, and annoying.

Accordingly, this conventional method causes problems in the case where a plurality of the concealed slide fasteners 1 are successively sewn to successive pairs of the fabric pieces 7, 7 and in which the sewn concealed slide fasteners 1 are temporarily stacked and are then supplied one after another to a finishing station where the opposed stringers 4, 4 of each concealed slide fastener 1 are coupled by moving the slider 5.

The present invention seeks to provide a method and apparatus for sewing a slide fastener to a pair of fabric pieces, in which a pair of opposed fastener stringers with the fabric pieces sewn thereto can be coupled together smoothly and quickly without occurrence of any objectionable inward bulge of the fabric pieces between the opposed stringers.

The present invention further seeks to provide a method and apparatus for sewing a plurality of slide fasteners one after another to successive pairs of fabric pieces, in which a pair of opposed fastener stringers of the individual slide fastener with the fabric pieces sewn thereto can be coupled together

smoothly and quickly without occurrence of any objectionable inward bulge of the fabric pieces between the opposed stringers.

According to a first aspect of the present invention, there is provided a method of sewing a slide fastener to a pair of fabric pieces, the slide fastener including a pair of fastener stringers, each stringer including a stringer tape having an inner longitudinal edge supporting a row of coupling elements attached to the tape edge, there being a slider slidable on and along the fastener stringers for opening and closing the slide fastener, said method comprising the steps of: supplying the pair of fabric pieces to a sewing station defined by a sewing machine; uncoupling the pair of fastener stringers by moving the slider to a bottom end portion of the slide fastener; introducing the uncoupled pair of fastener stringers, as superimposed over the respective fabric pieces, to the sewing station from a top end portion of the slide fastener, while turning the pair of fastener stringers upside down in such a manner that the stringers assume twisted positions in mirror symmetry with respect to the longitudinal centerline of the slide fastener; sewing the pair of fastener stringers to the respecture fabric pieces from the top end portion of the slide fastener in the sewing station; drawing the slide fastener by the top end thereof, with the pair of

fabric pieces sewn thereto, forwardly from the sewing station, as said sewing progresses; terminating said sewing when the bottom end portion of the slide fastener approaches the sewing station; upon termination of said sewing, at least partially coupling the pair of fastener stringers to close the slide fastener by moving the slider from the bottom end portion of the slide fastener into the region where each fastener stringer is sewn to the respective fabric piece; and finally, discharging the closed slide fastener, with the pair of fabric pieces sewn thereto.

According to a second aspect of the present invention, there is provided an apparatus for sewing a slide fastener to a pair fo fabric pieces, the slide fastener including a pair of fastener stringers, each stringer including a stringer tape having an inner longitudinal edge supporting a row of coupling elements attached to the tape edge, there being a slider slidable on and along the pair of fastener stringers for opening and closing the slide fastener, said apparatus comprising: a table; a sewing station defined by a double-needle sewing machine mounted on said table for receiving the slide fastener and the pair of fabric pieces in superimposed relationship; a first guide disposed upstream of said sewing station for guiding the pair of fabric pieces in laterally spaced relation to said sewing station; a second guide

supported on said table and disposed above said first guide for supporting the slide fastener with the pair of fastener stringers uncoupled, and for guiding the uncoupled pair of fastener stringers to said sewing station so as to turn the stringers upside down in such a manner that the stringers assume twisted positions in mirror symmetry with respect to the longitudinal centerline of the slide fastener; a gripper mechanism disposed downstream of said sewing station and reciprocable along a substantially horizontal first path, between an upstream position and a downstream position, for gripping a top end of the slide fastener and for drawing the slide fastener, with the pair of fabric pieces sewn thereto, from said sewing station; and a slider-moving unit disposed downstream of said sewing station and reciprocable, along a second path parallel to said first path, for moving the slider on the pair of fastener stringers from the bottom end portion of the slide fastener into the region where each fastener stringer is sewn to the respective fabric piece, said slider-moving unit being retractable from said second path so as not to obstruct the movement of said fabric pieces along said first path.

Other objects, features and additional advantages of the present invention will become manifest to those versed in the art upon making reference to the detailed description and the

accompanying drawings in which two preferred embodiments incorporating the principles of the present invention are shown by way of illustrative example.

Figure 1 is a fragmentary perspective view of a concealed slide fastener;

Figure 2 is a transverse cross-sectional view taken along line II-II of Figure 1;

Figure 3 is a transverse cross-sectional view of a pair of uncoupled and unfolded fastener stringers, illustrating the manner in which the two stringers are sewn to a pair of fabric pieces, respectively, on a sewing machine;

Figure 4 is a transverse cross-sectional view of the opposed stringers sewn to the respective fabric pieces and coupled together by a slider;

Figure 5 is a fragmentary perspective view of the concealed slide fastener sewn to the fabric pieces, with the opposed stringers uncoupled;

Figure 6 is a fragmentary perspective view of the sewn slide fastener closed by the slider;

Figures 7 and 8 are views similar to Figures 5 and 6, respectively, illustrating the prior problem;

Figure 9 is a fragmentary perspective view of a sewing apparatus embodying the present invention;

Figure 10 is a perspective view, with parts omitted, of the apparatus;

Figure 11 is a side elevational view, with parts

omitted, of the apparatus, showing a slider-moving unit in detail;

Figure 12 is a fragmentary side elevational view, on a reduced scale, of Figure 11;

Figure 13 is a view similar to Figure 12, illustrating the operations of a gripping mechanism and a stacker;

Figure 14 is an enlarged perspective view, with parts omitted, of the slider-moving unit;

Figures 15 to 17 are side elevational views of Figure 14, illustrating the operation of the slider-moving unit;

Figures 18A and 18B are cross-sectional views illustrating the operation of a brake;

Figure 19A to 19F are plan views of the concealed slide fastener, each illustrating a respective one of successive steps of the present sewing method;

Figures 20A to 20G are side elevational views corresponding to Figures 19A to 19F, illustrating a sequence of steps of operation of the apparatus;

Figure 21 is a fragmentary plan view of the concealed slide fastener sewn to the fabric pieces, with the opposed stringers uncoupled;

Figure 22 is an enlarged perspective view of Figure 21;

Figure 23 is a fragmentary plan view of the

concealed slide fastener of Figure 21, showing the slide fastener fully closed;

Figures 24A - 24D are plan views of a non-concealed, or exposed, slide fastener inllustrating successive steps of the present sewing method;

Figure 25 is a cross-sectional view taken along line XXV - XXV of Figure24;

Figure 26 is a view similar to Figure 11, showing a modified slider-moving unit;

Figure 27 is an enlarged plan view of the modified slider-moving unit;

Figure 28 is an enlarged perspective view, with parts broken away, of the modified slider-moving unit;

Figures 29A to 29C are side elevational view with parts broken away, illustrating the operation of the modified slider-moving unit;

Figures 30A to 30C are cross-sectional view similar to Figures 18A and 18B, illustrating the operation of a modified brake; and

Figures 31A to 31E are side elevational views similar to Figures 20A to 20G, illustrating the sequence of steps of operation of the apparatus with the modified slider-moving unit.

Figures 9 through 13 show an apparatus for sewing a concealed slide fastener 1 to a pair of fabric pieces 7, 7.

As shown in Figure 9, the apparatus generally

comprises a table 13, a sewing machine 15 mounted centrally on the table 13 and defining a sewing station 14, a fabric guide 16 supported on the table 13 upstream of the sewing station 14, a slide-fastener guide 17 supported on the table 13 and disposed above the fabric guide 16, a gripper mechanism 18 mounted on the table downstream of the sewing station 14 for horizontal linear movement, a stacker 19 disposed beneath the gripper mechanism 18, a sewn-product guide 20 disposed downstream of the sewing station 14 for vertical movement, and a slider-moving unit 21 (Figures 10 and 11) disposed beneath the sewn-product guide 20 for horizontal linear movement.

The sewing machine 15 may be a conventional type on the market. It includes a presser foot 9, a pair of feed dog (not shown), and a pair of sewing needles 11, 11. As shown in Figure 3, the presser foot 9 has in its bottom surface a pair of parallel grooves 8, 8, each receptive of an inner longitudinal edge of the respective stringer tape 2 together with a row of coupling elements 3 attached thereto. Upon depression of a start button (not shown), the presser foot 9 is lowered and then the sewing of the concealed slide fastener 1 and the fabric pieces 7, 7 in "lock stitch" takes place. This lock-stitch sewing is followed by back-tacking, cutting the sewing threads and raising of the presser foot 9 in this order. The details of the

sewing machine 15 itself are not pertinent here and its detailed description is omitted for clarity.

As better shown in Figures 9 and 10, the fabric guide 16 includes a pair of transparent horizontal guide plates 22, 22 spaced from the upper surface of the table 13 by a gap substantially equal to the thickness of the individual fabric piece 7, and a pair of guide rods 23, 23 mounted on the front or upstream side of the table 13. The pair of convergent guide rods 23, 23 lie in a horizontal plane substantially coplanar to the upper surface of the table 13. As the pair of fabric pieces 7, 7 are supplied to the sewing station 14, each fabric piece 7 is supported on the respective guide rod 23 and is then introduced into the gap between the corresponding guide plate 22 and the table 13.

As shown in Figures 9, 10, 12 and 13, the slide-fastener guide 17 includes an elongated flanged guiding plate 24 sloping downwardly toward the sewing station 14 and an elongated flanged auxiliary guiding plate 28 disposed upstream of the guiding plate 24 and sloping upwardly toward the guiding plate 24, for guiding the uncoupled stringers 4, 4 over the two guiding plates 24, 28.

As shown in Figure 10, the slide-fastener guide 17 also includes a pair of spaced track bodies 25, 25 mounted on the guiding plate 24 at one end thereof

adjacent to the sewing station 14 for guiding the respective coupling element rows 3, 3 in such a manner that each coupling element row 3 assumes an erected position. A slider detector 26 is mounted on the guiding plate 24 and is pivotable vertically between the two track bodies 25, 25 when the slider 5 on the concealed slide fastener 1 passes through the space between the two track bodies 25, 25. The detector 26 is associated with a microswitch 27 which is operative, in response to the pivotal movement of the detector 26, to terminate the advance of the slide fastener 1.

The purposes of the gripper mechanism 18 are to keep the tension of both the slide fastener 1 and the fabric pieces 7, 7 to a constant degree during the sewing, thus not only causing a uniform rate of sewing but making the sewn stitches 12, 12 aligned with the respective folding lines of the opposed stringers 4, 4. The gripper mechanism 18 also serves to quickly discharge the sewn product, i.e. the slide fastener 1 with the fabric pieces sewn thereto.

As shown in Figures 9, 11, 12 and 13, the gripper mechanism 18 includes a pair of laterally spaced grippers 29, 29, each gripper 29 being composed of an upper grip member 33 and a lower grip member 30. The lower grip member 30 is secured to a horizontal connector 31 in the form of a rod and is disposed slightly above the upper surface of the table 13. The

upper grip member 33 is pivotally connected to the connector 31 near the downstream end of the lower grip member 30 by a pin 32. The upper grip member 33 is also connected to an air cylinder 36 via a link 34 which is connected to a piston rod 35 of the air cylinder 36. Such two air cylinders 36,36 are pivotally mounted on the connector 31 remotely from the grippers 29, 29. Upon energization or de-energization of the two air cylinders 36, 36, each piston rod 35 projects or is retracted to close or open the respective gripper 29.

Fixed to the downstream side of the sewing machine 15 is a holder 37 from which a guide rail 38 extends horizontally in the direction of discharging the sewn product. A free end of the guide rail 38 is fixed to a bracket 40 supported by a hanger rod 39. A slide 41 is slidably mounted on the guide rail 38. As better shown in Figures 12 and 13, an endless belt 44 is wound about a pair of pulleys 42, 43 rotatably mounted on the holder 37 and the bracket 40, respectively, the endless belt 44 being fixed to the slide 41. The pulley 42 is connected to a servo motor (not shown) which drives the slide 41 selectively forwardly (downstream) and backwardly (upstream) and which changes the rate of movement of the slide 41 depending on the load. The downstream end of the connector 31 of the gripper mechanism 18 is integrally

connected to a transverse shaft 45 rotatably supported by the slide 41.

The backward or upstream movement of the slide 41 is limited by a stop (not shown) projecting therefrom and engageable with the holder 37; thus the backward movement of the two grippers 29, 29 terminates in a retracted position close to the sewing station 14. The forward or downstream movement of the slide 41 is limited by a contact member 48 extending therefrom and engageable with an actuator of a microswitch 47 which is adjustably mounted on a support rod 46 extending between the holder 37 and the bracket 40 in parallel relationship to the guide rail 38.

Upon its actuation, the microswitch 47 produces a signal to stop the rotation of the non-illustrated servo motor, thus terminating the forward movement of the slide 41. As a result, the forward movement of the two grippers 29, 29 terminates in an advanced position, which is adjustable by changing the position of the microswitch 48 on the support rod 46.

The transverse shaft 46 is operatively connected to a drive, such as a motor or an air cylinder, for turning the transverse shaft 46 through a predetermined angle. In response to clockwise (Figures 12, and 13) turning of the transverse shaft 46, the connector 31 of the gripper mechanism 18 is angularly movable about the transverse shaft 46 in the direction of an arrow b from

the position (horizontal) of Figure 12 to the position (vertical in this embodiment) of Figure 13. This arrangement is particularly useful when a relatively long sewn product 49 is to be discharged without elongating the guide rail 38.

As shown in Figures 9, 10, 12 and 13, the stacker 19 is disposed beneath the gripper mechanism 18 for receiving the successive sewn products 49 (released from the gripping mechanism 18 as described below) one over another and for discharging a stack of the sewn products 49 out of the apparatus when the stack reaches a predetermined amount.

The stacker 19 includes a generally T-shaped hanger having a horizontal pipe 50 connected to an upper end of an arm 51 pivotally mounted on a base beneath the table 13. An air cylinder 52 is pivotally supported by the base, and a piston rod 53 of the air cylinder 52 is pivotally connected to the arm 51 at a midportion thereof. In timed relation to the forward movement of the two grippers 29, 29, the piston rod 53 of the air cylinder 52 projects to cause the stacker 19 to pivotally move in the direction of an arrow d in Figure 13 from a retracted position (solid lines) to an advanced position (dash-and-dot lines) where the sewn product 49 released from the grippers 29, 29 is received on the transverse pipe 50. Thereafter, when the piston rod 53 of the air cylinder 52 is retracted,

the stacker 19 is returned in the direction of an arrow e in Figure 13 to its original or retracted position, with the sewn product 49 hanging on the transverse pipe 50.

As shown in Figures 10 and 11, the sewn-product guide 20 is disposed downstream of the sewn station 14 and is vertically movable in the directions of arrows f and g by means of an air cylinder 54 supported by the holder 37. The sewn-product guide 20, as shown in Figures 18A and 18B, has a downwardly opening guide channel 55. When the sewn product 49 is pulled forwardly by the gripper mechanism 18, the sewn-product guide 20 is lowered from the dash-and-dot-line position to the solid-line position in Figure 18A and the slide 5 (disposed at the lower end portion of the sewn product 49) is guided along the guide channel 55 of the guide to the slider-moving unit 21. While the slide fastener 1 is being sewn to the pair of fabric pieces 7, 7, the guide 20 is in raised position, as shown in Figure 10, so as not to obstruct the movement of the gripper mechanism 18.

The slider-moving unit 21, as shown in Figures 10 and 11, is disposed immediately downstream of the sewn-product guide 20 for linear movement to move the slider 5 from the bottom end stop (not shown) of the sewn slide fastener 1 toward the top end stops (not shown) to couple the opposed stringers 4, 4 through a

predetermined length. As a result, the slider 5 has been moved to the region where the slide fastener 1 is sewn to the fabric pieces 7, 7.

The thus partly closed product 49 is discharged out of the apparatus, and then the slider 5 can be moved all the way to the top end stops of the slide fastener 1 smoothly to provide a fully closed concealed slide fastener 1 sewn to a pair of fabric pieces 7, 7.

As better shown in Figures 14 to 17, the slider-moving unit 21 includes a slider catch 56 of a generally C-shape opening backwardly for receiving the slider 5, and a retainer 57 pivotally mounted on a lower portion of the catch 56 for retaining the slider 5 in the catch 56. The catch 56 has a support rod 58 extending substantially downwardly (Figures 14, 16, and 17) from the lower portion of the catch 56 at an angle thereto and terminating in an block on which an air cylinder 59 is pivotally mounted, a piston rod 60 of the air cylinder 59 being pivotally connected to the retainer 57. As the piston rod 60 of the air cylinder 59 projects (Figure 17), the retainer 57 is pivotally moved counterclockwise from the position of Figure 16 to the position of Figure 17 to push the slider body 5 against the catch 56, thus preventing the slider body 5 from being removed from the catch 56. On the contrary, as the piston rod 60 of the air cylinder 59 is retracted (Figure 16), the retainer 57 is pivotally

moved clockwise from the position of Figure 17 to the position of Figure 16 so that the slider 5 can be removed from the catch 56.

As shown in Figure 11, a slide 62 is slidably mounted on a pair of parallel horizontal guide rails 61, 61 which is supported by the base (of the apparatus) beneath the table 13. An endless belt 66 is wound around a pair of small-sized upper pulleys 63, 64 and a large-sized lower pulley 65 (all of the pulleys is rotatable on the base) and is fixed to the slide 62. The two small-sized pulleys 63, 64 are disposed between the two guide rails 61, 61 and are spaced away from each other along the guide rails 61, while the large-sized pulley 65 is disposed below the guide rails 61.

The large-sized pulley 65 has a coaxial pinion 70 meshing with a rack 68 formed on a piston rod 69 of an air cylinder 67 which is pivotally supported by the base. As the pinion 70 and thus the large-sized pulley 65 is rotated counterclockwise in response to extension of the racked piston rod 69 of the air cylinder 67, the slider 62 is moved forwardly leftwardly away from the sewing station 14 along the guide rails 61, 61. Reversely, as the large-sized pulley 65 is rotated clockwise in response to shrinking of the racked piston rod 69 of the air cylinder 67, the slider 62 is then moved backwardly, i.e. rightwardly toward the sewing

station 14 along the guide rails 61, 61.

The slider catch 56 is pivotally mounted on the slide 62 and is reciprocable, in response to the reciprocating movement of the slide 62, for pulling the slider 5 forwardly along the opposed stringers 4, 4 to close the sewn slide fastener 1 while the opposite end portions of the slide fastener 1 is held in position in a manner described below.

The slide 62 has a pair of parallel support rods 71, 71 extending downwardly from a lower end portion of the slide 62 and interconnected at their lower ends by a horizontal connector 72. An air cylinder 73 is pivotally supported centrally on the horizontal connector 72, and a piston rod 74 of the air cylinder 73 is pivotally connected to the slider catch 56. As the piston rod 74 of the air cylinder 73 is retracted (Figure 15), the catch 56 is pivotally moved counterclockwise from the position of Figure 16 to the position of Figure 15 below the table 13 so as not to impede not only the movement of the gripper mechanism 18 but the discharging of the sewn product 49. Reversely, as the piston rod 74 of the air cylinder 73 is extended, the catch 56 is pivotally moved clockwise from the position of Figure 15 to the position of Figures 16 and 17 to project above the upper surface of the table 13. The slider 5 is received in the catch 56 (Figure 16) and is then retained therein by the

retainer 57 (Figure 17), whereupon the forward or downstream movement of the catch 56 is started.

As shown in Figure 11, the brake 75 is supported on the pair of guide rails 61, 61 at a fixed position adjacent to their upstream ends for temporarily stop the forward movement of the sewn product 49 to thereby facilitate the forward movement of the slider 5 on the sewn slide fastener 1 by the slider-moving unit 21.

As better shown in Figures 18A and 18B, the brake 75 includes a bracket 76 fixed to the guide rails 61, 61, an air cylinder 77 supported by the bracket 76, and a pressing member 79, in the form of a thin plate (Figures 20A to 20G), to which a piston rod 78 of the air cylinder 77 is connected. As the piston rod 78 of the air cylinder 77 is extended, the pressing member 79 is raised in the direction of an arrow h from the position of Figure 18A and 18B for pressing the bottom end portion of the sewn product 49 against the lower surface of the product guide 20. To the contrary, as the piston rod 78 of the air cylinder 77 is retracted, the pressing member 79 is returned to its original or lowered position (Figure 18A) for releasing the sewn product 49.

The manner in which a concealed slide fastener 1 is sewn to a pair of fabric pieces 7, 7 on the apparatus of Figures 9 - 17 and 18A - 18B will be described hereinbelow in connection with Figures 19A -

19F and 20A - 20G.

As shown in Figure 19A, before the start of sewing work, a pair of fabric pieces 7, 7 is introduced into the sewing station 14 (only the two sewing needles 11, 11 are illustrated in Figures 19A - 19F), while a concealed slide fastener 1 is fully opened by moving the slider 5 and then the uncoupled stringers 4, 4 are turned upside down through the entire length of the slide fastener 1 except the bottom end portion thereof. Thus the two turned stringers 4, 4 assume twisted positions in mirror symmetry. The concealed slide fastener 1 is introduced into the sewing station 14, with the opposed stringers 4, 4 superimposed over the respective fabric pieces 7, 7.

More specifically, in introducing the fabric pieces 7, 7 into the sewing station 14, each fabric piece 7 passes over the respective guide rod 23 and then through the gap between the corresponding guide plate 22 and the upper surface of the table 13, as shown in Figure 9. On the other hand, the concealed slide fastener 1 is opened manually and is then placed over the guide plate 24 while turning the uncoupled stringers 4, 4 upside down, as shown in Figure 9. Then the leading end portion of each stringer 4 is introduced into the sewing station 14 via the respective track body 25. In the sewing station 14, the leading end portion of each stringer 4 is

superimposed over the respective fabric piece 7 in such a manner that the coupling elements 8 are erected with the head portions 10 directed downwardly. At that time, as shown in Figure 11, the gripper mechanism 18 is diposed at a position near the presser foot 9 in the sewing station 14, with each gripper 29 open. And the sewn-product guide 20 is in raised position so as not to interfere with the gripper mechanism 18, as shown in Figure 11. The slide-moving unit 21 is in retracted position near the sewing station 14, the slider catch 56 being retracted below the table 13. The brake 75 is also lowered or retracted below the table 13.

When a start button (not shown) is depressed, the presser foot 9 and the sewing needles 11, 11 are lowered to start sewing work. As the sewing work progresses, both the leading end portion of each fabric piece 7 and the leading end portion of the corresponding stringer 4 are advanced between the upper and lower grip members 33, 30 of the respective gripper 29, as shown in Figure 9B. The arrival of the leading ends of the fabric pieces 7, 7 and the stringers 4, 4 is detected by a photosensor (not shown) disposed at a suitable position in the sewing station 14. The photosensor is responsive to this arrival to issue a command signal to the air cylinder 36, whereupon the piston rod 35 is extended to cause each gripper 29 to grip the superimposed end portions of the respective

fabric piece 7 and the corresponding stringer 4, as shown in Figure 20A. The grippers 29 pull the sewn product 49 forwardly to discharge the same from the sewing station 14 under a constant tension smaller than the tension under which the sewn product 49 is advanced by the feed dog (not shown) of the sewing machine 15. This discharging tension is virtually automatically controlled by the non-illustrated servo motor that is the drive source for moving the slider 41 of the gripper mechanism 18.

When the grippers 29, 29, as the sewing work further progresses, are removed from the region where both the sewn-product guide 20 and the slider-moving unit 21 are disposed, the sewn-product guide 20 is lowered and the slider catch 56 of the slider-moving unit 21 projects above the upper surface of the table 13, as shown in Figures 20B and 20C.

Subsequently, when the slider 5 disposed at the bottom end portion of the slide fastener 1 arrives at the slider detector 26, the detector 26 is pivotally moved upwardly to actuate the microswitch 27 associated therewith, whereupon the microswitch 27 issues a command signal to the sewing machine 15 to start back-tacking . The sewing threads are cut and the presser foot 9 is then raised to terminate the operation of the sewing machine 15. As shown in Figure 9C, the sewn stitches 12 extend from the leading end of

the slide fastener 1 and terminates immediately short of the slider 5 disposed at the bottom end portion of the slide fastener 1, thus leaving the bottom end portions of the opposed stringers 4, 4 not sewn and hence floating from the fabric pieces 7, 7.

After the sewing operation of the sewing machine 1 is stopped, the gripper mechanism 18 is continued to discharge the sewn product 49 that has been removed from the sewing station 14.

With continued discharging of the sewn product 49 by the gripper mechanism 18, the bottom end portion of the sewn slide fastener 1, including the slider 5, is introduced into the sewn-product guide 20. Then the slider 5 of the sewn slide fastener 1 is blocked or caught by the slider catch 56 of the slider-moving unit 21, as shown in Figure 20D. This blocking is detected by a photosensor (not shown) which then issues a command signal to energize the air cylinder 59, (Figures 16 and 17), causing the retainer 57 to pivot to keep the slider body 5 in the catch 56.

Upon receipt of the slider 5 in the catch 56, the forward movement of the gripper mechanism 18 is stopped and the operation of the brake 75 is started. Thus the leading end of the sewn product 49 is held in position by the grippers 29, 29, and the trailing end of the sewn-product 49 is held in position by the brake 21, giving the concealed slide fastener 1 a constant

tension.

While the sewn product is 49 thus kept from moving, as shown in Figures 19E and 20E, the slider-moving unit 21 is moved forwardly by the action of the air cylinder 67 (Figure 11) to pull the slider 5 along the uncoupled stringers 4, 4 to partly close the sewn slide fastener 1. This pulling is continued until the slider 5 is moved into the region where each stringer 4 and the corresponding fabric piece 7 are sewn. Then, as shown in Figure 20F, the retainer 57 is returned to its original or retracted position to release the slider 5 and the slider catch 56 is retracted below the table 13, during which time the brake 75 is continued to be operative.

Thereafter, as shown in Figures 19F and 20G, the brake 75 is rendered inoperative to release the trailing end of the sewn product 49, while the gripper mechanism 18 is continued to discharge the sewn product 49. More specifically, in discharging the sewn product 49, when the contact member 48 on the slide 41 of the gripper mechanism 18 hits the actuator of the microswitch 47, a command signal is issued from the switch 47 to stop the non-illustrated servo motor which is a drive for the endless belt 44. The discharging of the sewn product 49 of the gripper mechanism 18 is terminated. Then the connector 31 is pivotally moved on the slide 41 to direct downwardly, during which time

the stacker 19 is pivotally moved, by the action of the air cylinder 52, forwardly of the base beneath the table 13, as shown in Figure 13. The grippers 29 at the end portion of the connector 31 are opened to release the sewn product 49, which thus falls onto the transverse pipe 50 of the stacker 19. The stacker 19 and the gripper mechanism 18 are returned to their original or upstream positions. The slider-moving unit 21 is also returned to its original or upstream position near the sewing station 14, during which time the slide-moving unit 21 remains retracted below the table 13. And the product guide 20 is returned to it raised position. Now the apparatus is in condition for start of the next cycle of the sewing operation, and a single cycle has been completed.

Figures 21 and 22 show the sewn product including the concealed slide fastener 1 sewn to the pair of fabric pieces 7, 7 according to the present invention. In this sewn product, the opposed coupling element rows 8, 8 can be coupled smoothly and quickly by manually moving the slider 5 toward the top end stops (not shown), as shown in Figure 23, during which time the opposed stringers 4, 4 are progressively turned back in mirror symmetry.

In the sewn product obtained by the present method, since the slider is disposed into the region where each concealed fastener stringer and the

corresponding fabric piece are sewn, smooth and quick coupling of the opposed stringers can be achieved simply by manually pulling the slider. Accordingly, the present method is particularly useful for the case in which a plurality of concealed slide fasteners are sewn to successive pairs of the fabric pieces and in which the sewn products are temporarily stacked and then supplied one after another to a finishing station where the opposed fastener stringers of each concealed slide fastener are coupled by manually moving the slider.

With the apparatus constructed according to the present invention, partly because the slider-moving unit is retractable below the upper surface of the table so as not to interfere with the gripper mechanism, it is possible to sew a plurality of concealed slide fasteners successively to successive pairs of fabric pieces without impeding the sewing and discharging operations, causing an improved rate of production.

The apparatus of the invention is especially useful in the sewing of concealed slide fasteners, as described above. However, it is clear that exposed slide fasteners may as well be sewn with the apparatus of the invention. Such assembly is illustrated in Figures 24A - 24E. As there shown, tapes 2',2' of stringers 4',4' are aligned for sewing along stich

lines 12',12' located further from the coupling element rows 3',3', then in the concealed slide fasteners embodiment of Figures 19A - 19F. An exposed type fastener is employed, so that coupling element rows 3' face downwardly, toward the fabric 7',7' in the initial setup shown in Figure 24A. As a result, when the sewing is completed the fabric 7',7' does not meet, leaving the coupling element rows and tapes exposed as shown in Figures 24D and 24E. The apparatus and method are in other respects the same, providing a substantially improved, more rapid system for fastener sewing and assembly.

Figures 26 - 28 illustrate a modified slider-moving unit 21' having an alternative slider holding mechanism.

As better shown in Figures 27, 28 and 29A - 29C, the slider-holding mechanism includes a slider catch 56' for receiving the slider 5, and a retainer 57' for retaining the slider 5 in the catch 56'. The slider catch 56' is mounted on a piston rod 74' of a first vertical air cylinder 37' fixedly secured to a lower portion of a slide 62', while the retainer 57' is mounted on a piston rod 60' of a second vertical air cylinder 59' fixedly secured to a lower portion of the catch 56'. The slide 62' is slidably mounted on a pair of vertically spaced horizontal guide rails 61',61' which is supported by the base (of the apparatus)

beneath the table 13.

As the piston rod 74' of the first cylinder 73' is extended, the catch 56' is moved upwardly on the slide 62' from the position of Figure 29A to the position of Figure 29B to receive the slider 5. At that time the second air cylinder 59', with its piston rod 60' and hence the retainer 57' retracted, is moved upwardly along with the catch 56'. Then as the piston rod 60' of the second air cylinder 59' is extended, the retainer 57' is raised from the position of Figure 29B to the position of Figure 29C to press the slider 5 against the catch 56', thus preventing the slider 5 from being removed from the catch 56'.

As shown in Figure 26, an endless belt 66' is wound around a pair of small-sized upper pulleys 63', 64' and a large-sized lower pulley 65' and is fixedly secured to the slide 62', all the pulleys 63', 64', 65' being rotatable on the base of the apparatus. The two small-sized pulleys 63', 64' are disposed between the two guide rails 61', 61' and are spaced away from each other along the guide rails 61', 61', while the large-sized pulley 65' is disposed below the guide rails 61',61'.

The large-sized pulley 65' is operatively connected to a drive 76', such as a rotary actuator, for rotation in opposite directions. As the large-sized pulley 65' is driven by the drive 25 for

counterclockwise rotation, the slide 62' is moved forwardly (leftwardly) away from the sewing station 14 along the guide rails 61',61'. Reversely, as the large-sized pulley 65' is rotated clockwise, the slide 62' is then moved backwardly (rightwardly) toward the sewing station 14 along the guide rails 61',61'.

The slider catch 56', along with the retainer 57', is reciprocable, in response to the reciprocating movement of the slide 62', for pulling the slider 5 forwardly along the opposed stringers 4, 4 to close the slide fastener 1 of the sewn product 49 while the opposite ends of the slide fastener 1 is held in position in a manner described below

As the piston rod 74' of the first air cylinder 73' is retracted, the catch 56' is moved downwardly from the position of Figure 29C to the position of Figure 29A below the table 13 so as not to impede not only the movement of gripper mechanism 18 but the discharging of the sewn product 49. Reversely, as the piston rod 74' of the first air cylinder 73' is extended, the catch 56' is moved upwardly from the position of Figure 29A to the position of Figure 29B to project above the top surface of the table 13. The slider 5 is received in the catch 56' and is then retained therein by the retainer 57' (Figure 29C), whereupon the forward (leftward) movement of the catch 56' is started.

As shown in Figures 26 - 28, the slider-moving unit 21' also includes a brake 75' supported on the guide rails 61',61' at a fixed position adjacent to their upstream ends to temporarily stop the forward movement of the sewn product 49 to thereby facilitate the forward movement of the slider 5 on the slide fastener 1 by the slider-holding mechanism, namely, the catch 56' and the retainer 57'.

As shown in Figures 26 - 28 and 30A - 30C, the brake 75' includes a bracket 76' fixed to the guide rails 61', 61', a third vertical air cylinder 77' supported by the bracket 76', and a pressing member 79' mounted on a piston rod 78' of the third air cylinder 77'. As the piston rod 78' of the third air cylinder 77' is extended, the pressing member 79' is raised in the direction of an arrow h' from the position of Figures 30A and 30B to the position of Figure 30C for pressing the bottom end portion of the slide fastener 1 against the lower surface of the sewn-product guide 20'. Reversely, as the piston rod 78' of the third air cylinder 77' is retracted, the pressing member 79' is returned to its original or lowered position (Figure 30A) for releasing the sewn product 49.

The manner in which an ordinary slide fastener 1 is sewn to a pair of fabric pieces 7,7 on the apparatus of Figures 9 - 13, 26 - 28, 29A - 29C and 30A - 30C will be described hereinbelow in connection with

Figures 31A - 31E.

Before starting the sewing work, a pair of fabric pieces 7,7 is introduced into the sewing station 14, and a slide fastener 1 is fully opened by moving the slider 5 and then the uncoupled stringers 4,4 are turned upside down through the entire length of the slide fastener 1 except the bottom end portion thereof. Thus the two turned stringers 4,4 assume twisted positions in mirror symmetry. The slide fastener 1 is introduced into the sewing station 14, with the opposed stringers 4,4 superimposed over the respective fabric pieces 7,7.

More specifically, in introducing the fabric pieces 7,7 into the sewing station 14, each fabric piece 7 passes over the respective guide rod 23 and then through the gap between the corresponding guide plate 22 and the upper surface of the table 13. On the other hand, the slide fastener 1 is opened manually and is then placed over the guide plate 24 while turning the uncoupled stringers 4,4 upside down. Then the leading end portion of each stringer 4 is introduced into the sewing station 14 via the respective track body 25. In the sewing station 14, the leading end portion of each stringer 4 is superimposed over the respective fabric piece 7 in such a manner that the coupling elements 3 are erected with the head portions 10 directed downwardly. At that time, as shown in

Figure 26, the gripper mechanism 18 is disposed at a position near the presser foot 9 in the sewing station 14, with each gripper 29 open. The sewn-product guide 20' is in raised position so as not to interfere with the gripper mechanism 18, as shown in Figure 26. The slide-moving unit 21' is in retracted position near the sewing station 14, the slider catch 56' being retracted below the table 13.

When a start button (not shown) is depressed, the presser foot 9 and the sewing needles 11,11 are lowered to start sewing work. As the sewing work progresses, both the leading end portion of each fabric piece 7 and the leading end portion of the corresponding stringer 4 are advanced between the upper and lower grip members 33, 30 of the respective gripper 29. The arrival of the leading ends of the fabric pieces 7,7 and the stringers 4,4 is detected by a photosensor (not shown) disposed at a suitable position in the sewing station 14. The photosensor is responsive to this arrival to issue a command signal to the air cylinder 36, whereupon the piston rod 35 is extended to cause each gripper 29 to grip the superimposed end portions of the respective fabric piece 7 and the corresponding stringer 4, as shown in Figure 31A. The grippers 29 pull the sewn product 49 forwardly to discharge the same from the sewing station 14 under a constant tension smaller than the tension

under which the sewn product 49 is advanced by the feed dog (not shown) of the sewing machine 15. This discharging tension is automatically controlled by the non-illustrated servo motor that is the drive source for moving the slide 41 of the gripper mechanism 18.

When the grippers 29,29, as the sewing work further progresses, are removed from the region where both the sewn-product guide 20' and the slider-moving unit 21' are located, the sewn-product guide 20' is lowered and the slider catch 56' of the slider-moving unit 21' projects above the upper surface of the table 13, as shown in Figure 31B.

Subsequently, when the slider 5 disposed at the bottom end portion of the slide fastener 1 arrives at a non-illustrated slider detector mounted on the forward end of the slide fastener guide 17, the detector is pivotally moved upwardly to actuate a microswitch (not shown) associated therewith, whereupon the microswitch issues a command signal to the sewing machine 15 to start back-tacking. The sewing threads are cut and the presser foot 9 is then raised to terminate the operation of the sewing machine 15. As shown in Figures 19C and 19D, the sewn stitches 12 extend from the leading end of the slide fastener 1 and terminate just short of the slider 5 disposed at the bottom end portion of the slide fastener 1, thus leaving the bottom end portions of the opposed stringers 4,4 not

sewn, and hence floating, from the fabric pieces 7,7.

After the sewing operation of the sewing machine 1 is stopped, the gripper mechanism 18 continues to discharge the sewn product 49 that has been removed from the sewing station 14.

With continued discharging of the sewn product 49 by the gripper mechanism 18, the bottom end portion of the sewn slide fastener 1, including the slider 5, is introduced into the sewn-product gide 20'. Then the slider 5 of the sewn slide fastener 1 is blocked or caught by the slider catch 56' of the slider-moving unit 21', as shown in Figure 8C. This blocking is detected by a photosensor (not shown) which then issues a command signal to energize the second air cylinder 59' (Figures 29B and 29C), causing the retainer 57' to raise to hold the slider body 5 against the catch 56'.

Upon receipt of the slider 5 in the catch 56', the forward movement of the gripper mechanism 18 is stopped and the operation of the brake 75' is started. Thus the leading end of the sewn product 49 is held in position by the grippers 29,29 and the bottom end portion of the slide fastener 1 is held in position by the brake 75' (Figure 30C), giving the slide fastener 1 a constant tension.

While the sewn product 49 is thus kept from moving, as shown in Figure 31D, the slider-moving unit 21' is moved fowardly by the action of the drive 67',

(Figure 26) to pull the slider 5 along the uncoupled stringers 4,4 to partially close the sewn slide fastener 1. This pulling continues until the slider 5 is moved into the region where each stringer 4 and the corresponding fabric piece 7 are sewn together. Then the retainer 57' is returned to its original or retracted position (phantom lines in Figure 31D) to release the slider 5 and the slider catch 56' is retracted below the table 13 (Figure 31E), during which time the brake 75' continues to be operative.

Thereafter, as shown in Figure 31E, the brake 75' is rendered inoperative to release the trailing end of the sewn product 49, while the gripper mechanism 18 continues to discharge the sewn product 49. More specifically, in discharging the sewn product 49, when the contact member 48 on the slide 41 of the gripper mechanism 18 hits the actuator of the microswitch 47, a command signal is issued from the switch 47 to stop the servo motor driving the endless belt 44. The discharging of the sewn product 49 of the gripper mechanism 18 is terminated. Then the connector 31 is pivotally moved on the slide 41 to direct downwardly, during which time the stacker 19 is privotally moved, by the action of the air cylinder 52, forwardly of the base beneath the table 13, as shown in Figure 13. The grippers 29 at the end portion of the connector 31 are opened to release the sewn product 49, which thus falls

onto the transverse pipe 50 of the stacker 19. The stacker 19 and the gripper mechanism 18 are returned to their original or upstream positions. The slider-moving unit 21' is also returned to its original or upstream position near the stations 14, during which time the slider-moving unit 21' remains retracted below the table 13. The product guide 20' is returned to its raised position. Thus a single cycle of the sewing operation has been completed and now the apparatus is in conditions for start of the next cycle of the sewing operation.

Since the slider-moving unit 21' is retractable below the top surface of the table 13 so as not to interfere with the gripper mechanism 18, it is possible to sew a plurality of slide fasteners 1 successively to successive pairs of fabric pieces 7,7 without impeding the sewing and discharging operations.

An advantage of the slider-moving unit 21' is that because the slider catch 56' and the retainer 57' are moved vertically, and an adequate horizontal stroke of the slider-moving unit 21' can be achieved, thus causing an improved rate of production. With this arrangement, the slider-moving unit 21' is particularly useful in the case where the sewn products 49 are relatively short, in which case the horizontal stroke of the gripper mechanism 18 must be short and the the slider catch 56' must start raising to project into the

path of the sewn product 49 without delay after the gripper mechanism 18 has passed over the catch 56'. Further, the slider-moving unit 21' is simple in construction and hence inexpensive to manufacture.

CLAIMS:

1. A method of sewing a slide fastener (1,1') to a pair of fabric pieces (7,7; 7',7'), the slide fastener (1,1') including a pair of fastener stringers (4,4; 4',4'), each stringer (4,4') including a stringer tape (2,2') having an inner longitudinal edge supporting a row of coupling elements (3,3') attached to the tape edge, there being a slider (5) slidable on and along the fastener stringers (4,4; 4',4') for opening and closing the slide fastener (1,1'), said method comprising the steps of: supplying the pair of fabric pieces (7,7; 7',7') to a sewing station (14) defined by a sewing machine (15); uncoupling the pair of fastener stringers (4,4; 4',4') by moving the slider (5) to a bottom end portion of the slide fastener (1,1'); introducing the uncoupled pair of fastener stringers (4,4; 4',4'), as superimposed over the respective fabric pieces (7,7; 7',7'), to the sewing station (14) from a top end portion of the slide fastener (1,1'), while turning the pair of fastener stringers (4,4; 4',4') upside down in such a manner that the stringers (4,4; 4',4') assume twisted positions in mirror symmetry with respect to the longitudinal centerline of the slide fastener (1,1'); sewing the pair of fastener stringers (4,4; 4',4') to the respecture fabric pieces (7,7; 7',7') from the top end portion of the slide fastener (1,1') in the sewing

station (14); drawing the slide fastener (1,1') by the top end thereof, with the pair of fabric pieces (7,7; 7',7') sewn thereto, forwardly from the sewing station (14), as said sewing progresses; terminating said sewing when the bottom end portion of the slide fastener (1,1') approaches the sewing station (14); upon termination of said sewing, at least partially coupling the pair of fastener stringers (4,4; 4',4') to close the slide fastener (1,1') by moving the slider (5) from the bottom end portion of the slide fastener (1,1') into the region where each fastener stringer (4,4') is sewn to the respective fabric piece (7,7'); and finally, discharging the closed slide fastener (1,1'), with the pair of fabric pieces (7,7; 7',7') sewn thereto.

2. An apparatus for sewing a slide fastener (1,1') to a pair fo fabric pieces (7,7; 7',7'), the slide fastener (1,1') including a pair of fastener stringers (4,4; 4',4'), each stringer including a stringer tape (2,2') having an inner longitudinal edge supporting a row of coupling elements (3,3') attached to the tape edge, there being a slider (5) slidable on and along the pair of fastener stringers (4,4; 4',4') for opening and closing the slide fastener (1,1'), said apparatus comprising: a table (13); a sewing station (14) defined by a double-needle sewing machine (15) mounted on said table (13) for receiving the slide

fastener (1,1') and the pair of fabric pieces (7,7; 7',7') in superimposed relationship; a first guide (16) disposed upstream of said sewing station (14) for guiding the pair of fabric pieces (7,7; 7',7') in laterally spaced relation to said sewing station (14); a second guide (17) supported on said table (13) and disposed above said first guide (16) for supporting the slide fastener (1,1') with the pair of fastener stringers (4,4; 4',4') uncoupled, and for guiding the uncoupled pair of fastener stringers (4,4; 4',4') to said sewing station (14) so as to turn the stringers upside down in such a manner that the stringers assume twisted positions in mirror symmetry with respect to the longitudinal centerline of the slide fastener (1,1'); a gripper mechanism (18) disposed downstream of said sewing station (14) and reciprocable along a substantially horizontal first path, between an upstream position and a downstream position, for drawing the slide fastener (1,1'), with the pair of fabric pieces (7,7; 7',7') sewn thereto, from said sewing station (14); and a slider-moving unit (21, 21') disposed downstream of said sewing station (14) and reciprocable, along a second path parallel to said first path, for moving the slider (5) on the pair of fastener stringers (4,4; 4',4') from the bottom end portion of the slide fastener (1,1') into the region where each fastener stringer is sewn to the respective

fabric piece (7,7'), said slider-moving unit (21, 21') being retractable from said second path so as not to obstruct the movement of said fabric pieces (7,7; 7',7') along said first path.

3. An apparatus according to claim 2, including brake means (75,75') frictionally pressing said fastener (1,1') adjacent its bottom end prior to movement of said slider (5) by said slider-moving unit (21, 21').

4. An apparatus according to claim 2 or 3, wherein said gripper mechanism (18) comprises a pair of transversely spaced gripper means (33, 30) for gripping respective stringers (4,4; 4',4') and wherein said slider-moving unit (21, 21') is selectively movable into and out of the plane defined by the distance between the spaced gripper means (33, 30) as they move longitudinally along said first path.

5. An apparatus according to one of the claims 2 to 4, wherein said slider-moving unit (21, 21') is projected into said first path after said gripper mechanism (18) has moved downstream of the most upstream position of said slider-moving unit (21, 21').

6. An apparatus according to one of the claims 2 to 5, wherein said gripping mechanism (18) pivots out of said

horizontal first path adjacent the end of its downstream movement to extend the downstream movement of the fabric (7,7').

7. An apparatus according to one of the claims 2 to 6, said slider-moving unit (21') including a slide (62') disposed below the first horizontal path and reciprocable along the second horizontal path, a slider catch (56') carried on said slide (62') and vertically movable with respect thereto for receiving the slider (5), and a retainer (57') carried on said slider catch (56') and vertically movable with respect thereto for pressing the slider (5) against said slide catch (56').

8. an apparatus according to claim 7, said slider-moving unit (21') further including: a first vertical air cylinder (73') fixedly secured to said slide (62') and having a piston rod (74') on which said slider catch (56') is mounted; and a second vertical air cylinder (59') fixedly secured to said slider catch (56') and having a piston rod (60') on which said retainer (57') is mounted.

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FIG. 1

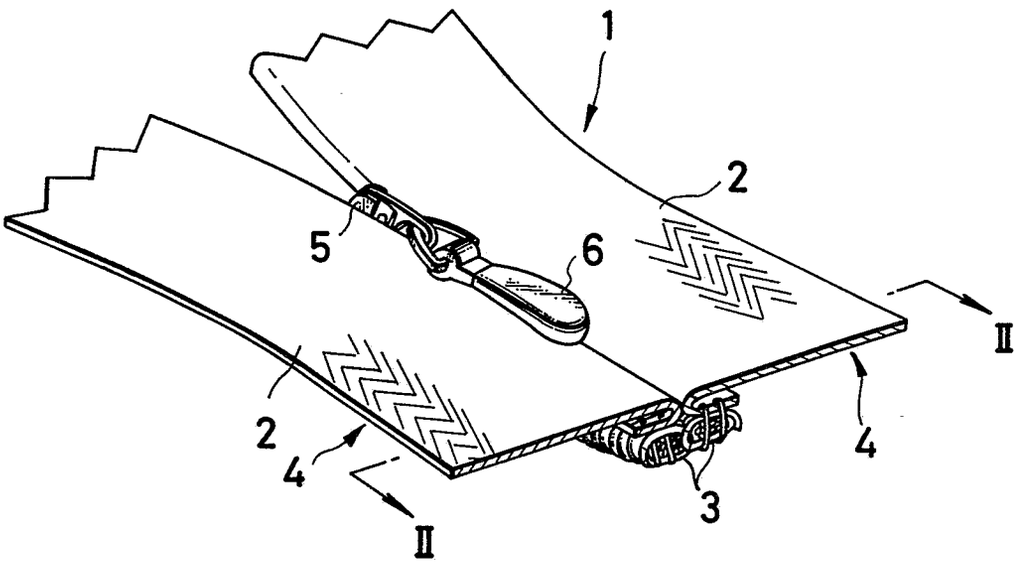

FIG. 2

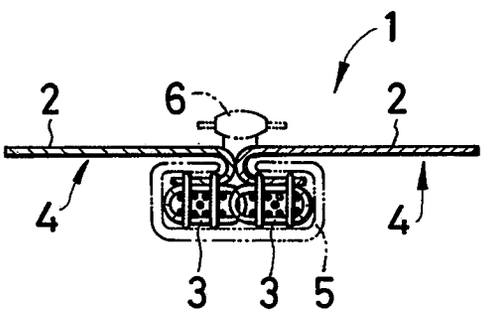

FIG. 3

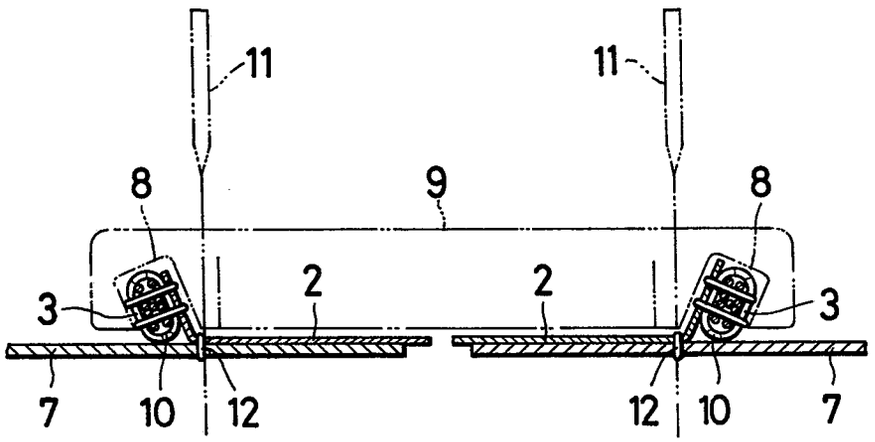

FIG. 4

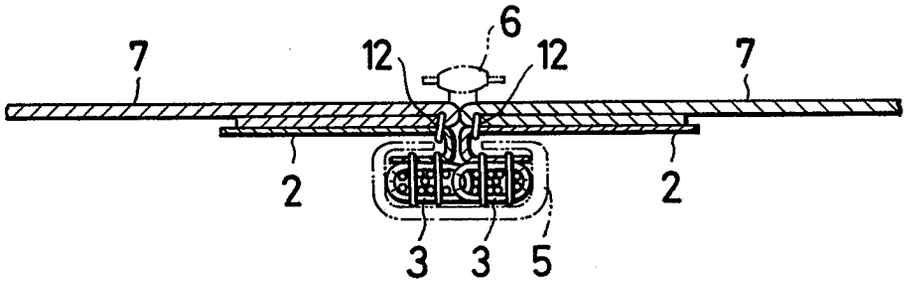

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FIG. 5

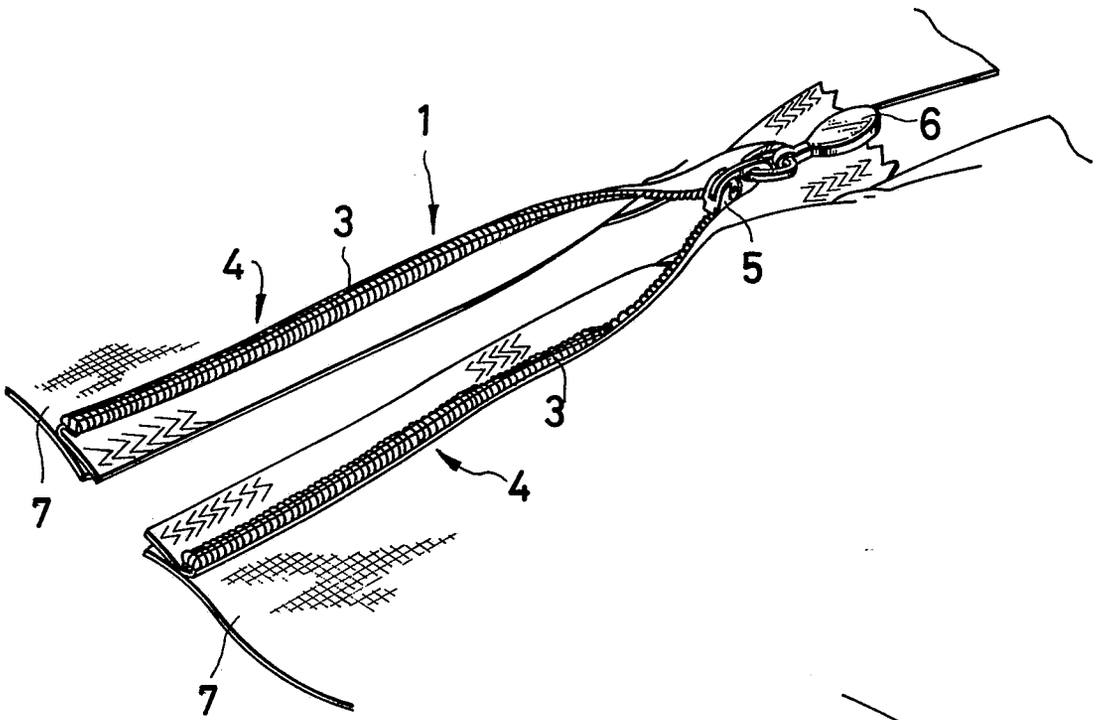


FIG. 6

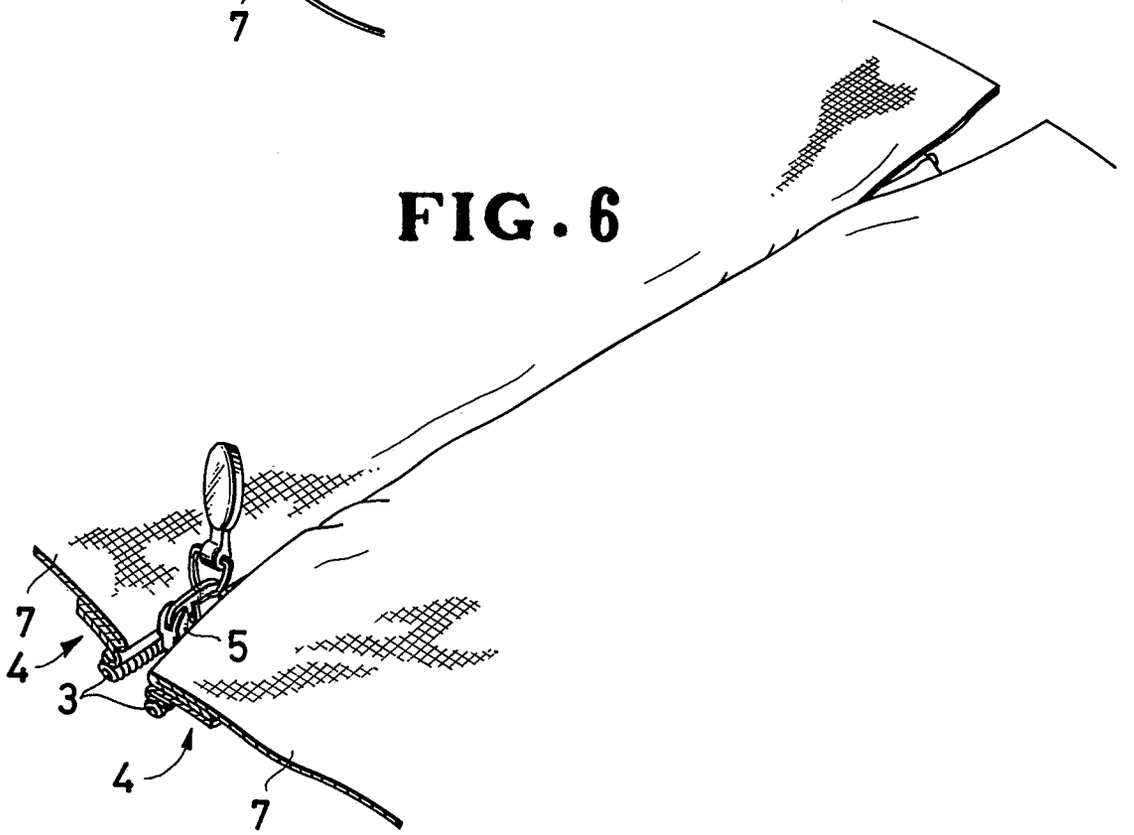


FIG. 7

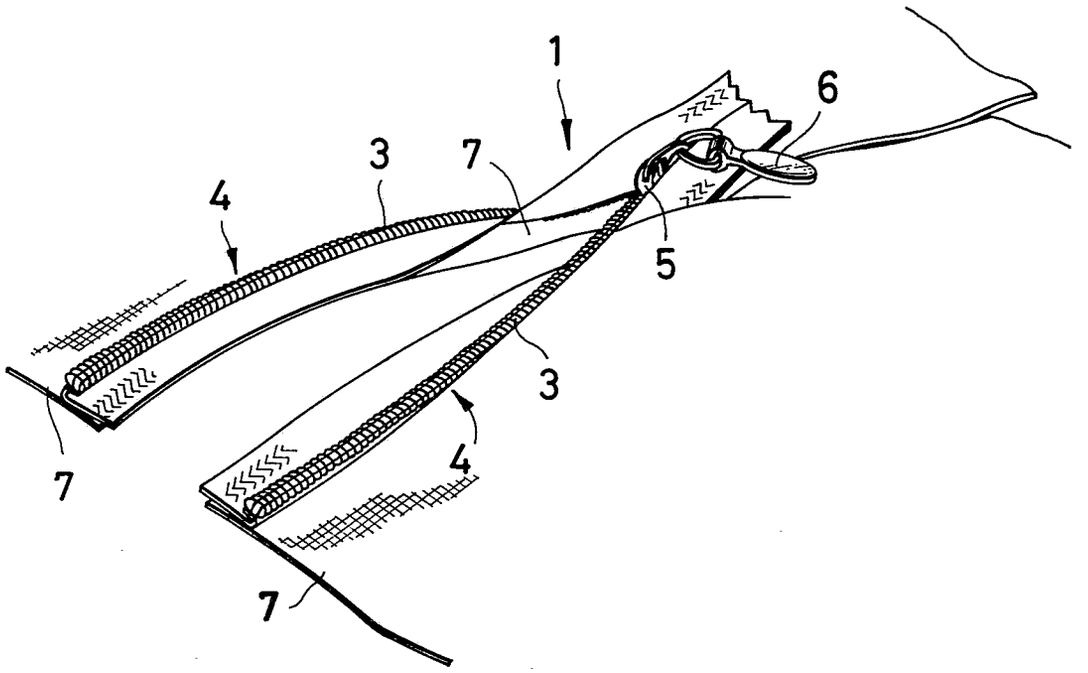


FIG. 8

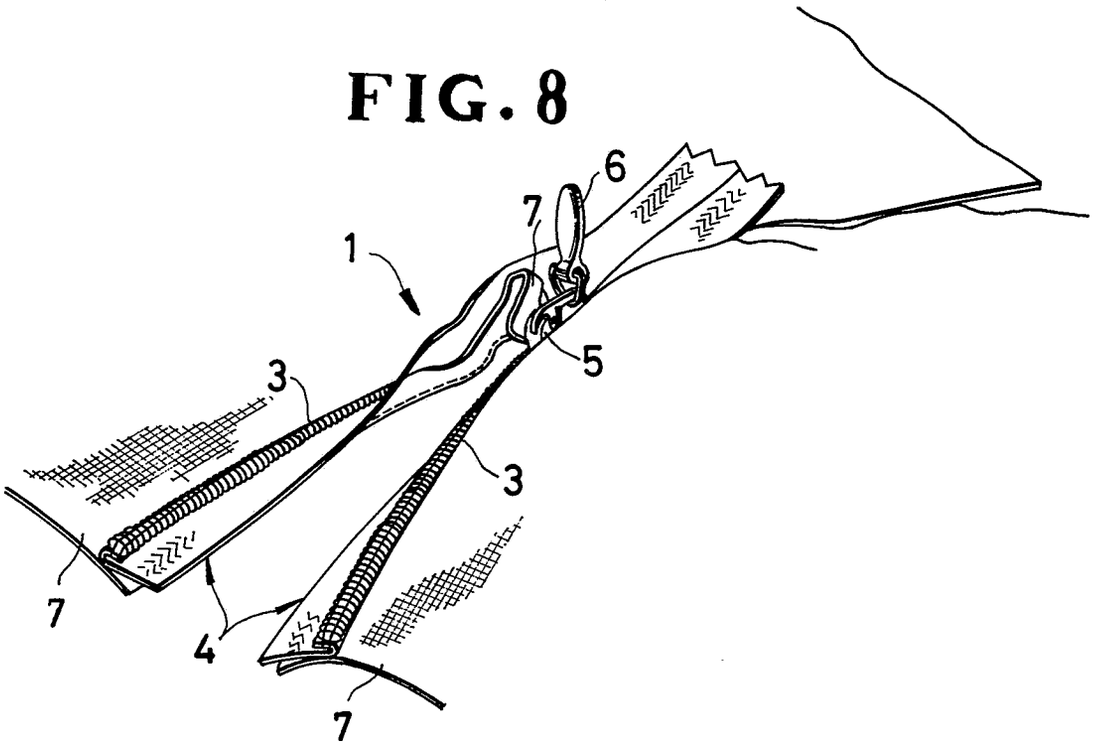
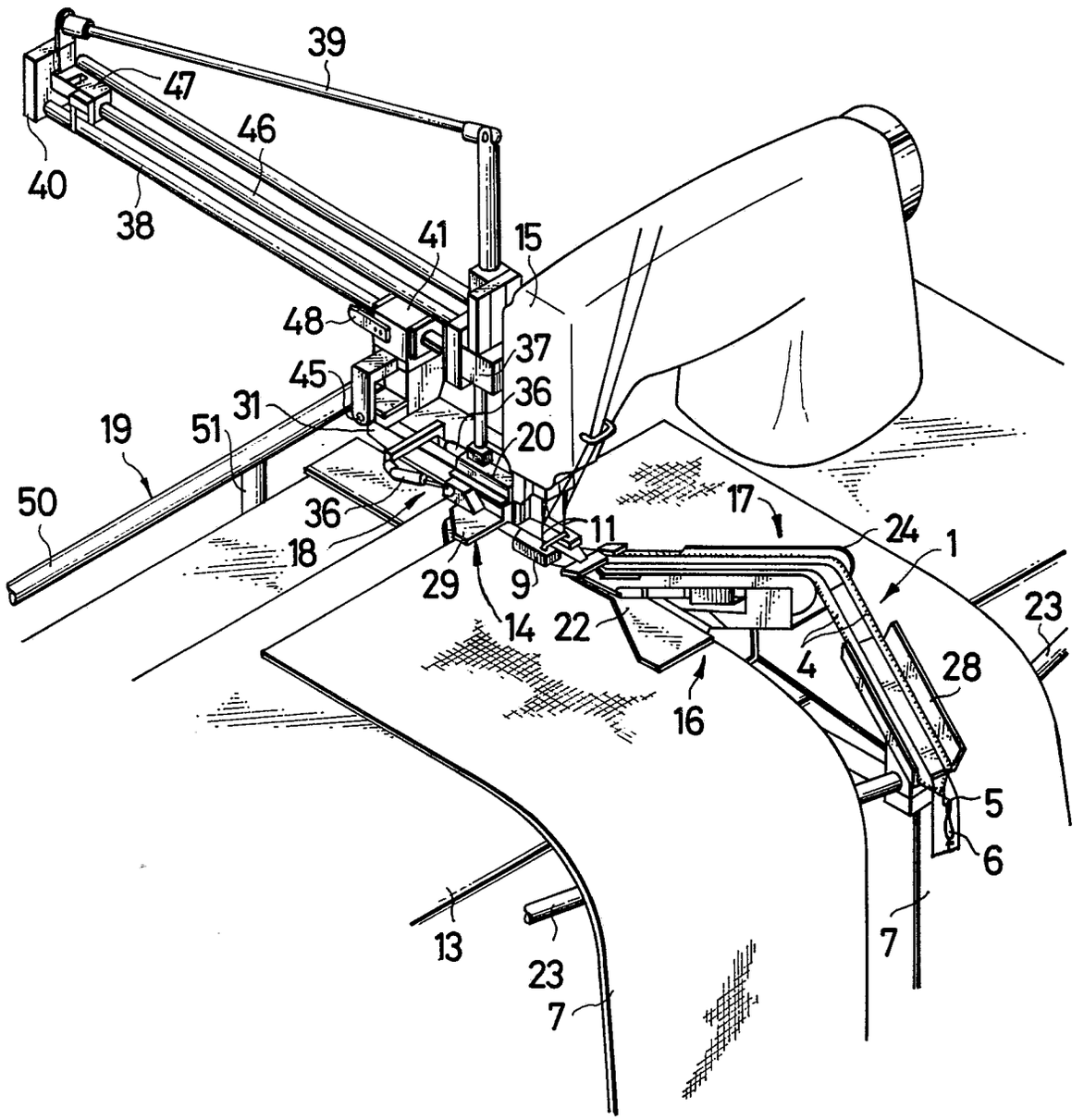


FIG. 9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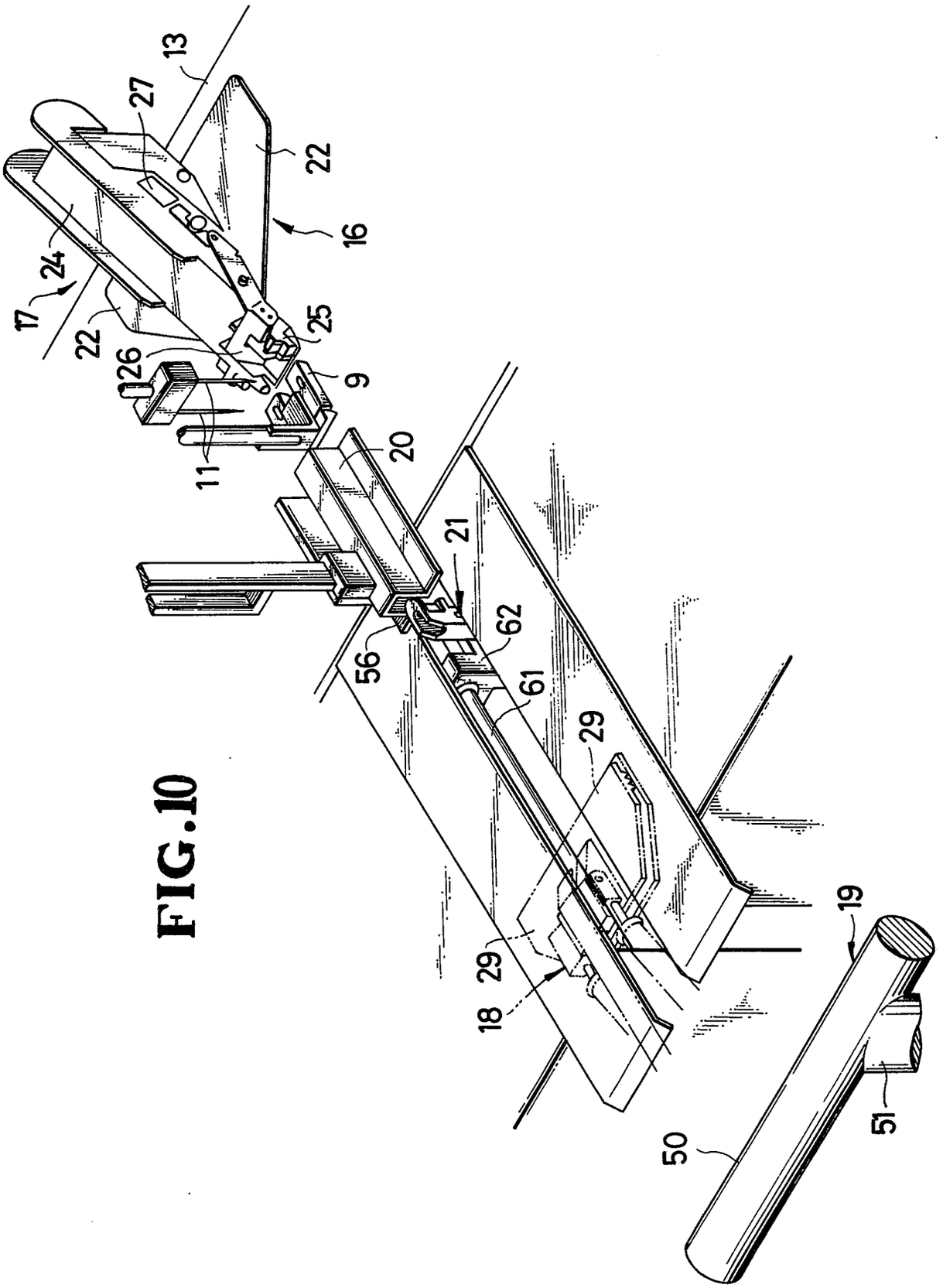

FIG.10

FIG. 11

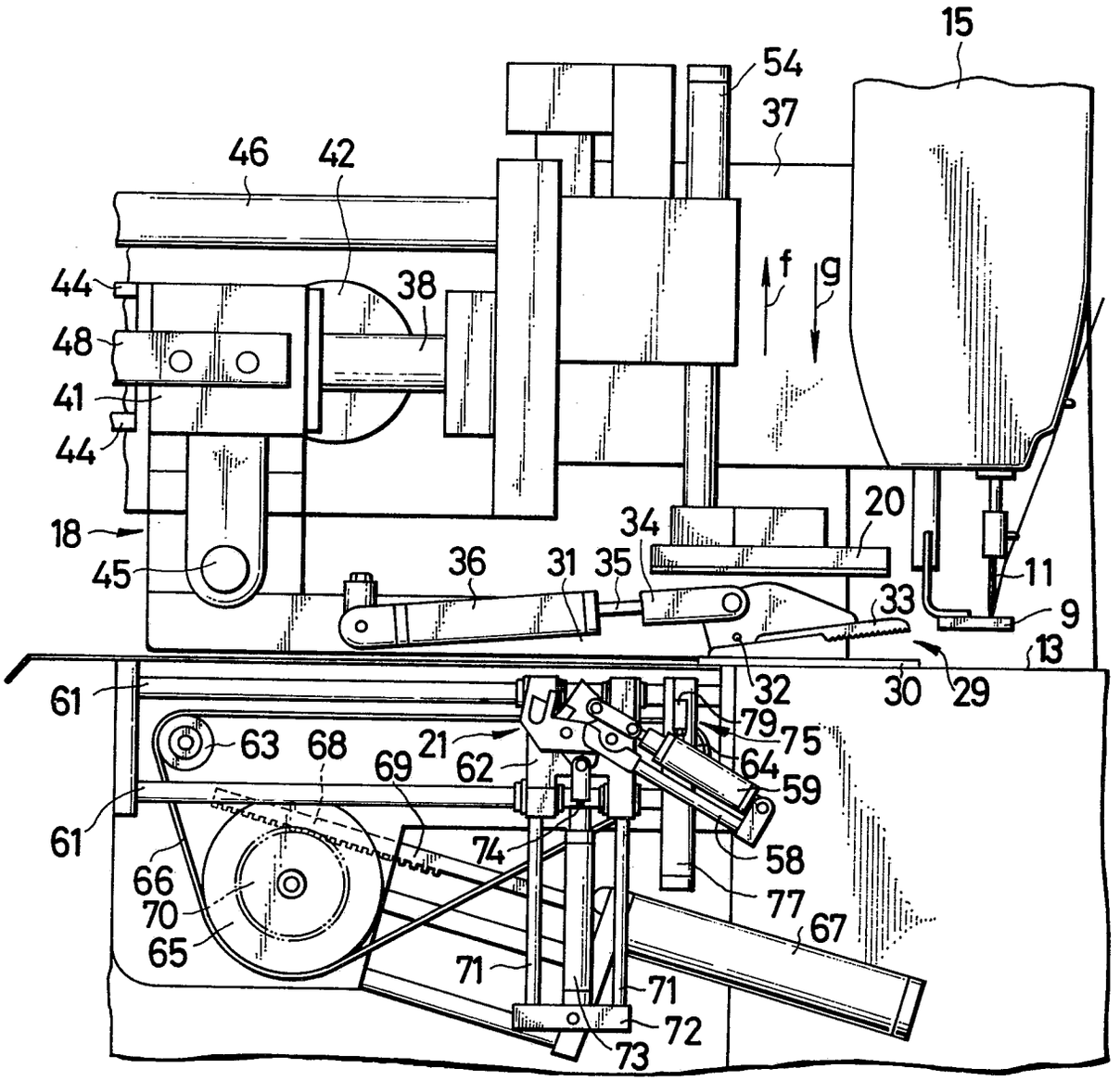
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FIG. 12

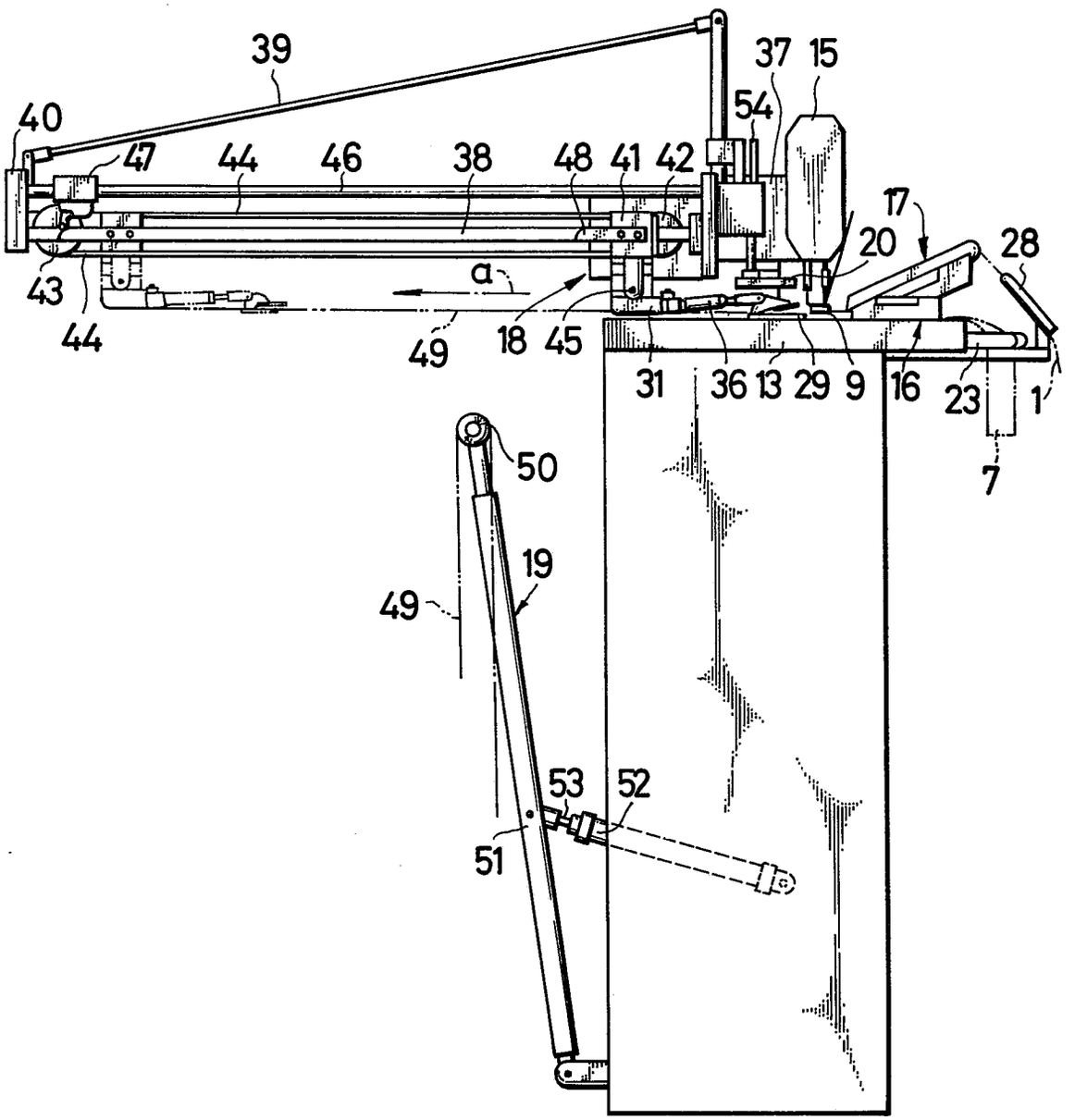
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FIG.13

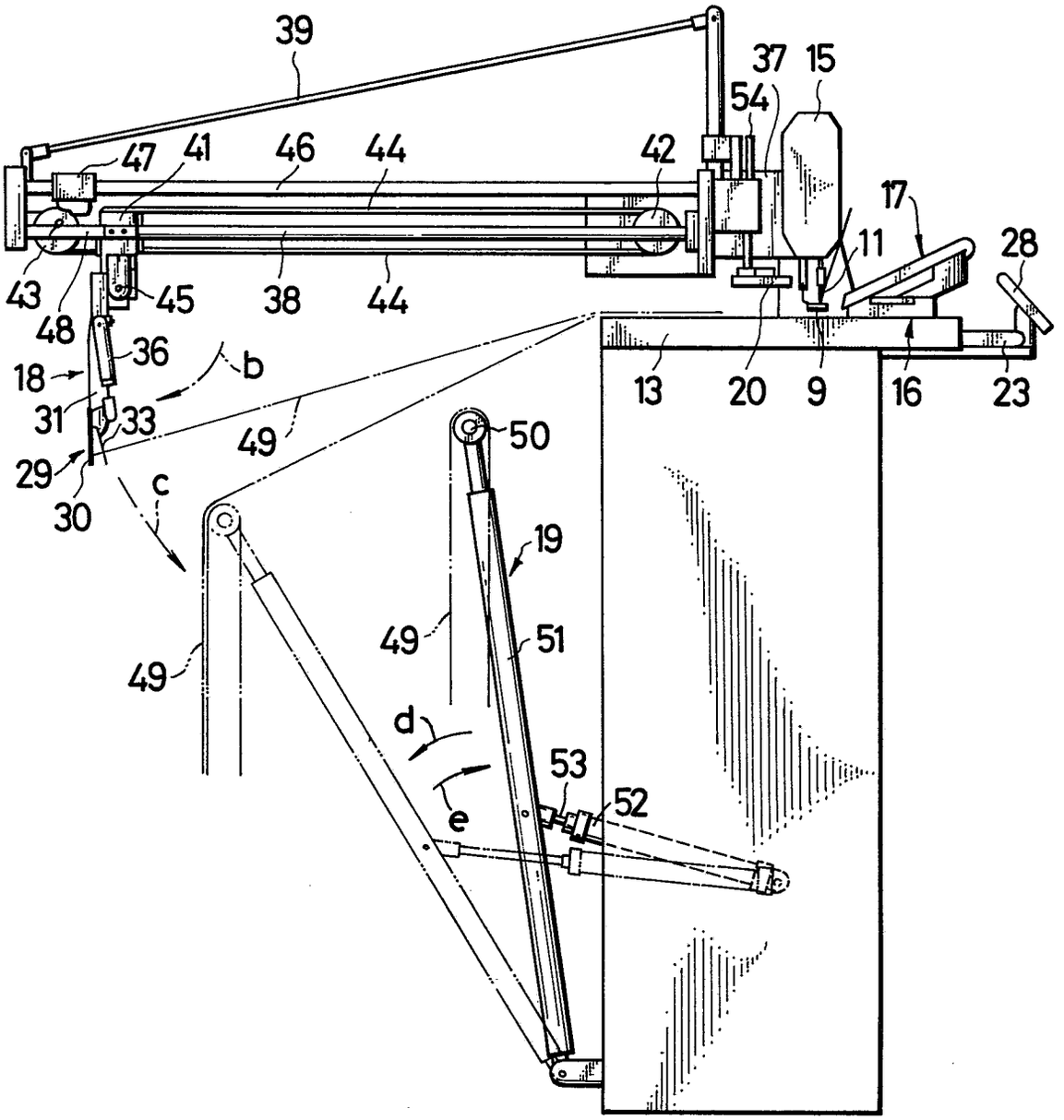
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FIG.14

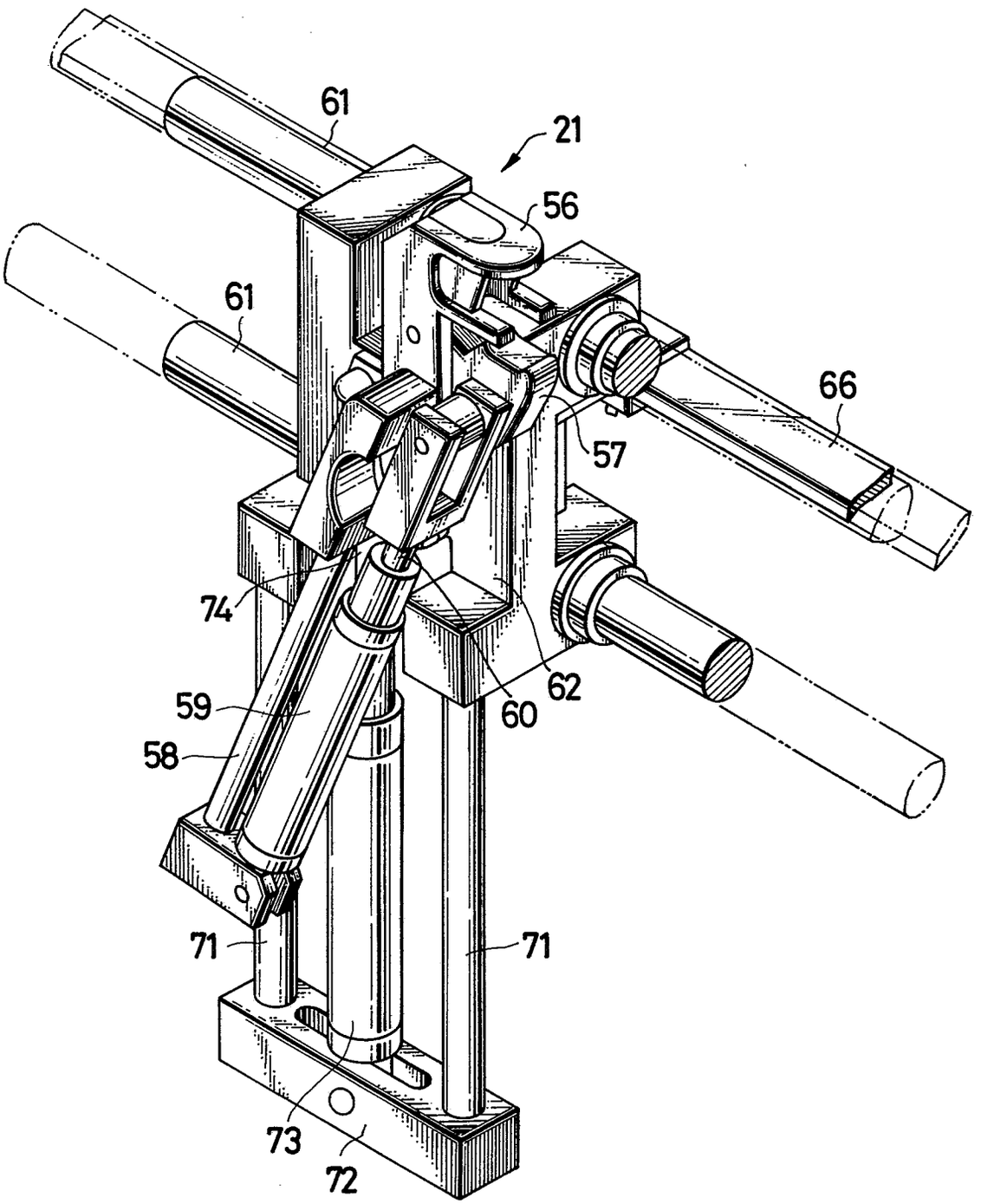

FIG. 15

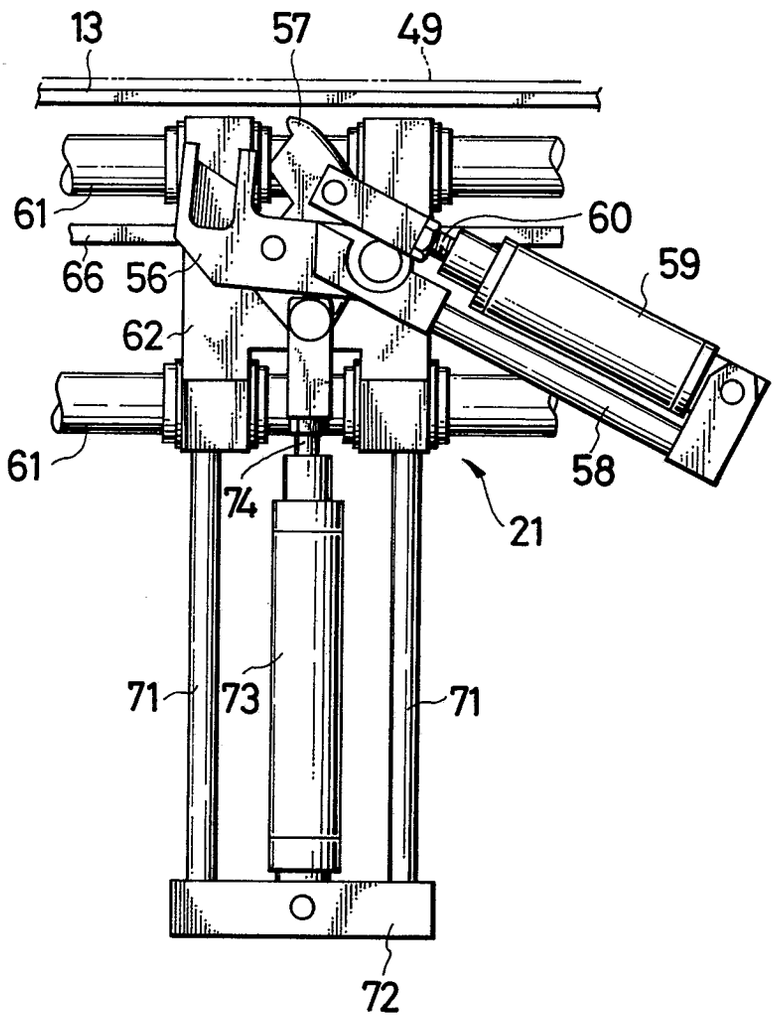

FIG. 16

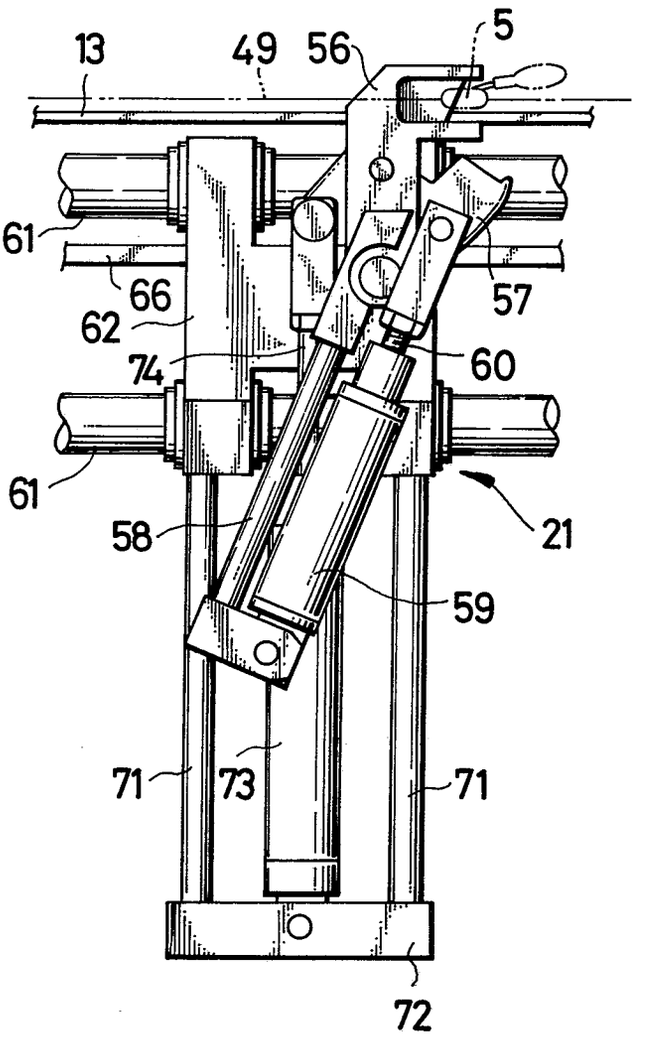

FIG. 17

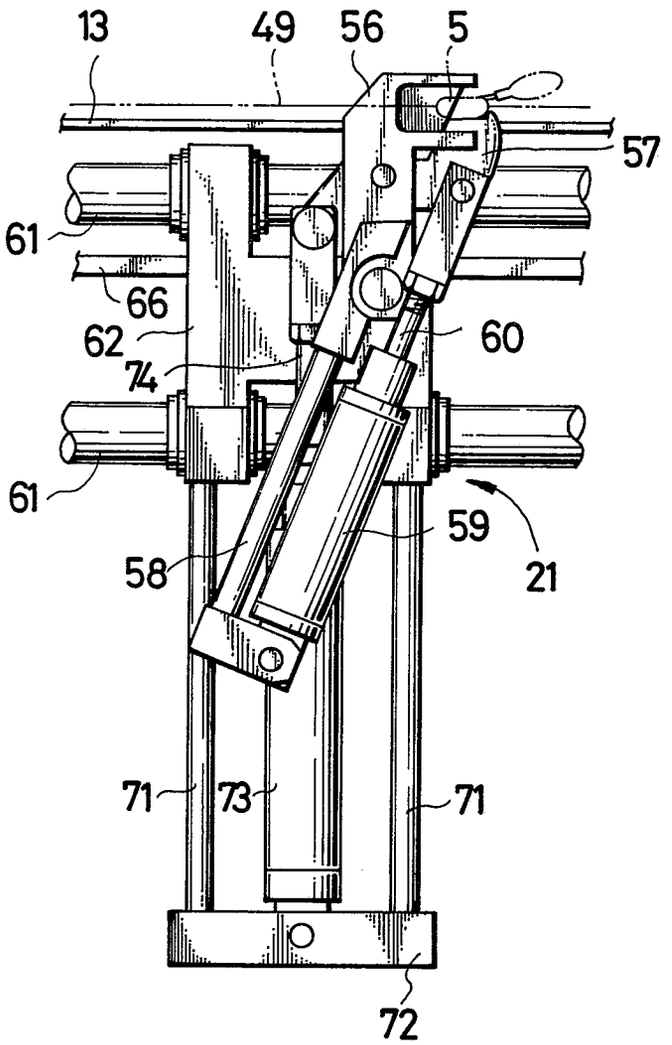

FIG. 18A

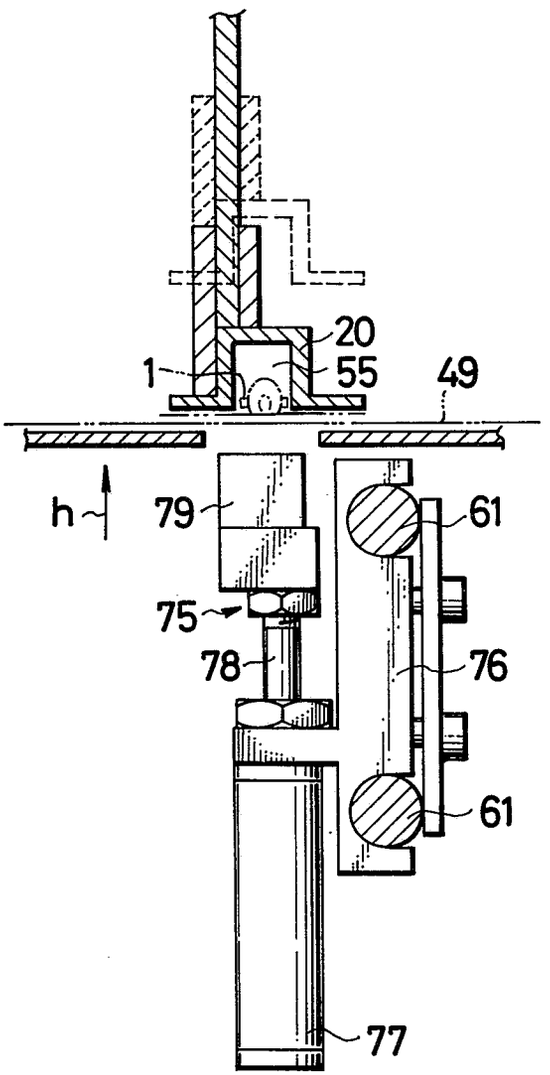

FIG. 18B

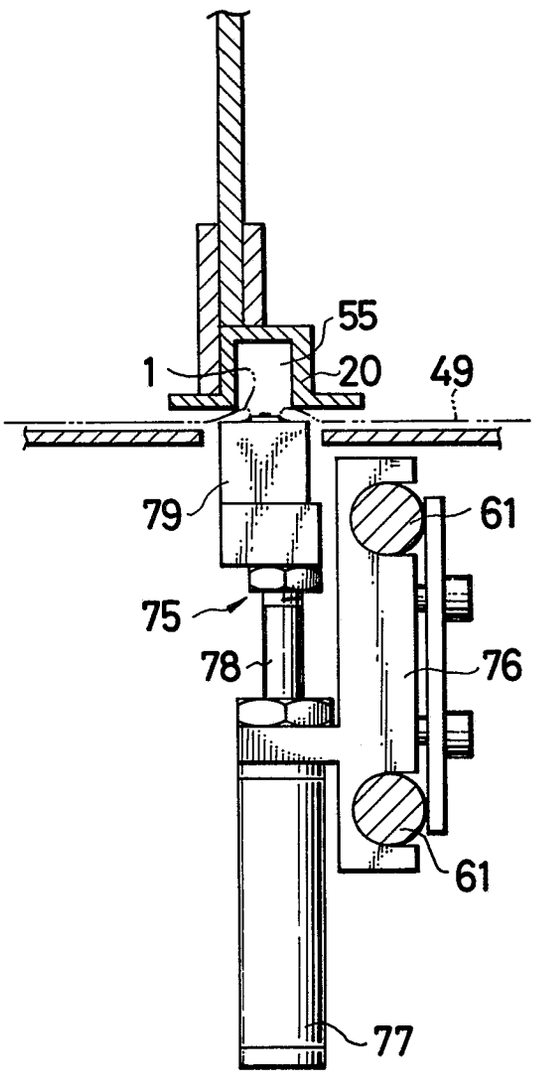

FIG. 19A

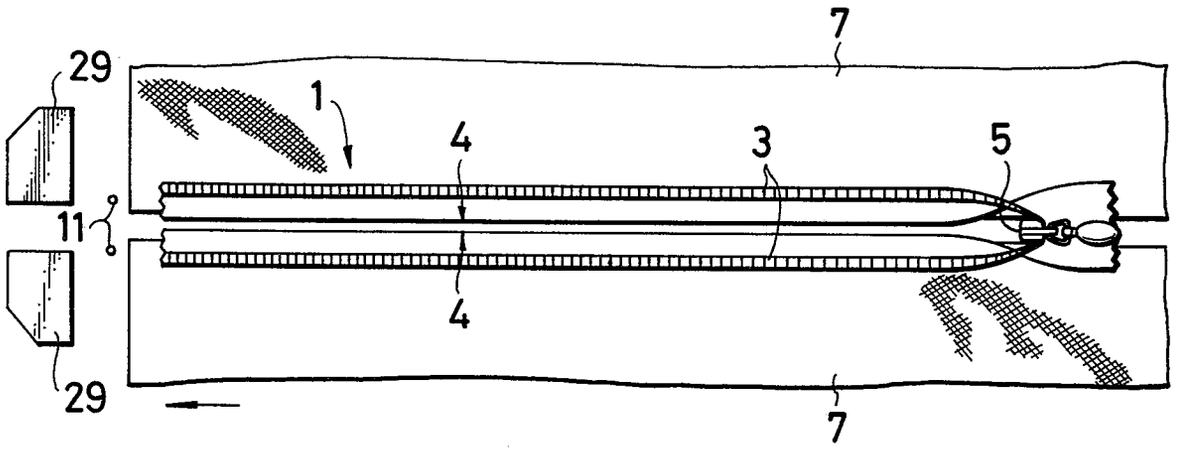

FIG. 19B

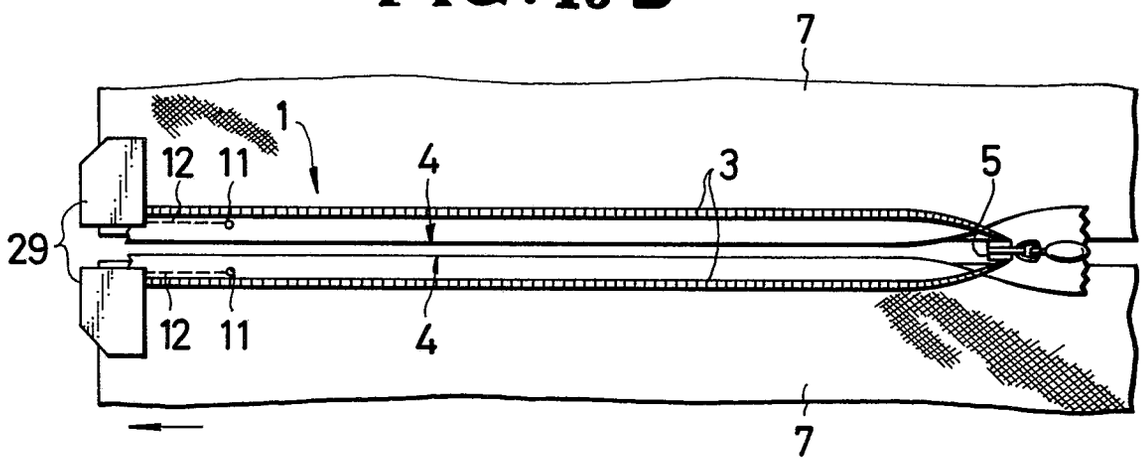

FIG. 19C

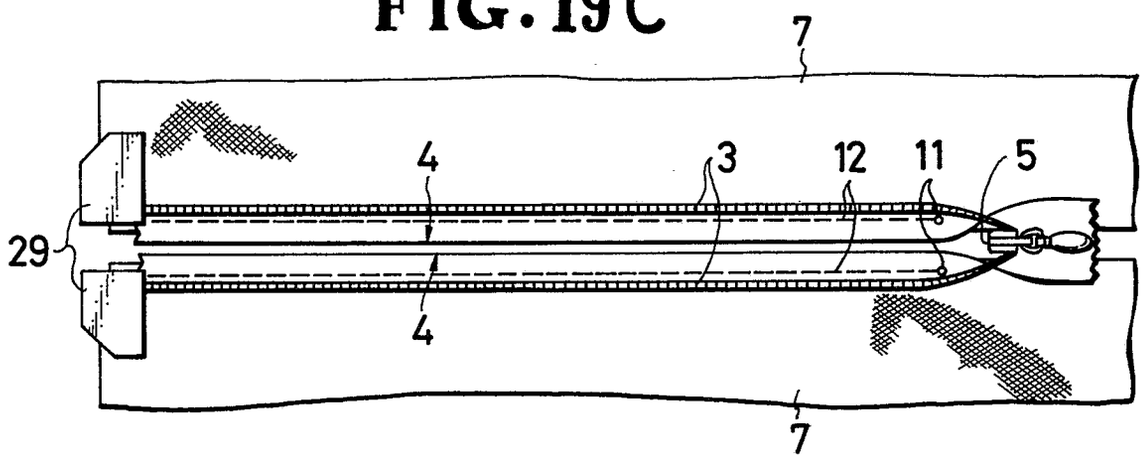

FIG. 19D

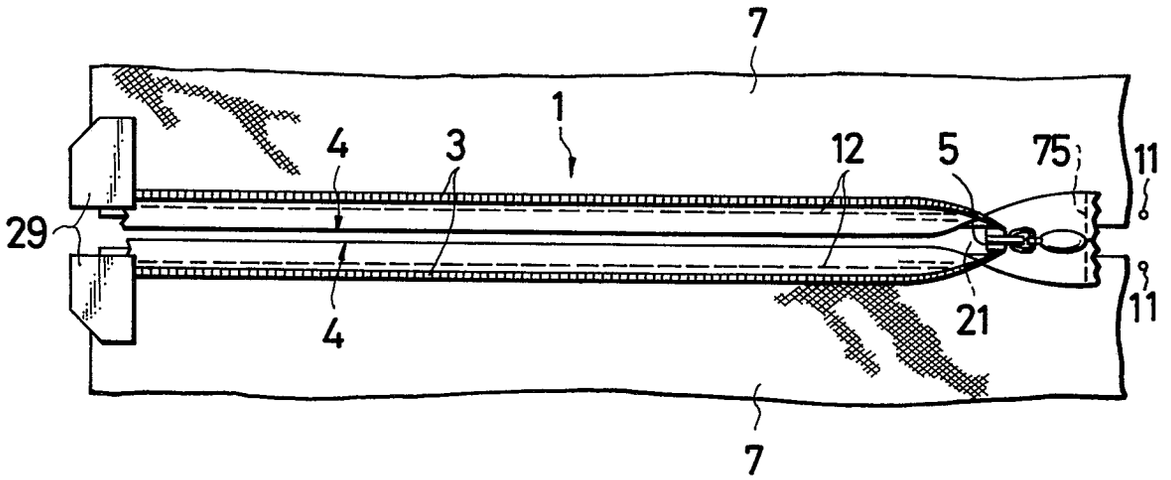

FIG. 19E

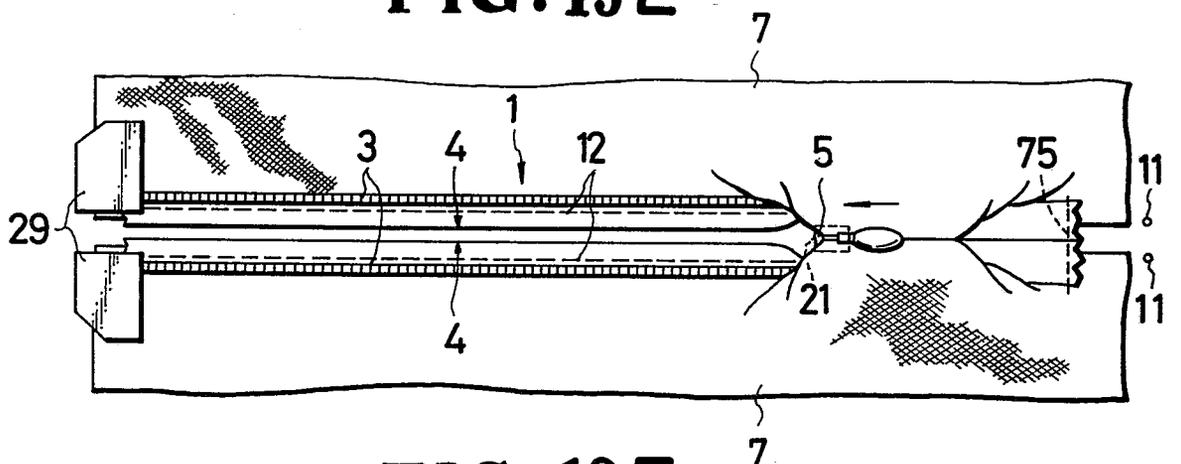

FIG. 19F

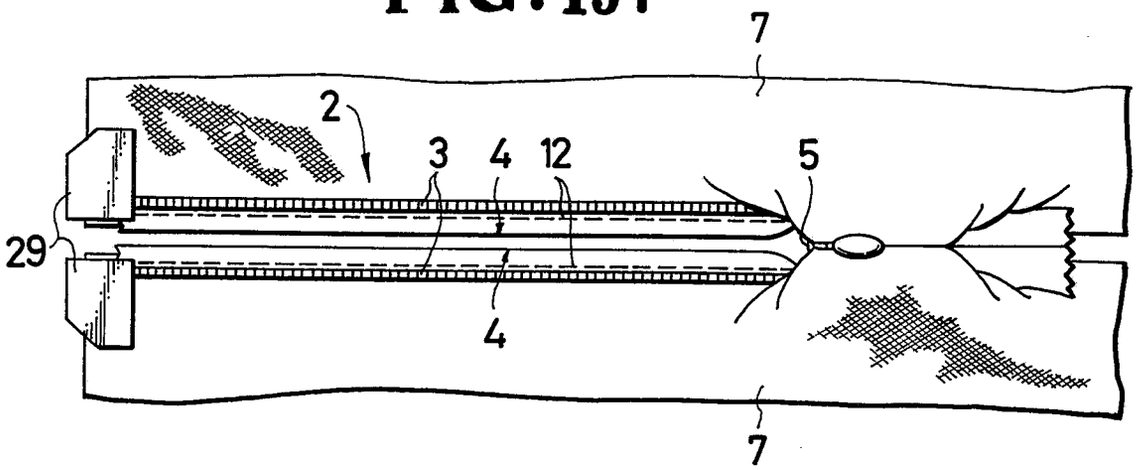

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FIG. 20A

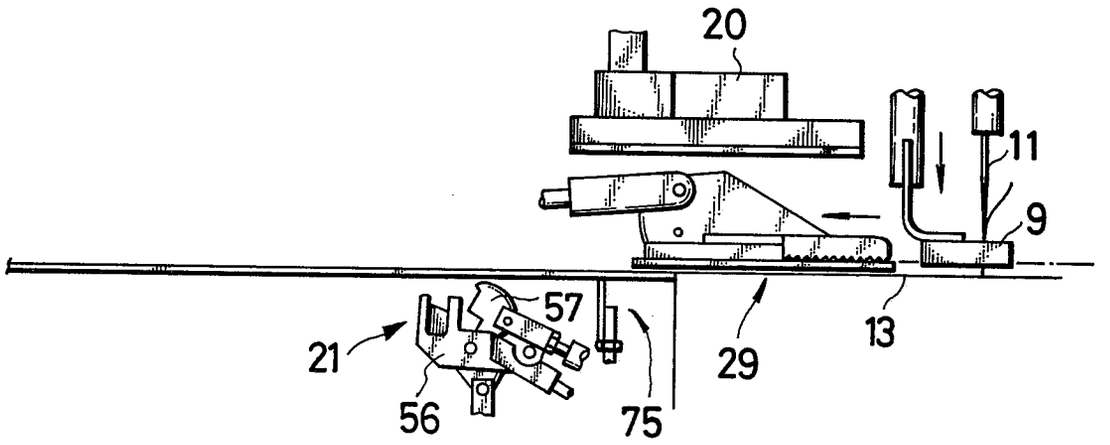


FIG. 20B

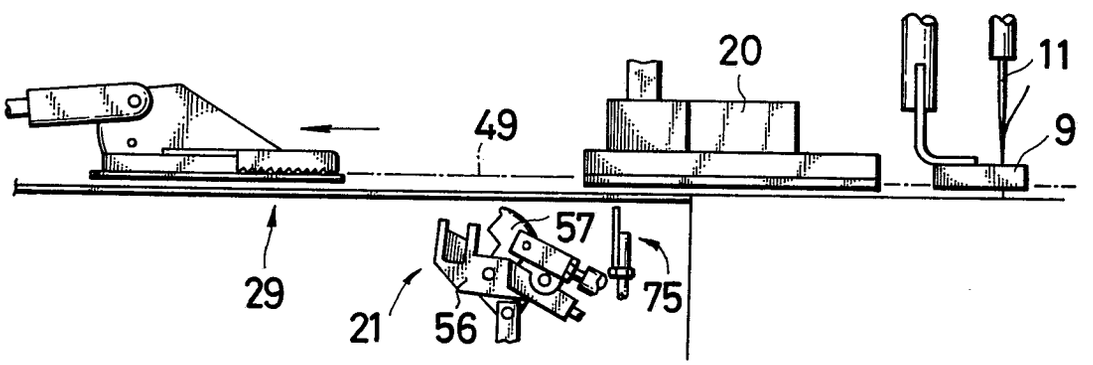


FIG. 20C

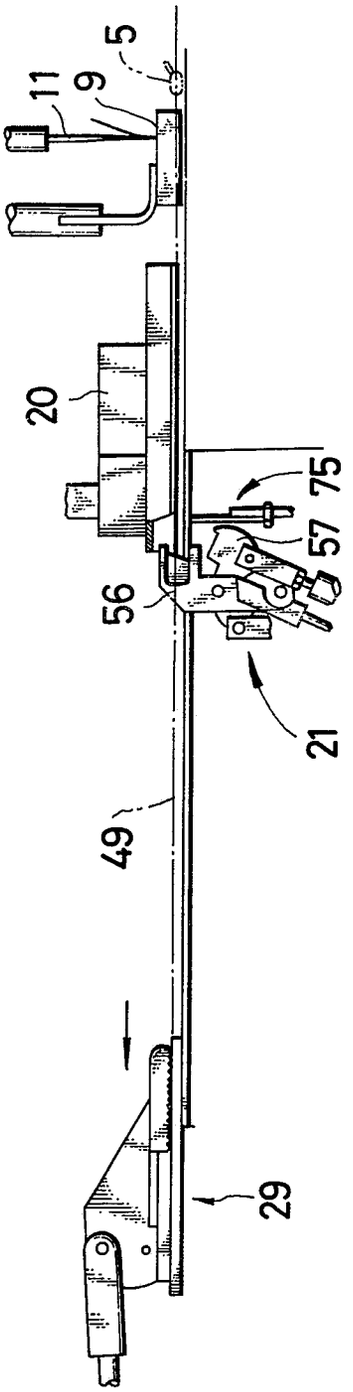
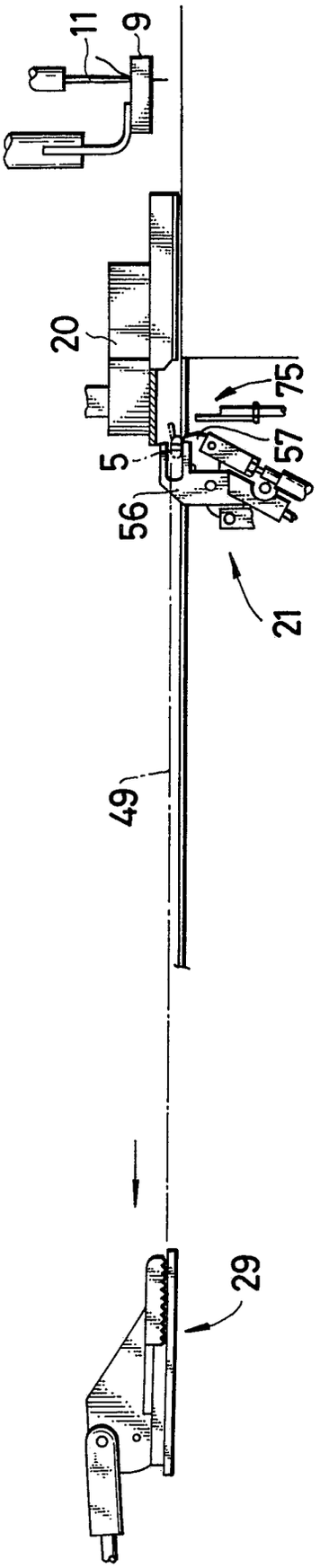


FIG. 20D



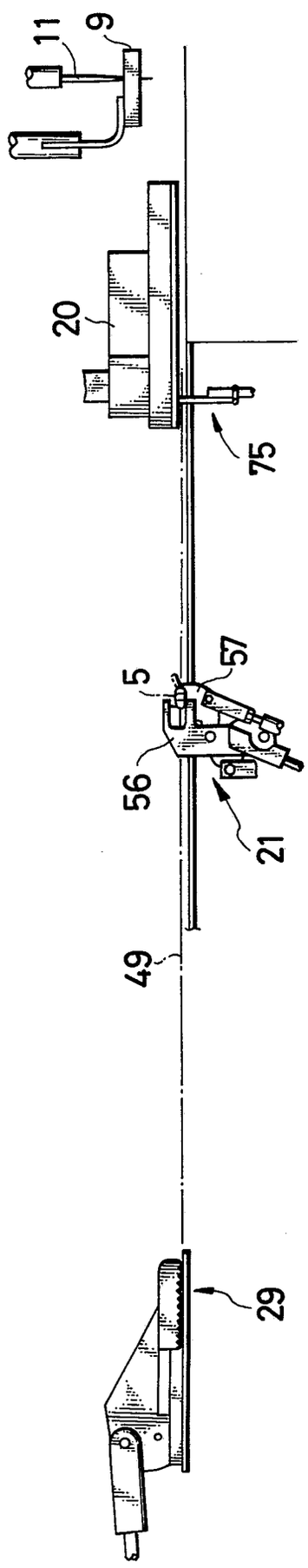


FIG.20E

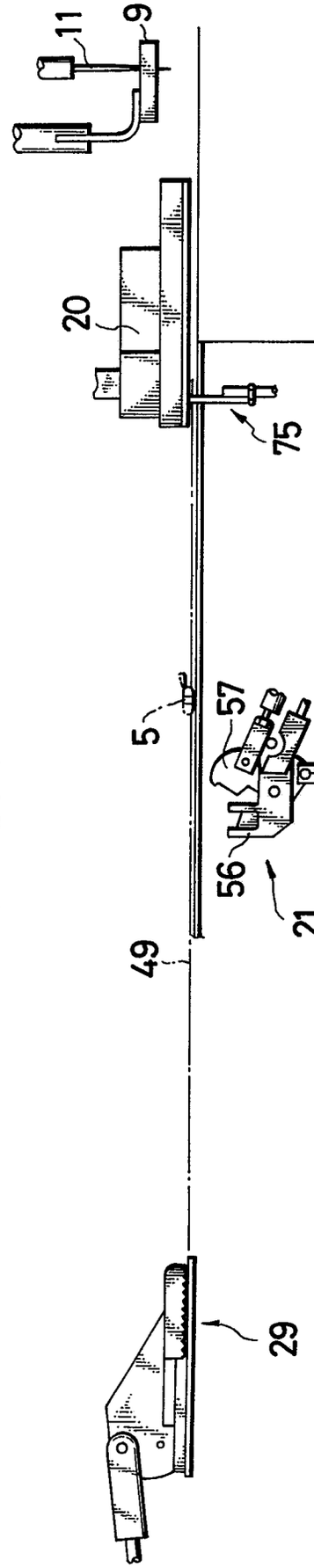


FIG.20F

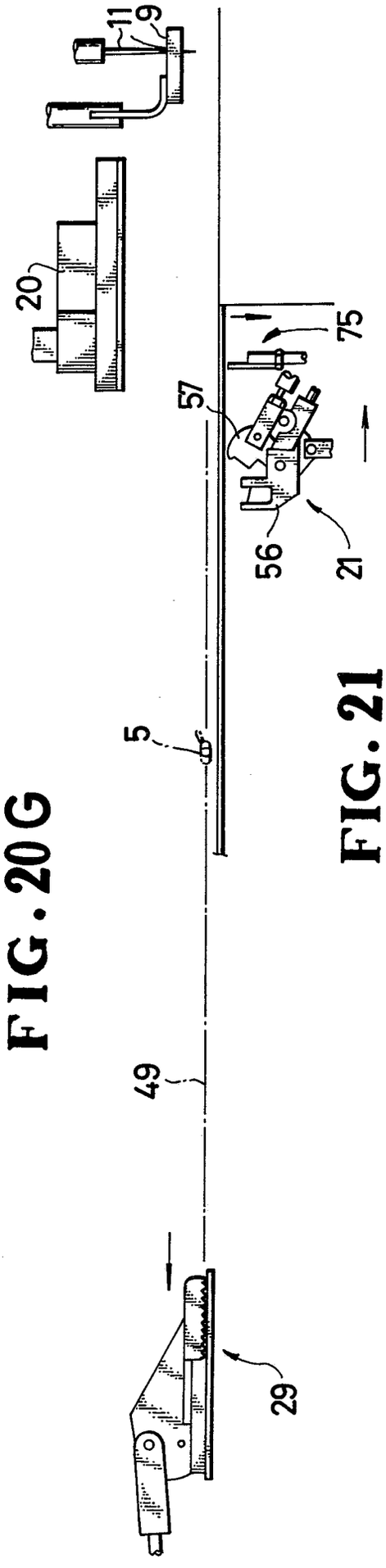


FIG. 20G

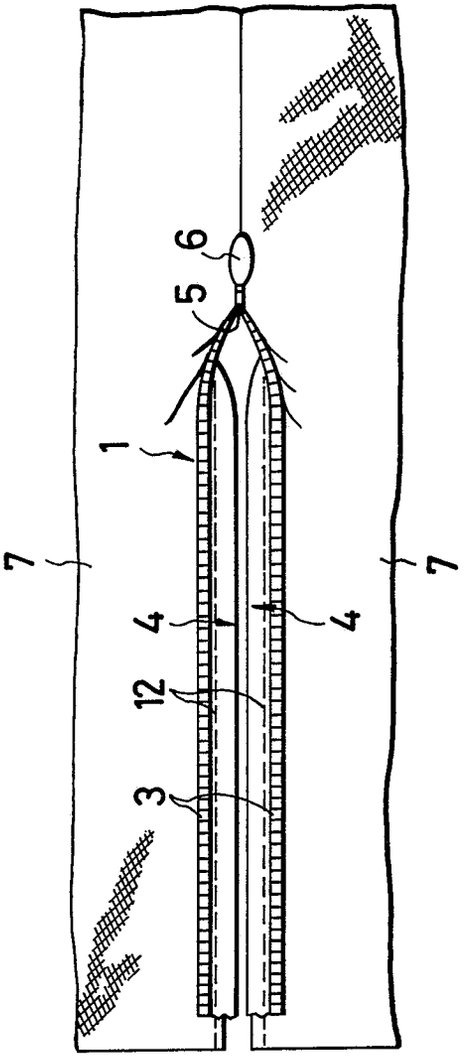


FIG. 21

FIG. 22

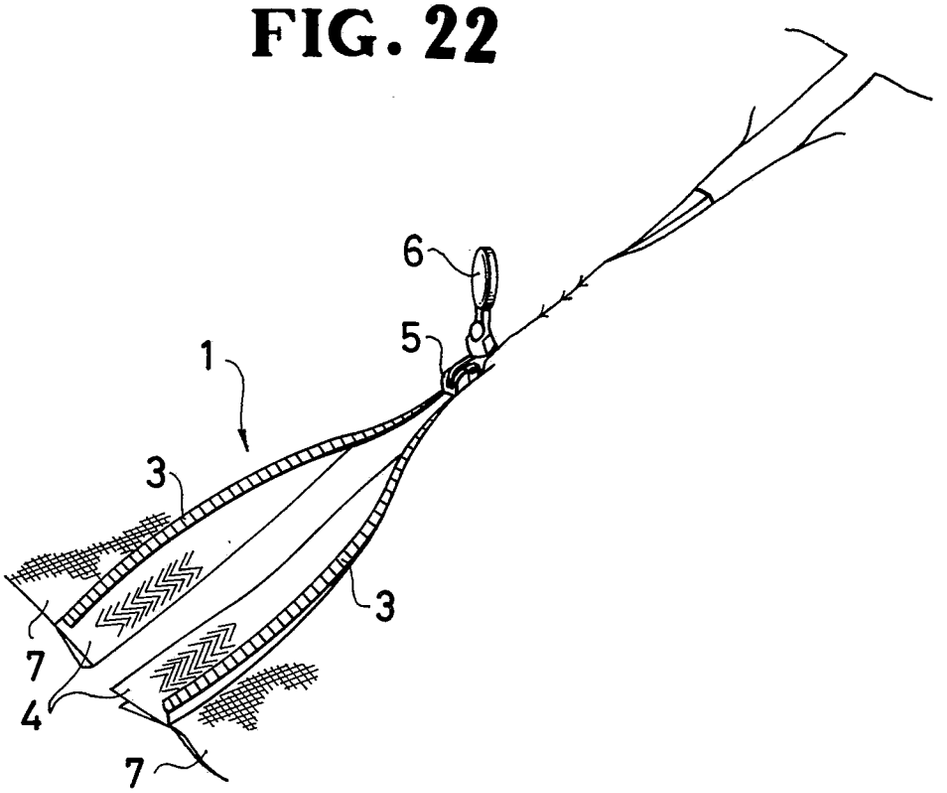


FIG. 23

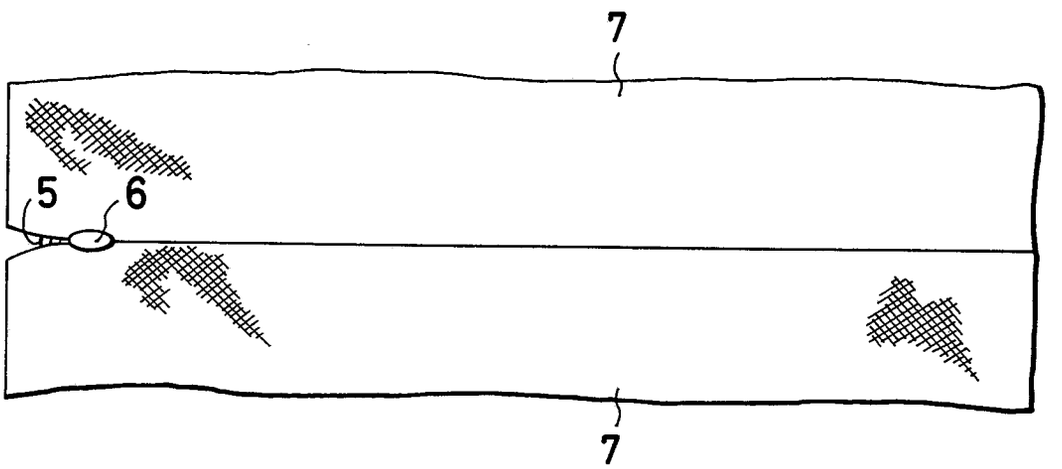


FIG. 24 A

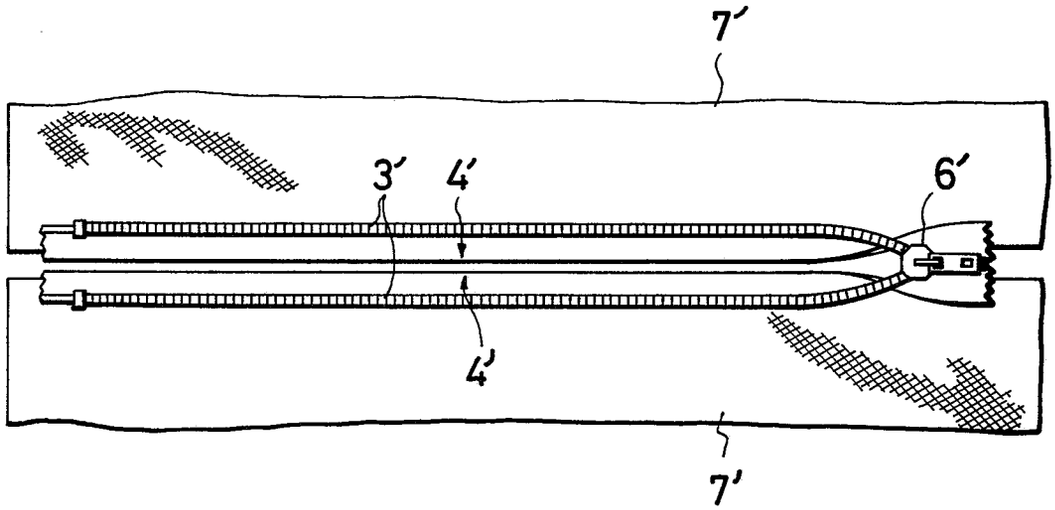


FIG. 24 B

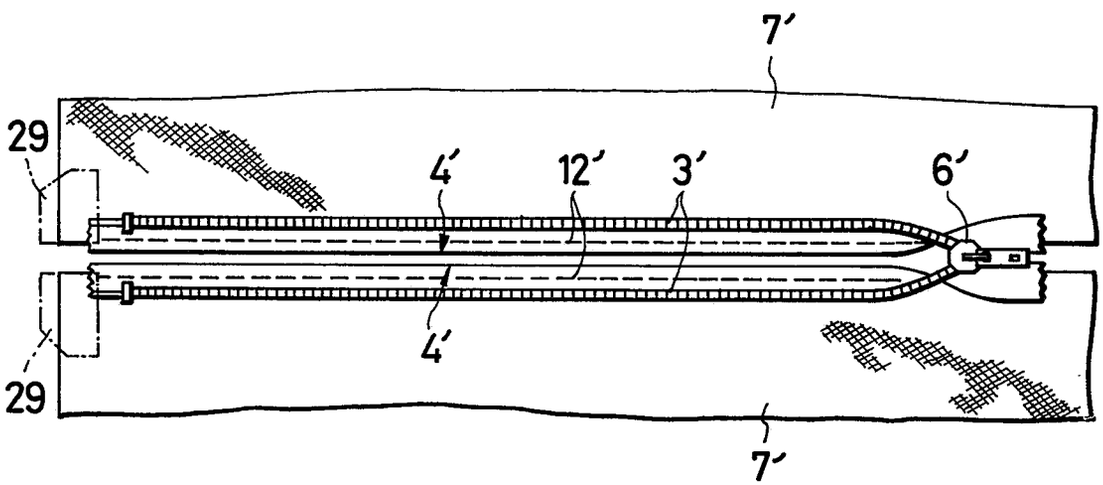


FIG. 24 C

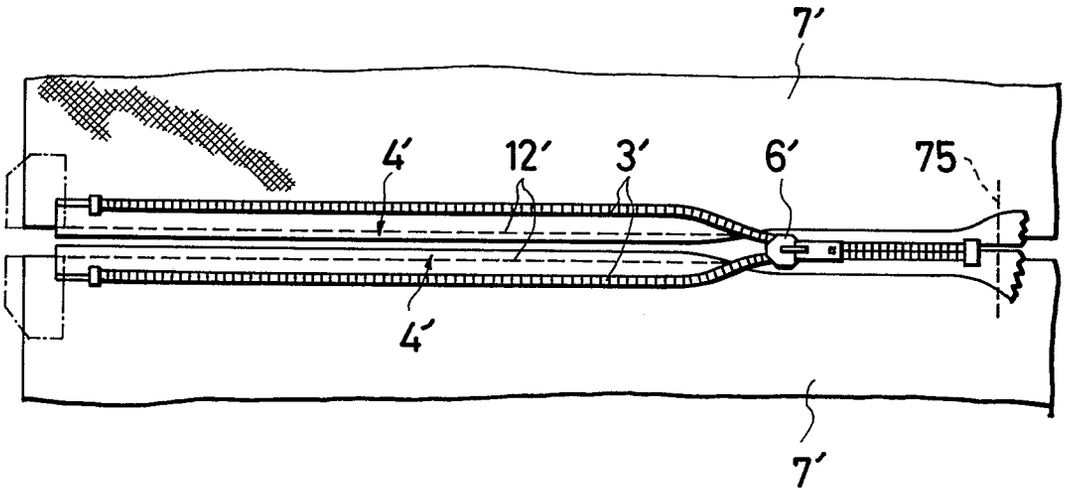


FIG. 24 D

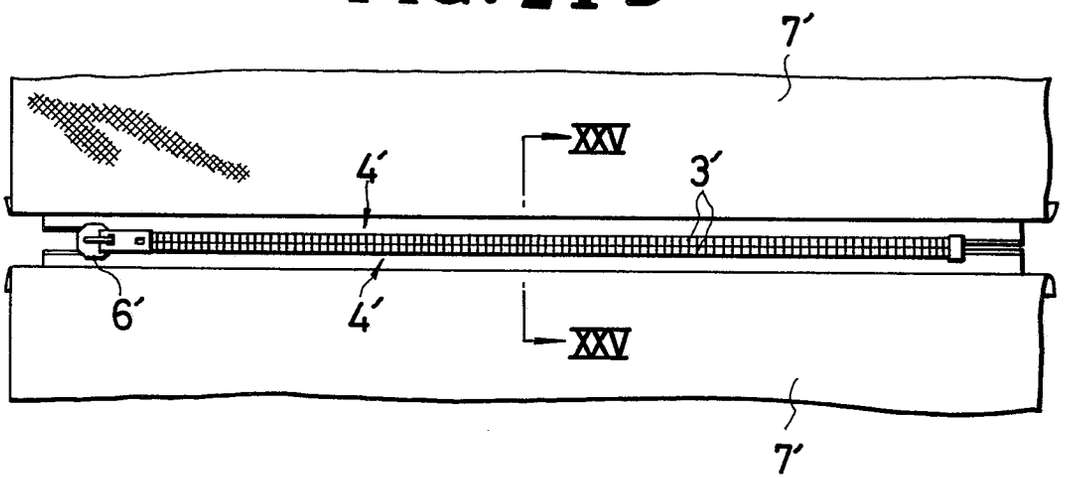


FIG. 25

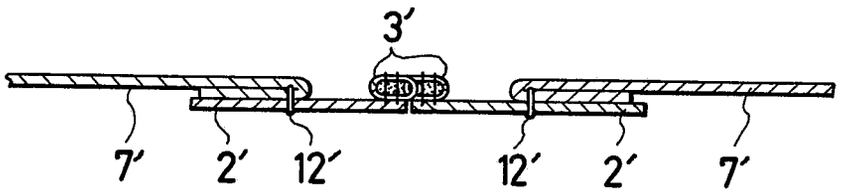


FIG. 26

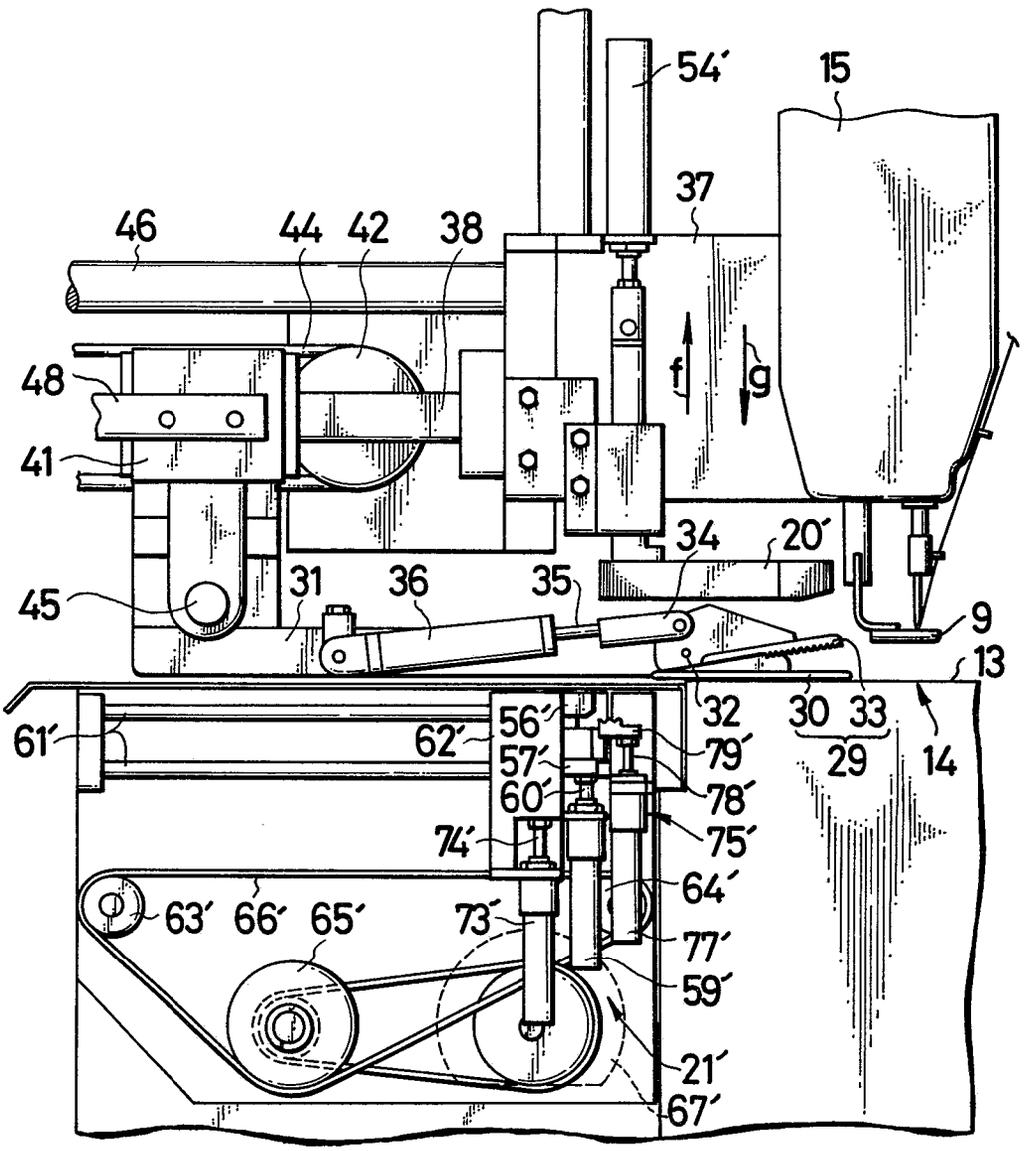

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FIG. 27

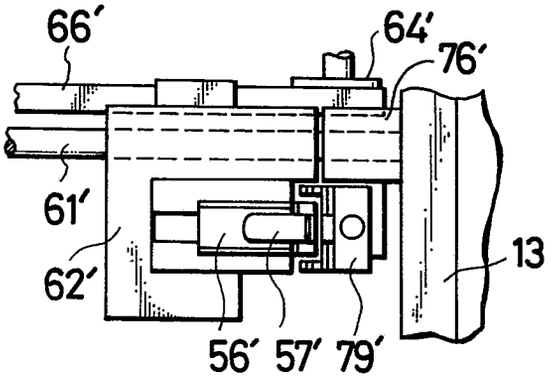


FIG. 28

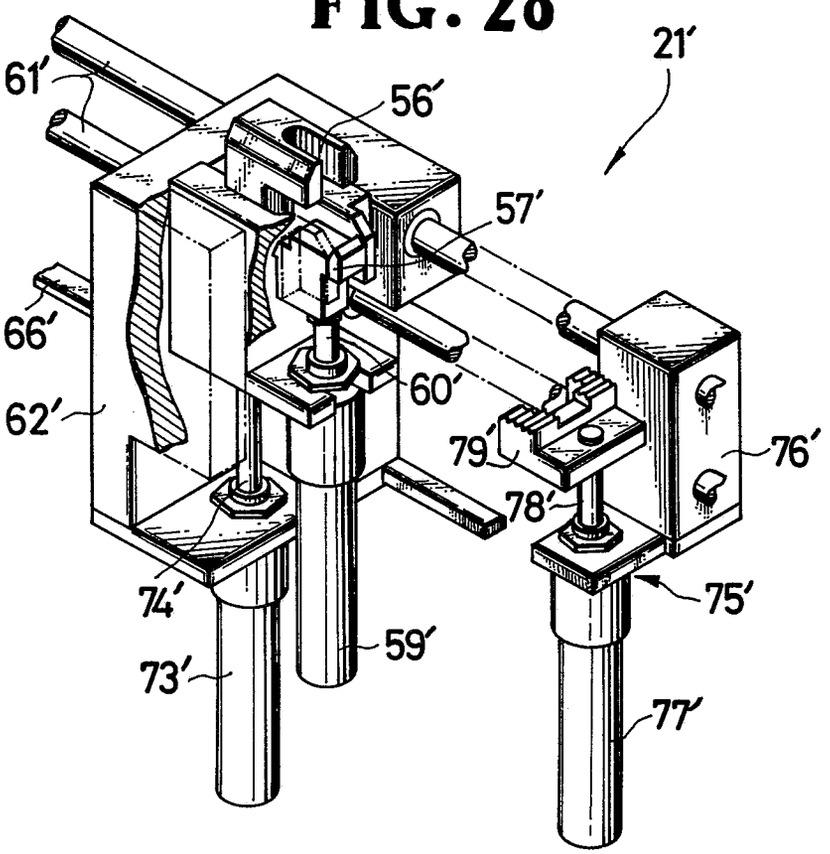


FIG. 29A

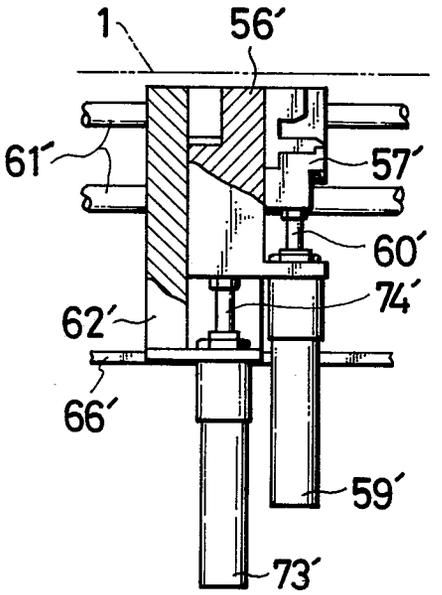


FIG. 29B

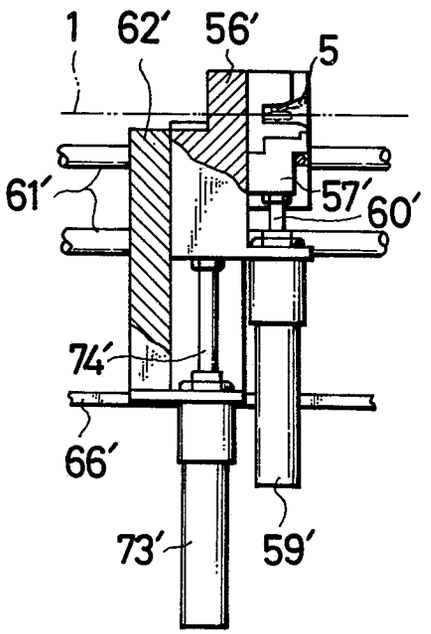


FIG. 29C

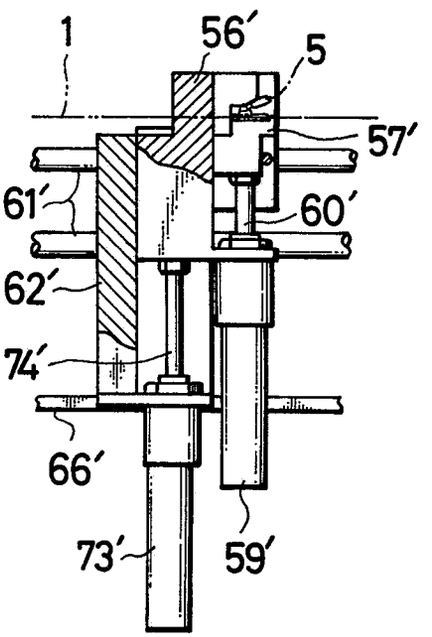


FIG. 30A

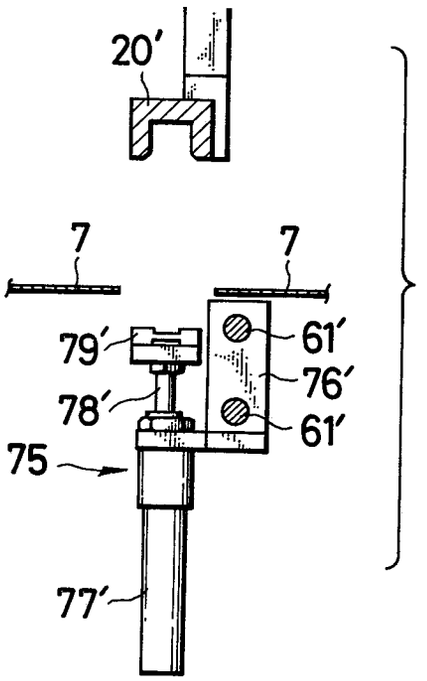


FIG. 30B

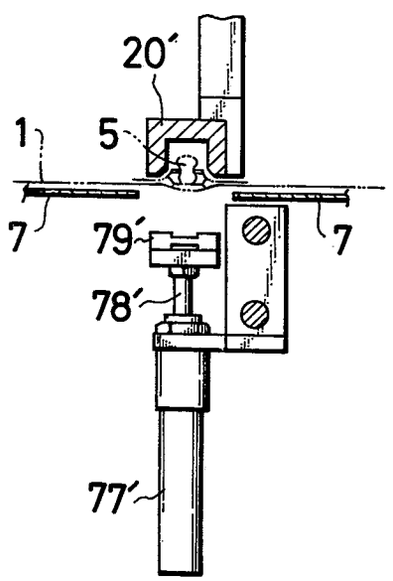


FIG. 30C

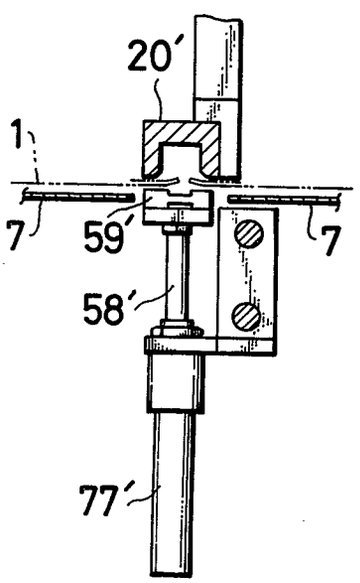


FIG. 31A

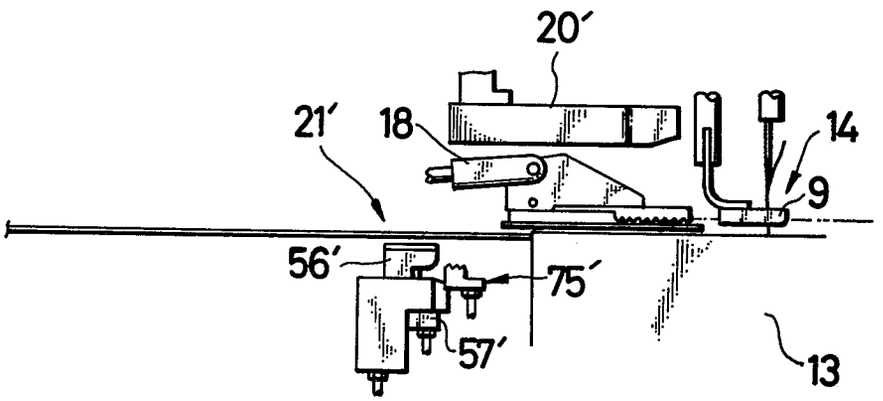
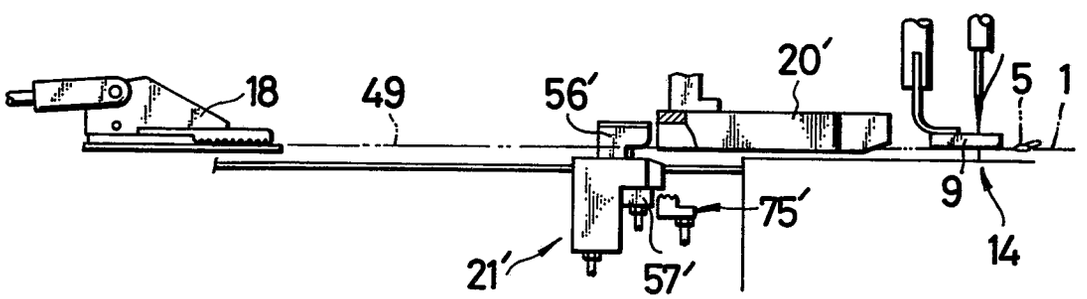


FIG. 31B



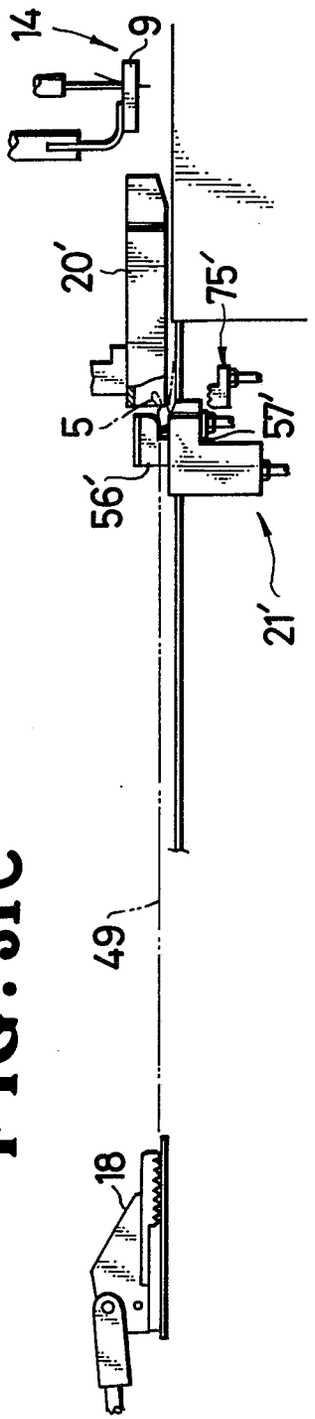


FIG.31C

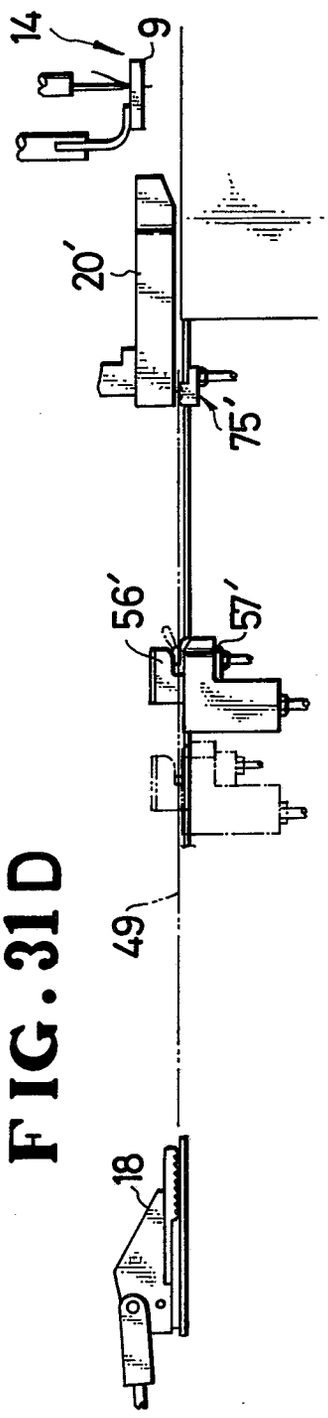


FIG.31D

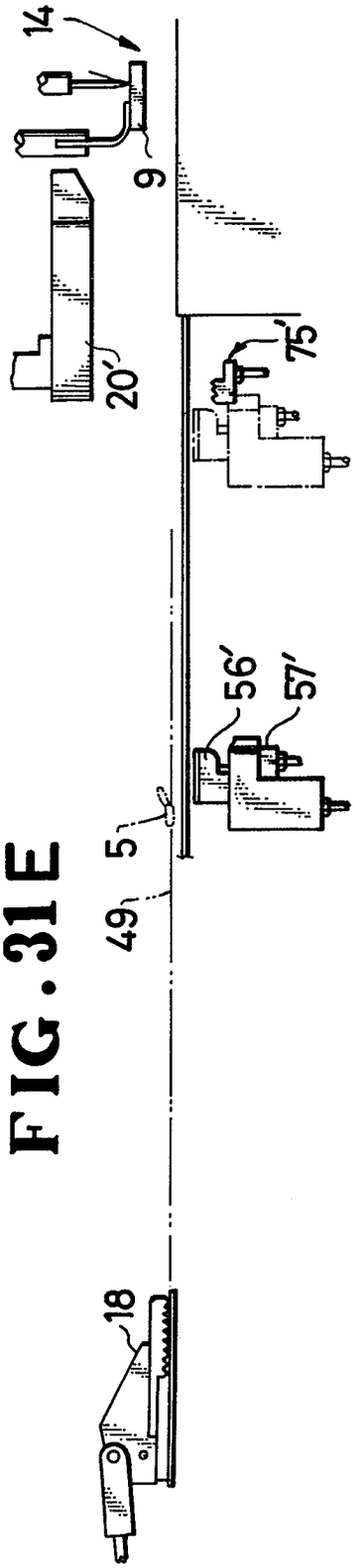


FIG.31E