



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication: **03.12.2008 Bulletin 2008/49** (51) Int Cl.: **D05B 3/06 (2006.01) D05B 19/02 (2006.01)**
(21) Application number: **08157438.6**
(22) Date of filing: **02.06.2008**

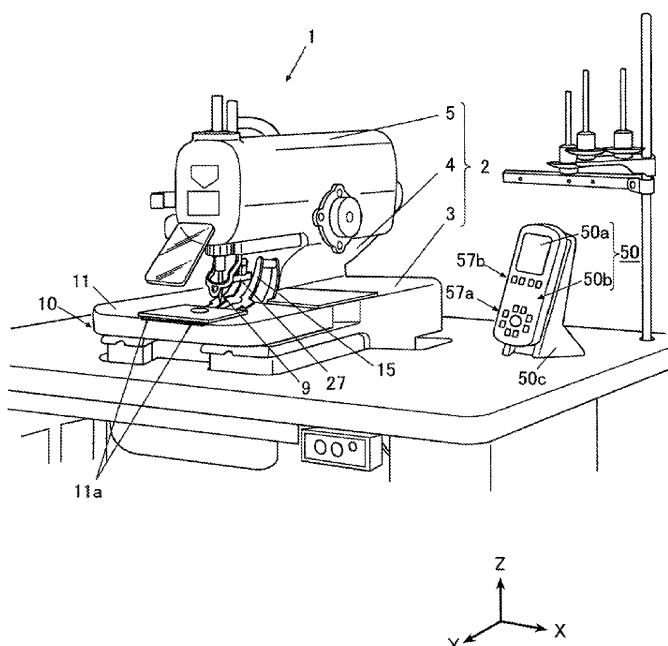
(84) Designated Contracting States: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR Designated Extension States: AL BA MK RS (30) Priority: 31.05.2007 JP 2007145168	(71) Applicant: JUKI Corporation Chofu-Shi, Tokyo 182-8655 (JP) (72) Inventor: Murai, Kenji Tokyo 182-8655 (JP) (74) Representative: Hoeger, Stellrecht & Partner Patentanwälte Uhlandstrasse 14 c 70182 Stuttgart (DE)
--	---

(54) **Buttonholing machine**

(57) A buttonholing machine includes a stitching mechanism, a cloth feeding mechanism having a mounting table on which a workpiece is mounted, a cloth cutting mechanism operable to cut the workpiece, which has been delivered to a cutting position by the cloth feeding mechanism, to form a buttonhole, and control means for controlling each of the mechanisms to form the button-

hole on the workpiece and to form side stitches along the buttonhole. The buttonholing machine further includes image capturing means for capturing an image of the workpiece mounted on the mounting table from below, the image capturing means being disposed below a cloth mounting surface of the mounting table, and display means for displaying the image of the workpiece captured by the image capturing means.

Fig. 1



Description

TECHNICAL FIELD

[0001] The present invention relates to a buttonholing machine having a cloth cutting mechanism for forming a buttonhole.

BACKGROUND ART

[0002] Conventionally, there has been known a buttonholing machine for forming a cut for a buttonhole on a cloth to be a workpiece and carrying out a side stitch over the cut (see, e.g., JP 4-26434 A).

[0003] The buttonholing machine includes a cloth cutting mechanism for forming a cut for an eyelet buttonhole (see Fig. 22A) on a cloth mounted on a feeding table by means of a cloth cutting knife and a knife receiver (not shown) making a pair which are vertically disposed with the cloth interposed therebetween, a cloth feeding mechanism for feeding the cloth in an XY direction (a horizontal direction) in conformity to a shape of the eyelet buttonhole formed by the cloth cutting mechanism while holding the cloth, a needle oscillating mechanism for oscillating a needle (not shown) in a horizontal direction which is orthogonal to a cloth feeding direction through the cloth feeding mechanism, a needle driving mechanism for vertically driving the needle synchronously with an oscillation of the needle through the needle oscillating mechanism, and a looper mechanism for forming stitches in cooperation with the needle driving mechanism and the needle oscillating mechanism.

[0004] When the needle driving mechanism, the needle oscillating mechanism and the looper mechanism are horizontally turned integrally corresponding to a movement of the cloth through the cloth feeding mechanism, a side stitch is carried out along an edge portion of the eyelet buttonhole.

[0005] In the case in which a buttonhole is formed on a cloth having stripes as shown in Fig. 20B or cross stripes as shown in Fig. 20C as a pattern of a fabric, for example, it is preferable to form the buttonhole in parallel with or orthogonally to a stripe expressed on a surface side of the fabric.

[0006] In the case in which the side stitch is carried out through the conventional buttonholing machine, however, stitches are formed such that a lower surface side of the cloth to be mounted on a feeding table, that is, a side provided in contact with a cloth mounting surface of the feeding table is a front side. When the cloth is to be mounted on the feeding table, therefore, it is necessary to set the cloth such that a surface (a pattern surface) of the fabric is turned downward and a back face of the fabric is turned upward. For this reason, it is hard to confirm an accurate direction and position of the cloth to be mounted on the feeding table from an upper part to be a position in which an operator is standing. Consequently, there is a problem in that a great deal of time and labor is taken

for positioning the cloth.

[0007] When the cloth to be mounted on the feeding table is to be positioned, it is also possible to propose that the cloth is positioned based on a pattern and a stripe (see Fig. 21B) which are formed continuously on a back side of the fabric to be an upper surface side through a fold-back from a front side in a state in which the cloth is mounted on the feeding table. However, a cloth end in the vicinity of a buttonhole is not always a straight, and there is a possibility that the buttonhole and the pattern on the front side might be shifted from each other in the case in which a stripe on the front side and a stripe on the back side do not accurately overlap with each other. For this reason, conventionally, stay stitching is previously carried out or a marking needle is put along the stripe on the front side, thereby determining a position in which the buttonhole is to be formed, that is, a position of the cloth based on a stay stitching seam or the marking needle which appears on the back side.

[0008] In the case in which the stay stitching is carried out over the cloth, however, a great time and labor is taken for undoing the stay stitching. In the case in which the marking needle is put, moreover, a great deal of time and labor is taken for pulling the marking needle out and the cloth is loosened. For this reason, they are not preferable for forming a cut for a buttonhole. In other words, there is a problem in that a man-hour is increased to take a great deal of time and labor for positioning the cloth, resulting in a reduction in a production efficiency in any case.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to facilitate a positioning of a workpiece in a buttonholing process.

[0010] According to a first aspect of the invention, a buttonholing machine (1, 101, 201) includes: a stitching mechanism operable to move a needle (9) in a vertical direction (Z) to form a stitch; a cloth feeding mechanism (10) having a mounting table (11, 211) on which a workpiece is mounted so as to be orthogonal to a vertical moving path of the needle (9), the cloth feeding mechanism (10) being operable to deliver the mounted workpiece in a certain direction (X, Y); a cloth cutting mechanism (20) operable to cut the workpiece, which has been delivered to a cutting position by the cloth feeding mechanism (10), to form a buttonhole; and control means (70) for controlling each of the mechanisms to form the buttonhole on the workpiece and to form side stitches along the buttonhole.

[0011] The buttonholing machine (1, 101, 201) is characterized in that it further includes: image capturing means (40, 140, 240) for capturing an image of the workpiece mounted on the mounting table (11, 211) from below, the image capturing means (40, 140, 240) being disposed below a cloth mounting surface of the mounting table (11, 211); and display means (50) for displaying the image of the workpiece captured by the image capturing

means (40, 140, 240).

[0012] According to a second aspect of the invention, the display means (50) may display, on a screen (52) thereof, a first reference mark (59) corresponding to a buttonhole forming position.

[0013] According to a third aspect of the invention, the first reference mark (59) may be an image of a shape of the buttonhole to be formed on the workpiece by the cloth cutting mechanism (20).

[0014] According to a fourth aspect of the invention, the display means (50) may display, on the screen (52) thereof, a second reference mark (58) corresponding to a position of an end of the workpiece.

[0015] According to a fifth aspect of the invention, the cloth cutting mechanism (20) may include a cloth cutting knife (21) and a knife receiver (27) disposed above the cloth cutting knife (21), the knife receiver (27) being opposed to the cloth cutting knife (21) and movable in the vertical motion (Z).

[0016] The buttonholing machine (1) may further include: a support (22) holding the image capturing means (40) and the cloth cutting knife (21); and driving means (43) for moving the support (22) such that the cloth cutting knife (21) and the image capturing means (40) are alternately opposed to a downward moving position of the knife receiver (27).

[0017] According to a sixth aspect of the invention, the cloth cutting mechanism (20) may include a knife receiver (27) and a cloth cutting knife (21) disposed above the knife receiver (27), the cloth cutting knife (21) being opposed to the knife receiver (27) and movable in the vertical motion (Z).

[0018] The buttonholing machine (1) may further include: a support (22) holding the image capturing means (40) and the knife receiver (27) close to each other; and driving means (43) for moving the support (22) such that the knife receiver (27) and the image capturing means (40) are alternately opposed to a downward moving position of cloth cutting knife (21).

[0019] According to a seventh aspect of the invention, the buttonholing machine (1, 101, 201) may further include display position correcting input means (57b) for correcting a display position of the first reference mark (59).

[0020] According to an eighth aspect of the invention, the buttonholing machine (1, 101, 201) may further include display position correcting input means (57b) for correcting a display position of the second reference mark (58).

[0021] According to the first aspect of the invention, in the buttonholing machine, the image of the workpiece mounted on the mounting table can be captured from below through the image capturing means, and the image can be displayed on the display means. In other words, an operator of the buttonholing machine can easily recognize a surface of the workpiece on the side provided in contact with the mounting table while seeing the image displayed on the display means when mounting the work-

piece on the mounting table to position the buttonhole. When positioning the workpiece, accordingly, it is not necessary to fold back the workpiece, thereby confirming the direction of the pattern, or to carry out stay stitching or to put a marking needle, thereby making a mark for the buttonhole. Thus, it is possible to easily carry out the positioning work. Consequently, it is possible to reduce a man-hour and a working time required for positioning the workpiece. Thus, it is possible to easily carry out the positioning work and to enhance a production efficiency.

[0022] According to the second aspect of the invention, the workpiece is positioned by setting, as an index, the first reference mark corresponding to the buttonhole forming position displayed on the surface of the display means. Consequently, it is possible to carry out the work by comparing the buttonhole position with a state of the pattern of a fabric. When mounting the workpiece on the mounting table, therefore, it is possible to easily carry out the positioning work. In addition, it is possible to obtain an advantage that quality of a product can be enhanced without damaging a design of a sewn product.

[0023] According to the third aspect of the invention, the first reference mark takes the shape of the buttonhole. Therefore, the fabric can be placed in a corresponding position to the shape of the buttonhole, and the workpiece can be easily positioned more precisely. In addition, it is possible to obtain an advantage that quality of a product can be enhanced without damaging a design of a sewn product.

[0024] According to the fourth aspect of the invention, the second reference mark corresponding to the end position of the workpiece for the buttonhole is displayed on the surface of the display means. By carrying out the positioning work while adapting the end of the workpiece to the end position displayed on the display means, therefore, it is possible to easily position the workpiece. Also in the case in which a surface of the workpiece mounted on the mounting table which is provided in contact with the mounting table is a plain, for example, it is possible to easily carry out the positioning work. Furthermore, it is possible to carry out the positioning work while confirming the end position of the buttonhole forming position. Consequently, it is possible to carry out the positioning work more precisely.

[0025] According to the fifth aspect of the invention, the image capturing means and the cloth cutting knife are disposed on the support close to each other and are alternately moved to the downward moving position of the knife receiver through the support by the driving means. Consequently, it is possible to form the buttonhole by means of the cloth cutting knife and the knife receiver in the sewing work and to carry out the work for positioning the workpiece while capturing the image of the workpiece in the vicinity of the cutting position when disposing the image capturing means opposite to the downward moving position of the knife receiver, that is, the cutting position. Thus, the positioning work can be performed easily and accurately.

[0026] According to the sixth aspect of the invention, the image capturing means and the knife receiver are alternately moved to the downward moving position of the cloth cutting knife through the driving means. Consequently, it is possible to form the buttonhole by means of the cloth cutting knife and the knife receiver in the sewing work, and furthermore, to carry out the work for positioning the workpiece while capturing the image of the workpiece in the vicinity of the cutting position when disposing the image capturing means opposite to the downward moving position of the knife receiver, that is, the cutting position. Thus, it is possible to perform the positioning work easily and accurately.

[0027] According to the seventh aspect of the invention, the first reference mark corresponding to the buttonhole forming position can be displayed in a desirable position in which the operator can easily recognize a positional relationship of the buttonhole over the screen of the display means. Thus, it is possible to easily carry out the work for positioning the workpiece and to enhance a production efficiency.

[0028] According to the eighth aspect of the invention, the second reference mark corresponding to the cloth end position can be displayed in a desirable position in which the operator can easily recognize a positional relationship of the cloth end over the screen of the display means. Thus, it is possible to easily carry out the work for positioning the workpiece and to enhance a production efficiency. In the case in which the reference mark corresponding to both the buttonhole position and the cloth end position is displayed, moreover, it is possible to display the reference mark in a corresponding position to the position of the buttonhole.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

Fig. 1 is a schematic perspective view showing a structure of an appearance of a buttonholing machine according to a first embodiment,

Fig. 2 is a schematic perspective view showing a turning mechanism according to the first embodiment,

Fig. 3 is a plan view showing a feeding mechanism according to the first embodiment,

Fig. 4 is a schematic side view showing the feeding mechanism according to the first embodiment,

Fig. 5 is a schematic plan view showing a structure of a main part according to the first embodiment,

Fig. 6 is a schematic front view showing the structure of the main part according to the first embodiment as seen in a direction A in Fig. 5,

Fig. 7 is a schematic side view showing the structure of the main part according to the first embodiment as seen in a direction B in Fig. 5,

Fig. 8 is a schematic view showing a display panel according to the first embodiment,

Fig. 9 is an explanatory view showing an operation of the sewing machine according to the first embodiment (an image capturing position),

Fig. 10 is an explanatory view showing the operation of the sewing machine according to the first embodiment (a cutting position),

Fig. 11 is a block diagram showing a structure of a control portion according to the first embodiment,

Fig. 12 is a flowchart showing an operation of the buttonholing machine according to the first embodiment,

Fig. 13 is a plan view showing a structure of a main part of a buttonholing machine according to a second embodiment,

Fig. 14 is a schematic side view showing a schematic structure seen in a C direction of Fig. 13,

Fig. 15 is an explanatory view showing an operation of the sewing machine according to the second embodiment (an image capturing position),

Fig. 16 is a flowchart showing an operation of the buttonholing machine according to the second embodiment,

Fig. 17 is a plan view showing a structure of a main part of a buttonholing machine according to a third embodiment,

Fig. 18 is a schematic side view showing a schematic structure seen in a D direction of Fig. 17,

Fig. 19 is a flowchart showing an operation of the buttonholing machine according to the third embodiment,

Figs. 20A to 20C are typical views showing various patterns expressed on a surface of a workpiece (a front side of a cloth), Fig. 20A showing a plain, Fig. 20B showing a stripe and Fig. 20C showing a check pattern,

Figs. 21A and 21B are typical views showing a relationship between a position in which a buttonhole is to be formed on the workpiece and a pattern, Fig. 21A showing a surface (a front side of a cloth) and Fig. 21B showing a back face (a facing),

Fig. 22A is a schematic view showing an eyelet buttonhole, and

Fig. 22B is a schematic view showing a straight buttonhole.

DETAILED DESCRIPTION

[0030] Hereinafter, embodiments of the invention will be explained with reference to the drawings. The following embodiments do not limit the scope of the invention.

[0031] In the following description, orientation of respective components of a sewing machine will be explained with reference to X, Y and Z axes which are shown in the drawings. In a state in which the sewing machine is planed on a horizontal plane, a Z-axis direction is a vertical direction (i.e., an up-and-down direction), a Y-axis direction is a front-and-rear direction which is coincident with a longitudinal direction of an arm portion

of the sewing machine, and an X-axis direction is a right-and-left direction which is horizontal and is orthogonal to the Y-axis direction.

FIRST EMBODIMENT

[0032] Fig. 1 shows a buttonholing machine 1 (hereinafter, also referred to as a sewing machine 1) according to a first embodiment of the invention. The sewing machine 1 serves to form, on a cloth (a workpiece), a cut for a buttonhole, for example, a so-called eyelet buttonhole having a straight portion L and an almost circular drop-shaped portion Q shown in Fig. 22A, and a straight hole shown in Fig. 22B and to carry out a side stitch over an edge of the cut.

[0033] The sewing machine 1 includes a sewing machine frame 2, a cloth feeding mechanism 10 having a feeding table 11 (a mounting table) for mounting a cloth on a bed portion 3 of the sewing machine frame 2 and capable of delivering the cloth mounted on the feeding table 11 in X-Y directions, a cloth cutting mechanism 20 having a knife receiver 27 and a cloth cutting knife 21 (see Figs. 3 to 7) which are vertically disposed opposite to each other with the feeding table 11 interposed therebetween, a needle oscillating mechanism for oscillating a needle 9 in an intersection with a cloth feeding direction through the cloth feeding mechanism 10, a needle driving mechanism (not shown) for vertically driving the needle 9 synchronously with the oscillation of the needle 9 through the needle oscillating mechanism, a looper mechanism 60 (see Figs. 2 to 4) for forming a side stitch in cooperation with the needle driving mechanism and the needle oscillating mechanism, a camera unit 40 (see Figs. 4 to 7) to be image capturing means which is provided below a mounting surface of the feeding table 11 and serves to capture an image the cloth mounted on the feeding table 11 from below, an operation panel 50 having a display portion 50a (display means) on which the image of the cloth which is captured by the camera unit 40 is displayed and an operating portion 50b for causing an operator to carry out various setting works, and a control portion 70 to be control means for controlling each of the structures to form a buttonhole on the cloth and to form side stitches around the buttonhole. A stitching mechanism includes the needle oscillating mechanism, the needle driving mechanism and the looper mechanism 60.

[0034] Each portion will be described below in detail.

[Sewing Machine Frame]

[0035] As shown in Fig. 1, the sewing machine frame 2 has the bed portion 3 mounted on a sewing machine table, a vertical drum portion 4 erected upward from the bed portion 3, and the arm portion 5 extended forward (in the Y-axis direction) from an upper part of the vertical drum portion 4, and takes an external shape of almost U seen from a front. A sewing machine main shaft (not

shown) to be rotated by a sewing machine motor 8 (see Fig. 11) is rotatably provided in the X-axis direction on an almost central part in a longitudinal direction in the arm portion 5.

[Needle Driving Mechanism]

[0036] The needle driving mechanism which is not shown has a well-known structure in which a needle bar holding the needle 9 at a lower end is vertically moved interlockingly with the sewing machine main shaft and is supported to be oscillatable around a shaft in the X-axis direction.

[Needle Oscillating Mechanism]

[0037] The needle oscillating mechanism which is not shown is provided in the arm portion 5 of the sewing machine frame 2 and applies an oscillating force to the needle bar through an eccentric cam and a link member corresponding to the rotation of the sewing machine main shaft. The needle oscillating mechanism is coupled to the looper mechanism 60 which will be described below through a turning mechanism 30 shown in Fig. 2.

[0038] As shown in Fig. 2, the turning mechanism 30 applies a turning force to the looper mechanism 60 through pulleys 37 and 38 and a belt 32 by a driving operation of a turning pulse motor 31 coupled to the control portion 70 and applies a turning force from the belt 32 to the needle oscillating mechanism through a pulley 35, a shaft 34, pulleys 36 and 39 and a belt 33. The needle oscillating mechanism and the looper mechanism 60 are interlockingly turned at the same time in the same direction around a shaft in the Z-axis direction which is coaxial with a needle bar 9a in a state in which the needle bar 9a is supported vertically.

[0039] Moreover, the needle oscillating mechanism oscillates the needle 9 in a direction crossing the cloth feeding direction with respect to the cloth delivered through the cloth feeding mechanism 10 which will be described below, thereby radially forming stitches, for example, the drop-shaped portion Q of the eyelet buttonhole shown in Fig. 22A and an end of the straight buttonhole shown in Fig. 22B in addition to the straight portion L. Thus, side stitches for the buttonhole is formed.

[Looper Mechanism]

[0040] The looper mechanism 60 has a well-known structure including a pair of left and right loopers and a pair of left and right spreaders which are disposed below a throat plate, which is not shown in detail. The left and right loopers are oscillated right-and-left synchronously with the vertical motion of the needle 9, and the left and right spreaders carry out opening/closing motions synchronously with the oscillating motion of the left and right loopers. The looper mechanism 60 is turned interlockingly with the needle 9 and the needle oscillating mech-

anism through the turning mechanism 30 in a work for sewing the drop-shaped portion Q of the eyelet button-hole, thereby radially forming the stitches in cooperation with the needle 9 for carrying out the vertical motion and the oscillation to perform the side stitch over the button-hole.

[Cloth Feeding Mechanism]

[0041] As shown in Figs. 3 and 4, the cloth feeding mechanism 10 includes the feeding table 11 (the mounting table) on which a workpiece is mounted orthogonally to a vertical moving path of the needle 9, an X-axis pulse motor 12 and a Y-axis pulse motor 13 (see Fig. 11), which are feed driving means for moving the feeding table 11 in a horizontal plane in the XY direction, and a pressing mechanism 14 for pressing the cloth mounted on the feeding table 11 from above.

[0042] The feeding table 11 is provided on a stitching side of an upper surface of the bed portion 3 and serves as a mounting table having a shape of a hollow box and capable of carrying out a horizontal movement. The pressing mechanism 14 is mounted on the feeding table 11 and is wholly moved in the front-and-rear direction and in the right-and-left direction (i.e., in a horizontal direction) by the driving operations of the X-axis pulse motor 12 and the Y-axis pulse motor 13 while pressing the cloth mounted on an upper surface of the feeding table 11 through the pressing mechanism 14.

[0043] Moreover, the feeding table 11 has a bottom portion taking an almost U shape which is opened toward the vertical drum portion 4 side as seen on a plane, and can be moved in the X-Y directions while avoiding an interference with the looper mechanism 60 provided at a stitch point inside the bed portion 3 which is opposed to the needle 9 or the cloth cutting mechanism 20 provided adjacently to the looper mechanism 60.

[0044] The upper surface of the feeding table 11 is provided with pressing plates 11a and 11a which are divided in right and left as seen from a working position side of the operator, that is, a tip side of the arm portion 5 in order to avoid the stitch point of the needle 9 and the cloth cutting knife 21 (see Fig. 3). A pair of pressing mechanisms 14 for interposing the cloth in cooperation with the pressing plates 11a and 11a are provided on ends (right ends in Fig. 3) at the vertical drum portion 4 side in the pressing plates 11a and 11a, respectively. As shown in Fig. 5, moreover, a sufficient clearance W is provided between both side ends of the pressing plates 11a and 11a in the X-axis direction of the cloth cutting knife 21 in order to prevent a coincidence of the knife receiver 27 with the cloth cutting knife 21 from being blocked.

[0045] The X-axis pulse motor 12 and the Y-axis pulse motor 13 are electrically coupled to the control portion 70 which will be described below, and move and position the feeding table 11 to an optional XY coordinate position along a driving belt (not shown) provided in the bed por-

tion 3 and each of guide shafts in the X and Y directions based on a control signal sent from the control portion 70.

[0046] The pressing mechanism 14 includes a presser arm 15 having a base end which is rotatably coupled to the upper part of the feeding table 11 around a shaft in the X-axis direction, a presser foot 16 coupled to the other end of the presser arm 15, and a presser driving air cylinder 17 (Fig. 11) for oscillating the presser arm 15, thereby driving the presser foot 16 vertically. In the pressing mechanism 14, an electromagnetic valve 17a (Fig. 11) is opened or closed in response to a signal output from the control portion 70 which will be described below so that the presser driving air cylinder 17 is expanded or contracted. In the pressing mechanism 14, the presser foot 16 supported on the tip (the other end) of the presser arm 15 presses the cloth from above when it is moved downward, and furthermore, the presser foot 16 is moved upward to prevent put-in/out of the cloth from being clocked before a start of the sewing operation and at an end of the sewing operation based on a program stored in the control portion 70 which will be described below. The sewing machine 1 according to the first embodiment is provided with a presser switch (not shown) for operating the pressing mechanism 14.

[Cloth Cutting Mechanism]

[0047] As shown in Figs. 3 to 7, the cloth cutting mechanism 20 is provided side by side with the looper mechanism 60 in the U-shaped portion of the feeding table 11, and is mounted on the upper surface of the bed portion 3 at the vertical drum portion 4 side from the looper mechanism 60. The cloth cutting mechanism 20 includes the cloth cutting knife 21 having a blade tip for an eyelet buttonhole, an upper knife support 22 (a support) for holding the cloth cutting knife 21 and the camera unit 40, a lower knife support 24 for supporting the upper knife support 22 movably in the X-axis direction, the knife receiver 27 provided in a lower part on the tip of the arm portion 5 which is opposed to the cloth cutting knife 21 and supported to be vertically movable toward the cloth cutting knife 21, and a cloth cutting pulse motor 26 (Fig. 11) serving as cloth cut driving means for driving the knife receiver 27 in a vertical direction with respect to the cloth delivered to a cutting position (which will be described below) through the cloth feeding mechanism 10 and cutting the cloth when the cloth cutting knife 21 is coincident with the knife receiver 27, thereby forming a buttonhole.

[0048] As shown in Fig. 7, the lower knife support 24 is attached to the upper surface of the bed portion 3 with a setscrew 24a. A lower knife support key portion 25 is provided on an upper surface of the lower knife support 24 in the X-axis direction. The upper knife support 22 sliding along the lower knife support key portion 25 is provided on an upper side of the lower knife support 24 so as to be horizontally movable in the X-axis direction.

[0049] A lower surface of the upper knife support 22 is provided with an upper knife support key groove portion

23 to be slidably fitted in the lower knife support key portion 25 in the X-axis direction. The upper knife support key groove portion 23 of the first embodiment has a shape of a groove in which the lower knife support key portion 25 having a shape of a pigeon tail is fitted as shown in Figs. 5 to 7. In other words, the lower knife support key portion 25 is fitted in the upper knife support key groove portion 23 so that a movement in a vertical direction of the upper knife support 22 is controlled, and the upper knife support 22 is provided slidably in the X-axis direction without separating from an upper surface of the lower knife support 24. Consequently, the cloth cutting knife 21 and the camera unit 40 which are mounted on the upper knife support 22 are moved integrally with the upper knife support 22 in only the X-axis direction without changing heights.

[0050] The cloth cutting knife 21 is removably fixed to the upper knife support 22 through a fixing plate 21a and a setscrew 21b shown in Figs. 5 and 6 and a knife stopper 21c and a setscrew 21d shown in Figs. 5 and 7. As shown in Figs. 4 to 7, the cloth cutting knife 21 is disposed in the Y-axis direction with a blade chip 21e turned upward such that the blade chip 21e is horizontal on almost the level with the mounting surface to be the upper surface of the feeding table 11. As shown in Fig. 3, moreover, the cloth cutting knife 21 is disposed to be positioned between a pair of left and right presser feet 16 and 16 supported on the presser arms 15 and 15 when the respective presser feet 16 and 16 are moved downward.

[0051] The knife receiver 27 is supported to be vertically movable by means of a link mechanism (not shown) provided in the arm portion 5. The knife receiver 27 is vertically driven through the link mechanism by a driving operation of the cloth cutting pulse motor 26 provided in the arm portion 5. The knife receiver 27 is moved downward at an appropriate timing toward the cloth cutting knife 21 provided above the bed portion 3 and forms an eyelet buttonhole on the cloth in cooperation with the cloth cutting knife 21.

[0052] The cloth cutting pulse motor 26 is electrically coupled to the control portion 70 which will be described below and carries out normal and reverse rotations at an appropriate timing based on a control signal sent from the control portion 70. Consequently, a driving force for carrying out a vertical motion is applied to the cloth cutting knife 21 through the link mechanism.

[Camera Unit]

[0053] As shown in Figs. 4 to 7, the camera unit 40 includes a camera module 41 operable to capture an image of a lower surface of the cloth mounted on the feeding table 11, an illuminating device 46 (illuminating means) operable to irradiate light for capturing the image the lower surface of the cloth with the camera module 41, and a camera moving air cylinder 43 (driving means) operable to move the camera unit 40 and the cloth cutting knife 21 to a downward moving position of the knife re-

ceiver 27, that is, an opposed position to the knife receiver 27 moved downward.

[0054] A video camera is used for the camera module 41 in the first embodiment, and the camera module 41 is arranged close to a side in the X-axis direction with respect to the cloth cutting knife 21 and is attached to an upper surface of the upper knife support 22 with a lens 41a oriented upward such that a cutting position of the cloth positioned above the cloth cutting knife 21 can be recognized from below as shown in Figs. 5 to 7. The camera module 41 is coupled through a cable 42 to the control portion 70 (see Fig. 11) in a control box (not shown) provided below a sewing machine table.

[0055] The illuminating device 46 is disposed in the vicinity of a side of the camera module 41 and is provided in a state in which a case 47 having an LED lamp 49 (a light emitting portion) disposed thereon is attached to the upper surface of the bed portion 3 with a screw 48 so that an upper part can be illuminated. More specifically, the LED lamp 49 serves to irradiate a light, from below, onto the cloth placed in the downward moving position of the knife receiver 27, that is, positioned above the cloth cutting knife 21, thereby illuminating a lower surface side of the cloth in the cutting position. The illuminating device 46 is coupled to the control portion 70 through a cable 49a.

[0056] The camera moving air cylinder 43 is fixed to the lower knife support 24 with a setscrew 43a. A cylinder rod 44 of the camera moving air cylinder 43 has a tip fixed to the upper knife support 22 and is provided to be forward and backward movable in the X-axis direction. Moreover, two air tubes 43c and 43c for forward and backward movements are coupled to the camera moving air cylinder 43 and are coupled to an electromagnetic valve 45 (see Fig. 11). The camera driving air cylinder 43 moves the upper knife support 22 forward and backward in the X-axis direction corresponding to opening and closing operations of the electromagnetic valve 45 based on a control signal sent from the control portion 70.

[0057] In a state in which the cylinder rod 44 is placed in a rearmost position, the camera unit 40 has such a structure that the cloth cutting knife 21 is disposed in an opposed position to the downward moving position of the knife receiver 27 and the camera module 41 is disposed to be retreated on a side thereof as shown in Fig. 10. On the other hand, in a state in which the cylinder rod 44 is disposed in a foremost position, the lens 41a of the camera module 41 is disposed in an opposed position to the downward moving position of the knife receiver 27 as shown in Fig. 9. In other words, by moving the upper knife support 22 with the camera moving air cylinder 43, the cloth cutting knife 21 and the camera module 41 are moved to alternately oppose to a downward moving position of the knife receiver 27.

[0058] Although the camera moving air cylinder 43 (the air cylinder) is used as the driving source (driving means) for moving the camera unit 40 in the first embodiment, an actuator such as a solenoid or a pulse motor may be

used for the driving source, for example. While the cloth cutting knife 21 and the camera module 41 are moved by one driving source (the camera moving air cylinder 43) through the upper knife support 22 in the first embodiment, moreover, it is also possible to employ a structure in which they are moved by individual driving sources respectively. Although the illuminating device 46 is fixed to the upper surface of the bed portion 3 through the case 47 in the first embodiment, furthermore, it is also possible to employ a structure in which the illuminating device 46 is fixed to the upper knife support 22 to be provided side by side with the camera module 41 and is moved in the X-axis direction together with the cloth cutting knife 21 and the camera module 41 by the driving operation of the camera moving air cylinder 43, for example.

[Operation Panel]

[0059] The operation panel 50 is fixed through an attaching plate 50c onto the sewing machine table through which an operator carrying out a work on a sewing machine surface portion side can easily see a screen and which does not disturb the work. The operation panel 50 is coupled to the control portion 70 in the control box through a cable which is not shown. As shown in Fig. 8, the operation panel 50 includes a liquid crystal screen 52 (a display portion) for displaying various set information of the sewing machine 1 and projecting the image of the cloth captured by the camera unit 40, an operation key group 57a for carrying out various setting operations of the sewing machine 1, and an operation key group 57b for regulating a display state of the image of the cloth which is displayed.

[0060] The liquid crystal screen 52 is a display screen provided in an almost central part of a case 51 and taking an almost rectangular shape, and an image is displayed such that a vertical direction in the screen corresponds to the Y-axis direction of the sewing machine 1. More specifically, a lower side of the liquid crystal screen 52 indicates a tip side of the bed portion 3 and an upper side of the liquid crystal screen 52 indicates the vertical drum portion 4 side in the bed portion 3. In other words, the liquid crystal screen 52 serves to display an arrangement of the cloth seen from the sewing machine surface portion side to be a standing position of the operator in such a state that the operator seeing the liquid crystal screen 52 can easily make a recognition by intuition. An image of the lower surface side of the cloth which is captured by the camera unit 40 is displayed on the liquid crystal screen 52.

[0061] The operation key group 57b is provided with a mode key 53 for switching an image regulating command, a plus (+) key 55 and a minus (-) key 56 which serve to change a numeric value in each mode, and a reset key 54 for resetting the command or numeric value thus changed.

[0062] The operation panel 50 according to the first embodiment serves to display, on the screen, that is, a

surface of the liquid crystal screen 52, a cloth end mark 58 and an eyelet buttonhole mark 59 as reference marks to be a basis for mounting the cloth on the feeding table 11 through the control portion 70 which will be described below.

[0063] As shown in Fig. 8, the cloth end mark 58 is displayed as a straight line extended in a transverse direction (a right-and-left direction in Fig. 8) in an upper part of the liquid crystal screen 52. The cloth end mark 58 is an end position setting mark for setting an end position of the cloth with respect to a buttonhole over the surface of the liquid crystal screen 52 and functions as a reference line for adapting the end of the cloth (see Fig. 21B) seen from a back side (a facing side) of a fabric, thereby positioning the cloth to be mounted on the upper surface of the feeding table 11 easily.

[0064] As shown in Fig. 8, the eyelet buttonhole mark 59 is displayed in a shape of an eyelet buttonhole in the vertical direction of the screen in almost the central part of the liquid crystal screen 52. The eyelet buttonhole mark 59 is an image indicative of a position of the eyelet buttonhole to be formed on the cloth through the cloth cutting mechanism 20 and is displayed with the eyelet drop-shaped portion Q (see Fig. 22A) on an upper end separated from the cloth end mark 58 by a certain distance corresponding to the forming position.

[0065] Furthermore, the operation panel 50 of the first embodiment can display the cloth end mark 58 by optionally changing a position and an inclination in vertical and oblique directions through the mode key 53, the plus key 55 and the minus key 56. In other words, the operation key group 57b of the first embodiment functions as cloth end display position correcting input means for correcting the display position of the cloth end mark 58. Moreover, the operation panel 50 can change the position of the eyelet buttonhole mark 59 in transverse and vertical directions of the screen, and furthermore, can change and display the inclination in an optionally oblique direction through the mode key 53, the plus key 55 and the minus key 56. More specifically, the operation key group 57b of the first embodiment functions as eyelet buttonhole display position correcting input means for correcting the display position of the eyelet buttonhole mark. The eyelet buttonhole mark 59 may be a straight mark in the vertical direction in the liquid crystal screen 52 which has one of ends (an upper end in Fig. 8) indicating an apex of the eyelet buttonhole, a circle (a round mark) indicative of the drop-shaped portion Q of the eyelet buttonhole or a cross mark indicative of a center of the drop-shaped portion Q, for example.

[0066] Moreover, the operation panel 50 also includes the operation key group 57a (see Figs. 1 and 11) for functioning as input means for carrying out various setting operations to the sewing machine 1 and an operation for inputting various data by the operator, and a cursor and a pointer, the feeding table 11 and necessary information in that case are displayed on the display portion

52a. Various data set and input through various keys in the operation panel 50 are output to the control portion 70 which will be described below and are stored in an EEPROM 74 which will be described below.

[Control Portion]

[0067] Next, a structure of a control system of the sewing machine 1 will be described in detail with reference to Fig. 11.

[0068] Fig. 11 is a control block diagram showing an electrical structure of the sewing machine 1 according to the invention. As shown in Fig. 11, the control portion 70 includes a CPU 71, an ROM 72, an RAM 73, the EEPROM 74 and an I/O interface 75. The ROM 72, the RAM 73, the EEPROM 74 and the I/O interface 75 are coupled to the CPU 71 through a bus.

[0069] The CPU 71 intensively controls an operation processing of each portion in accordance with various control programs for the buttonholing machine 1 which are stored in the ROM 72 or various data stored in the EEPROM 74 in response to an operation signal input from an operation pedal 6 and various setting operations or various data which are input through the operation panel 50, and stores a result of the processing in a work area in the RAM 73, and furthermore, stores, in the EEPROM 74, various data input through the operation of the operation panel 50 and the result of the processing which is stored in the RAM 73 if necessary. The CPU 71 controls a driving operation of each portion of the sewing machine 1.

[0070] The ROM 72 stores a control program (a normal sewing program) for causing the sewing machine 1 to carry out a normal buttonholing work, set data related to various sewing works and a basic sewing program for driving each of the actuators 8, 12, 13, 17 and 26 to form desirable stitches. Furthermore, the ROM 72 of the first embodiment stores a program for displaying the image of the cloth which is captured by the camera unit 40, the cloth end mark 58 and the eyelet buttonhole mark 59 on the liquid crystal screen 52 of the operation panel 50.

[0071] The ROM 73 is provided with various work memories and a counter and is used as a work area during a sewing operation.

[0072] The EEPROM 74 stores sewing data on a plurality of stitching patterns which serves to operate the needle 9 and the feeding table 11 in order to form various stitching shapes. For the respective sewing data, plural types of commands such as a sewing command, an idle feeding command and a thread cutting command and data on a control amount required for an execution of the commands (for example, a stitching length, a main shaft motor rotating speed, a stitching length (X direction) - main shaft rotating speed table, and a stitching length (Y direction) - main shaft rotating speed table) are recorded in order of an execution of a processing. More specifically, a cloth feeding amount (a stitching length) through the X-axis pulse motor 12 and the Y-axis pulse motor 13

every stitch is set to the sewing command, a cloth feeding amount through each of the X-axis pulse motor 12 and the Y-axis pulse motor 13 without a sewing work is set to the idle feeding command, and a driving instruction for an electromagnetic valve 18a of a thread cutting air cylinder 18 is set to the thread cutting command. When reading the sewing data, the CPU 71 executes the commands in order and drives the X-axis pulse motor 12 and the Y-axis pulse motor 13 to move the cloth to a given position, carries out stitching by the needle 9 onto the cloth moved to the given position and cuts a thread after a serial needle handling operation is executed, thereby performing an operation control for executing a serial sewing work set to one sewing data.

[0073] In addition, the EEPROM 74 of the first embodiment stores data on a reference mark correction value for displaying the cloth end mark 58 or the eyelet buttonhole mark 59 to be the reference mark at a certain position on the liquid crystal screen 52. The reference mark correction value indicates data on a correction value for shifting (moving) the display positions of the reference mark 58 and the eyelet buttonhole mark 59 which are to be displayed in an overlap with the image captured by the camera module 41 over the liquid crystal screen 52 from a preset position (for example, see Fig. 8) in a vertical direction or a transverse direction corresponding to an input operation from the operation key group 57b and thus displaying them, for example. The reference mark correction value may serve to obliquely display the reference mark 58 and the eyelet buttonhole mark 59 which are to be displayed on the liquid crystal screen 52 with an inclination or a rotation from reference positions, for example.

[0074] The sewing machine motor 8 is coupled to the I/O interface 75 through a driver 8a for the sewing machine motor 8. When a detection signal is input from an encoder 8b for detecting a rotating speed of the sewing machine motor 8 to the control portion 70, the sewing machine motor 8 can carry out a feedback control. Moreover, a needle upper position sensor (not shown) for detecting that the needle 9 is lifted is coupled to the driver 8a, and the number of stitches formed by the needle 9 is counted by the control portion 70.

[0075] Moreover, the X-axis pulse motor 12 and the Y-axis pulse motor 13 are coupled to the I/O interface 75 through drivers 12a, 13a respectively, and an X-axis origin sensor 12b and a Y-axis origin sensor 13b which serve to detect origin positions of both of the pulse motors 12, 13 are coupled thereto. The X-axis pulse motor 12 and the Y-axis pulse motor 13 are driving means for moving the feeding table 11 in the XY direction based on sewing data (a stitching pattern), and the X-axis origin sensor 12b and the Y-axis origin sensor 13b serve to detect the origin positions of the X-axis pulse motor 12 and the Y-axis pulse motor 13 which act as the driving means respectively, and are disposed in the bed portion 3 respectively.

[0076] Furthermore, the turning pulse motor 31 is cou-

pled to the I/O interface 75 through a driver 31a and an origin sensor 31b for detecting an origin position of the turning pulse motor 31 is coupled thereto. Consequently, the CPU 71 can execute a program for an eyelet buttonholing work, for example, a normal sewing program stored in the ROM 72, thereby driving the turning pulse motor 31 in a given amount at a given timing.

[0077] In addition, the cloth cutting pulse motor 26 is coupled to the I/O interface 75 through a driver 26a and an origin sensor 26b for detecting an origin position of the cloth cutting pulse motor 26 is coupled thereto. Consequently, the CPU 71 can execute the program for an eyelet buttonholing work, for example, the normal sewing program stored in the ROM 72, thereby driving the cloth cutting pulse motor 26 in a given amount at a given timing.

[0078] Moreover, the thread cutting air cylinder 18 is coupled to the I/O interface 75 through a driver 18b and the electromagnetic valve 18a. The CPU 71 turns ON/OFF the electromagnetic valve 18a at a given timing through the driver 18b based on the program for the eyelet buttonholing work, for example, the normal sewing program stored in the ROM 72 so that the thread cutting air cylinder 18 is operated to cut the thread.

[0079] Furthermore, the presser driving air cylinder 17 is coupled to the I/O interface 75 through a driver 17b and the electromagnetic valve 17a. The CPU 71 turns ON/OFF the electromagnetic valve 17a at a given timing through the driver 17b based on the program for the eyelet buttonholing work, for example, the normal sewing program stored in the ROM 72 so that the presser driving air cylinder 17 is operated to press the cloth.

[0080] In addition, the camera moving air cylinder 43 is coupled to the I/O interface 75 through a driver 45a and the electromagnetic valve 45. The CPU 71 turns ON/OFF the electromagnetic valve 45 at a given timing through the driver 45a based on the program for the eyelet buttonholing work, for example, the normal sewing program stored in the ROM 72 so that the camera driving air cylinder 43 is operated to move the camera unit 40.

[0081] When detecting signals sent from the operation pedal 6, the operation panel 50 and various sensors which are not shown, the control portion 70 carries out various calculation processings by using the RAM 73 as a work area based on various control programs stored in the ROM 72 and the EEPROM 74 and outputs a control signal for a driving operation to the various actuators 8, 12, 13, 17 and 26 to execute a sewing operation. Consequently, the control portion 70 integrally performs an intensive control to drive each of the actuators 8, 12, 13, 17, 26 and 31 at a given timing.

[0082] Furthermore, the control portion 70 of the first embodiment functions as cloth end display control means for displaying the cloth end mark 58 as a reference mark at a certain position on the liquid crystal screen 52. Moreover, the CPU 71 functions as eyelet buttonhole display control means for displaying the eyelet buttonhole mark 59 as a reference mark at a certain position on the liquid crystal screen 52.

[Operation]

[0083] Next, an operation of the sewing machine 1 having the structure will be described with reference to a flowchart shown in Fig. 12.

[0084] When it is detected that a preparation key (not shown) on the operation panel 50 is pressed to bring an ON state (Step S2) after a main power supply of the sewing machine 1 is turned ON so that a power-ON state (Step S1) is brought, the CPU 71 retrieves origins of the pulse motors (for example, the X-axis pulse motor 12, the Y-axis pulse motor 13 and the cloth cutting pulse motor 26) which are provided in the respective portions of the sewing machine 1 and initializes the respective origins (Step S3). At this time, the cloth cutting knife 21 is disposed in a sewing position shown in Fig. 10. Thereafter, the CPU 71 decides whether the camera module 41 is set into ON by means of a setting switch (not shown) provided in the operation panel 50 and is thus brought into a valid state or not (Step S4).

[0085] If the camera module 41 is valid at Step S4 (Step S4; Yes), the CPU 71 turns ON the electromagnetic valve 45 of the camera moving air cylinder 43 (Step S5) and then turns ON the illuminating device 46 (Step S6), and furthermore, carries out a control for displaying the image captured by the camera module 41 on the operation panel 50 (Step S7). At this time, the electromagnetic valve 45 is turned ON so that the camera moving air cylinder 43 is driven and the cylinder rod 44 is moved in a forward moving direction (a leftward direction in Figs. 9 and 10). Consequently, the upper knife support 22 is moved to a foremost position (see Fig. 9) to be a cloth setting position along the lower knife support key portion 25 and the upper knife support key groove portion 23 and the camera module 41 is disposed in the cloth cutting position, that is, the opposed position to the knife receiver 27 through the upper knife support 22 (see Fig. 9). In this state, the image captured by the camera module 41 is displayed on the liquid crystal screen 52 of the operation panel 50.

[0086] When the operator mounts the cloth on the upper surface of the feeding table 11, an image (a video) of a lower surface side (i.e., a front surface) of the cloth cutting position to be cut by the cloth cutting knife 21 and the knife receiver 27 is captured by the camera module 41 from the clearance W (see Fig. 6) provided between the respective presser plates 11a and 11a and is displayed on the liquid crystal screen 52 of the operation panel 50. Moreover, the cloth end mark 58 and the eyelet buttonhole mark 59 to be positioning references in the mounting of the cloth are displayed on the liquid crystal screen 52. Therefore, the operator positions the cloth based on the respective marks 58 and 59.

[0087] When it is detected that the presser switch (not shown) is pressed by the operator of the sewing machine 1 after the cloth is completely positioned, the CPU 71 drives the presser driving air cylinder 17 through the driver 17b and the electromagnetic valve 17a, thereby carrying out a control for downward moving the presser arm

15 and the presser foot 16 (Step S8). Consequently, the cloth is interposed between the presser foot 16 and the feeding table 11 and is held in a movable state in a horizontal direction. Moreover, the CPU 71 drives the presser driving air cylinder 17 at Step S8 and the electromagnetic valve 45 is then turned OFF to carry out a control for moving the cylinder rod 44 backward to a rearmost position (Step S9). Consequently, the cloth cutting knife 21 is disposed in a cutting position (see Fig. 10) through the upper knife support 22 so that a sewing enable state is brought.

[0088] Next, the CPU 71 ends the display of the image captured by the camera module 41 over the operation panel 50 (Step S10) and carries out a control for turning OFF the illuminating device 46 (Step S11). In this stage, a normal setting screen is displayed on the liquid crystal screen 52. Next, the CPU 71 decides whether the presser switch is pressed or not again (Step S12). If it is detected that the presser switch is pressed again at Step S12 (Step S12 ; Yes), the CPU 71 proceeds to Step S4 in which it decides whether the camera module 41 is valid or not again. In other words, when the presser switch is pressed again at Step S12, there is ensured a procedure for executing the cloth positioning work (mounting work / setting work) in Steps S4 to S11 again.

[0089] If the presser switch is turned ON (Step S16) in a state in which the camera module 41 is not valid (Step S4 ; No) at Step S4, the CPU 71 proceeds to Step S12 in which it decides whether the presser switch is pressed or not again. In other words, in the case in which the camera module 41 is not required, for example, the case in which a buttonholing work is carried out over a plain cloth shown in Fig. 20A or the case in which a buttonhole does not need to be adapted to a stripe or a check stripe, a conventional cloth mounting work is carried out without requiring to replace the cloth cutting knife 21 with the camera module 41, thereby capturing the image of the lower surface side of the cloth. Whether the camera module 41 is valid can be preset to be switchable by an input operation through the operation panel 50.

[0090] When the presser switch is not pressed at Step S12 (Step S12 ; No) but a start switch (not shown) for starting the sewing operation is pressed (Step S 13), moreover, the CPU 71 drives each portion of the sewing machine 1 to execute a control for carrying out the sewing work based on the various programs stored in the ROM 72 and the EEPROM 74 (Step S14).

[0091] In the stage of the sewing work, the downward moving operation of the knife receiver 27 with respect to the cloth cutting knife 21 is carried out so that a cut for a buttonhole is formed, and the stitching and the needle oscillating operation of the needle 9 are carried out through the needle driving mechanism and the needle oscillating mechanism and the cloth feeding operation is carried out through the cloth feeding mechanism 10 so that an overlock sewing work is performed over an edge of the cut. It is also possible to form a cut through the downward movement of the knife receiver 27 or to carry

out a buttonholing work through the needle 9 earlier.

[0092] Then, the CPU 71 decides whether the preparation key is pressed or not again (Step S15). If the preparation key is pressed (Step S15 ; Yes), the processing proceeds to Step S3 in which the control for initializing the origin of each of the pulse motors is carried out. On the other hand, if the preparation key is not pressed at Step S15 (Step S15 ; No), the CPU 71 proceeds to Step S4 and the operation is repetitively executed until the preparation key is subsequently pressed.

[0093] In the buttonholing machine 1 according to the first embodiment, thus, the cloth cutting knife 21 and the camera module 41 are mounted on the upper knife support 22 to be driven by the camera moving air cylinder 43 mounted on the feeding table 11 and serving as another independent driving source from the feeding table 11, and the cloth cutting knife 21 and the camera module 41 are switched to the opposed position to the knife receiver 27 and are thus disposed so that a pattern on the front side of the cloth is captured from below (under) the cutting position.

[0094] As described above, according to the sewing machine 1 of the first embodiment, the image of the cloth mounted on the feeding table 11 can be captured from below by means of the camera unit 40, and the image can be displayed on the liquid crystal screen 52 of the operation panel 50. When mounting the cloth on the feeding table 1 to position the buttonhole, consequently, the operator of the sewing machine 1 can easily recognize a surface on a side provided in contact with the mounting table in the cloth while seeing the image displayed on the operation panel 50. When the cloth is to be positioned, accordingly, it is not necessary to fold the cloth back to confirm a direction of the pattern or to carry out stay stitching or put a marking needle, thereby making a mark for a buttonhole and it is possible to easily carry out the positioning work. Therefore, it is possible to reduce a man-hour and a working time which are required for positioning the cloth, thereby carrying out the positioning work easily and enhancing a production efficiency. Moreover, the control portion 70 automatically turns ON the camera moving air cylinder 43, the illuminating device 46 and the operation panel 50 interlockingly with a preparing operation before the start of the sewing work to dispose the camera module 41 in the cutting position (the image capturing position) and automatically turns OFF the camera moving air cylinder 43, the illuminating device 46 and the operation panel 50 interlockingly with the touching of the presser switch to dispose the camera module 41 in the rearmost position. Consequently, the operation for displaying the image of the lower surface of the cloth on the liquid crystal screen 52 of the operation panel 50 can be carried out very easily.

[0095] Moreover, it is possible to position the cloth by setting, as an index, the reference mark such as the cloth end mark 58 or the eyelet buttonhole mark 59 displayed on the surface of the liquid crystal screen 52. When mounting the cloth on the feeding table 11, therefore, it

is possible to carry out the positioning work more easily. In particular, the cloth is positioned to be coincident with the cloth end mark 58. Consequently, also in the case in which the surface on the front side of the cloth provided in contact with the upper surface of the feeding table 11 in the cloth mounted on the feeding table 11 is plain as shown in Fig. 20A, for example, the cloth can easily be positioned.

[0096] Furthermore, the camera module 41 is disposed in the vicinity of the side of the cloth cutting knife 21. Consequently, the image of the cutting position for the cloth cutting mechanism 20 and a portion of the surface therearound provided in contact with the feeding table 11 in the cloth mounted on the feeding table 11 can be captured more clearly and easily. In addition, the illuminating device 46 is provided. Consequently, the image of the cloth which is to be displayed on the operation panel 50 can be displayed more clearly. As a result, it is possible to enhance a reliability of the cloth positioning work.

[0097] By the control portion 70 functioning as the cloth end display position correcting input means or the eyelet buttonhole display position correcting input means, moreover, it is possible to correct the display position of the cloth end mark 58 or the eyelet buttonhole mark 59 in the liquid crystal screen 52. Consequently, it is possible to display the cloth end mark 58 and the eyelet buttonhole mark 59 in desirable positions on the liquid crystal screen 52 of the operation panel 50 in which the operator can easily recognize a positional relationship between the cloth end and the buttonhole, for example. As a result, it is possible to easily carry out the cloth positioning work and to enhance a production efficiency.

SECOND EMBODIMENT

[0098] Next, a second embodiment of the invention will be described in detail with reference to Figs. 13 to 16. In the following second and third embodiments, the same structures as those in the first embodiment have the same reference numerals, and repetitive description thereof will be omitted.

[0099] A buttonholing machine 101 (hereinafter, also referred to as a sewing machine 101) according to the second embodiment is different from the first embodiment in that a camera unit 140 to be image capturing means is attached to an upper surface of a bed portion 3 in a position placed apart from a cloth cutting position in cooperation of a cloth cutting knife 21 with a knife receiver 27.

[0100] More specifically, the camera unit 140 according to the second embodiment is provided side by side with a looper mechanism 60 and is disposed on the upper surface of the bed portion 3 at a tip side of the bed portion 3 from the looper mechanism 60, that is, at a working position side (a left side in Fig. 14) of an operator in the sewing machine 101.

[0101] The camera unit 140 is attached to a position

in which an interference with a feeding table 11 opened to take a U shape can be avoided through a bottom portion of the feeding table 11, and includes a camera module 41 and an illuminating device 46 which are coupled to a control portion 70 through a cable which is not shown.

[0102] Moreover, the cloth cutting knife 21 is fixed to an opposed position to the knife receiver 27 and is fixed to the upper surface of the bed portion 3 through a knife support 122 for supporting the cloth cutting knife 21. In other words, in the second embodiment, the cloth cutting knife 21 and the knife support 122 are not moved during a sewing work but are fixed to the upper surface of the bed portion 3.

[0103] Furthermore, an ROM 72 provided in the control portion 70 stores a control program for carrying out a image capturing control operation which will be described below. A CPU 71 drives each portion of the sewing machine 101 based on the control program stored in the ROM 72, thereby carrying out a control for displaying, on an operation panel 50, an image of a cloth captured by the camera module 41.

[0104] Next, an operation of the buttonholing machine 101 according to the second embodiment will be described with reference to a flowchart shown in Fig. 16.

[0105] When it is detected that a preparation key is pressed to bring an ON state (Step S21) after a main power supply of the sewing machine 101 is turned ON so that a power-ON state (Step S20) is brought, the CPU 71 retrieves an origin of each pulse motor provided in each portion of the sewing machine 101 and initializes each origin in the same manner as in the first embodiment (Step S22). At this time, the feeding table 11 is disposed in a feeding origin position shown in Fig. 13, that is, a cutting position in which a cloth is cut by means of the cloth cutting knife 21 and the knife receiver 27 with the feeding table 11 disposed on a most vertical drum portion 4 side. Then, the CPU 71 decides whether the camera module 41 is turned ON and is thus brought into a valid state or not (Step S23).

[0106] If the camera module 41 is valid at Step S23 (Step S23; Yes), the CPU 71 drives a Y-axis pulse motor 13 to move the feeding table 11 to a feeding set position at the operator side from a sewing position (see Fig. 15) (Step S24) and then turns ON the illuminating device 46 (Step S25), and furthermore, carries out a control for displaying an image captured by the camera module 41 through the operation panel 50 (Step S26). In the feeding set position, an almost central part in a longitudinal direction of each presser foot 16 of a pressing mechanism 14 is disposed on both sides above the camera module 41 as shown in Fig. 15. In this state, the image captured by the camera module 41 is displayed on a liquid crystal screen 52 of the operation panel 50.

[0107] When the operator mounts the cloth on an upper surface of the feeding table 11, a surface of a body of the cloth disposed in an opposed position to the knife receiver 27 is positioned above the camera module 41 in the disposition of the feeding table 11 in the cloth cutting

position (see Fig. 13) in the cloth mounted on the feeding table 11 and an image (a video) thereof is displayed on the liquid crystal screen 52 of the operation panel 50. Moreover, a cloth end mark 58 and an eyelet buttonhole mark 59 to be positioning references for mounting the cloth are displayed on the liquid crystal screen 52. Therefore, the operator positions the cloth based on the respective marks 58 and 59.

[0108] When it is detected that a presser switch is pressed by the operator of the sewing machine 101 after the cloth is completely positioned, the CPU 71 drives a presser driving air cylinder 17 through a driver and an electromagnetic valve 17a, thereby carrying out a control for downward moving a presser arm 15 and the presser foot 16 (Step S27). Consequently, the cloth is interposed between the presser foot 16 and the feeding table 11 and is held in a movable state in a horizontal direction.

[0109] Next, the CPU 71 ends the display of the image captured by the camera module 41 over the operation panel 50 (Step S28) and carries out a control for turning OFF the illuminating device 46 (Step S29). In this stage, a normal setting screen is displayed on the liquid crystal screen 52. Subsequently, the CPU 71 decides whether the presser switch is pressed or not again (Step S30). If it is detected that the presser switch is pressed again at Step S30 (Step S30 ; Yes), the CPU 71 proceeds to Step S23 in which it decides whether the camera module 41 is valid or not. In other words, when the presser switch is pressed again at Step S30, there is ensured a procedure for executing the cloth positioning work (mounting work / setting work) in Steps S23 to S29 again.

[0110] If the presser switch is turned ON (Step S34) in a state in which the camera module 41 is not valid (Step S23 ; No) at Step S23, the CPU 71 proceeds to step S30 in which it decides whether the presser switch is pressed or not again. In other words, in the same manner as in the first embodiment, in the case in which the camera module 41 is not required, a conventional cloth mounting work is carried out without capturing the image on the lower surface side of the cloth. It is possible to switchably preset whether the camera module 41 is valid or not through an input operation from the operation panel 50.

[0111] When the presser switch is not pressed at Step S30 (Step S30 ; No) but a start switch for starting the sewing operation is pressed (Step S31), moreover, the CPU 71 drives each portion of the sewing machine 101 to execute a control for carrying out the sewing work based on various programs stored in the ROM 72 and an EEPROM 74 (Step S32).

[0112] In the stage of the sewing work, the downward moving operation of the knife receiver 27 with respect to the cloth cutting knife 21 is carried out so that a cut for a buttonhole is formed, and a stitching by a needle 9 and a needle oscillating operation are carried out through a needle driving mechanism and a needle oscillating mechanism and the cloth feeding operation is carried out through a cloth feeding mechanism 10 so that an overlock sewing work is performed over an edge of the cut.

[0113] Then, the CPU 71 decides whether the preparation key is pressed or not again (Step S33). If the preparation key is pressed (Step S33 ; Yes), the processing proceeds to Step S22 in which the control for initializing the origin of each of the pulse motors is carried out. On the other hand, if the preparation key is not pressed at Step S33 (Step S33 ; No), the CPU 71 proceeds to Step S23 and the operation is repetitively executed until the preparation key is subsequently pressed.

[0114] In the buttonholing machine 101 according to the second embodiment, thus, the camera module 41 and the illuminating device 46 are fixed to the upper surface of the bed portion 3 at the working position side of the operator from the looper mechanism 60, that is, from the stitch point, and the cloth is mounted while a pattern on a front side of the cloth captured from below (under) is confirmed on the operation panel 50 with the feeding table 11 moved to the working position side of the operator. Then, a cut for a buttonhole is formed in a state in which the feeding table 11 is moved to the cutting position and a sewing work is carried out at the stitch point.

[0115] According to the buttonholing machine 101 of the second embodiment which has the structure, the camera module 41 and the illuminating device 46 are fixed to the upper surface of the bed portion 3 and the image the lower surface of the cloth is captured in a position placed apart from the cutting position when the cloth is to be positioned. Consequently, it is not necessary to provide another mechanism or driving source for moving the camera module 41 or the illuminating device 46. Consequently, it is possible to easily carry out a cloth mounting work while reducing a cost with a simple structure. By disposing a camera unit 40 in the position placed apart from the cloth cutting knife 21, moreover, it is possible to provide the camera unit 40 in a position in which it does not interfere with another mechanism such as a cloth cutting mechanism 20 or the cloth feeding mechanism 10, for example. Consequently, a degree of freedom can be enhanced in the disposition of the camera unit 40. Furthermore, the camera module 41 and the illuminating device 46 are attached to the operator side from the looper mechanism 60 so that a setting position in which the cloth is set into the feeding table 11 is close to the operator side. Therefore, the mounting work can easily be carried out.

THIRD EMBODIMENT

[0116] Next, a third embodiment of the invention will be described in detail with reference to Figs. 17 to 19.

[0117] A buttonholing machine 201 according to the third embodiment is different from the first and second embodiments in that a camera unit 240 to be image capturing means is mounted on a feeding table 211. The camera unit 240 is provided with a camera module 41 and an illuminating device 46 which are coupled to a control portion 70 through a cable (not shown) respectively and are attached to an inner part of the feeding table 211

with setscrews respectively as shown in Figs. 17 and 18. In the camera module 41, a lens is disposed upward on an extension of a line in an almost Y-axis direction connecting a cloth cutting knife 21 and a stitch point of a needle 9 at a working position side of an operator from a looper mechanism 60 (a left side in Fig. 18). It is sufficient that the camera module 41 and the illuminating device 46 are attached into any position at a lower side of a cloth mounted on the feeding table 211. Moreover, the feeding table 211 has an opening portion P formed above the camera module 41 in an upper surface portion (a mounting table), and an image of a lower side of the cloth mounted on the feeding table 211 can be captured by the camera module 41.

[0118] Moreover, an ROM 72 provided in the control portion 70 stores a control program for carrying out a image capturing control operation which will be described below. A CPU 71 drives each portion of the sewing machine 201 based on the control program stored in the ROM 72, thereby carrying out a control for displaying, on an operation panel 50, an image of the cloth captured by the camera module 41.

[0119] It is sufficient that the camera unit 240 according to the third embodiment can be moved together with the feeding table 211. For example, the camera unit 240 may be attached below a presser foot 16.

[0120] Next, an operation of the buttonholing machine 201 according to the third embodiment will be described with reference to a flowchart shown in Fig. 19.

[0121] When it is detected that a preparation key is pressed to bring an ON state (Step S41) after a main power supply of the sewing machine 201 is turned ON so that a power-ON state (Step S40) is brought, the CPU 71 retrieves an origin of a pulse motor provided in each portion of the sewing machine 201 and initializes each origin (Step S42). At this time, the feeding table 211 is disposed in a cutting position shown in Fig. 17. Then, the CPU 71 decides whether the camera module 41 is turned ON and is thus brought into a valid state or not (Step S43).

[0122] If the camera module 41 is valid at Step S43 (Step S43; Yes), the CPU 71 turns ON the illuminating device 46 (Step S44) and then carries out a control for displaying an image captured by the camera module 41 through the operation panel 50 (Step S45). In this state, the image captured by the camera module 41 is displayed on a liquid crystal screen 52 of the operation panel 50.

[0123] When the operator mounts the cloth on an upper surface of the feeding table 211, an image (a video) on a lower surface side of a position placed apart from the cutting position of the cloth through the cloth cutting knife 21 and a knife receiver 27 toward the working position side of the operator in the Y-axis direction in the cloth mounted on the feeding table 211, that is, a front side of a cloth is displayed on the liquid crystal screen 52 of the operation panel 50. Moreover, a cloth end mark 58 and an eyelet buttonhole mark 59 to be positioning references in the mounting of the cloth are displayed on the liquid crystal screen 52. The operator positions the

cloth based on the respective marks 58 and 59.

[0124] After the cloth is completely positioned, the CPU 71 decides whether a presser switch is pressed or not (Step S46). If it is detected that the presser switch is pressed at Step S46 (Step S46 ; Yes), the CPU 71 drives a presser driving air cylinder 17 through a driver 17b and an electromagnetic valve 17a, thereby moving a presser arm 15 and the presser foot 16 downward. Consequently, the cloth is interposed between the presser foot 16 and the feeding table 211 and is held in a movable state in a horizontal direction. Then, the CPU 71 ends the display, on the operation panel 50, of the image captured by the camera module 41 (Step S47) and carries out a control for turning OFF the illuminating device 46 (Step S48). In this stage, a normal setting screen is displayed on the liquid crystal screen 52.

[0125] If it is not detected that the presser switch is pressed at Step S46 (Step S46 ; No), the CPU 71 proceeds to Step S43 in which it decides whether the camera module 41 is valid or not again. In other words, there is ensured a procedure for executing the cloth positioning work (mounting work / setting work) in Steps S43 to S46 until the presser switch is pressed at Step S46.

[0126] If the presser switch is turned ON (Step S52) in a state in which the camera module 41 is not valid (Step S43 ; No) at Step S43, the CPU 71 proceeds to Step S49. When a start switch is pressed (Step S49), then, the CPU 71 drives each portion of the sewing machine 201 to execute a control for carrying out a sewing work based on various programs stored in the ROM 72 and an EEPROM 74 (Step S50).

[0127] Thereafter, the CPU 71 decides whether a preparation key is pressed or not again (Step S51). If the preparation key is pressed (Step S51 ; Yes), the processing proceeds to Step S42 in which the control for initializing the origin of each of the pulse motors is carried out. On the other hand, if the preparation key is not pressed at Step S51 (Step S51 ; No), the CPU 71 proceeds to Step S43 and the operation is repetitively executed until the preparation key is subsequently pressed.

[0128] In the buttonholing machine 201 according to the third embodiment, thus, a pattern on the front side of the cloth of the cloth is captured from below a position placed apart from a cutting position by means of the camera module 41 and the illuminating device 46 which are mounted on the feeding table 211.

[0129] According to the buttonholing machine 201 in accordance with the third embodiment which has the structure, the camera module 41 and the illuminating device 46 are directly attached to the feeding table 211. Consequently, it is possible to employ a simple structure. Moreover, the camera module 41 and the illuminating device 46 are directly attached to the feeding table 211. Also in a second setting position in which a normal cloth setting position is set to the operator side, consequently, it is possible to capture the image of the lower surface side of the cloth by the camera module 41.

[0130] In this case, as described in the first and second

embodiments, it is desirable that an image of the front side of the cloth be captured in the cloth cutting position through the cloth cutting knife 21 and the knife receiver 27. In the case in which patterns expressed on the front side of the cloth are arranged regularly at an equal interval, for example, it is also possible to attach them into positions placed apart from the cloth cutting knife 21 or the knife receiver 27 as in the third embodiment. In this case, even if the image of the front side of the cloth is captured in a position placed apart from a position in which a buttonhole is formed, a direction of the cloth can be adapted.

OTHER EMBODIMENTS

[0131] The cloth cutting knife 21 and the knife receiver 27 may be provided with respective upper and lower positions being reversed. More specifically, although the cloth cutting knife 21 is provided on a lower bed portion 3 side with the cloth feeding table 11, 211 interposed therebetween and the knife receiver 27 is provided on an upper arm portion 5 side in the embodiments described above, it is also possible to employ a structure in which the cloth cutting knife 21 is provided on the arm portion 5 side and the knife receiver 27 is provided on the bed portion 3 side to cut the cloth while the cloth cutting knife 21 is moved downward, for example.

[0132] Moreover, the light emitting portion is not restricted to an LED lamp 49 but it is possible to employ various light sources which can recognize a pattern on the front side of the cloth through the image capturing operation of the camera module 41. In addition, a desirable number of light sources to be required (for example, the LED lamps 49) can be mounted as the light emitting portions.

[0133] While the description has been given by taking the eyelet buttonhole as an example of the buttonhole (see Fig. 22A) in the embodiments described above, furthermore, it is possible to apply the invention to various buttonholes such as a straight buttonhole (see Fig. 22B) having no drop-shaped portion but only a straight portion.

[0134] Although there has been employed the structure in which the cloth end mark 58 and the eyelet buttonhole mark 59 to be the reference marks are displayed as the images on the liquid crystal screen 52 of the operation panel 50 in the first to third embodiments, moreover, the cloth end mark 58 and the eyelet buttonhole mark 59 may be stuck or directly printed at certain positions on the surface of the liquid crystal screen 52 so as to be the references for mounting the cloth on the feeding table 11, for example.

[0135] In this case, by causing the cloth cutting position through the cloth cutting knife 21 and the knife receiver 27, the position of the image to be captured by the camera unit 40 and displayed on the liquid crystal screen 52 and the position of the reference mark to be added to the liquid crystal screen 52 to correspond to each other, it is possible to cause the marks to function as the reference

marks for efficiently mounting the cloth on the upper surface of the feeding table 11 with a simple structure.

[0136] While there has been employed the structure in which the image captured by the camera unit 40 is displayed on the operation panel 50 in the embodiments described above, furthermore, it is also possible to employ a structure in which a display panel is provided separately from the operation panel 50 to display the image of the cloth captured by the camera unit 40 and the reference mark and to have the same function as the operation key group 57b of the operation panel 50.

Claims

1. A buttonholing machine (1, 101, 201) comprising:

a stitching mechanism operable to move a needle (9) in a vertical direction (Z) to form a stitch; a cloth feeding mechanism (10) having a mounting table (11, 211) on which a workpiece is mounted so as to be orthogonal to a vertical moving path of the needle (9), the cloth feeding mechanism (10) being operable to deliver the mounted workpiece in a certain direction (X, Y); a cloth cutting mechanism (20) operable to cut the workpiece, which has been delivered to a cutting position by the cloth feeding mechanism (10), to form a buttonhole; and control means (70) for controlling each of the mechanisms to form the buttonhole on the workpiece and to form side stitches along the buttonhole,

characterized in that the buttonholing machine (1, 101, 201) further comprises:

image capturing means (40, 140, 240) for capturing an image of the workpiece mounted on the mounting table (11, 211) from below, the image capturing means (40, 140, 240) being disposed below a cloth mounting surface of the mounting table (11, 211); and display means (50) for displaying the image of the workpiece captured by the image capturing means (40, 140, 240).

2. The buttonholing machine (1, 101, 201) according to claim 1, wherein the display means (50) may display, on a screen (52) thereof, a first reference mark (59) corresponding to a buttonhole forming position.

3. The buttonholing machine (1, 101, 201) according to claim 2, wherein the first reference mark (59) includes an image of a shape of the buttonhole to be formed on the workpiece by the cloth cutting mechanism (20).

4. The buttonholing machine (1, 101, 201) according to any of claims 1 to 3, wherein the display means (50) displays, on the screen (52) thereof, a second reference mark (58) corresponding to a position of an end of the workpiece. 5

5. The buttonholing machine (1) according to claim 1, wherein the cloth cutting mechanism (20) comprises:
 - a cloth cutting knife (21); and 10
 - a knife receiver (27) disposed above the cloth cutting knife (21), the knife receiver (27) being opposed to the cloth cutting knife (21) and movable in the vertical motion (Z), 15
 wherein the buttonholing machine (1) further comprises:
 - a support (22) holding the image capturing means (40) and the cloth cutting knife (21); and 20
 - driving means (43) for moving the support (22) such that the cloth cutting knife (21) and the image capturing means (40) are alternately opposed to a downward moving position of the knife receiver (27). 25

6. The buttonholing machine (1) according to claim 1, wherein the cloth cutting mechanism (20) comprises:
 - a knife receiver (27); and 30
 - a cloth cutting knife (21) disposed above the knife receiver (27), the cloth cutting knife (21) being opposed to the knife receiver (27) and movable in the vertical motion (Z), 35
 wherein the buttonholing machine (1) further comprises:
 - a support (22) holding the image capturing means (40) and the knife receiver (27) close to each other; and 40
 - driving means (43) for moving the support (22) such that the knife receiver (27) and the image capturing means (40) are alternately opposed to a downward moving position of cloth cutting knife (21). 45

7. The buttonholing machine (1, 101, 201) according to claim 2 or 3, further comprising display position correcting input means (57b) for correcting a display position of the first reference mark (59). 50

8. The buttonholing machine (1, 101, 201) according to claim 4, further comprising display position correcting input means (57b) for correcting a display position of the second reference mark (58). 55

Fig. 1

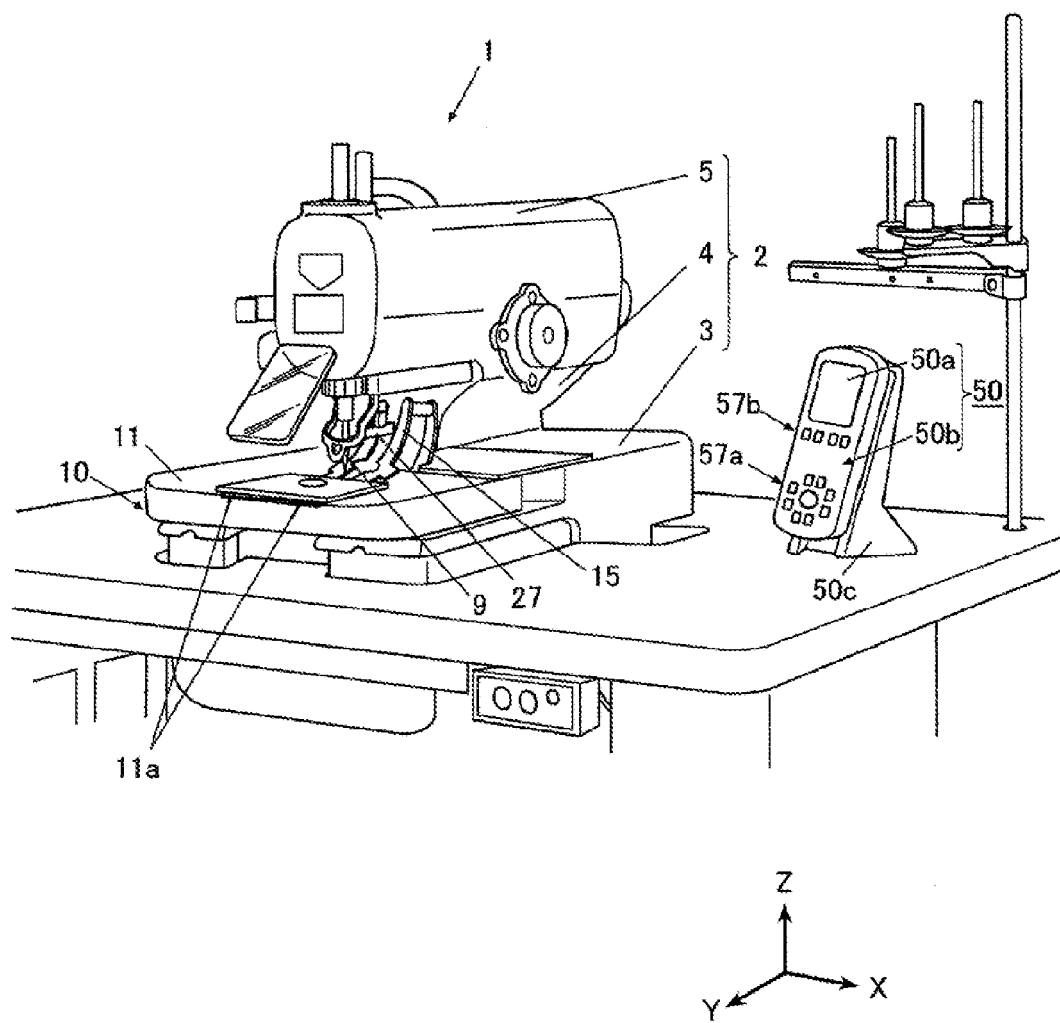


Fig. 2

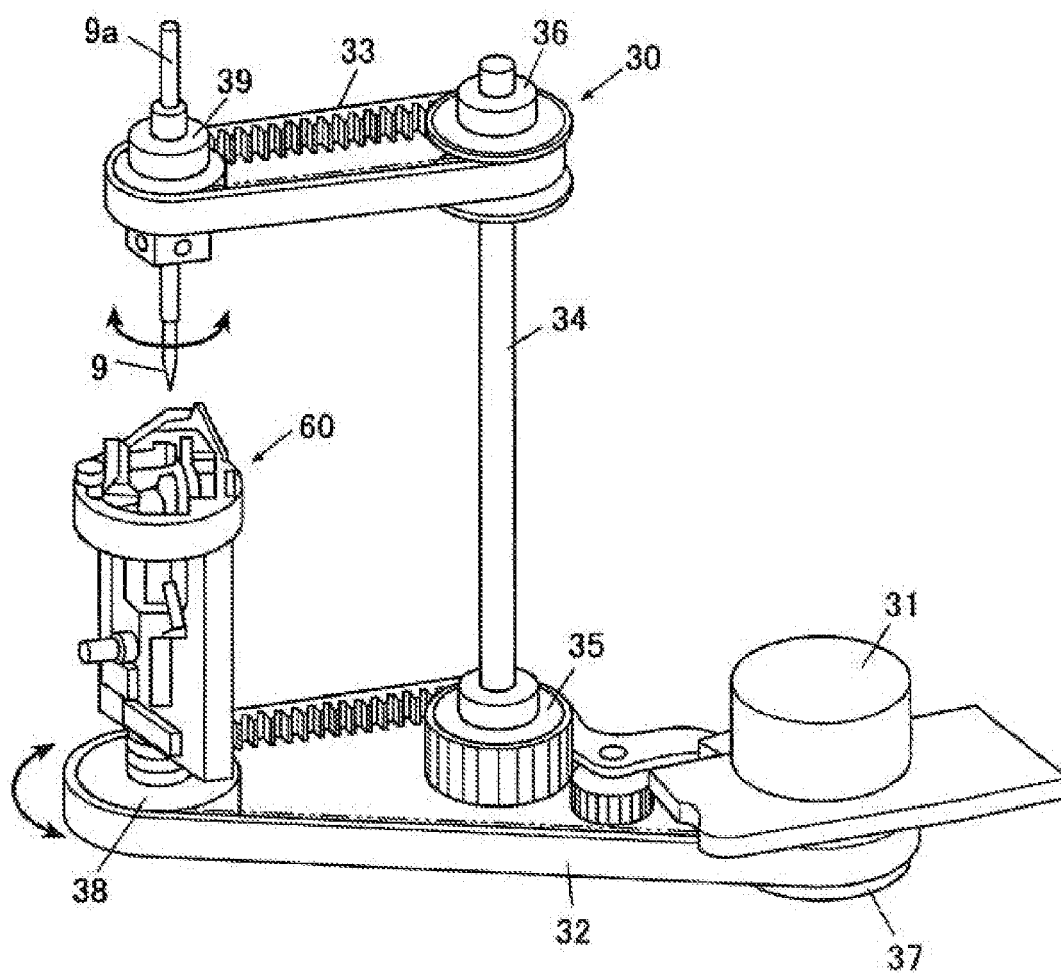


Fig. 3

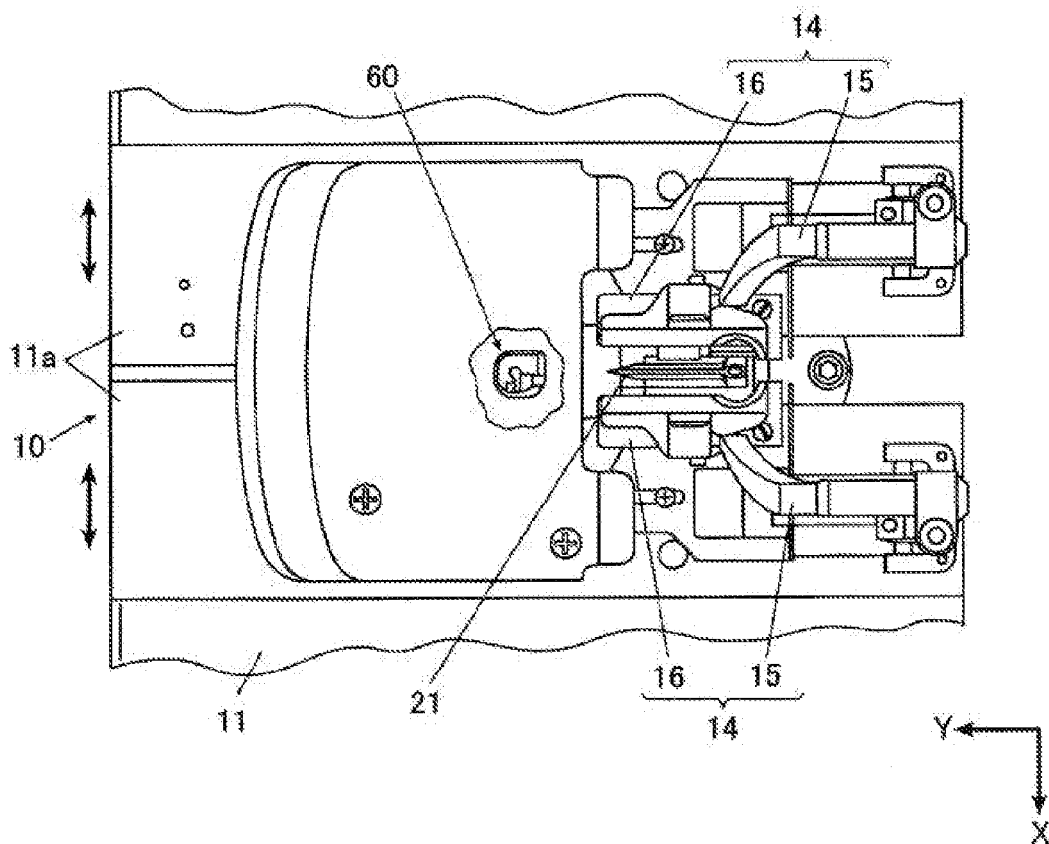


Fig. 4

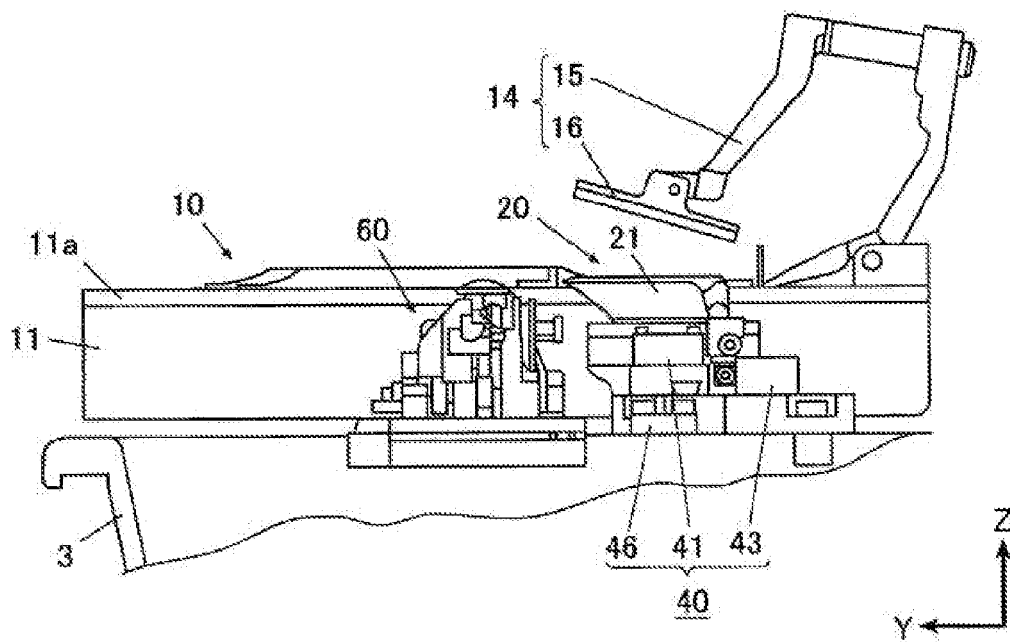


Fig. 5

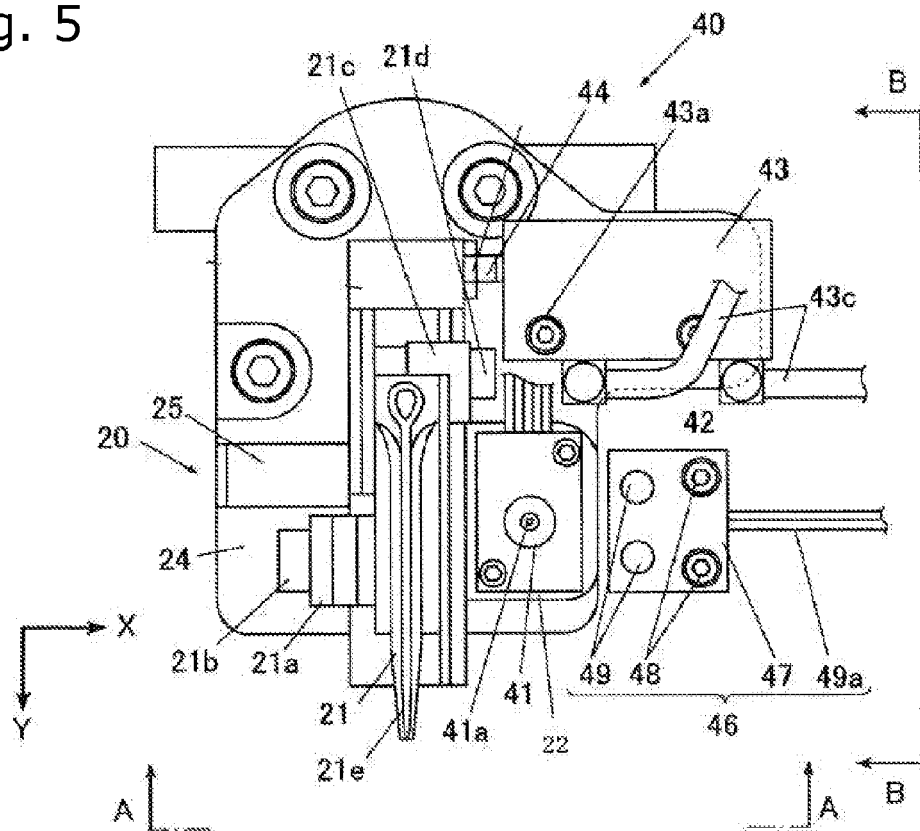


Fig. 6

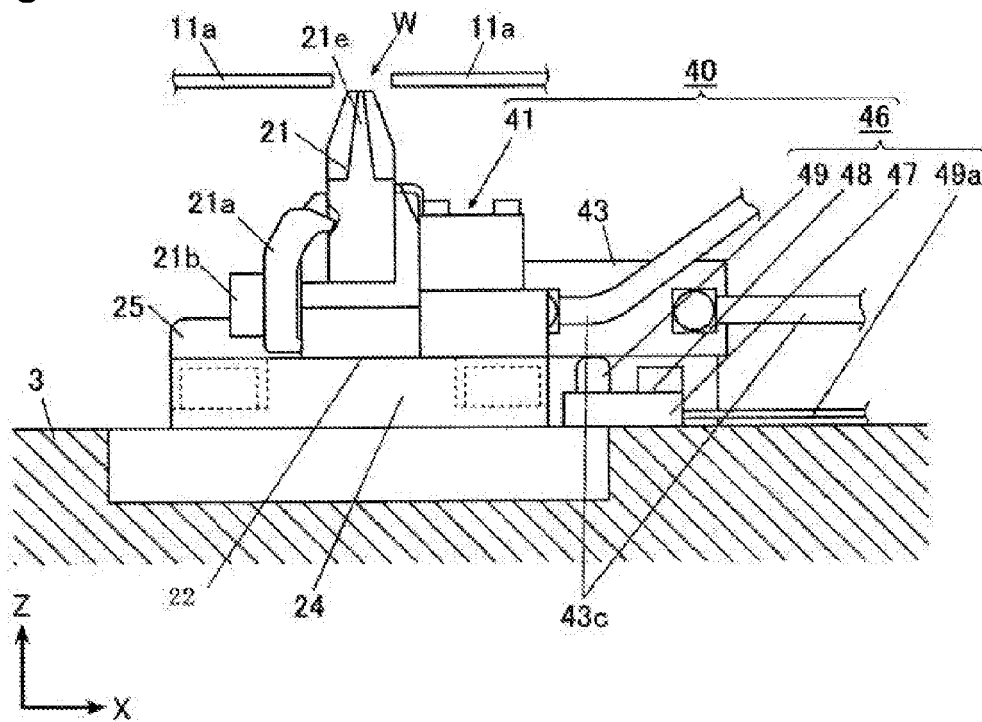


Fig. 7

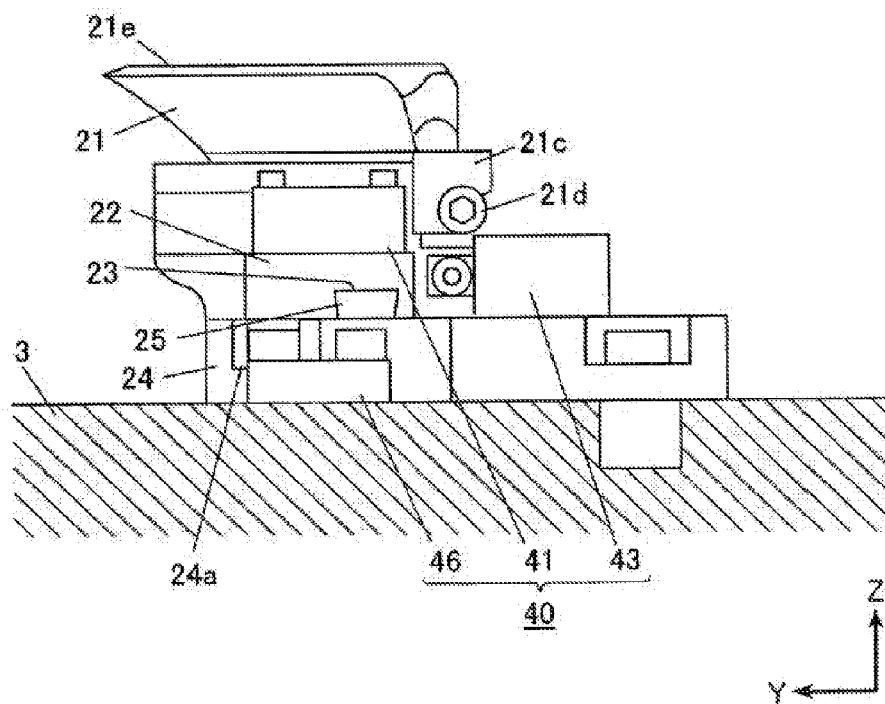


Fig. 8

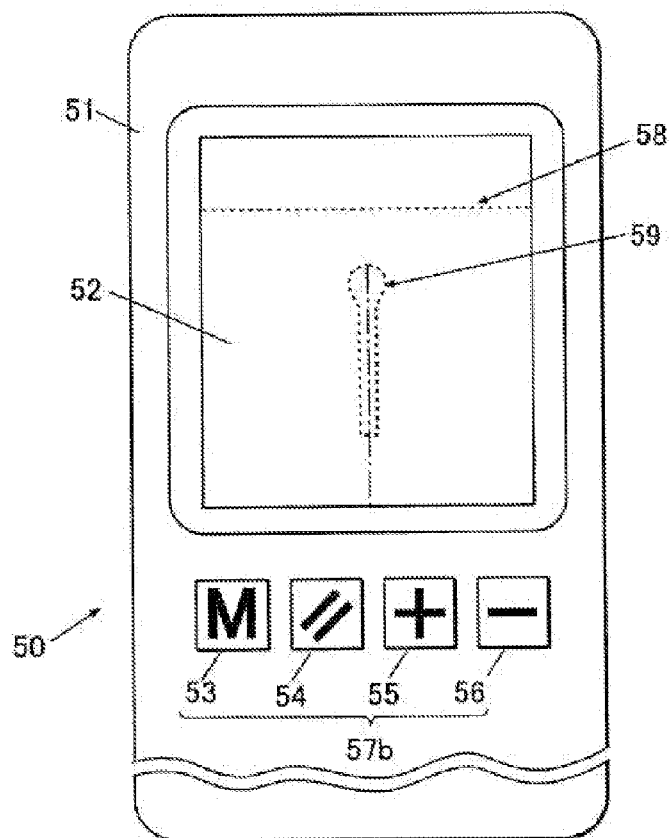


Fig. 9

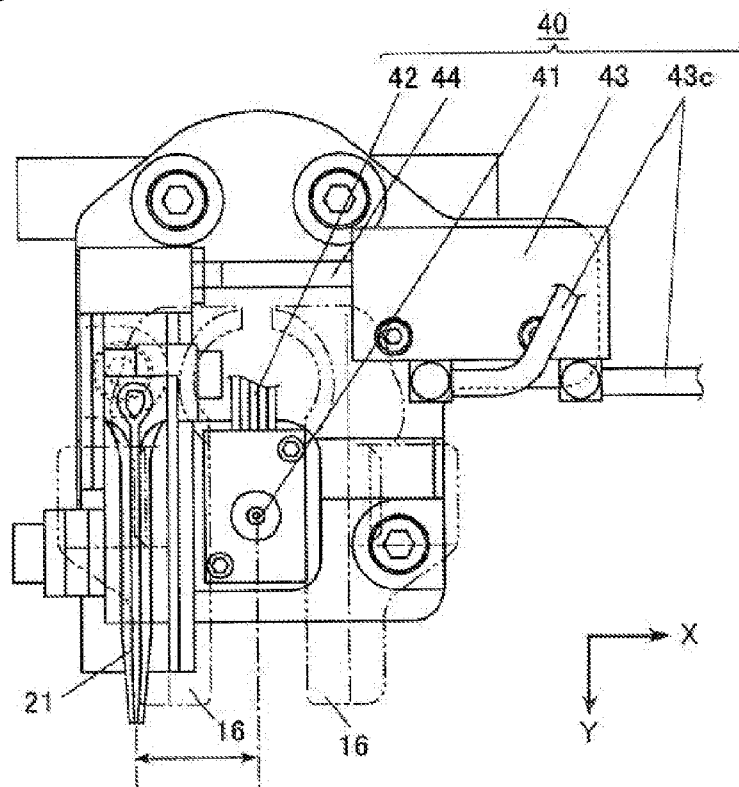


Fig. 10

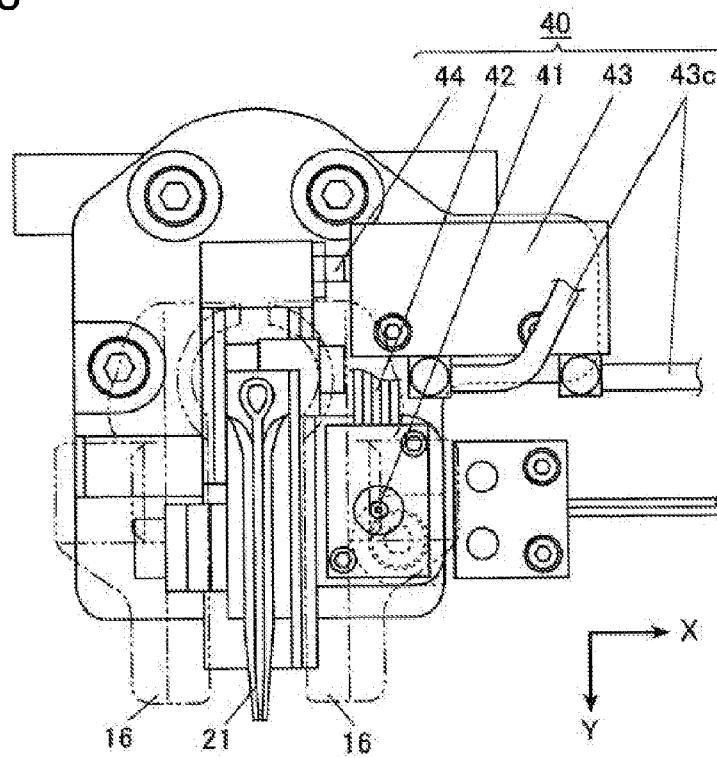


Fig. 11

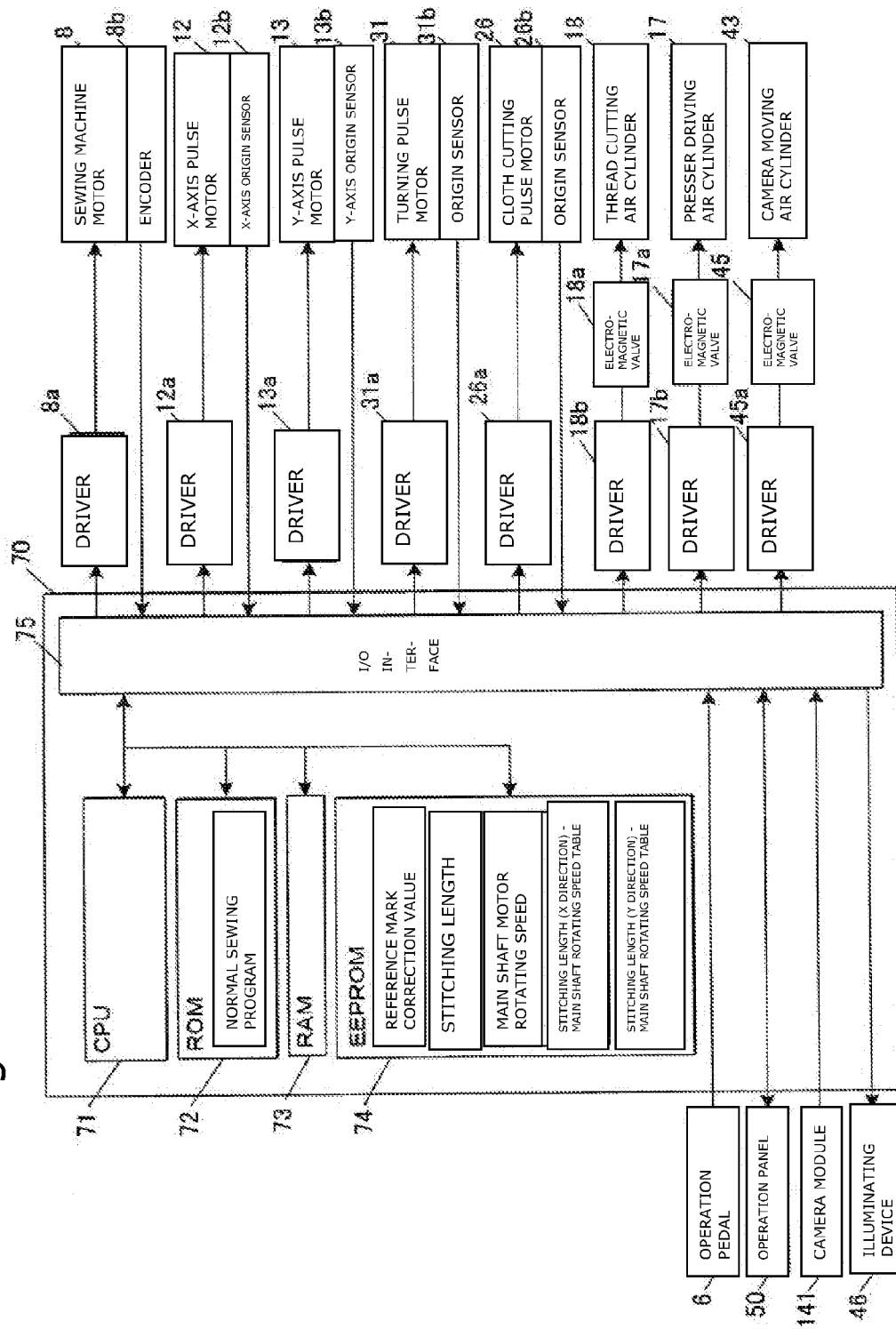


Fig. 12

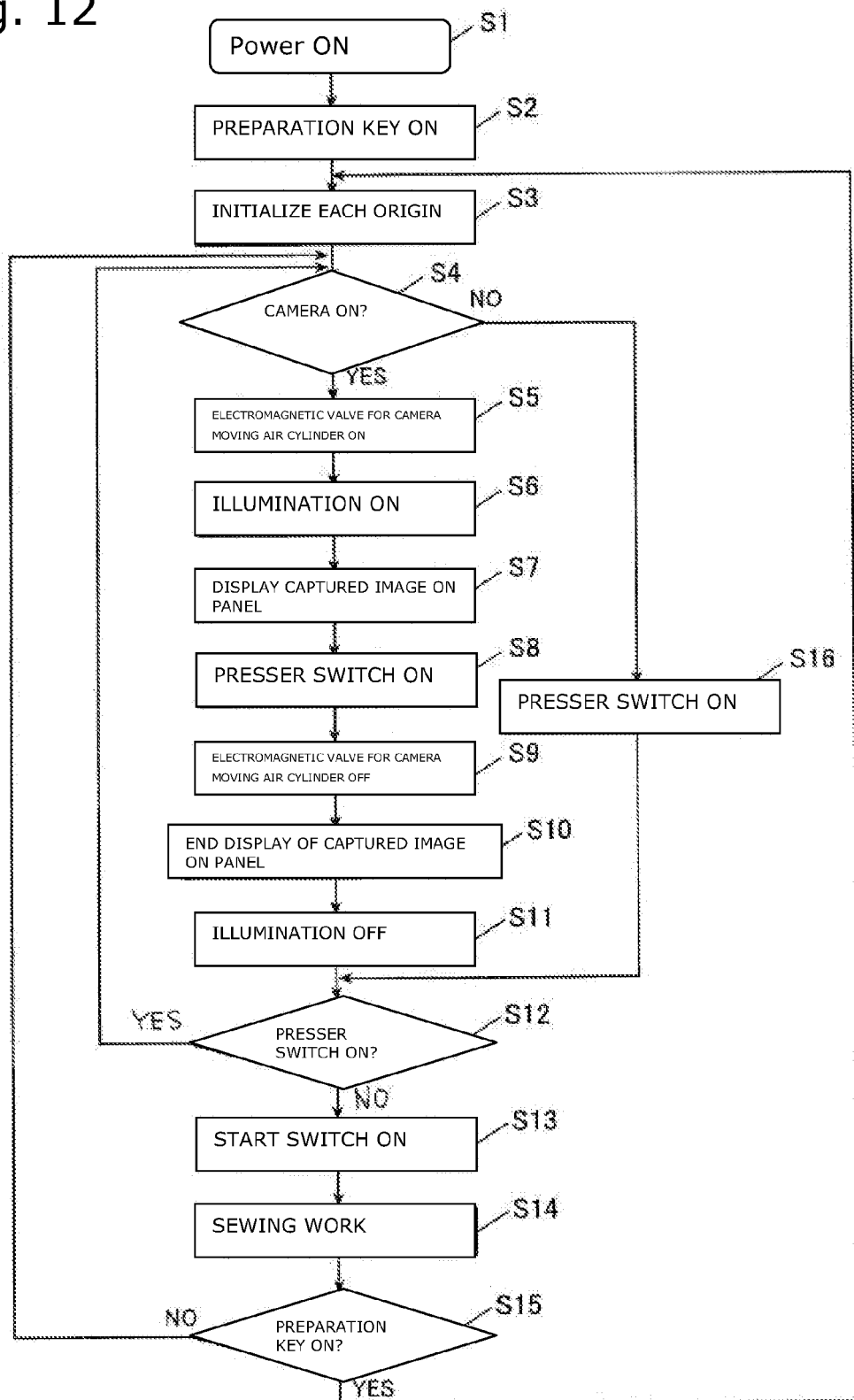


Fig. 13

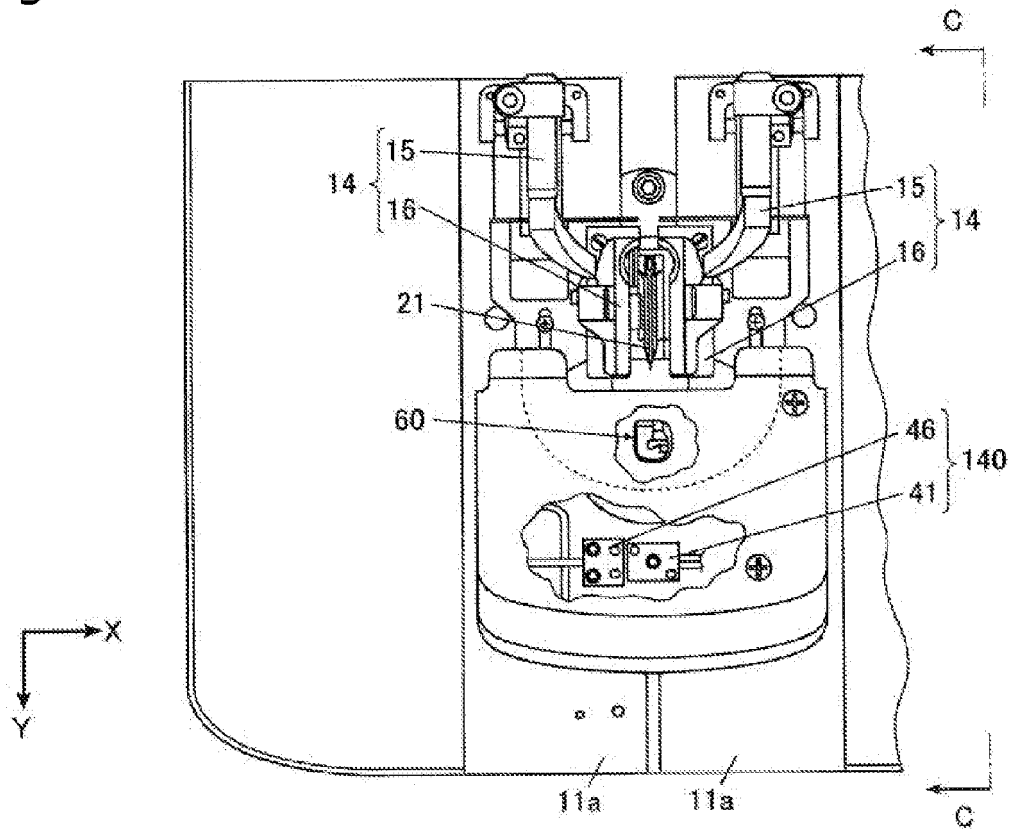


Fig. 14

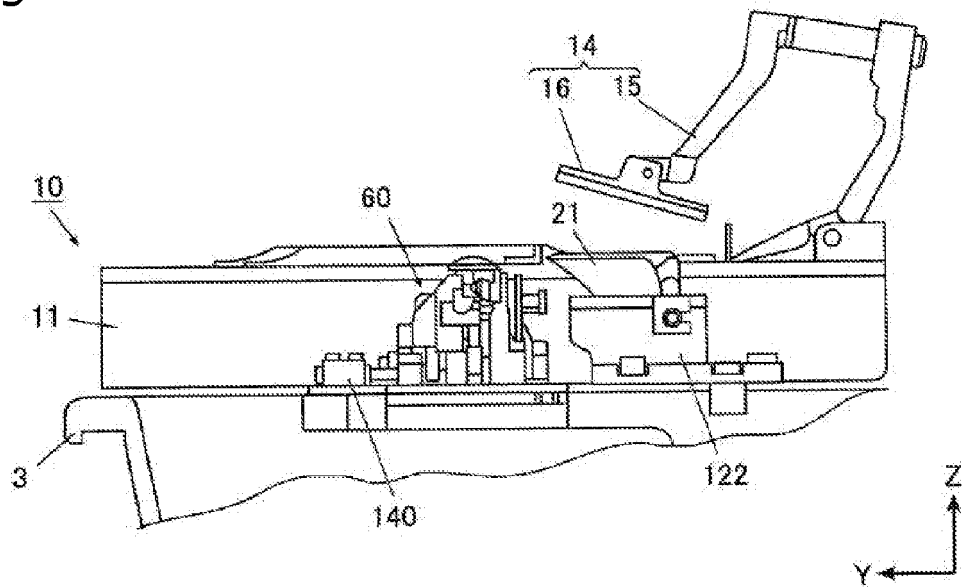


Fig. 15

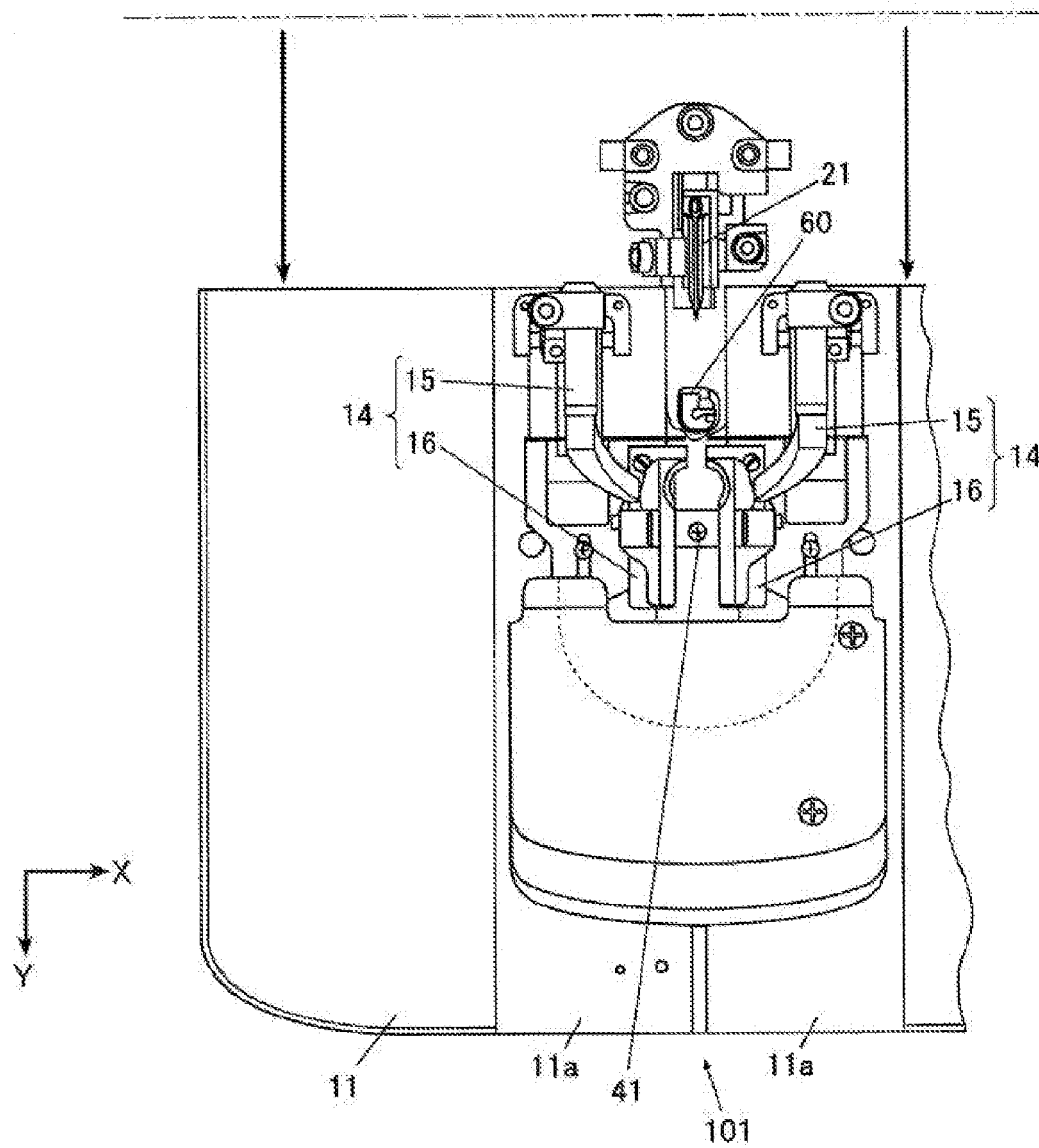


Fig. 16

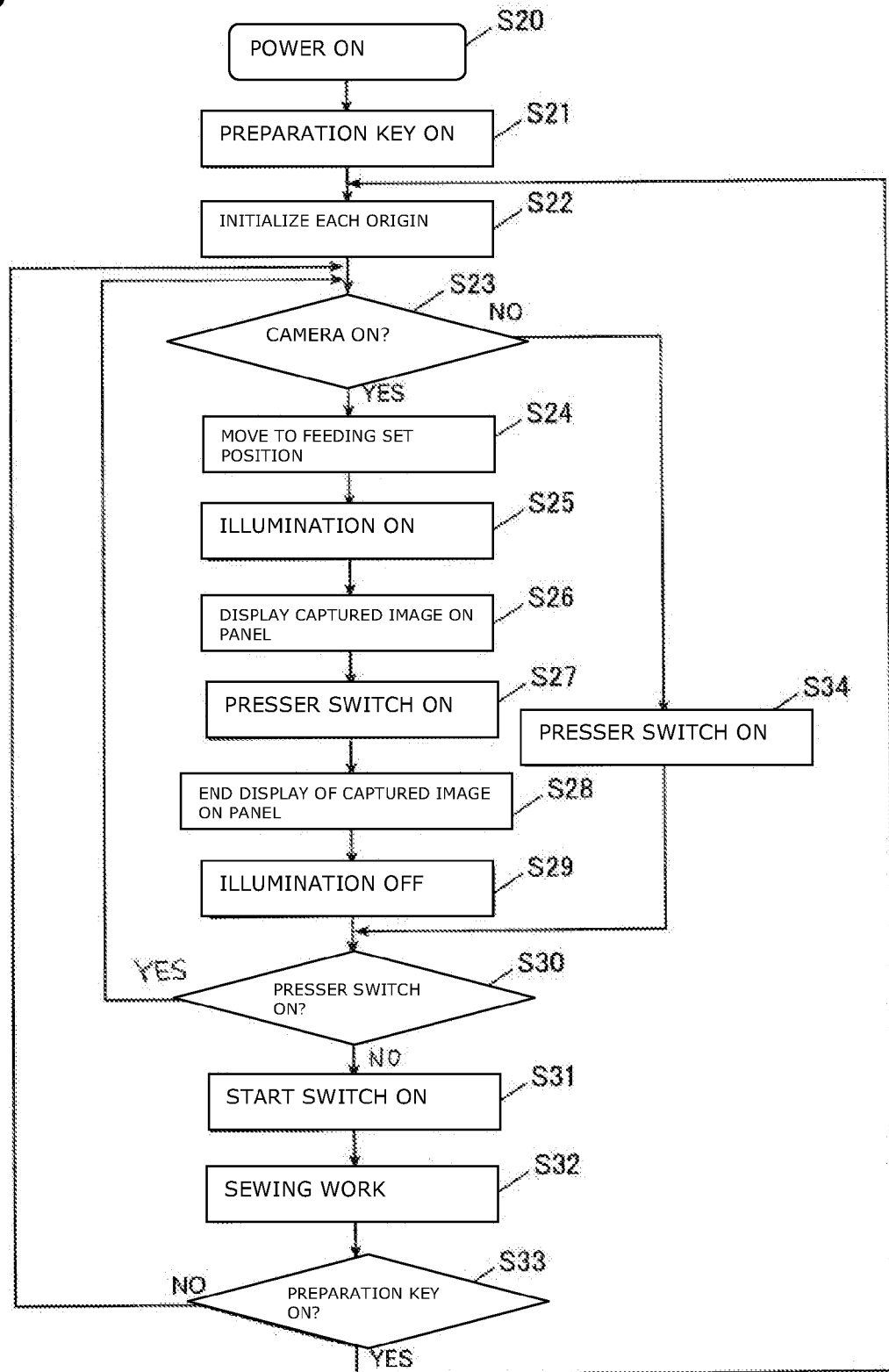


Fig. 17

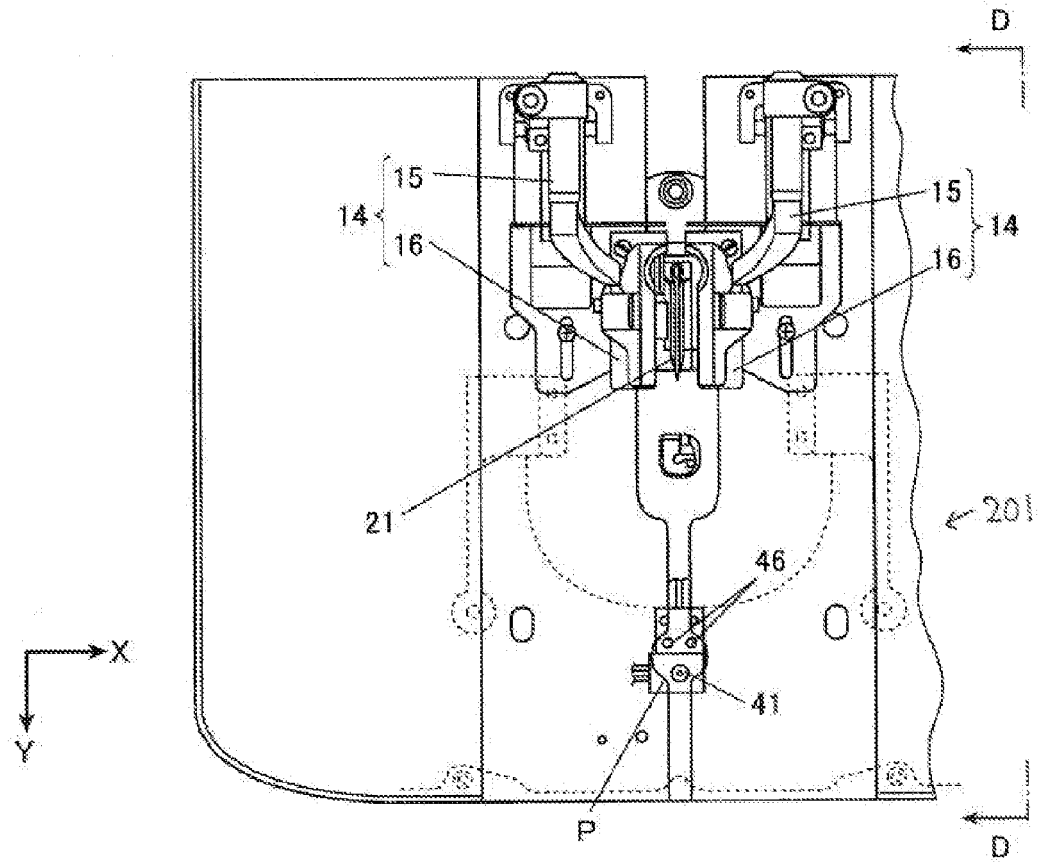


Fig. 18

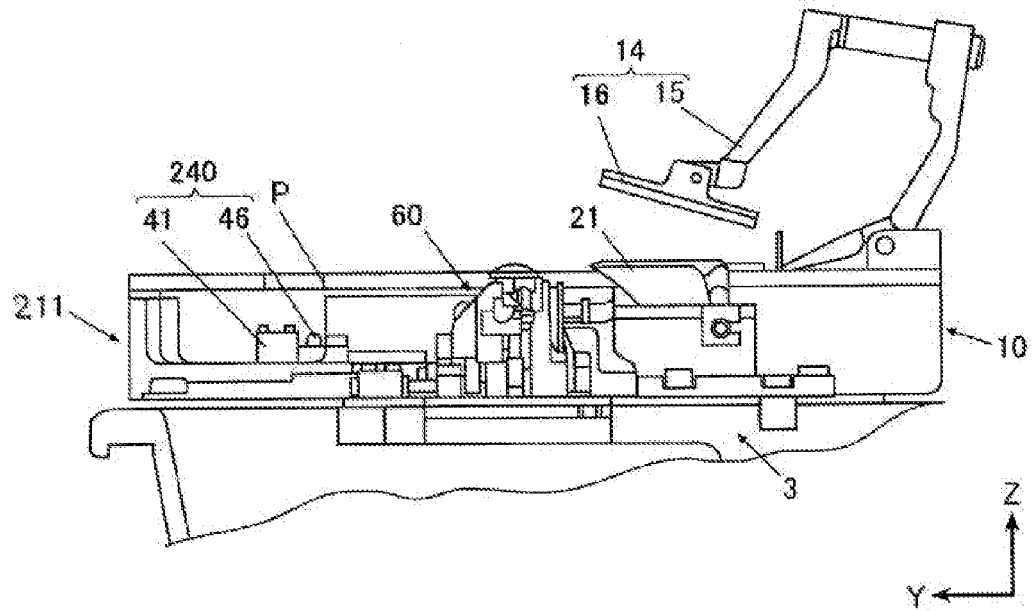


Fig. 19

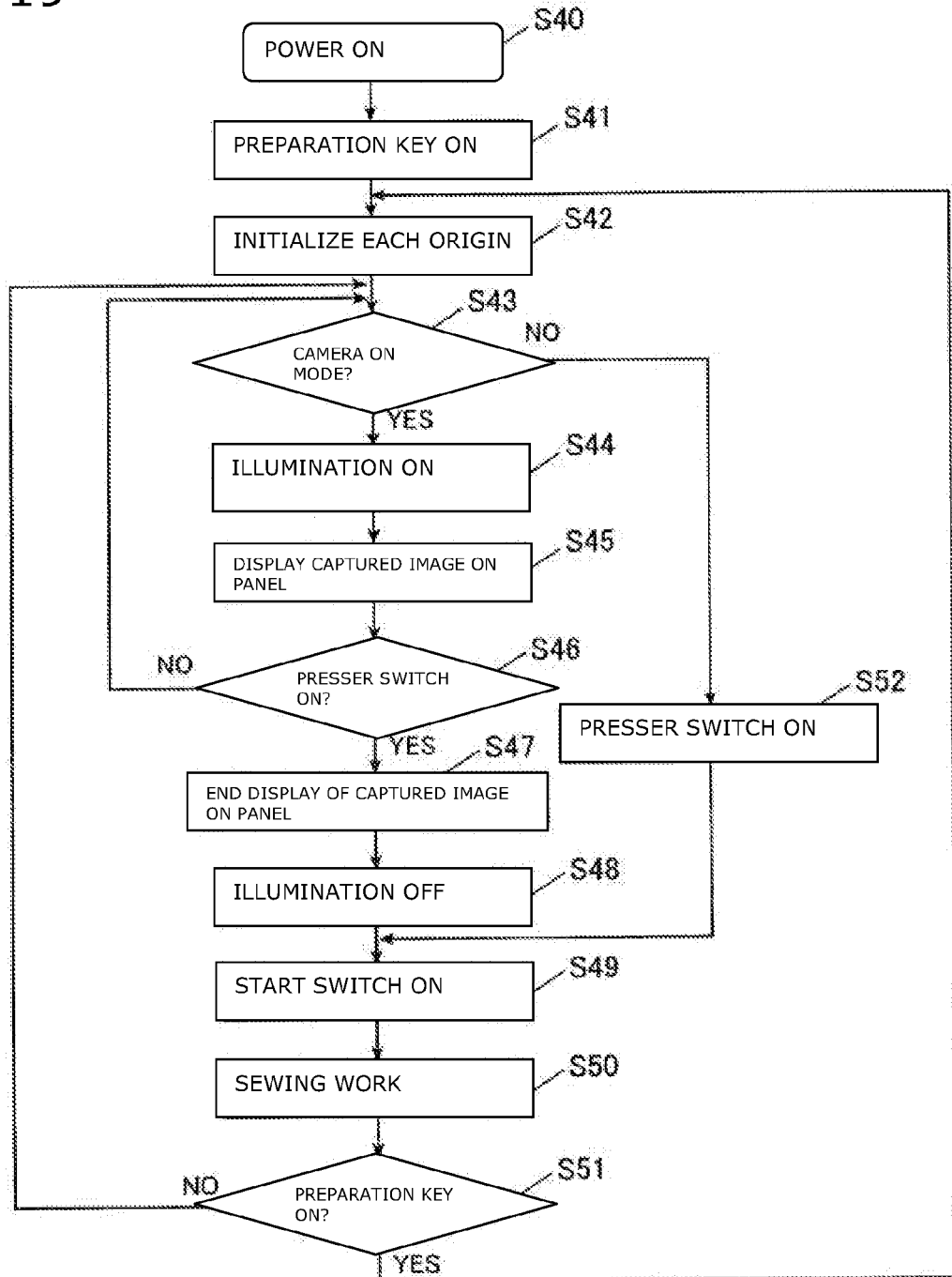


Fig. 20A

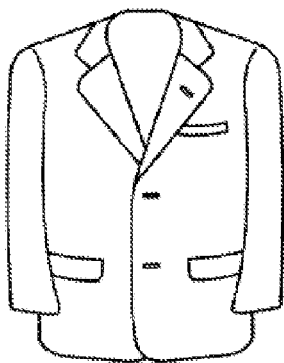


Fig. 20B

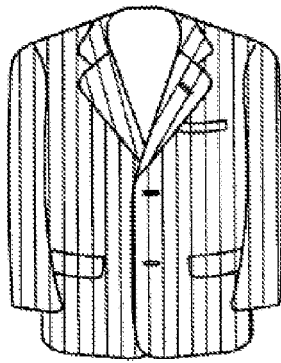


Fig. 20C

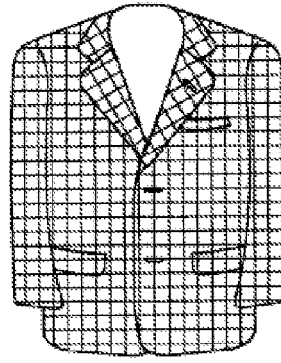


Fig. 21A

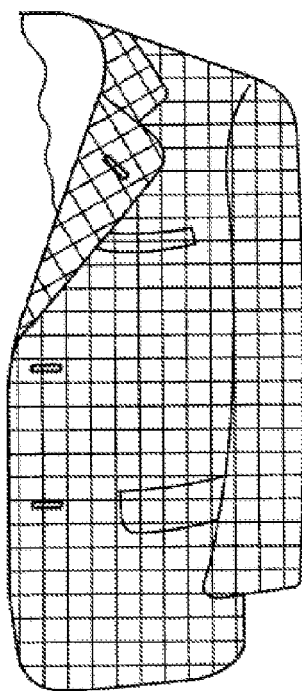


Fig. 21B

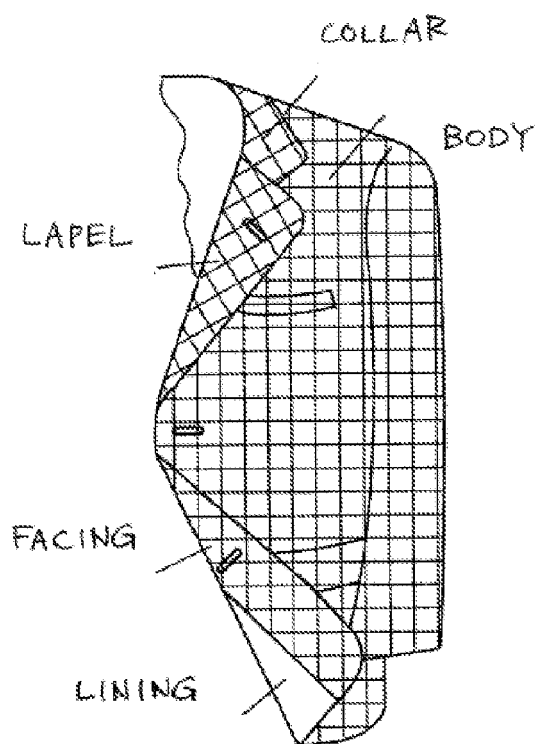


Fig. 22A

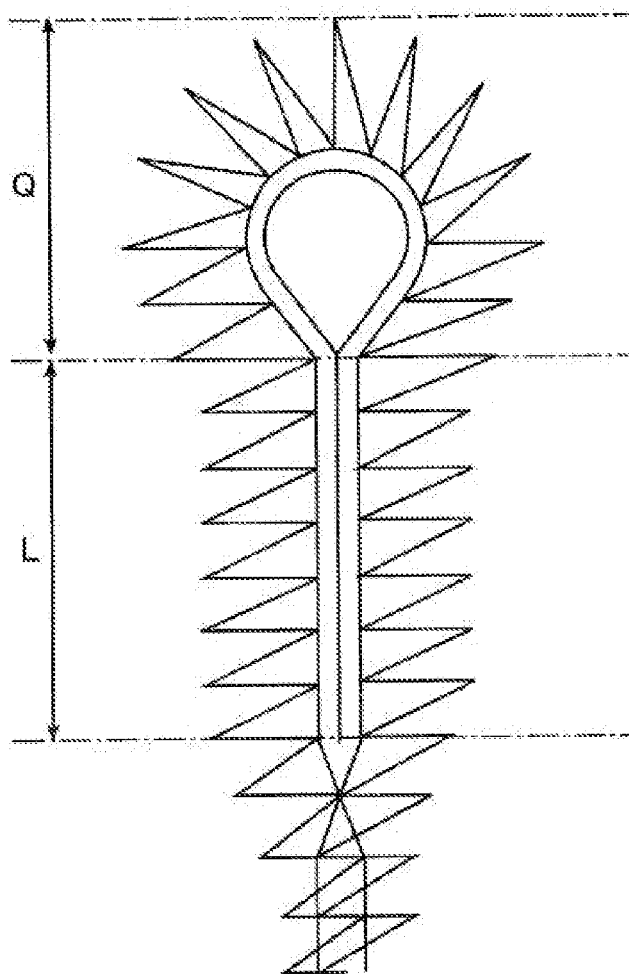
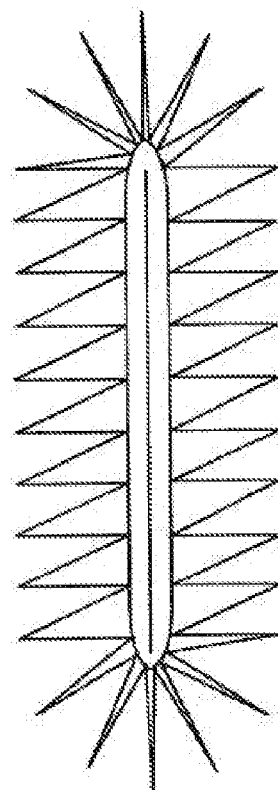


Fig. 22B





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 15 7438

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	DE 100 22 238 A1 (JUKI KK [JP]) 9 November 2000 (2000-11-09)	1	INV. D05B3/06 D05B19/02
A	* page 3, line 43 - page 7, line 48; figures 1-10 *	2-8	
Y	US 4 798 152 A (SIMONS FRANK H [US] ET AL) 17 January 1989 (1989-01-17)	1	
A	* column 3, line 54 - column 5, line 56; figures 1-6 *	2-8	
A,D	JP 04 026434 A (BROTHER IND LTD) 29 January 1992 (1992-01-29) * abstract; figures 1-12 *	1-8	
A	WO 89/12126 A (PFAFF IND MASCH [DE]) 14 December 1989 (1989-12-14) * page 5, line 28 - page 16, line 27; figures 1-4 *	1-8	TECHNICAL FIELDS SEARCHED (IPC) D05B
A	EP 1 321 556 A (GEGAUF FRITZ AG [CH]) 25 June 2003 (2003-06-25) * paragraph [0010] - paragraph [0017]; figures 1-11 *	1-8	
A	JP 2006 272011 A (JUKI KK) 12 October 2006 (2006-10-12) * abstract; figures 1-26 *	1-8	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 24 September 2008	Examiner Herry-Martin, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 15 7438

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-09-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10022238	A1	09-11-2000	
		CZ 20001672 A3	12-12-2001
		JP 2000317161 A	21-11-2000
		KR 20010049286 A	15-06-2001
		TW 490525 B	11-06-2002
US 4798152	A	17-01-1989	
		CA 1331595 C	23-08-1994
		EP 0378885 A1	25-07-1990
		JP 2206497 A	16-08-1990
JP 4026434	A	29-01-1992	
		JP 2762697 B2	04-06-1998
WO 8912126	A	14-12-1989	
		BR 8907470 A	28-05-1991
		EP 0420867 A1	10-04-1991
		ES 2016023 A6	01-10-1990
		JP 4504962 T	03-09-1992
		US 5103749 A	14-04-1992
EP 1321556	A	25-06-2003	
		AT 315120 T	15-02-2006
		US 2003131773 A1	17-07-2003
JP 2006272011	A	12-10-2006	
		NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 4026434 A [0002]