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(72) Inventor: **Kawai, Yasunori**
Kariya-shi
Aichi 448-8650 (JP)

(74) Representative: **Albutt, Anthony John**
D Young & Co LLP
120 Holborn
London EC1N 2DY (GB)

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(71) Applicant: **AISIN SEIKI KABUSHIKI KAISHA**
Kariya-shi, Aichi 448-8650 (JP)

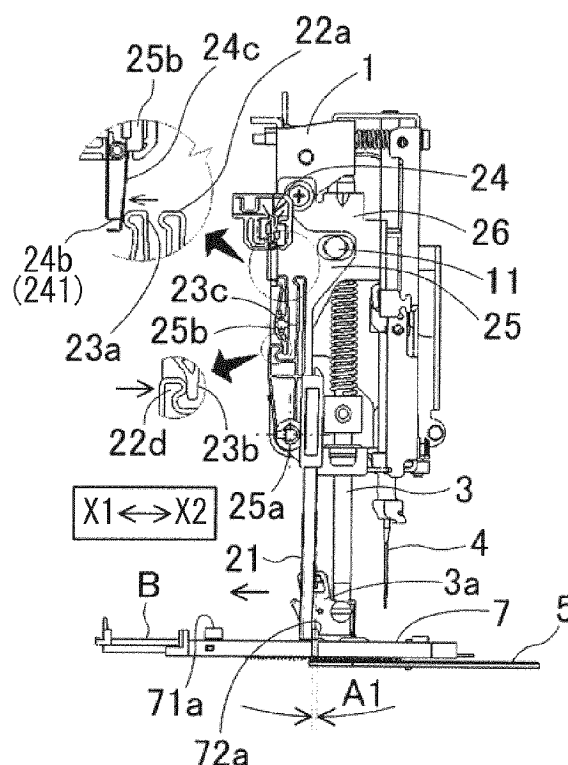
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(54) **Buttonhole sewing machine**

(57) A buttonhole sewing machine includes a buttonhole presser (7) including a presser frame (72) and two projection portions (71 a, 72a), and a buttonhole switch mechanism (2) including a detection switch (24) changing an open and closed states when the presser frame (72) is positioned at a foremost position and at a rearmost position, the buttonhole switch mechanism (2) including a lever member (21, 22, 23) having a lower end portion (21 b) positioned between the mentioned two projection portions (71 a, 72a) of the buttonhole presser (7) and rotatably supported for moving the lower end portion (21 b) in a front-rear direction. The detection switch (24) includes first and second contact points (24b, 24c) that are selectively connected to each other. The lever member (21, 22, 23) changes the open and closed states of the detection switch (24) when the lower end portion (21 b) rotates by being thrust by the projection portions (71 a, 72a), respectively.

FIG. 6A



Description

TECHNICAL FIELD

[0001] This disclosure generally relates to a buttonhole sewing machine that enables to automatically sew buttonholes.

BACKGROUND DISCUSSION

[0002] According to a sewing machine that is configured to sew buttonholes, it is necessary to change buttonhole sewing lengths in accordance with diameters of buttons. For example, computerized sewing machines disclosed in JPH08-141235A (hereinafter referred to as Patent reference 1) and JP2008-12052A (hereinafter referred to as Patent reference 2) include a detection mechanism that detects a diameter of the button and automatically sews a buttonhole with a predetermined length in accordance with the diameter of the button by automatically moving the fabric work piece in a front-rear direction in accordance with the detected diameter of the button.

[0003] The computerized sewing machine disclosed in Patent reference 1 is provided with a buttonhole sensor for detecting the diameter of the button at a housing of a machine main body. The buttonhole sensor is structured with a detection lever, a button case and a variable resistor (slide volume). After setting the button in the button case, by providing the button between an inner wall of the button case and the detection lever by moving the detection lever, a resistance value of the variable resistor changes in response to a moving amount of the detection lever, and the diameter of the button corresponding to the resistance value can be detected. At a CPU of the sewing machine, sewing data of the buttonhole is created on the basis of the feed amount of the cloth that a user set and on the basis of the detected diameter of the button, and the buttonhole is automatically sewn on the basis of the sewing data.

[0004] The computerized sewing machine disclosed in Patent reference 2 includes the built-in variable resistor at a buttonhole presser attached at a bottom end of a presser bar of the sewing machine. The buttonhole presser includes a presser member fixed to the presser bar and a presser frame that slides in a front-rear direction relative to the presser member. A relative displacement of the presser member and the presser frame is detectable by the variable resistor. According to the sewing machine disclosed in Patent reference 2, the buttonholes are automatically sewn while detecting the diameter of the button mounted to the buttonhole presser and constantly detecting the position of the buttonhole presser on the basis of the changes in the resistance value of the variable resistor.

[0005] According to the sewing machine disclosed in Patent reference 1, the variable resistor is applied as the detection mechanism for detecting the diameter of the button while the variable resistor is applied as the detec-

tion mechanism for detecting the diameter of the button and the position of the buttonhole presser according to the sewing machine disclosed in Patent reference 2. Thus, the sewing machines disclosed in Patent references 1 and 2 include drawbacks because of the application of the variable resistor described as follows. First, because the variable resistor is relatively expensive, manufacturing costs increase. Second, because of variations of the resistance values and hysteresis generated even in the same production lot for the variable resistor, an adjusting mechanism and adjusting process, for example, a manufacturer electrically changing the resistance value of the variable resistor or changing set values of calibration factor that is multiplied by the resistance value of the variable resistor in the manufacturing process of the sewing machine are necessary. Because the adjustment is performed by trial and error by the manufacturer in the adjusting process, in a case where the repetition of the trial and error increases, the man-hours increase to increase the manufacturing costs.

[0006] Further, according to the sewing machine disclosed in Patent reference 2, because the variable resistor is built in the buttonhole presser, it is necessary to connect a harness extending from the buttonhole presser to a connection portion of the sewing machine main body. Thus, a user has to be careful so as not to hook the cloth onto the harness during the sewing process and when setting the cloth, the fabric work piece, to the sewing machine.

[0007] According to a sewing machine disclosed in Japanese Patent Application No. 2011-283091 (hereinafter referred to as Patent reference 3), a distance between two operation arms changes in accordance with the diameter of the button set at the buttonhole presser, and by alternately conducting two switches by the operation of a buttonhole lever of the sewing machine main body by the operation arms, the buttonhole sewing is performed by a microcomputer control. The buttonhole switch mechanism disclosed in Patent reference 3 allows to automatically sew buttonholes with lower costs than by the constructions disclosed in Patent references 1 and 2. However, because two positions are detected, according to the construction of Patent reference 3, it is necessary to use two single contact switches which are relatively lower price or one double contact switch which is relatively higher price.

[0008] JP2003-141960A (hereinafter referred to as Patent reference 4) discloses a switch device that fixes a contact piece and prevents the contact piece from falling down when a plane portion is deformed according to the construction in which two contact pieces formed in L-shape are positioned to face a base and plural bosses are positioned through the contact pieces to support the contact pieces and the plural bosses are provided at a switch base. The switch device disclosed in Patent reference 4 realizes a mounting operation of a stable contact point with high reliability readily and in a simple manner. However, because the switch base needs the plural

bosses in order to prevent the deformation other than the plane portion and to prevent the contact pieces from falling down when deformed, the switch device of Patent reference 4 is not suitable for smaller contact pieces having length equal to or shorter than 20 millimeters. That is, the switch device of Patent reference 4 is not suitable for a device in which parts with various functions are disposed in small space, for example, a sewing machine. Further, a structure for realizing a fulcrum for the elastic deformation by retaining the plane portion is manufactured by insert molding, which increases manufacturing costs.

[0009] A need thus exists for a buttonhole sewing machine which automatically sews buttonholes and is lower price.

SUMMARY

[0010] In light of the foregoing, the disclosure provides a buttonhole sewing machine, which includes a buttonhole presser including a presser frame mounted to a lower end of a presser bar and being movable in a front-rear direction relative to the presser bar and two projection portions positioned keeping a distance from one another in the front-rear direction in accordance with a diameter of a button, the projection portions moving integrally with the presser frame, a feed dog provided below the buttonhole presser and moving a fabric work piece in a front-rear direction with a predetermined feed pitch in cooperation with the presser frame, a sewing needle moving in an upward and downward direction to form stitches on the fabric work piece and configured to move in a right-left direction, a buttonhole switch mechanism including a detection switch provided at an arm portion and changing an open and closed states when the presser frame is positioned at a foremost position and at a rearmost position, the buttonhole switch mechanism including a lever member having a lower end portion positioned between said two projection portions of the buttonhole presser and rotatably supported for moving the lower end portion in a front-rear direction, and a control portion controlling a motion of the sewing needle and the feed dog on the basis of changes in the open and closed states of the detection switch. The detection switch includes first and second contact points that are selectively connected to each other. The lever member changes the open and closed states of the detection switch when the lower end portion rotates by being thrust by the projection portions, respectively.

[0011] According to another aspect of the disclosure, the detection switch includes a first contact piece including the first contact point and a second contact piece including the second contact point and made from a leaf spring, the second contact piece is fixed at a first end and facing the first contact point with a distance at a second end and the second contact piece is configured to displace towards the first contact point in response to a rotation of the lever member.

[0012] According to still another aspect of the disclosure, the first contact piece includes a plane portion formed in a rectangular strip shape and a bent portion protruding from an end of the plane portion to bend to be opposing to the second contact piece, and the second contact piece is formed in the same configuration with the first contact piece and is fixed in a state being shifted in an upward-downward direction relative to the first contact piece.

[0013] According to further aspect of the disclosure, the lever member includes a switch lever including a switch action portion, a point of application and a rotation center provided between the switch action portion and the point of application, the switch action portion changes the open and closed states of the detection switch when the switch lever rotates in a first direction. The lever member includes a buttonhole switching arm including a first switch lever thrusting portion thrusting the switch action portion to rotate the switch lever in the first direction by rotating in the first direction and a second switch lever thrusting portion thrusting the point of application to rotate the switch lever in the first direction by rotating in a second direction. One of the first switch lever thrusting portion and the second switch lever thrusting portion does not interfere with the switch lever when the other one of the first switch lever thrusting portion and the second switch lever thrusting portion thrusts the switch lever in the first direction. The first switch lever thrusting portion and the second switch lever thrusting portion are in contact with the switch lever when the lower end portion is not pushed by the projection portions.

[0014] According to the disclosure, the buttonhole switch mechanism with lower price can be attained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The foregoing and additional features and characteristics of this disclosure will become more apparent from the following detailed description considered with the reference to the accompanying drawings, wherein:

Fig. 1 is a perspective view of a buttonhole sewing machine in a state where a housing is removed according to an embodiment disclosed here;

Fig. 2A is a perspective view of a buttonhole switch mechanism for the buttonhole sewing machine in a state where a buttonhole switching lever is housed according to the embodiment disclosed here;

Fig. 2B is a perspective view of the buttonhole switch mechanism for the buttonhole sewing machine in a state where the buttonhole switching lever is at a lowered state according to the embodiment disclosed here;

Fig. 3 is an exploded perspective view of the buttonhole switch mechanism for the buttonhole sewing machine according to the embodiment disclosed here;

Fig. 4 is a perspective view of a buttonhole presser

combined with the buttonhole switch mechanism for the buttonhole sewing machine according to the embodiment disclosed here;

Fig. 5 is an explanatory exploded perspective view of a main portion of the buttonhole switch mechanism for the buttonhole sewing machine showing a state where a detection switch is not conducted according to the embodiment disclosed here;

Fig. 6A is an explanatory view showing an operation of the buttonhole switch mechanism for the buttonhole sewing machine in a state where the buttonhole presser is at a start position for sewing a buttonhole according to the embodiment disclosed here;

Fig. 6B is an explanatory view showing the operation of the buttonhole switch mechanism for the buttonhole sewing machine in a state where the buttonhole presser is at a reverse position for sewing the buttonhole according to the embodiment disclosed here;

Fig. 6C is an explanatory view showing the operation of the buttonhole switch mechanism for the buttonhole sewing machine in a state where the buttonhole presser is at a position where the buttonhole sewing is completed according to the embodiment disclosed here;

Fig. 7 is a block diagram for a control portion of the buttonhole sewing machine provided with the buttonhole switch mechanism according to the embodiment disclosed here;

Fig. 8 is an explanatory view for explaining procedures of buttonhole sewing by the buttonhole sewing machine provided with the buttonhole switch mechanism according to the embodiment disclosed here; and

Fig. 9 is a table showing relationships between count numbers by a detection switch and the procedures of the buttonhole sewing by the buttonhole switch mechanism for the buttonhole sewing machine according to the embodiment disclosed here.

DETAILED DESCRIPTION

[0016] One embodiment of a buttonhole sewing machine will be explained with reference to Figs. 1 to 9 as follows. Up (upper, top), down (lower, bottom), right (rightward), left (leftward), front (forward), rear (rearward) in the descriptions refer to up (upper, top), down (lower, bottom), right (rightward), left (leftward), front (forward), rear (rearward) in Fig. 1 and indicate up (upper, top), down (lower, bottom), right (rightward), left (leftward), front (forward), rear (rearward) for a user when the user uses the sewing machine.

[0017] A main body of the sewing machine includes a housing serving as a contour of the sewing machine and a sewing machine frame M serving as a main element that is covered with the housing. As illustrated in Fig. 1, the sewing machine frame M is structured with a machine frame 1 (immovable portion) and various component

parts for the sewing machine mounted to the machine frame 1. The machine frame 1 includes an upper arm portion (serving as an arm portion) 1a, a bed portion (work supporting arm) 1b provided at a lower portion, and a vertical arm portion 1c connecting the upper arm portion 1a and the bed portion 1b at right-hand bottom end of the upper arm portion 1a and right-hand top end of the bed portion 1b. A buttonhole switch mechanism 2, a presser bar 3, and a sewing needle 4 are provided at a left end of the upper arm portion 1a of the machine frame 1. The presser bar 3 is movable in an upward-downward direction in accordance with a thickness of a fabric which serves as a work piece. The sewing needle 4 is configured to form stitches in response to an upward-downward motion thereof and to move in rightward-leftward directions. A throat plate 5 and a feed dog 6 which protrudes and retracts relative to an upper surface of the throat plate 5 for feeding a fabric work piece are disposed at the leftward portion of the bed portion 1b of the machine frame 1. A buttonhole presser 7 is attached to a presser holder 3a that is fixed to a bottom end of the presser bar 3 by means of a screw.

[0018] As illustrated in Figs. 2A, 2B, and 3, the buttonhole switch mechanism 2 includes a buttonhole switching lever (i.e., serving as a lever member) 21, a buttonhole switching arm (i.e., serving as a lever member) 22, a switch lever (i.e., serving as a lever member) 23, a detection switch 24, and an attaching portion 25. After integrally assembling the buttonhole switching lever 21, the buttonhole switching arm 22, the switch lever 23, the detection switch 24, and the attaching portion 25 as a unit, as illustrated in Fig. 1, by fixing the unit onto the left-hand side of the upper arm portion 1a of the machine frame 1 via a base plate 26 by means of the screw, the buttonhole switch mechanism 2 is attached to the machine frame 1.

[0019] The buttonhole switching lever 21 is a bar shaped, or rod shaped member having a cross-section in rectangular shape and elongated in an upward-downward direction. The buttonhole switching lever 21 is provided with an engagement pawl 21a at an upper end and a knob portion (lower end portion) 21b at a lower end. The buttonhole switching lever 21 is inserted from the downward to the upward into a lever retaining portion 22b of the buttonhole switching arm 22 so that the buttonhole switching lever 21 is retained to be slidable in an upward-downward direction relative to the buttonhole switching arm 22.

[0020] The buttonhole switching arm 22 is formed with a first switch lever thrusting portion 22a, a second switch lever thrusting portion 22d, the lever retaining portion 22b, and a bearing hole 22c. The second switch lever thrusting portion 22d is provided at, or diverges from a middle, or a center portion of the buttonhole switching arm 22 in an upward-downward direction to protrude forward and upward. The lever retaining portion 22b is provided at a lower portion of the buttonhole switching arm 22. The bearing hole 22c is provided at a forward of the

lever retaining portion 22b and penetrates through in a rightward-leftward direction. The first switch lever thrusting portion 22a includes a round portion protruding forward and protrudes higher than the second switch lever thrusting portion 22d. The second switch lever thrusting portion 22d includes a round portion protruding rearward and is positioned at a lower end level of the first switch lever thrusting portion 22a. The lever retaining portion 22b is formed in a sleeve or pipe shape which extends in an upward-downward direction and is formed to have a rectangular cross-section. The bearing hole 22c is positioned at a portion below the diverging portion of the first switch lever thrusting portion 22a and the second switch lever thrusting portion 22d. A rotation shaft 25a formed at the attaching portion 25 is positioned inside the bearing hole 22c, and an engagement pawl formed at a distal end of the rotation shaft 25a is engaged with a left-hand end of the bearing hole 22c to prevent the buttonhole switching arm 22 from falling off from the rotation shaft 25a. The buttonhole switching arm 22 is supported by the rotation shaft 25a formed at the attaching portion 25 to be rotatable in a front-rear direction in a state where the buttonhole switching lever 21 is retained at the lever retaining portion 22b.

[0021] By a user's operation of the buttonhole switching lever 21, pinching the knob portion 21 b to draw the buttonhole switching lever 21 downward, the buttonhole switching lever 21 is switched from a housed state (normal sewing state) shown in Fig. 2A to a lowered position state shown in Fig. 2B. Then, the knob portion 21 b of the buttonhole switching lever 21 comes to contact with the buttonhole presser 7 to electrically conduct the detection switch 24 so that a control portion 8 (see Fig. 7) determines that the buttonhole switching lever 21 is at the lowered position and a state which allows the buttonhole sewing is established (see Fig. 6). At the lowered position state of the buttonhole switching lever 21 shown in Fig. 2B, by the engagement of the engagement pawl 21 a with the upper end of the lever retaining portion 22b, the buttonhole switching lever 21 is prevented from falling off from the lever retaining portion 22b.

[0022] The switch lever 23 includes a switch action portion 23a at an upper end thereof, a point of application 23b at a lower end thereof, and a rotation center 23c at a lower portion relative to the center thereof. The switch action portion 23a includes a round portion protruding forward, positioned at a forward of the first switch lever thrusting portion 22a and at an approximately the same height with an end of the first switch lever thrusting portion 22a so as to be contactable with the first switch lever thrusting portion 22a. The point of application 23b is positioned between the second switch lever thrusting portion 22d and the lower end of the first switch lever thrusting portion 22a at the portion where the first switch lever thrusting portion 22a and the second switch lever thrusting portion 22d of the buttonhole switching arm 22 diverge, and the point of application 23b is contactable with the second switch lever thrusting portion 22d. The rota-

tion center 23c penetrates in the right-left direction and a rotation shaft 25b formed at the attaching portion 25 is inserted to be positioned in the rotation center 23c. An engagement pawl formed at a distal end of the rotation shaft 25b is engaged with the rotation center 23c in the front-rear direction so as to prevent the switch lever 23 from falling off from the rotation shaft 25b.

[0023] The detection switch 24 includes a first contact piece 241 and a second contact piece 242 each made of metal. Each of the first contact piece 241 and the second contact piece 242 includes a harness connection portion 24a at an upper end thereof, a bent portion 24b at a lower end thereof, a plane portion 24c which is formed in a rectangular strip shape elongated in an upward-downward direction and connects the harness connection portion 24a and the bent portion 24b, and a fitting portion 24d formed above the plane portion 24c. The first contact piece 241 and the second contact piece 242 have the same configuration and dimension. The harness connection portion 24a is formed with a through hole penetrating in an approximately front-rear direction and is connected to a harness for transmitting an input signal to the control portion 8. The bent portion 24b is bent in a substantially right angle relative to the plane portion 24c. The fitting portion 24d is bent in a substantially U-shape to protrude to the opposite direction relative to the bent portion 24b. In the detection switch 24, the first contact piece 241 and the second contact piece 242 are arranged so that the bent portions 24b protrude to oppose to each other and are shifted in an upward-downward direction from each other and face one another in the front-rear direction. The detection switch 24 is fixed to the attaching portion 25 by snap-fitting the fitting portion 24d to a detection switch fixing portion 25d. The second contact piece 242 is shifted downward so that the bent portion 24b of the first contact piece 241 faces the plane portion 24c of the second contact piece 242 with a distance. The second contact piece 242 is positioned at the rearward relative to the first contact piece 241. The plane portion 24c of the second contact piece 242 is positioned at the forward of the switch action portion 23a of the switch lever 23. The bent portion 24b of the first contact piece 241 serves as a first contact point. A portion of the plane portion 24c of the second contact piece 242 which is positioned opposing to, or facing the bent portion 24b of the first contact piece 241 serves as a second contact point.

[0024] When the buttonhole switching arm 22 rotates in the clockwise direction, the second switch lever thrusting portion 22d thrusts the point of application 23b of the switch lever 23 in a rearward direction (i.e., the counterclockwise direction). When the buttonhole switching arm 22 rotates in the counterclockwise direction, the first switch lever thrusting portion 22a thrusts the switch action portion 23a of the switch lever 23 in the forward direction (i.e., counterclockwise direction). Namely, irrespective of the rotation direction of the buttonhole switching arm 22, the switch lever 23 always operates in the counterclockwise direction. Thus, the switch action por-

tion 23a thrusts, or pushes the plane portion 24c of the second contact piece 242, the plane portion 24c is elastically deformed, the second contact point displaces towards the bent portion 24b serving as the first contact point, and the detection switch 24 is electrically conducted when the plane portion 24c contacts the bent portion 24b. When the first switch lever thrusting portion 22a rotates the switch lever 23, the second switch lever thrusting portion 22d and other portions of the buttonhole switching arm 22 do not interfere with the switch lever 23. When the second switch lever thrusting portion 22d rotates the switch lever 23, the first switch lever thrusting portion 22a and other portions of the buttonhole switching arm 22 do not interfere with the switch lever 23. The integrated buttonhole switching lever 21, the buttonhole switching arm 22, and the switch lever 23 serve as a lever member.

[0025] The attaching portion 25 is a plate-shaped member having surfaces extending in an upward-downward direction and front-rear direction and elongated in the upward-downward direction. The rotation shaft 25a for the buttonhole switching arm 22, the rotation shaft 25a protruding in the leftward, is formed at a lower portion of the surface of the attaching portion 25. The rotation shaft 25b for the switch lever 23, the rotation shaft 25b protruding in the leftward direction, is formed at a center portion of the attaching portion 25. A stopper hole 25c that is an elongated hole elongated in the front-rear direction and penetrated in the right-left direction is formed between the rotation shaft 25a and the rotation shaft 25b in the upward-downward direction. By the insertion of a pin provided at a reverse side (right-hand surface) of the buttonhole switching arm 22 into the stopper hole 25c, a rotational range of the buttonhole switching arm 22 is restricted.

[0026] The detection switch fixing portion 25d for fixing the detection switch 24 is formed at a face of an upper front portion of the attaching portion 25. A screw stopper hole 25e which is an elongated hole elongated in a front-rear direction and penetrating in right-left direction is formed at an upper rear portion of the surfaces of the attaching portion 25. A pin 25f protruding in a rightward direction is provided at a backside (right-hand surface) of the attaching portion 25 at slightly lower position relative to the screw stopper hole 25e. The attaching portion 25 is fixed to the base plate 26 by means of a fixation screw (set screw) 11 that is positioned in the screw stopper hole 25e in a state where the pin 25f is positioned in a long hole of the base plate 26 (see Fig. 6).

[0027] As illustrated in Fig. 4, the buttonhole presser 7 includes a presser frame 72 that is a main body of the buttonhole presser 7, a button diameter measurement member 71 that is provided to be slidable in a front-rear direction relative to the presser frame 72, and a slide member 73 that is provided to be slidable on the presser frame 72. The slide member 73 is biased to contact the presser frame 72 by a tensile force of a spiral spring (power spring) provided within the presser frame 72. By the

attachment of the slide member 73 to the presser holder 3a provided at the lower end of the presser bar 3, the presser frame 72 is movable in the front-rear direction relative to the presser bar 3.

[0028] The presser frame 72 includes a plane surface formed in a rectangular shape elongated in a front-rear direction. A lever operation arm 72a, serving as a projection portion, that protrudes upward and leftward is formed at an intermediate portion of the presser frame 72 at leftwards in the front-rear direction. A button contact surface 72b that protrudes upward is formed at a front end of the presser frame 72. A stopper 72c that is configured to contact the slide member 73 is formed at a rear portion within the presser frame 72. The slide member 73 is biased to contact the stopper 72c by means of a biasing force (spring force) of a biasing member.

[0029] The button diameter measurement member 71 includes a plane surface formed in a rectangular shape elongated in a front-rear direction. Long sides at right-hand and left-hand of the button diameter measurement member 71 are slidably supported by long sides at right-hand and left-hand of the presser frame 72 in a sandwiched manner. A lever operation arm 71a, serving as a projection portion, protruding upward and leftward is formed at a leftward-rear end of the button diameter measurement member 71. A button contact surface 71b protruding upward is formed at a front end of the button diameter measurement member 71. When the button diameter measurement member 71 is at a rearmost slidable position relative to the presser frame 72, the lever operation arm 71a contacts the lever operation arm 72a and the button contact surface 71b contacts the button contact surface 72b. As illustrated in Figs. 1, 4 and 6, when a button B is sandwiched between the button contact surface 71b of the button diameter measurement member 71 and the button contact surface 72b of the presser frame 72, a distance H between the lever operation arm 71a of the button diameter measurement member 71 and the lever operation arm 72a of the presser frame 72 change in accordance with a diameter of the button B. Length (dimension) of the buttonhole when finishing sewing is determined by the distance H.

[0030] The buttonhole sewing by the computerized sewing machine including the buttonhole switch mechanism 2 and the buttonhole presser 7 will be explained with reference to Figs. 5 to 9. Figs. 6A, 6B, 6C illustrate transitional states of the operation of the buttonhole switch mechanism 2 and the buttonhole presser 7 when performing the buttonhole sewing. Fig. 6A shows a state A where the buttonhole presser 7 is at a start position for the buttonhole sewing. Fig. 6B shows a state B where the buttonhole presser 7 is at a reverse position for the buttonhole sewing. Fig. 6C shows a state C where the buttonhole presser 7 is at a position where the buttonhole sewing is completed.

[0031] In a normal sewing state, as illustrated in Figs. 1 and 2A, the buttonhole switching lever 21 is at the housed state. In those circumstances, as illustrated in

Fig. 5, the bent portion 24b of the first contact piece 241 of the detection switch 24 and the plane portion 24c of the second contact piece 242 are separated, and the detection switch 24 is not electrically conducted because the first contact point and the second contact point are not in contact (disconnected). In this case, as a preparatory operation for performing the buttonhole sewing by the user, as illustrated in Fig. 4, the slide member 73 of the buttonhole presser 7 comes to contact the stopper 72c to establish a state where the presser frame 72 is moved to be positioned at a foremost position.

[0032] As illustrated in Fig. 6A, upon drawing the knob portion 21 b provided at the lower end of the buttonhole switching lever 21 downward to contact the lever operation arm 72a of the buttonhole presser 7, the buttonhole switching arm 22 rotates in the clockwise direction about the rotation shaft 25a and the second switch lever thrusting portion 22d thrusts the point of application 23b of the switch lever 23 in a rearward direction (i.e., direction X2 in Fig. 6). The switch lever 23 rotates in the counterclockwise direction about the rotation center 23c, the plane portion 24c of the second contact piece 242 is thrust, or pushed by the switch action portion 23a in a forward direction (i.e., direction X1 in Fig. 6) to be elastically deformed thus contacting the bent portion 24b of the first contact piece 241 to electrically conduct. This electric conduction corresponds to an input signal of the detection switch 24 (buttonhole sensor) shown in Fig. 7. In a case where the user selects a buttonhole sewing mode, by controlling for allowing the activation of the sewing machine by a foot controller connected to the sewing machine frame M or start/stop switch (i.e., serving as an input portion) 10 only when the input signal of the detection switch 24 (buttonhole sensor) is conducted, the activation of the sewing machine while the user forget drawing, or moving the buttonhole switching lever 21 downward is prevented.

[0033] When the user activates the sewing machine by the operation of the start/stop switch 10 of the sewing machine frame M or by the operation of the foot controller connected to the sewing machine frame M, the buttonhole is sewn automatically in an order shown in Fig. 8. When the sewing machine is activated in a state indicated with 101 in Fig. 8 and a state shown in Fig. 6A (defined as state A), the control portion 8 controls a sewing machine actuation motor 9a (see Fig. 7) to perform straight stitching while moving the cloth rearward (i.e., direction X2 in Fig. 6) together with the buttonhole presser 7 by means of a feed mechanism with the feed dog 6 of the sewing machine frame M. Then, when the knob portion 21 b of the buttonhole switching lever 21 comes in contact with the lever operation arm 71 a of the buttonhole presser 7, the buttonhole switching arm 22 rotates in the counterclockwise direction about the rotation shaft 25a so that the first switch lever thrusting portion 22a thrusts, or pushes the switch action portion 23a of the switch lever 23 forward (i.e., direction X1 in Fig. 6). The switch lever 23 rotates in the counterclockwise direction about the rota-

tion center 23c and the plane portion 24c of the second contact piece 242 is thrust, or pushed forward (i.e., direction X1 in Fig. 6) by the switch action portion 23a and is elastically deformed so as to contact the bent portion 24b of the first contact piece 241, thus to electrically conduct the detection switch 24. This electric conduction corresponds to an input signal of the detection switch 24 (buttonhole sensor) shown in Fig. 7. The control portion 8 reverses the feeding direction of the cloth (fabric) to the forward by moving a feed mechanism stepping motor 9b.

[0034] In a state indicated with 103 in Fig. 8 corresponding to a state shown in Fig. 6C (defined as state C), similarly to the state A in Fig. 6A, the plane portion 24c of the second contact piece 242 is thrust, or pushed forward (i.e., direction X1 in Fig. 6) to be elastically deformed and to come to contact the bent portion 24b of the first contact piece 241 to electrically conduct the detection switch 24 so that the input signal of the detection switch 24 (buttonhole sensor) shown in Fig. 7 is transmitted to the control portion 8. The control portion 8 reverses the feeding direction of the cloth, or fabric to the rearward (i.e., direction X2 in Fig. 6) by moving the feed mechanism stepping motor 9b. Then, in a state indicated with 104 shown in Fig. 8, the control portion 8 performs a zigzag sewing by moving the sewing needle 4 in the right-left direction alternatively by a swing width mechanism stepping motor 9c. Accordingly, in response to the input number of times of the input signal of the detection switch 24 (buttonhole sensor) shown in Fig. 7, the control portion 8 controls the sewing machine actuation motor (i.e., serving as an output portion) 9a, the feed mechanism stepping motor (i.e., serving as an output portion) 9b, and the swing width mechanism stepping motor (i.e., serving as an output portion) 9c to automatically perform the buttonhole sewing in the order indicated with 101 to 108 in Fig. 8. The correspondence of the input number of times of the input signal of the buttonhole sensor and the procedures 101 to 108 is as shown in Fig. 9. The counter number is reset when exceeding eight (8) or when the start/stop switch 10 of the sewing machine frame M is pressed. As long as the control portion 8 enables to judge that an input signal is transmitted from the detection switch 24 (buttonhole sensor), any form of input signal is applicable.

[0035] According to the construction of the buttonhole switch mechanism 2 and the buttonhole presser 7, the knob portion 21 b of the buttonhole switching lever 21 is disengaged from (non-contact) the lever operation arm 71 a or the lever operation arm 72a of the buttonhole presser 7 in positional states between states shown in Fig. 6A and Fig. 6B, and between states shown in Fig. 6B and Fig. 6C. As illustrated in Fig. 5, by the elastic force of the plane portion 24c of the second contact piece 242, a clearance, or gap is made between the contact portion (bent portion 24b) of the first contact piece 241 and the plane portion 24c of the second contact piece 242. In those circumstances, the first switch lever thrusting por-

tion 22a of the buttonhole switching arm 22 and the switch action portion 23a of the switch lever 23 are in contact with each other and the second switch lever thrusting portion 22d of the buttonhole switching arm 22 and the point of application 23b of the switch lever 23 are in contact with each other.

[0036] At the completion of the buttonhole sewing, at the sewing end indicated with 108 in Fig. 8, whisker-shaped stitching pattern (sewing trace) corresponding to length D1 may be generated, which impairs the appearance of the finished buttonhole. The sewing trace that impairs the appearance is generated provided that the user makes the knob portion 21 b of the buttonhole switching lever 21 contact the lever operation arm 72a of the buttonhole presser 7 excessively to excessively thrust the detection switch 24 in the state A shown in Fig. 6 whereas the thrust amount of the detection switch 24 when the knob portion 21 b automatically contacts the lever operation arm 72a is the minimum necessary amount in the state C in Fig. 6. In consequence, in the state C shown in Fig. 6, as indicated with 103 and 106 in Fig. 8, the feeding direction of the cloth (fabric) is reversed at a timing before returning to the state A at the start position. In other words, the sewing trace that impairs the appearance is unlikely generated in a case where the thrust amount of the detection switch 24 at the state A in Fig. 6 is the minimum necessary amount likewise the thrust amount of the detection switch 24 at the state C in Fig. 6.

[0037] In order to solve the above described problem, the position for electrically conducting the detection switch may be adjusted so that the excessive thrust amount of the detection switch 24 in the state A in Fig. 6A is assumed to be equal to the minimum requirements of the thrust amount of the detection switch 24 in the state C in Fig. 6C. For example, an adjusting mechanism for performing the foregoing adjustment is disclosed in JP2011-283091A. The buttonhole switch mechanism according to this embodiment may include a similar adjusting mechanism.

[0038] According to the buttonhole switch mechanism 2 of the embodiment, the fitting portion 24d of the detection switch 24 is strengthened (rigidly formed) by being bent in a U-shape and a base portion of the plane portion 24c extended from the bent portion 24b (i.e., the portion fixed to the detection switch fixing portion 25d) serves as a fulcrum for the elastic deformation and thus the buttonhole switch mechanism 2 is formed in a relatively small dimension (equal to or less than 20 millimeter in the total length). Further, according to the detection switch 24 of the embodiment, because the contact pieces (241, 242) formed in the same configuration and dimension are used and are positioned in a manner that the bent portions 24b are opposed to one another where the contact pieces are displaced from one another in an upward-downward direction, productivity in the mass production is enhanced. Instead of the switch described above, a single contact switch with lower price may be readily applicable.

Thus, according to the buttonhole switch mechanism 2 of the embodiment, a sewing machine with lower price can be provided to end users.

[0039] The buttonhole switch mechanism of the disclosure is not limited to the above-described embodiment. For example, the lever members (21 to 23) are not limited to the construction to thrust, or push the second contact piece 242 of the detection switch 24 in one direction. Alternatively, the first contact piece 241 and the second contact piece 242 may be pushed towards the opposing contact pieces one another.

Claims

1. A buttonhole sewing machine, comprising:

a buttonhole presser (7) including a presser frame (72) mounted to a lower end of a presser bar (3) and being movable in a front-rear direction relative to the presser bar (3) and two projection portions (71 a, 72a) positioned keeping a distance from one another in the front-rear direction in accordance with a diameter of a button, the projection portions (71 a, 72a) moving integrally with the presser frame (72);

a feed dog (6) provided below the buttonhole presser (7) and moving a fabric work piece in a front-rear direction with a predetermined feed pitch in cooperation with the presser frame (72);

a sewing needle (4) moving in an upward and downward direction to form stitches on the fabric work piece and configured to move in a right-left direction;

a buttonhole switch mechanism (2) including a detection switch (24) provided at an arm portion (1 a) and changing an open and closed states when the presser frame (72) is positioned at a foremost position and at a rearmost position, the buttonhole switch mechanism (2) including a lever member (21, 22, 23) having a lower end portion (21 b) positioned between said two projection portions (71 a, 72a) of the buttonhole presser (7) and rotatably supported for moving the lower end portion (21 b) in a front-rear direction;

a control portion (8) controlling a motion of the sewing needle (4) and the feed dog (6) on the basis of changes in the open and closed states of the detection switch (24);

wherein the detection switch (24) includes first and second contact points (24b, 24c) that are selectively connected to each other; and

the lever member (21, 22, 23) changes the open and closed states of the detection switch (24) when the lower end portion (21 b) rotates by being thrust by the projection portions (71 a, 72a), respectively.

2. The buttonhole sewing machine according to claim 1, wherein the detection switch (24) includes a first contact piece (241) including the first contact point (24b) and a second contact piece (242) including the second contact point (24c) and made from a leaf spring, the second contact piece (242) is fixed at a first end and facing the first contact point with a distance at a second end and the second contact piece (242) is configured to displace towards the first contact point in response to a rotation of the lever member (21, 22, 23).
3. The buttonhole sewing machine according to claim 2, wherein the first contact piece (241) includes a plane portion (24c) formed in a rectangular strip shape and a bent portion (24b) protruding from an end of the plane portion (24c) to bend to be opposing to the second contact piece (242), and the second contact piece (242) is formed in the same configuration with the first contact piece (241) and is fixed in a state being shifted in an upward-downward direction relative to the first contact piece.
4. The buttonhole sewing machine according to any one of claims 1 to 3, wherein the lever member (21, 22, 23) includes a switch lever (23) including a switch action portion (23a), a point of application (23b) and a rotation center provided between the switch action portion (23a) and the point of application (23b), the switch action portion (23a) changes the open and closed states of the detection switch (24) when the switch lever (23) rotates in a first direction; the lever member (21, 22, 23) includes a buttonhole switching arm (22) including a first switch lever thrusting portion (22a) thrusting the switch action portion (23a) to rotate the switch lever (23) in the first direction by rotating in the first direction and a second switch lever thrusting portion (22d) thrusting the point of application (23b) to rotate the switch lever (23) in the first direction by rotating in a second direction; one of the first switch lever thrusting portion (22a) and the second switch lever thrusting portion (22d) does not interfere with the switch lever (23) when the other one of the first switch lever thrusting portion (22a) and the second switch lever thrusting portion (22d) thrusts the switch lever (23) in the first direction; and the first switch lever thrusting portion (22a) and the second switch lever thrusting portion (22d) are in contact with the switch lever (23) when the lower end portion (21 b) is not pushed by the projection portions (71 a, 72a).

Amended claims in accordance with Rule 137(2) EPC.

1. A buttonhole sewing machine, comprising:

a buttonhole presser (7) including a presser frame (72) mounted to a lower end of a presser bar (3) and being movable in a front-rear direction relative to the presser bar (3) and two projection portions (71 a, 72a) positioned keeping a distance from one another in the front-rear direction in accordance with a diameter of a button, the projection portions (71 a, 72a) moving integrally with the presser frame (72);

a feed dog (6) provided below the buttonhole presser (7) and moving a fabric work piece in a front-rear direction with a predetermined feed pitch in cooperation with the presser frame (72);

a sewing needle (4) moving in an upward and downward direction to form stitches on the fabric work piece and configured to move in a right-left direction;

a buttonhole switch mechanism (2) including a detection switch (24) provided at an arm portion (1 a) and changing an open and closed states when the presser frame (72) is positioned at a foremost position and at a rearmost position, the buttonhole switch mechanism (2) including a lever member (21, 22, 23) having a lower end portion (21 b) positioned between said two projection portions (71 a, 72a) of the buttonhole presser (7) and rotatably supported for moving the lower end portion (21 b) in a front-rear direction;

a control portion (8) controlling a motion of the sewing needle (4) and the feed dog (6) on the basis of changes in the open and closed states of the detection switch (24);

wherein the detection switch (24) includes first and second contact points (24b, 24c) that are selectively connected to each other; and the lever member (21, 22, 23) changes the open and closed states of the detection switch (24) when the lower end portion (21 b) rotates by being thrust by the projection portions (71 a, 72a), respectively;

wherein the lever member (21, 22, 23) includes a switch lever (23) including a switch action portion (23a), a point of application (23b) and a rotation center provided between the switch action portion (23a) and the point of application (23b), the switch action portion (23a) changes the open and closed states of the detection switch (24) when the switch lever (23) rotates in a first direction; the lever member (21, 22, 23) includes a buttonhole switching arm (22) including a first switch lever thrusting portion (22a) thrusting the switch action portion (23a) to rotate the switch lever (23) in the first direction by rotating in the first direction and a second switch lever thrusting portion (22d) thrusting the point of application (23b) to rotate the switch lever (23) in the first direction by rotating in a second direction; one of the first switch lever thrusting portion

(22a) and the second switch lever thrusting portion (22d) does not interfere with the switch lever (23) when the other one of the first switch lever thrusting portion (22a) and the second switch lever thrusting portion (22d) thrusts the switch lever (23) in the first direction; and the first switch lever thrusting portion (22a) and the second switch lever thrusting portion (22d) are in contact with the switch lever (23) when the lower end portion (21 b) is not pushed by the projection portions (71 a, 72a).

2. The buttonhole sewing machine according to claim 1, wherein the detection switch (24) includes a first contact piece (241) including the first contact point (24b) and a second contact piece (242) including the second contact point (24c) and made from a leaf spring, the second contact piece (242) is fixed at a first end and facing the first contact point with a distance at a second end and the second contact piece (242) is configured to displace towards the first contact point in response to a rotation of the lever member (21, 22, 23).

3. The buttonhole sewing machine according to claim 2, wherein the first contact piece (241) includes a plane portion (24c) formed in a rectangular strip shape and a bent portion (24b) protruding from an end of the plane portion (24c) to bend to be opposing to the second contact piece (242), and the second contact piece (242) is formed in the same configuration with the first contact piece (241) and is fixed in a state being shifted in an upward-downward direction relative to the first contact piece.

FIG. 1

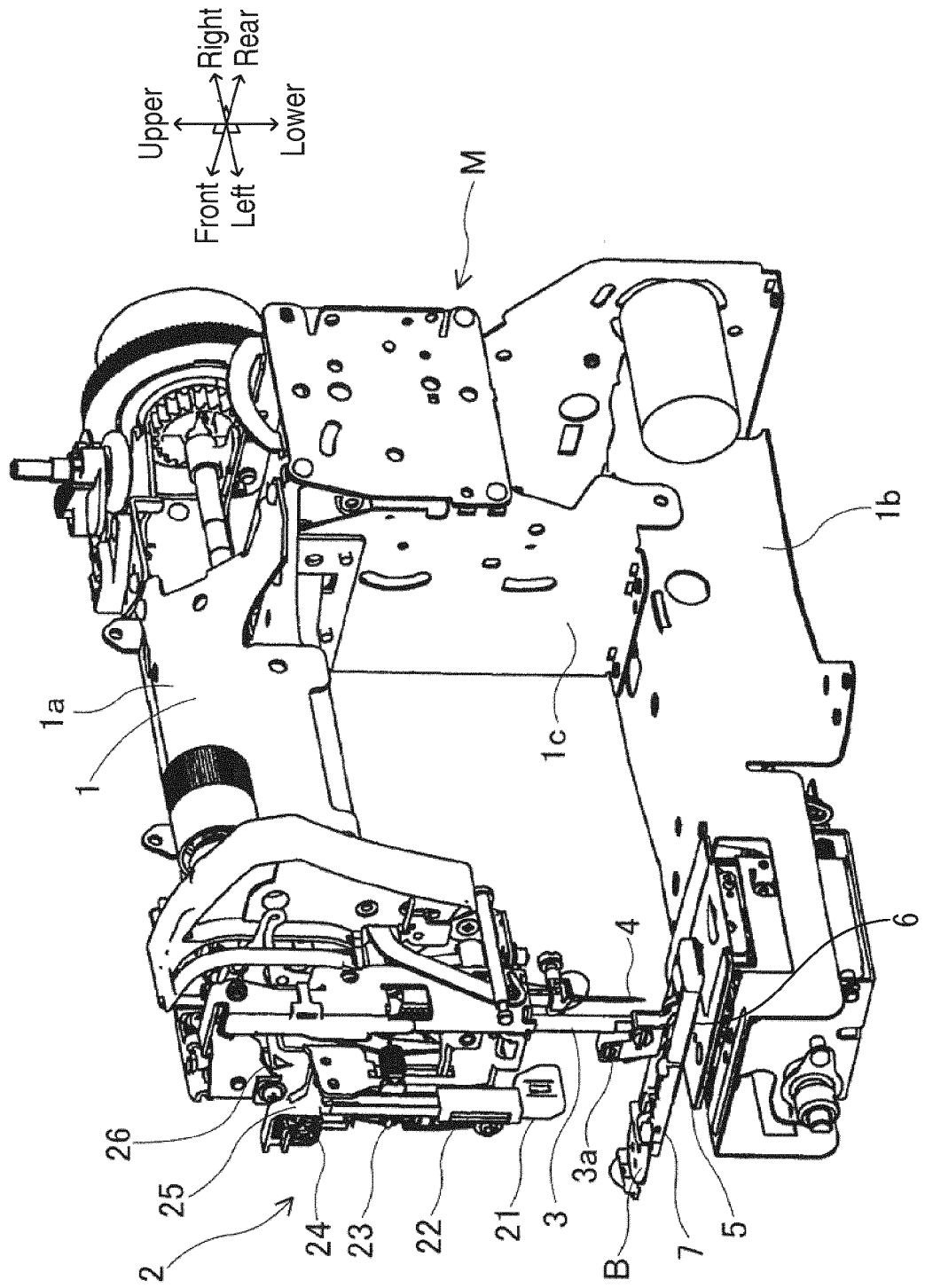


FIG. 2 A

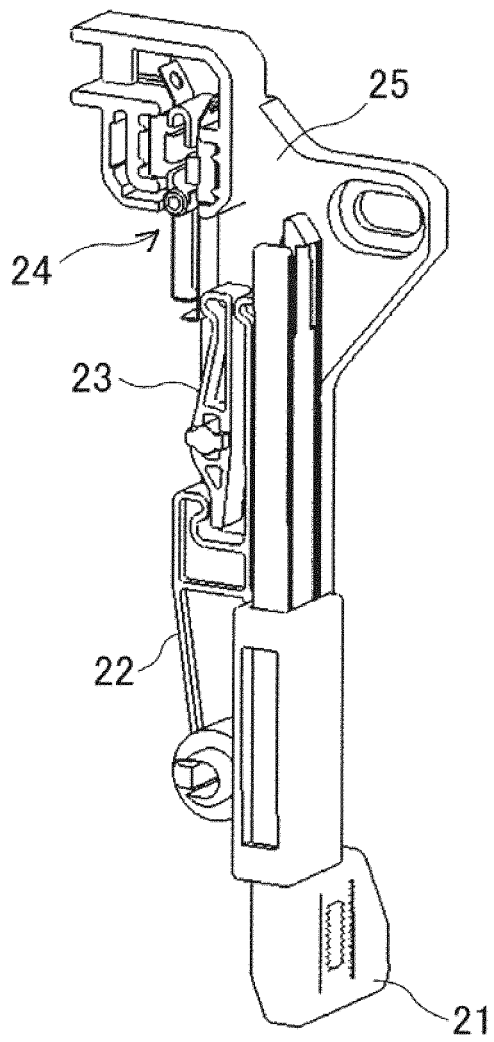


FIG. 2 B

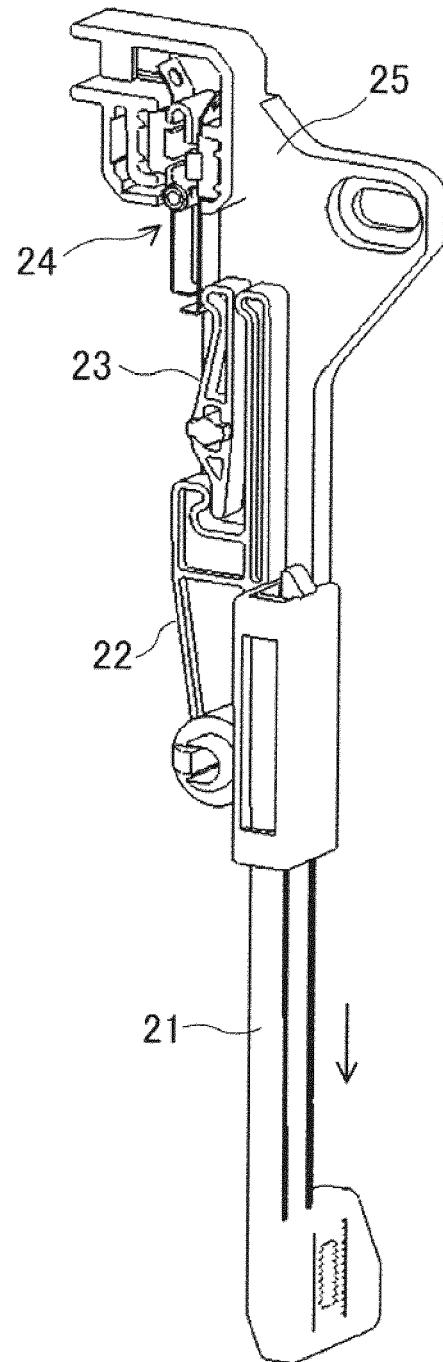


FIG. 3

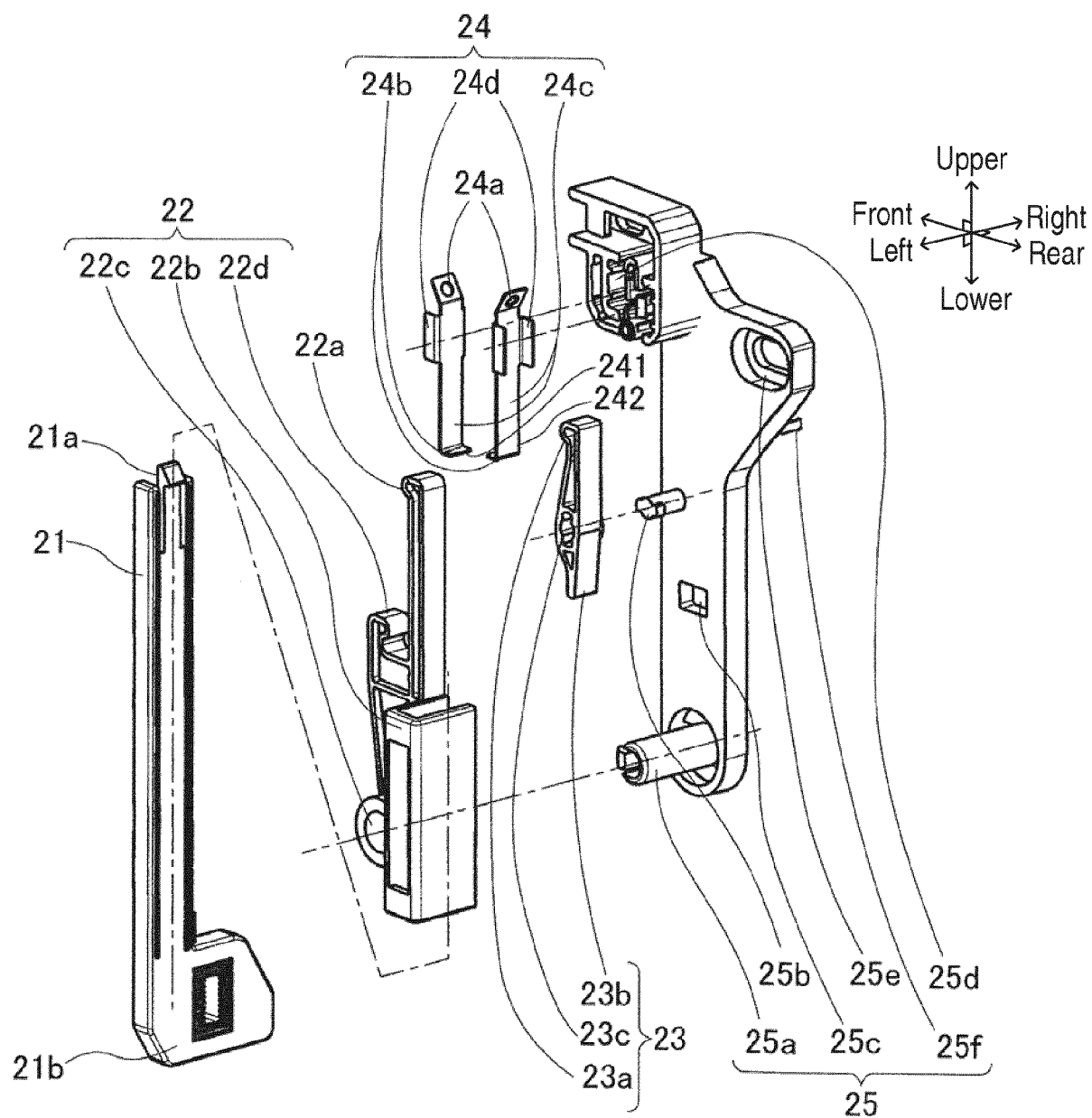


FIG. 4

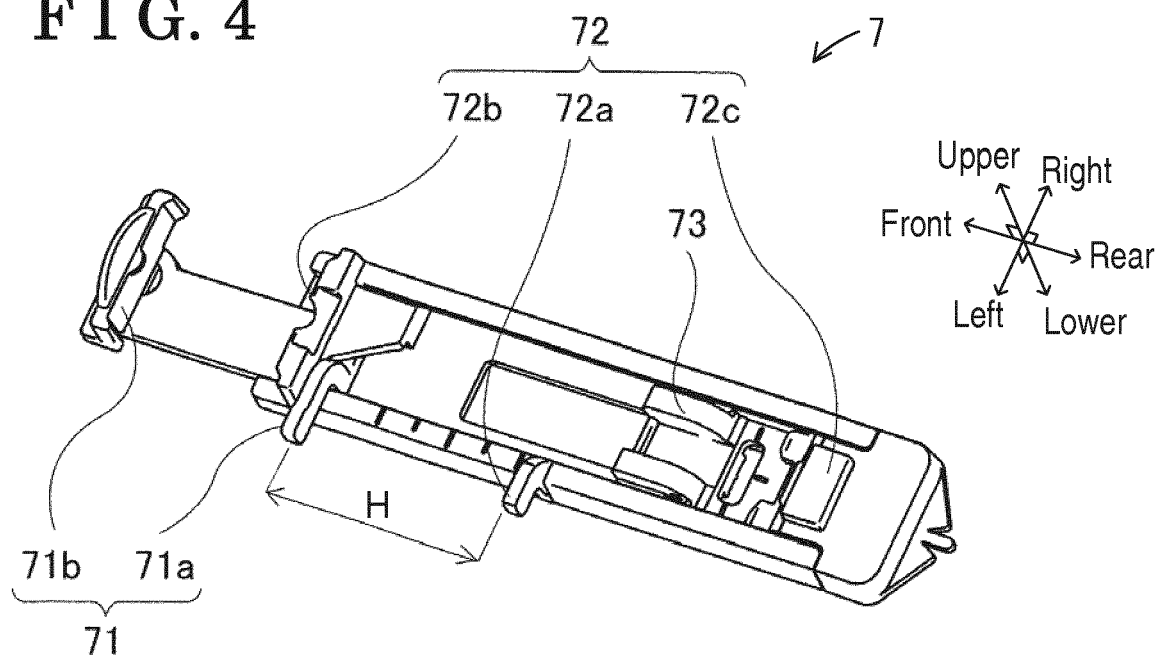


FIG. 5

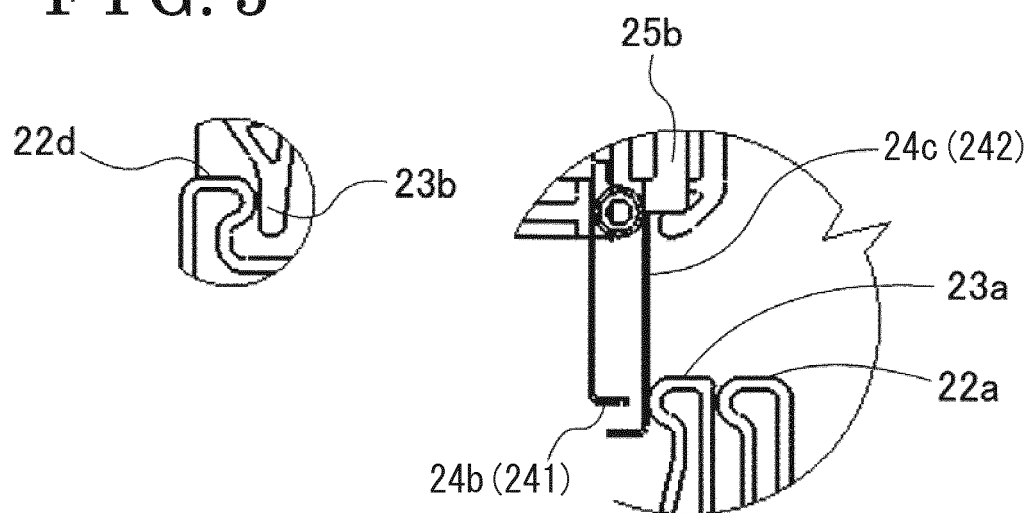


FIG. 6C

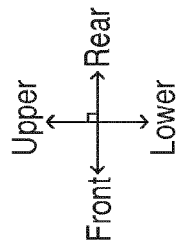


FIG. 6B

FIG. 6A

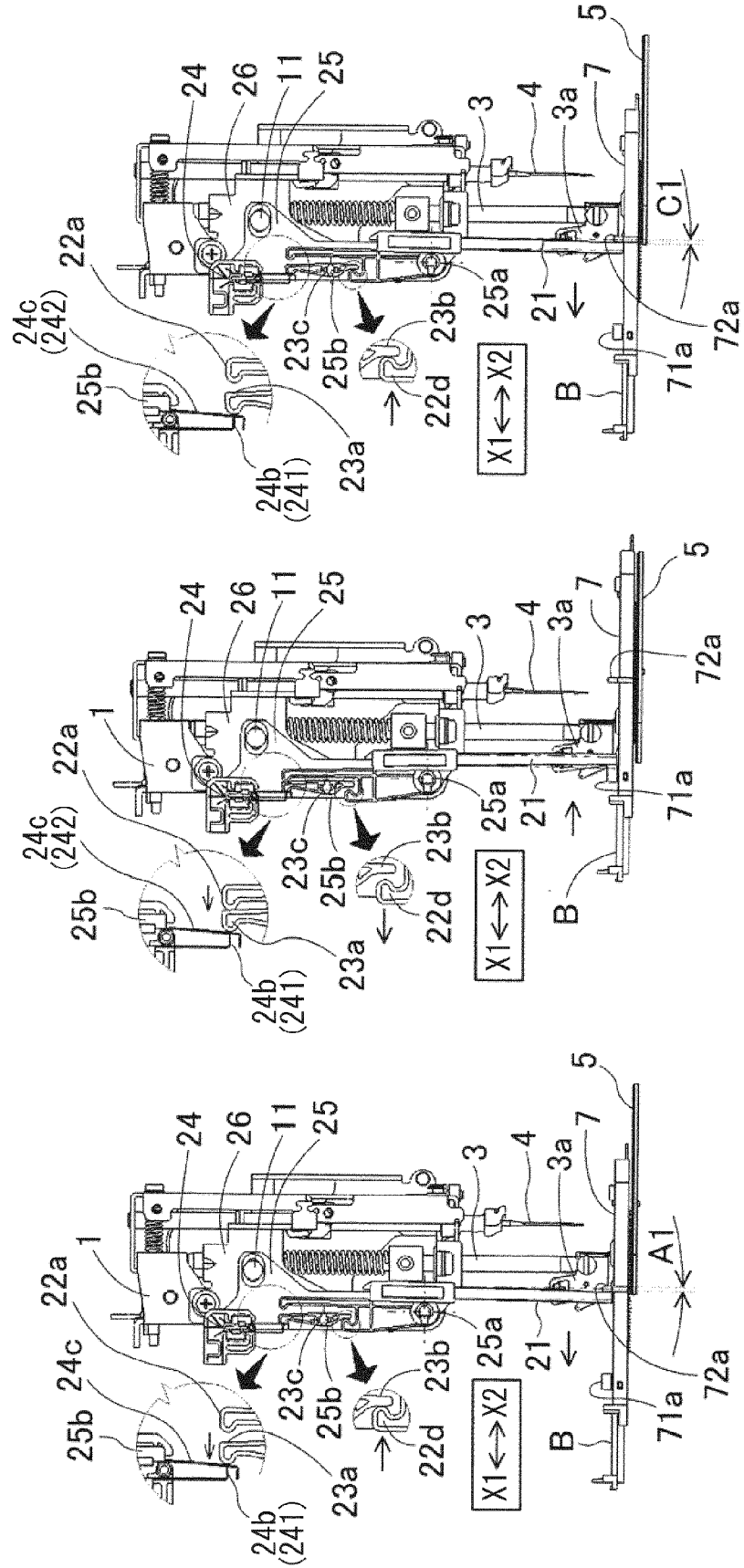


FIG. 7

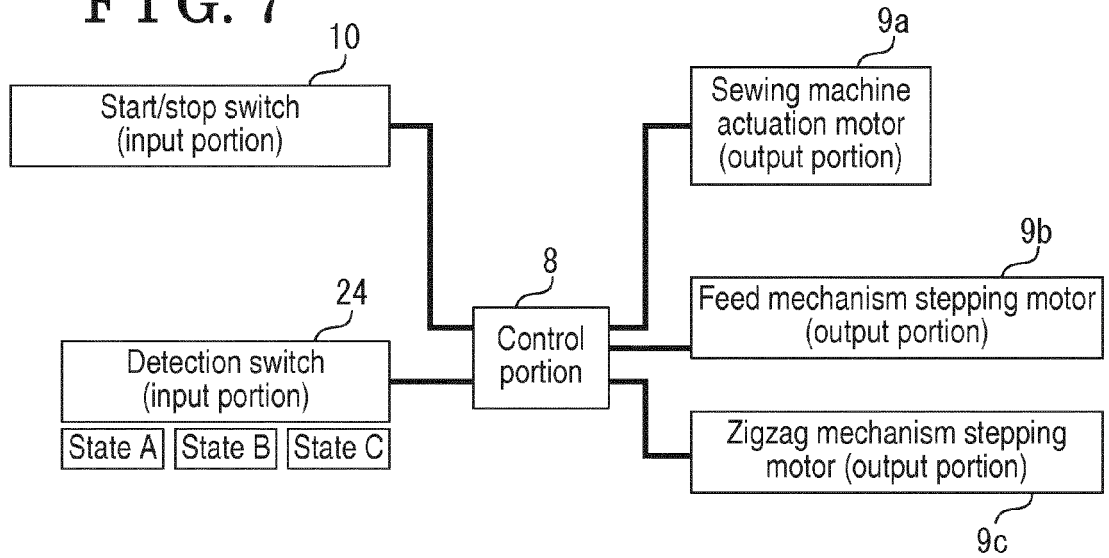


FIG. 8

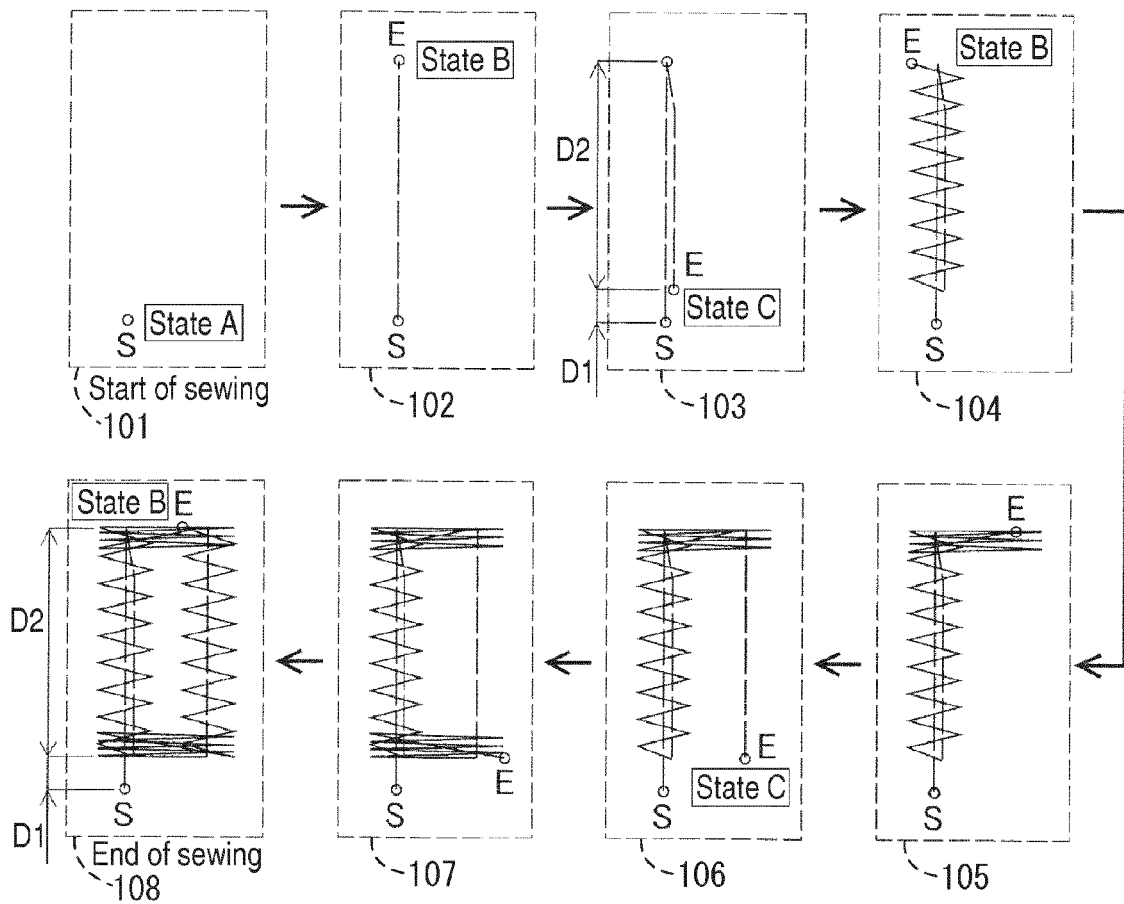


FIG. 9

Procedure for sewing buttonhole See Fig. 8	State of buttonhole switch See Figs. 6A, 6B, 6C	Number of times of input of detection switch
101	State A	1
102	State B	2
103	State C	3
104	State B	4
105	State C	5
106	State B	6
107	State C	7
108	State B	8



EUROPEAN SEARCH REPORT

Application Number
EP 14 16 1472

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Place of search Munich		Date of completion of the search 28 May 2014	Examiner Herry-Martin, D
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