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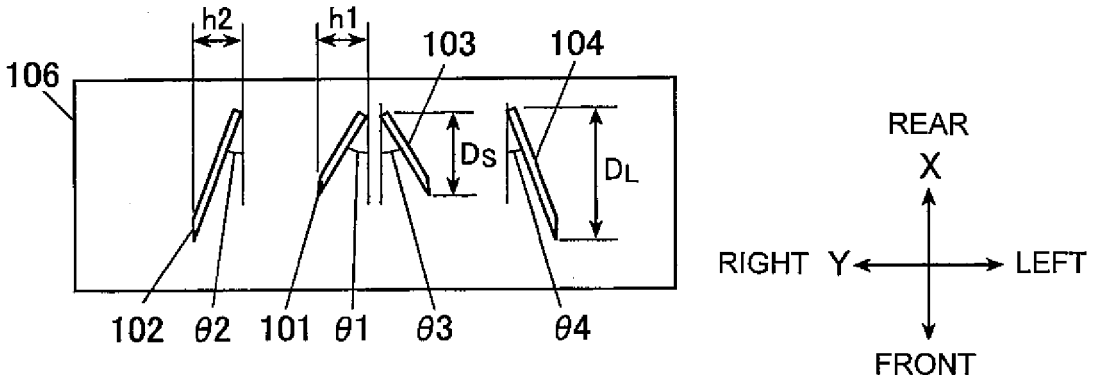
(54) **Corner knife mechanism of welting machine**

(57) The invention relates to a corner knife mechanism (100A, 100B) of a welting machine (10). The corner knife mechanism (100A, 100B) includes a plurality of first corner knives (101, 102, 101A, 102A) having different cutting edge angles (θe1, θe2) or different mounting angles (θ1, θ2), a plurality of second corner knives (103, 104, 103A, 104A) having different cutting edge angles (θe3, θe4) or different mounting angles (θ3, θ4), a corner knife holder (105) on which the first and second corner knives are arranged, a knife selecting actuator (121) which moves the corner knife holder (105) in a direction (Y) along which of the first and second corner knives are arranged, a cutting actuator (131, 132) which selectively moves up and down the first and second corner knives; and an operation control means (80) which controls the knife selecting actuator (121) and the cutting actuator (131, 132) to select a combination of one of the first corner knives and one of the second corner knives and to form a corner cut. The first corner knife and the second corner knife of the combination are symmetrically oriented with respect to the cloth feeding direction (F) and have the same mounting angle (θ1, θ3; θ2, θ4) or the same cutting edge angle (θe1, θe3; θe2, θe4).

FIG. 8B



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Description

[0001] The present invention relates to a corner knife mechanism of a welting machine which forms oblique slits.

[0002] A welting machine is a sewing machine for welting which is often applied to, for example, an opening portion of a pocket of a suit. The welting machine forms two parallel seams to join a body cloth and a welting patch placed on the body cloth, and also forms a linear slit between the two seams. The welting machine further forms, at each end of the linear slit, a corner cut consisting of a pair of oblique slits which are formed between the end of the linear slit and adjacent ends of the seams.

[0003] A corner knife mechanism is provided in the welting machine to form the corner cut.

[0004] A conventional corner knife mechanism includes a pair of corner knives for forming a pair of oblique slits on respective sides of the linear slit, a belt mechanism which moves the pair of corner knives along a cloth feeding direction, an actuator which moves one of the corner knives along the cloth feeding direction with respect to the other corner knife, and an actuator which moves up and down the pair of corner knives, wherein mounting angles of the corner knives are manually adjustable around an axis in the up-down direction (see, e.g., JP 2000-107473 A).

[0005] As shown in Fig. 15, during the formation of the linear slit and the straight seams, side end portions Br of the welting patch B are raised along an upright plate portion of a binder having an inverted-T sectional shape. After the formation of the linear slit and the straight seams, the corner cuts are formed between respective ends of the linear slit and the straight seams by pushing-up the corner knives from below.

[0006] When forming the corner cuts, however, depending on a mounting angle and/or a cutting edge angle of the corner knives being used, there has been a situation in which the side end portion Br of the welting patch B is unintentionally cut by a cutting edge of the corner knife and thus is damaged.

[0007] More specifically, as shown in Fig. 16A for example, when the mounting angle θ of the corner knife with respect to the linear slit is large toward the straight seam, the raised portion Br of the welting patch B is likely to be damaged by the cutting edge W of the corner knife, because the cutting edge W is closer to the raised portion Br than an outer face G of the edge portion of the corner knife.

[0008] On the other hand, when the mounting angle θ of the corner knife toward the straight seam is smaller as shown in Fig. 16B, the raised portion Br is less likely to be damaged, because the cutting edge W is more distant from the raised portions Br than the outer face G of the edge portion.

[0009] However, in a post process, the triangular portion T, two sides of which are defined by the oblique slits of the corner cut, is folded back along the virtual line t, and then the workpiece is pressed. As a result, a bulge corresponding to a thickness of the triangular portion T is produced. In the case of making the mounting angles of the corner knives smaller as shown in Fig. 16B, each of the oblique slits becomes longer accordingly. That is, the triangular portion T becomes larger. When the triangular portion T becomes larger, the corresponding bulge becomes prominent, depending on the kind of cloth being used (e.g., when the cloth is thick, stiff, stretchable, etc.), which may deteriorate external appearance of the sewn product. Therefore, in terms of making the triangular portion T smaller to improve external appearance, it is advantageous to increase the mounting angles of the corner knives.

[0010] Fig. 17A shows another situation in which the raised portions Br of the welting patch B are likely to be damaged. In this case, the cutting edge angle θe of the corner knife is small so that the cutting edge W is closer to the raised portion Br than the outer face G of the edge portion of the corner knife.

[0011] On the other hand, when the cutting edge angle θe of the corner knife is larger as shown in Fig. 17B, the raised portion Br is less likely to be damaged, because the cutting edge W is more distant from the raised portions Br than the outer face G of the edge portion.

[0012] However, as the cutting edge angle of the corner knife increases, cutting performance decreases. This becomes conspicuous depending on the kind of cloth being used (e.g., when the cloth is thick, stiff, stretchable, etc.), in which case it is advantageous to use the corner knives having smaller cutting edge angle.

[0013] As described above, depending on whether to give priority to preventing damage of the welting patch or to improving quality of a sewn product, it is necessary to adjust the mounting angles of the corner knives and/or to replace the corner knives to change the cutting edge angle. However, in conventional corner knife mechanisms, such adjustment of the mounting angles and replacement of the corner knives require onerous manual operations.

[0014] It is an object of the present invention to address the disadvantages described above.

[0015] According to a first aspect of the invention, a corner knife mechanism of a welting machine forms a corner cut having a pair of oblique slits between an end of a linear slit and adjacent ends of two straight seams, which are formed along a cloth feeding direction on a body cloth and a welting patch on respective sides of the linear slit. The corner knife mechanism comprises:

a plurality of first corner knives for forming one of the oblique slits, wherein the plurality of first corner knives has different cutting edge angles, or different mounting angles around respective axes perpendicular to a plane on which the body cloth is placed;

a plurality of second corner knives for forming the other of the oblique slits, wherein the plurality of second corner knives has different cutting edge angles,

or different mounting angles around respective axes perpendicular to said plane;
a corner knife holder on which the first and second corner knives are arranged along a direction which is parallel to said plane and is orthogonal to the cloth feeding direction;
a knife selecting actuator which moves the corner knife holder in the direction along which of the first and second corner knives are arranged;
a cutting actuator which selectively moves up and down the first and second corner knives along a direction perpendicular to said plane; and
an operation control means which controls the knife selecting actuator and the cutting actuator to select a combination of one of the first corner knives and one of the second corner knives and to form the corner cut, wherein the first corner knife and the second corner knife of the combination are symmetrically oriented with respect to the cloth feeding direction and have the same mounting angle or the same cutting edge angle.

[0016] According to a second aspect of the invention, the corner knife mechanism further comprises an operating part from which the selection of the combination of the first and second corner knives is set.

[0017] According to the first aspect of the invention, the corner knife mechanism includes a plurality of first corner knives corresponding to one of the oblique slits and having different mounting angles or cutting edge angles, and a plurality of second corner knives corresponding to the other of the oblique slits and having different mounting angles or cutting edge angles. The knife selecting actuator enables the selection of corner knives to be used. The operation control means selects a combination of the first and second corner knives having the same mounting angle or the same cutting edge angle to execute cutting. Therefore, it becomes possible to make a selection between a case in which a corner cut is formed with a mounting angle or a cutting edge angle that prevents unintentional cutting of the welting patch, and a case in which a corner cut is formed with another mounting angle or another cutting edge angle that is suitable for the kind of cloth to be used. Such a selection is made by controlling the knife selecting actuator, so that manual adjustment of angles and manual replacement of the corner knives become unnecessary, and therefore, the conventional onerous work can be eliminated and easy and quick switching of the corner knives becomes possible.

[0018] According to the second aspect of the invention, the corner knife mechanism includes an operating part from which the selection of the combination of first and second corner knives can be set. Therefore, the combination of corner knives can be easily and quickly switched through a setting operation from the operating part.

[0019] The following description of preferred embodiments of the invention serves to explain the invention in greater detail in conjunction with the drawings. These show:

Fig. 1: a perspective view of a welting machine according to an embodiment of the invention;
Fig. 2: an explanatory view of a layout of a linear slit formed by a center knife, corner cuts formed by corner knives, and seams formed by two needles in welting for a rectangular pocket opening;
Fig. 3: an explanatory view of a layout of a linear slit formed by the center knife, corner cuts formed by corner knives, and seams formed by the two needles in welting for forming a slanted pocket opening;
Fig. 4: a perspective view of a stitching mechanism;
Fig. 5: a perspective view of the stitching mechanism and a center knife mechanism in a cutting enabled state;
Fig. 6: a perspective view of corner knife mechanisms, in which two of the four corner knives are removed from each of the corner knife mechanisms;
Fig. 7: an enlarged perspective view showing how the corner knives are mounted;
Fig. 8A: an explanatory view showing an operation for selecting corner knives to be moved up and down;
Fig. 8B: an explanatory view showing an example of an arrangement of the corner knives;
Fig. 8C: an explanatory view showing how up-and-down brackets engage with a cylinder bracket;
Fig. 9A: an explanatory view showing an adjustment of a mounting angle of a corner knife around a Z axis;
Fig. 9B: an explanatory view showing an adjustment of a cutting length;
Fig. 10A: a top view of a corner knife;
Fig. 10B: a side view of the corner knife;
Fig. 11: a block diagram of a control system, including an operation control means, of the welting machine;
Fig. 12: a flowchart of an overall flow of a welting operation;
Fig. 13: a flowchart of a post-stitching operation (corner cut forming operation) in the welting operation;
Fig. 14: an explanatory view showing an example of an arrangement of corner knives having different cutting edge angles;
Fig. 15: a perspective view showing how a welting patch is held during the welting operation;
Fig. 16A: an explanatory view showing an example of corner knives which are likely to unintentionally cut a welting patch;
Fig. 16B: an explanatory view showing another example of corner knives which are less likely to

unintentionally cut a welting patch;

Fig. 17A: an explanatory view showing yet another example of corner knives which are likely to unintentionally cut a welting patch; and

Fig. 17B: an explanatory view showing yet another example of corner knives which re less likely to unintentionally cut a welting patch.

[0020] Respective directions mentioned in the following description are based on X, Y, and Z axes shown in the drawings. The Z axis direction is a vertical direction along which the center knife moved up and down. The X axis direction is a direction parallel to a working plane and along a cloth is fed, and the Y axis direction is parallel to the working plane and is orthogonal to the X axis direction.

[0021] Explanation of Welting

[0022] Welting for forming a pocket opening can be performed according to two methods, that is, a method in which a rectangular pocket opening shown in Fig. 2 is formed, and a method in which a slanted pocket opening shown in Fig. 3 is formed. The following description is given by defining the forward side of forward feeding in the cloth feeding direction F as the front side, the opposite side of forward feeding as the rear side, and the left with respect to the cloth feeding direction as the left side, and the right with respect to the cloth feeding direction as the right side.

[0023] The welting machine 10 includes two needles 41 for stitchign a welting patch B onto a body cloth M by forming two parallel straight seams TL, TR, a center knife 51 which forms a linear slit S which becomes a pocket hole along the cloth feeding direction F at an intermediate portion between the two straight seams TL, TR, and corner knife mechanisms which form V-shaped corner cuts, each consisting of a pair of oblique slits, at respective ends of the slit S.

[0024] In welting for forming a rectangular pocket opening, respective ends of two straight seams aligned in the cloth feeding direction.

[0025] On the other hand, in welting for forming a slanted pocket opening, each end of one of the straight seams (the right seam TR in Fig. 3) is deviated in the cloth feeding direction from the corresponding end of the other straight seam. Here, an amount of deviation in the cloth feeding direction from the rear end portion of the straight seam TR to the rear end portion of the straight seam TL is defined as a rear deviation CR, and the amount of deviation in the cloth feeding direction from the front end portion of the straight seam TR to the front end portion of the straight seam TL is defined as a front deviation CF.

[0026] In welting shown in Fig. 2, an oblique slit VFR is formed from the front end portion FE of the linear slit S to the front end portion of the right straight seam TR, and an oblique slit VFL is formed from the front end portion FE of the linear slit S to the front end portion of the left straight seam TL. Further, an oblique slit VRR is formed from the rear end portion RE of the linear slit S to the rear end portion of the right straight seam TR, and an oblique slit VRL is formed from the rear end portion RE of the linear slit S to the rear end portion of the left straight seam TL.

[0027] In welting shown in Fig. 3, an oblique slit VFR is formed from the front end portion of the linear slit S to the front end portion of the right straight seam TR, and an oblique slit VFL is formed from the front end portion of the linear slit S to the front end portion of the left straight seam TL. Further, an oblique slit VRR is formed from the rear end portion of the linear slit S to the rear end portion of the right straight seam TR, and an oblique slit VRL is formed from the rear end portion of the linear slit S to the rear end portion of the left straight seam TL. The oblique slits VFR, VFL constituting a corner cut are set so that the length in the cloth feeding direction of the VFR is longer according to the deviation CF, and the oblique slits VRR, VRL constituting a corner cut are set so that the length in the cloth feeding direction of VRL is longer according to the deviation CR.

[0028] The welting machine 10 can selectively perform two kinds of methods shown in Fig. 2 and Fig. 3 when performing welting for forming a pocket opening.

[0029] Overall Configuration of Welting Machine

[0030] The welting machine 10 includes a table 11 on which a sewing operation is carried out, a main frame 12 disposed on the table 11, a clamp feed mechanism 20 as a cloth feed mechanism which feeds a cloth consisting of a body cloth M and a welting patch B, a binder 30 which presses the welting patch B above the body cloth M from above, a stitching mechanism 40 as a seam forming mechanism which lowers and locates the needles on both sides of the slit S near the front end portion in the cloth feeding direction F of the binder 30, a center knife mechanism 50 as a movable knife mechanism which forms a slit S in a workpiece consisting of the body cloth M and the welting patch B placed by being overlapped by moving up and down a center knife 51 as a movable knife on the front side in the cloth feeding direction F of sewing needles 41, a corner knife mechanisms 100 which forms V-shaped slits at both ends of the linear slits (hereinafter, also referred to as linear slits S), and an operation control means 80 for controlling the respective components described above. Each of the components will be described in detail below.

[0031] Table

[0032] The table 11 has an upper surface (placing surface) in parallel to the X-Y plane, and is used in a horizontal posture. Sewing is performed upon placing a body cloth M and a welting patch B on the upper surface of this table 11.

[0033] On the table 11, the clamp feed mechanism 20 and the binder 30 are disposed, and below the table 11, the corner knife mechanisms 100 is disposed.

[0034] A throat plate 13 is provided on the table 11 so as to be opposed to the lower sides of the two sewing needles 41. In this throat plate 13, eyes which the two needles 41 penetrate through when they move up and

down are provided, and below the eyes, a pair of horizontal shuttles not shown are provided, and seams are formed by cooperation of the needles and the shuttles.

[0035] Further, at the front side in the cloth feeding direction F at substantially the middle between the two eyes of the throat plate 13, a slit into which the center knife 51 is inserted is formed, and inside this slit, a fixed knife not shown to cut the cloths in cooperation with the center knife 51 is disposed.

[0036] Main Frame

[0037] The main frame 12 includes a bed portion 12a, a vertical drum portion 12b upwardly extending from the bed portion 12a, and an arm portion 12c which extends from the upper end portion of the vertical drum portion 12b so as to be opposed to the bed portion 12a and supports the two needles 41 and the center knife 51 so as to allow these to move up and down. Inside the arm portion 12c, main components of the stitching mechanism 40 and the center knife mechanism 50 are housed, and a main shaft 46 which is driven to rotate by a main shaft motor 45 (Fig. 11) serving as a drive source is disposed.

[0038] Stitching Mechanism

[0039] As shown in Fig. 4, the stitching mechanism 40 includes two needle bars 42 holding the two sewing needles 41 individually at the lower end portions, a support frame 49 which supports the needle bars 42 movably up and down, a needle bar holder 44 which holds both two needle bars 42, a rotary spindle 47 which is fixed and joined to one end portion of the main shaft 46 and rotates, and a crank rod 48 having one end portion joined to a position eccentric from the rotation center of the rotary spindle 47 and the other end portion joined to the needle bar holder 44.

[0040] The main shaft 46 is supported by the arm portion 12c rotatably along the Y axis direction, and is given a driving force for full rotation by the main shaft motor 45. When the main shaft 46 is rotated, the rotation is transmitted to move up and down the needle bar holder 44 via the rotary spindle 47 and the crank rod 48.

[0041] Further, in the needle bar holder 44, a latch mechanism (not shown) which can switch holding and release of the needle bars 42 and 42 is installed, and in the upper end portion of the support frame 49, a holding mechanism not shown which can switch holding and release of the needle bars 42 is installed. The latch mechanism and the holding mechanism can switch holding and release of the needle bars 42 by applying a predetermined operation from the outside, and a needle selecting solenoid 43 (see Fig. 11) which applies a switching operation to these mechanisms is provided alongside the support frame 49.

[0042] By this needle selecting solenoid 43, switching can be made among a state where the needle bars 42 and 42 are held by the latch mechanism, a state where one needle bar 42 is held by the latch mechanism and the other needle bar 42 is held by the holding mechanism, and a state where one needle bar 42 is held by the holding mechanism and the other needle bar 42 is held by the latch mechanism, and in each state, a needle bar held by the needle bar holder 44 moves up and down, and a needle bar held by the latch mechanism stops near a top dead center.

[0043] When performing slant welting, by switching the above-described three holding states at predetermined timings, the left and right straight seams TL, TR can be formed so that deviations are caused in the cloth feeding direction on front and rear end portions.

[0044] The needle bars 42 and 42 hold the sewing needles 41, respectively, adjustably along the Y axis direction. Accordingly, the distances in the Y axis direction of the straight seams TL, TR are adjustable. This adjustment is normally performed so as to equalize the distances of the straight seams TL, TR to the linear slit S.

[0045] Center Knife Mechanism

[0046] As shown in Fig. 5, the center knife mechanism 50 includes a center knife 51 which forms a linear slit S by moving up and down, a fixed knife not shown which is fixed below the throat plate 13 and comes into sliding contact with the center knife 51 to urge cutting of the cloths B and M, a knife bar 52 which has the center knife 51 at the lower end portion and is supported so as to slide along the Z axis direction inside the arm portion 12c, a knife motor 57 which is a stepping motor to move up and down the center knife 51, a plurality of link bodies 59 which transmit a moving up-down driving force to the knife bar 52 via an eccentric cam 58 fitted eccentrically to an output shaft 57b of the knife motor 57, an air cylinder 65 as an actuator which serves as a drive source for switching between a cutting enabled state (lower position) and a cutting restricted state (upper state) of the center knife 51, and a stopper 68 which stops a plunger at a predetermined position when the air cylinder 65 projects.

[0047] The center knife mechanism 50 can be switched into a cutting enabled state where a rotation driving force of the knife motor 57 is converted into up and down reciprocation movements and transmitted to the center knife 51 when the air cylinder 65 is at a retreated position (state of Fig. 5), and can be switched into a cutting restricted state where a rotation driving force of the knife motor 57 is not transmitted to the center knife 51 when the air cylinder 65 is at an advanced position (not shown).

[0048] The knife motor 57 is driven and rotated in a state where the air cylinder 65 has retreated, a cutting operation is performed by moving up and down the knife bar 52 and the center knife 51 via the plurality of link bodies 59 by the eccentric cam 58 equipped on the output shaft 57b turned to the Y axis direction.

[0049] On the other hand, in a state where the air cylinder 65 has advanced, the plurality of link bodies 59 are arranged so as not to transmit the power of the knife motor 57 to the knife bar 52, and a state in which the center knife 51 is withdrawn more upward than the throat plate 13 is kept.

[0050] Therefore, by driving of the air cylinder 65, the

center knife 51 can be switched between a cutting enabled state and a cutting restricted state.

[0051] Binder

[0052] In Fig. 1, the binder 30 includes a bottom plate portion 31 which is a long-length flat plate, an upright plate portion 32 vertically extending from the upper surface of the bottom plate portion 31 along the longitudinal direction of the bottom plate portion 31, a guide member 33 which guides a welting patch B while avoiding the center knife 51, and is provided on a front end portion in the cloth feeding direction of the upright plate portion 32, and a vertical guide (not shown) which guides the welting patch B so that both end portions in the width direction of the welting patch B are fed while being raised along both surfaces of the upright plate portion 32.

[0053] The binder 30 is supported by a support mechanism not shown including an air cylinder, and stands-by apart from the positions below the two needles 41 as shown in Fig. 1 when it is not used. When the binder 30 is used, it is set at the throat plate position by driving of the air cylinder.

[0054] The bottom plate portion 31 has a rectangular shape, and is supported so that, when it is used, the longitudinal direction thereof becomes parallel to the X axis direction and the bottom surface is confronted with and placed on the upper surface of the table 11. On the tip end portion in the cloth feeding direction of the bottom plate portion 31, substantially U-shaped notches (not shown) to which the two sewing needles 41 are lowered and located are formed.

[0055] The upright plate portion 32 is entirely flat except for the portion near the guide member 33, and is vertically extened at an intermediate position in the width direction (Y axis direction) of the bottom plate portion 31 on the upper surface of the bottom plate portion 31 while its longitudinal direction is matched with the bottom plate portion 31. In other words, the bottom plate portion 31 and the upright plate portion 32 of the binder 30 are formed integrally so as to form an inverted T shape as viewed in the longitudinal direction.

[0056] When the welting patch B is superposed and set on the upper side of the body cloth M on the throat plate 13, the binder 30 is placed thereon from above, both end portions in the width direction (the left-right direction in Fig. 2) of the welting patch B are folded back and raised upward from both end portions in the width direction of the bottom plate portion 31, and further, both end portions in the width direction of the welting patch B are held by clamps 21 described later so that the both end portions are along both side surfaces of the upright plate portion 32. In other words, the welting patch B is set along the upright plate portion 32 from one side surface of the upright plate portion 32 to the other side surface via the bottom plate portion 31. In this state where the welting patch B is wound and set around the binder 30, while the welting patch B and the body cloth M are fed, sewing is performed by the two needles 41 on both sides of the upright plate portion 32, and a linear slit S is formed by moving up and down the center knife 51.

[0057] Immediately in front of the binder 30 in the cloth feeding direction F, the guide member 33 is provided to prevent the welting patch from being cut by the center knife 51. This guide member 33 is forked in the cloth feeding direction F so as to have a substantially V shape in a plan view. Due to this shape, both end portions in the width direction of the welting patch B are led to be spaced from the upright plate portion 32 when being fed, and guided in a direction of avoiding the center knife 51.

[0058] Clamp Feed Mechanism

[0059] In Fig. 1, the clamp feed mechanism 20 includes clamps 21 which clamp the body cloth M from above on both sides in the width direction of the welting patch B set on the binder 30, a support member 22 which supports these clamps 21, an air cylinder not shown which moves up and down the clamps 21 via the support member 22, folding plates not shown which are installed inside the clamps 21, and advance inward to fold both end portions in the width direction of the welting patch B to the upper side of the bottom plate portion 31 of the binder 30, and a feed motor 23 (Fig. 11) as a feed driving means which moves the welting patch B and the body cloth M clamped by the clamps 21 in the cloth feeding direction F via the support member 22.

[0060] The clamps 21 are rectangular flat plates, and are supported by the support member 22 while their longitudinal directions are along the X axis direction. The clamps 21 are supported so that their flat plate surfaces become parallel to the X-Y plane. By driving the air cylinder, the clamps can be switched to two upper and lower positions, and when the clamps are at the upper positions, they are separated from the upper surface of the table 11, and come to the upper surface height of the table 11 when they are at the lower positions. The two clamps 21 are supported while being spaced from each other in the Y axis direction so as to allow at least the upright plate portion 32 of the binder 30 to pass through between the clamps.

[0061] The support member 22 is supported movably along the X axis direction on the table 11, and is disposed so that the two clamps 21 supported by the support member 22 pass through the outsides of the up and down movement routes of the two needles 41. The support member 22 is driven by the feed motor 23 via a ball screw mechanism not shown.

[0062] Corner Knife Mechanism

[0063] As shown in Fig. 6 and Fig. 7, the corner knife mechanisms 100 includes two corner knife mechanisms 100A, 100B provided side by side along the cloth feeding direction.

[0064] The corner knife mechanisms 100A, 100B are disposed forward in the cloth feeding direction of the center knife 51 on the routes of passage of the clamps 21 by the clamp feed mechanism 20 below the table 11, and form V-shaped slits at positions on both ends of the linear slit S by piercing the welting patch B and the body cloth M conveyed by the clamp feed mechanism 20 from below

by pairs of corner knives.

[0065] The corner knife mechanisms 100A, 100B are provided side by side in the cloth feeding direction F, and the corner knife mechanisms 100A is disposed rearward of the corner knife mechanisms 100B. In other words, one corner knife mechanisms 100A forms a pair of oblique slits on the rear end portion side of the linear slit S, and the other corner knife mechanisms 100B forms a pair of oblique slits on the front end portion side of the linear slit S. Only the corner knife mechanisms 100B is equipped on the table 11 so as to be moved and positioned along the cloth feeding direction F by a unit moving motor 90 (see Fig. 11). Hereinafter, to distinguish the two corner knife mechanisms, the corner knife mechanisms 100A may be referred to as "fixed corner knife mechanism," and the corner knife mechanisms 100B may be referred to as "movable corner knife mechanism."

[0066] The corner knife mechanisms 100A and the corner knife mechanisms 100B have substantially the same structure so as to become mirror-symmetrical with respect to the Y-Z plane, so that only the corner knife mechanisms 100B is described in detail, and components of the corner knife mechanisms 100A having the mirror-symmetrical structure will be attached with the same reference numerals and description of these will be omitted.

[0067] The corner knife mechanisms 100B includes first corner knives 101 and 102 corresponding to one side oblique slit, second corner knives 103 and 104 corresponding to the other side oblique slit, a unit main body 105 as a corner knife holder supported by a pair of guide shafts 14 having round-bar shapes disposed on the lower surface side of the table 11, an index 106 having a block-shaped structure which is supported movably along the Y axis direction inside a recess 105a formed on the rear side surface of the unit main body 105, and holds the corner knives 101 to 104, an index movement mechanism 120 as a traverse feed mechanism having a corner knife selecting function which positions the index 106 along the Y axis direction, and a moving up-down mechanism 130 which selects corner knives in cooperation with the index movement mechanism 120 and moves these up and down.

[0068] The unit main body 105 has a frame structure, and is supported in a state where the pair of guide shafts 14 are inserted through one end portion in the Y axis direction. The recess 105a is formed on one side surface on the rear side of the unit main body 105, and within the recess 105a, the index 106 is disposed. The unit main body 105 of the corner knife mechanisms 100A is fixed and supported, however, the unit main body 105 of the corner knife mechanisms 100B can be positioned at an arbitrary position in the X axis direction by driving of the unit moving motor 90 via a belt feed mechanism or ball screw mechanism not shown. A longitudinal feed mechanism is constituted by the unit moving motor 90 and a linear motion mechanism such as belt feed mechanism or ball screw mechanism. As the unit moving motor 90, a linear motor may be adopted.

[0069] To the index 106, two upper and lower support rods 106a extending along the Y axis direction from one side surface in the Y axis direction of the index is fixed, and by inserting these rods into insertion holes provided on the unit main body 105 side, the index 106 is supported movably along the Y axis direction with respect to the unit main body 105.

[0070] On the upper surface of the index 106, mounting bases 107, 108, 109, 110 of the four corner knives are arranged in a line along the Y axis direction, and the mounting bases 107 to 110 hold the corner knives 101 to 104 individually. The mounting bases 107 to 110 are arranged so as to enable manual adjustments of angles around the Z axis of the corner knives 101 to 104 (see Fig. 9A) and inclination angles of the directions of the cutting edges (see Fig. 9B) by loosening fastening screws not shown. By adjusting the angles around the Z axis of the corner knives 101 to 104, formation inclination angles (mounting angles) of the oblique slits with respect to the linear slit S are determined, and by adjusting the inclination angles of the directions of the cutting edges, the cutting lengths of oblique slits are determined.

[0071] As shown in Fig. 8B, two first corner knives 101 and 102 on the right side are for forming an oblique slit on the right of the linear slit S, and both first corner knives are inclined rightward with respect to the front side around the Z axis, and they are inclined so that the cutting length of the oblique slit formed by the corner knife 102 becomes longer than the other. Further, the mounting angles around the Z axis are adjusted so that the widths h1 and h2 in the Y axis direction of oblique slits formed by the corner knives 101 and 102 become equal to each other. Therefore, the mounting angle $\theta 1$ around the Z axis of the corner knife 101 is larger than the mounting angle $\theta 2$ of the corner knife 102.

[0072] The two second corner knives 103 and 104 on the left side are for forming an oblique slit on the left side of the linear slit S, and both second corner knives are inclined leftward with respect to the front side, and they are inclined so that the cutting length of the oblique slit formed by the corner knife 104 becomes longer than the other. As in the case of the first corner knives 101 and 102, the inclination angles around the Z axis are adjusted so that the widths h1 and h2 in the Y axis direction of oblique slits formed by the corner knives 103 and 104 become equal to each other. Therefore, the mounting angle $\theta 3$ around the Z axis of the corner knife 103 is larger than the mounting angle $\theta 4$ of the corner knife 104.

[0073] The mounting angle $\theta 3$ of the corner knife 103 is set equal to the mounting angle $\theta 1$ of the corner knife 101 in a manner in which the directions of these corner knives become symmetrical laterally, and the mounting angle $\theta 4$ of the corner knife 104 is set equal to the mounting angle $\theta 2$ of the corner knife 102 in a manner in which the directions of these corner knives become symmetrical laterally.

[0074] The upper end portions of the corner knives 101 to 104 are, as shown in Fig. 10 (only 101 and 102 are

shown in Fig. 10) sharply pointed, and one side end portions are sharpened across the entire lengths in the longitudinal direction to form cutting edge E. Each of the corner knives 101 to 104 is moved upward while its cutting edge E is turned outward (turned to the opposite side of the other paired corner knife of corresponding left and right pairing) to perform cutting. On each of the corner knives 101 to 104, a tip end angle viewed from above the cutting edge E is referred to as a cutting edge angle θe. The cutting edge angles θe of the corner knives 101 to 104 are equal to each other.

[0075] The larger the mounting angles (angles with respect to the cloth feeding direction F as viewed from above) in the range of 0 to 90 degrees of the corner knives 101 to 104, the more likely the corner knives unintentionally cut the raised side end portions of the welting patch B which may come into contact with the cutting edge E during cutting. Therefore, when the welting patch B with fabric quality which is easily cut is used as a workpiece, preferably, the corner knives 102 and 104 with smaller mounting angles are used from the viewpoint of prevention of cutting of the welting patch. Therefore, in the case of cutting control by the corner knife mechanisms 100 described later, for preventing both side end portions of the welting patch B from being cut, the corner knives 102 and 104 are selected.

[0076] Further, the mounting bases 107 to 110 have sliding shafts (not shown) along the Z axis direction on the lower sides of the mounting bases, and are supported movably up and down with respect to the index 106 by sliding of the shafts. On lower end portions of the sliding shafts, up-and-down brackets 107a to 110a as engagement projections projecting forward are formed. These up-and-down brackets 107a to 110a project forward of the front face of the index 106, and the moving up-down mechanism 130 described later moves up and down the corner knives 101 to 104 via these up-and-down brackets 107a to 110a.

[0077] The index movement mechanism 120 includes an index motor 121 as a knife selecting actuator fixed to an upper part of the unit main body 105, a screw shaft 122 which is driven to rotate by the index motor 121, and a movable member 123 connected to the screw shaft 122 via a ball screw.

[0078] The screw shaft 122 is supported rotatably on the upper surface of the unit main body 105 while being along the Y axis direction, and one end portion of the screw shaft is joined to an output shaft of the index motor 121 via a coupling.

[0079] The movable member 123 is held by an arm portion 106b extending from one end portion in the Y axis direction of the index 106. Accordingly, when the screw shaft 122 is driven to rotate by the index motor 121, the movable member 123 is subjected to a moving force in the longitudinal direction (Y axis direction) of the screw shaft 122 due to an operation of the ball screw mechanism and the index 106 is moved in the Y axis direction.

[0080] The movement in the Y axis direction of the index 106 by the index movement mechanism 120 is used when a pair of corner knives to be moved up and down by the moving up-down mechanism 130 described later are selected among the corner knives 101 to 104, and is also used when positions at which oblique slits are formed by the selected corner knives are adjusted in the Y axis direction.

[0081] The moving up-down mechanism 130 includes a first air cylinder 131 as a cutting actuator for moving up a corner knife to form an oblique slit on the right of the linear slit S, a second air cylinder 132 as a cutting actuator for moving up a corner knife to form an oblique slit on the left of the linear slit S, and cylinder brackets 133, 134 as engagement members which are provided on the output shafts of the air cylinders 131, 132 and can selectively engage with the up-and-down brackets 107a to 110a.

[0082] The air cylinders 131, 132 are equipped in the unit main body 105 so that their movement directions become parallel to the Z axis direction.

[0083] The cylinder brackets 133, 134 are flanged cylindrical members, and are provided on the output shafts of the air cylinders 131, 132 in a state where their center lines are oriented in the Z axis direction. The air cylinders 131, 132 and the cylinder brackets 133, 134 are disposed in the unit main body 105 such that the tip end portions of the up-and-down brackets 107a to 110a pass between the flanged portions of the cylinder brackets 133, 134 when the index 106 move along the Y axis direction.

[0084] In other words, when the index 106 moves along the Y axis direction, the up-and-down brackets 107a to 110a pass between the flanged portions of the cylinder brackets 133, 134 in their arrangement order, so that by controlling the index motor 121 of the index movement mechanism 120 so that the up-and-down bracket of the corner knife to be moved stops between the flanged portions of the cylinder bracket 133 or 134, the predetermined up-and-down bracket and cylinder bracket engage with each other, and the predetermined corner knife can be moved up and down by driving of the first or second air cylinder 131 or 132.

[0085] On the lower surface of the unit main body 105, an optical index sensor 111 (see Fig. 11) is provided which detects three positions of the index 106, that is, (1) a position at which the up-and-down bracket 107a of the corner knife 101 engages with the cylinder bracket 133 and the up-and-down bracket 109a of the corner knife 103 engages with the cylinder bracket 134, (2) a position at which the up-and-down bracket 108a of the corner knife 102 engages with the cylinder bracket 133, and (3) a position at which the up-and-down bracket 110a of the corner knife 104 engages with the cylinder bracket 134, and by this sensor detection, the position of the index 106 is controlled. These states (1) to (3) are referred to as states where the corner knives 101 to 104 are at working positions.

[0086] The range of overlap between each of the cylinder brackets 133, 134 and each of the up-and-down brackets 107a to 110a has a certain width in the Y axis

direction as shown in Fig. 8C, so that engaged states can be kept even if the up-and-down brackets 107a to 110a are slightly moved in the Y axis direction with respect to the cylinder brackets 133, 134. The corner knives 101 to 104 are moved in the Y axis direction in a range in which the engaged states can be kept, and the cutting positions can be adjusted.

[0087] Control System of Welting Machine

[0088] Fig. 11 is a block diagram showing a control system including an operation control means 80 of the welting machine 10.

[0089] To the operation control means 80, a display/input means 85 which displays predetermined characters or image information, and performs input for various settings, and a start switch 87 which inputs a sewing start are connected via an input and output circuit. Further, to the operation control means 80, an encoder 88 which detects the number of rotations of the main shaft motor 45 is connected via an input circuit 88a, and can detect the rotation angle from a predetermined origin position and the rotation speed.

[0090] To the operation control means 80, objects to be controlled by the operation control means 80, that is, a main shaft motor 45, a feed motor 23, a knife motor 57, a unit moving motor 90, and a electromagnetic valve 70 of an air cylinder 65 which switches the center knife between an actuated state and a driven state, are connected, respectively, via the drivers 45a, 23a, 57a, 90a, 70a.

[0091] Electromagnetic valves (not shown) which drive an air cylinder which moves up and down the binder 30 and an air cylinder which vertically moves the clamps 21 are connected to the operation control means 80 via drivers. Similarly, electromagnetic valves 135, 136 of the first and second air cylinders 131, 132 which move up and down the corner knives in cooperation with the index motor 121, and the above-described index sensor 111, are connected via drivers 121a, 135a, 136a and the input circuit 111a.

[0092] To the operation control means 80, a knife driving and cylinder driving electromagnetic valve 89 not shown which is for driving knives to cut sewing threads, and the above-described needle selecting solenoid 43, are connected via drivers 89a, 43a.

[0093] The operation control means 80 includes a CPU 81 which performs various processings and controls, a ROM 82 on which a corner knife selecting program 82a for selecting corner knives when forming oblique slits by welting and a sewing control program 82b for executing operation control of the welting machine in welting are written, a RAM 83 as a work area for storing various data in processings of the CPU 81, and an EEPROM 71 for recording sewing data and various setting data.

[0094] Into the EEPROM 71, widths in the X axis direction, widths in the Y axis direction, mounting angles around the Z axis and cutting edge angles (see Fig. 8), the total length L of the left and right straight seams TL, TR, the lengths CFL, CFR in the cloth feeding direction of the front oblique slits VFL, VFR, the correction feed amounts HFL, HFR for the oblique slits VFL, VFR, the lengths CRL, CRR in the cloth feeding direction of the rear oblique slits VRL, VRR, and correction feed amounts HRL, HRR for the oblique slits VRL, VRR (see Fig. 2 and Fig. 3), which are determined by adjustments when attaching the corner knives 101 to 104 are input from the display/input means 85, and these are all stored as setting data.

[0095] Operations through Corner Knife Selecting Program

[0096] Next, control for selecting corner knives to be performed by the CPU 81 according to the corner knife selecting program 82a will be described. This processing is executed when forming corner cuts during execution of welting.

[0097] To select corner knives, a sewing mode must be selected in advance by an operator. Two sewing modes can be selected, that is, a damage preventing mode in which corner cuts are formed without cutting both raised side end portions of the welting patch, and a bulge preventing mode in which the bulge of the triangle portion formed by a corner cut at the time of pressing after sewing is prevented from becoming conspicuous, and an operator must select and set either of these modes from the display/input means 85. This mode setting is also stored as setting data in the EEPROM 71.

[0098] When executing the corner knife selecting program 82a, the CPU 81 reads-out the above-described mode setting from the EEPROM 71, and when the damage preventing mode is selected, as left and right corner knives to be used for cutting, corner knives with smaller mounting angles are selected. This selection is determined from the mounting angles around the Z axis of the corner knives 101 to 104 stored in the EEPROM 71. Here, concerning the right side, the mounting angle of the corner knife 102 is smaller ($\theta 2 < \theta 1$), and concerning the left side, the mounting angle of the corner knife 104 is smaller ($\theta 4 < \theta 3$), so that the corner knives 102 and 104 are specified as corner knives to be used. Then, by actuating the first air cylinder 131 by controlling the index motor 121 so that the up-and-down bracket 108a of the mounting base 108 to which the corner knife 102 is attached comes to a position at which the up-and-down bracket 108a engages with the cylinder bracket 133, an oblique slit is formed with the corner knife 102. Next, by actuating the second air cylinder 132 by controlling the index motor 121 so that the up-and-down bracket 110a of the mounting base 110 to which the corner knife 104 is attached comes to a position at which the up-and-down bracket 110a engages with the cylinder bracket 134, an oblique slit is formed with the corner knife 104. Either of the corner knives 102 and 104 may perform cutting earlier.

[0099] On the other hand, when the bulge preventing mode is selected, as left and right corner knives to be used for cutting, corner knives with larger mounting angles are selected. Generally, the corner knives 101 to 104 are attached so that the width h1 and h2 in the Y axis direction become equal to each other, so that the

corner knives with larger mounting angles are smaller in width in the X axis direction (DS < DL).

[0100] Selection of corner knives is made from setting data in the EEPROM 71 in the same manner as described above. Concerning the right side, the mounting angle of the corner knife 101 is larger, and concerning the left side, the mounting angle of the corner knife 103 is larger, so that the corner knives 101 and 103 are selected as corner knives to be used. By simultaneously actuating the first and second air cylinders 131, 132 by controlling the index motor 121 so that the up-and-down bracket 107a of the mounting base 107 to which the corner knife 101 is attached comes to a position at which the up-and-down bracket 107a engages with the cylinder bracket 133, and the up-and-down bracket 109a of the mounting base 109 to which the corner knife 103 is attached comes to a position at which the up-and-down bracket 109a engages with the cylinder bracket 134, oblique slits are formed with the corner knives 101 and 103.

[0101] Thus, according to the corner knife selecting program 82a, selection of corner knives and control of the corner cut forming operation by the selected corner knives are performed.

[0102] In welting at a slanted pocket opening as shown in Fig. 3, it is essential that a corner knife with a smaller mounting angle is used as one of the pair of corner knives, and a corner knife with a larger mounting angle is used as the other one of the pair of corner knives, and there is no alternative, so that the selection of corner knives is not performed.

[0103] As another pattern of welting at a slanted pocket opening, there is a method in which corner knives having mounting angles equal to each other are selected as the left and right corner knives, and corner cuts are formed by shifting the positions of the end portions on the linear slit side of the oblique slits by a deviation in the cloth feeding direction, and in this case, a selection may be made between a combination of corner knives with larger mounting angles and a combination of corner knives with smaller mounting angles although this method is not shown.

[0104] Welting Operation

[0105] Operation control for welting will be described with reference to the flowcharts of Fig. 12 and Fig. 13. Processings of these flowcharts are performed by mainly executing the sewing control program 82b by the CPU 81, and a part of processing of Fig. 13 is processing to be performed by executing the corner knife selecting program 82a by the CPU 81.

[0106] Fig. 12 is a flowchart of an overall flow of the welting operation, and Fig. 13 is a flowchart of a post-stitching operation in the welting operation.

[0107] First, the overall flow of the welting operation will be described with reference to Fig. 12.

[0108] When the welting operation starts, firstly, a body cloth M and a welting patch B are set (Step S20). Subsequently, straight seams TL, TR and a linear slit S are formed (Step S50), and last, as post-stitching operation, corner cuts are formed (Step S70), whereby a series of welting operations are completed. The processings of Steps S20 to S70 are repeatedly executed, and each time, welting of one body cloth and one welting patch B is performed.

[0109] In the setting operation, first, an operator sets a body cloth M so that stitching start points come to predetermined positions on the upper surface of the table 11 and sets a welting patch B on the clamps 21, the clamps 21 and the binder 30 move down and hold these cloths M and B while both side end portions of the welting patch B are raised up.

[0110] Then, the process shifts to a stitching operation. First, conveyance is started. On the assumption that the stitching start points of the cloths are set at predetermined positions, when it is detected that the stitching start points have reached stitch points of the needles 41 from the cloth feed amount, driving of the main shaft motor 45 is started to start forming of straight seams. Herein, operations are described on the assumption that the pocket opening has a rectangular shape, however, if it has a slant shape, the sewing start timings of the sewing needles are deviated as much as a deviation CF from each other.

[0111] Then, reaching to a cutting start position of a linear slit is determined from the length CFR in the cloth feeding direction of the oblique slit VFR and a correction feed amount HFR thereof, and when the cutting start position is reached, the air cylinder 65 is driven to start cutting of the linear slit. By monitoring reaching to a sewing finish position and a cutting finish position in the same manner, and when they are reached, sewing and cutting are finished in order.

[0112] Next, the post-stitching operation of the welting operation will be described with reference to Fig. 13.

[0113] Along with the finish of the operation for forming the straight seams TL, TR and the linear slit S, the workpiece is conveyed to the oblique slit forming position by the corner knife mechanisms 100 (Step S71).

[0114] Next, a distance of the corner knife mechanisms 100B from the corner knife mechanisms 100A (= length of linear slit S = L-HFR-CFR-CRR-HRR: see Fig. 2) is calculated (Step S72).

[0115] Next, based on the calculated distance, the corner knife mechanisms 100B is moved to a target position by driving of the unit moving motor 90 (Step S73).

[0116] Then, the CPU 81 reads the mode setting, and determines whether the damage preventing mode has been selected (Step S74).

[0117] Then, when the damage preventing mode is selected, in both corner knife mechanisms 100A, 100B, corner knives 102 and 104 with smaller mounting angles are selected as left and right corner knives. In other words, by control of the index motor 121, the corner knives 102 and 104 are positioned at cutting positions in order, and the air cylinders 131, 132 are actuated to perform a pushing-up operation in order (Step S75).

[0118] When the damage preventing mode is not se-

lected (when the bulge preventing mode is selected), in both corner knife mechanisms 100A, 100B, the corner knives 101 and 103 with larger mounting angles are selected as left and right corner knives. In other words, by control of the index motor 121, the corner knives 101 and 103 are simultaneously positioned at cutting positions and the air cylinders 131, 132 are simultaneously actuated to perform a pushing-up operation (Step S76).

[0119] Then, when all oblique slits are completely formed, the unit moving motor 90 is driven to return the corner knife mechanisms 100B to the origin position, and accordingly, a post-stitching operation is completed (Step S77).

[0120] In the welting machine 10, each of the corner knife mechanisms 100A, 100B includes two pairs of corner knives which are different in mounting angle between the corner knives 101 and 102 corresponding to one side oblique slit of a corner cut and between the corner knives 103 and 104 corresponding to the other side oblique slit, and these corner knives can be selected by the index motor 121, and by the operation control means 80, corner knives 101 and 103 (or 102 and 104) having symmetrical mounting angles are combined and this combination is selected by the mode setting to execute cutting.

[0121] Therefore, a selection can be made between a case where corner cuts are formed by the combination (the combination of corner knives 102 and 104) with mounting angles which can prevent cutting of the welting patch B, and a case where corner cuts are formed by the combination (the combination of corner knives 101 and 103) with the other mounting angles according to the kind of the cloth to be used. The selection between these is made by control of the index motor 121, so that manual angle adjustments when switching the angles are not required, and therefore, the onerous work is eliminated, and easy and quick switching becomes possible.

[0122] In the case of the combination of the corner knives 101 and 103 as the combination with the other mounting angles, the triangle portion of the corner cut formed with this combination can be made smaller, and can be prevented from bulging due to pressing after sewing, and in the case of sewing which greatly requires these, the quality of sewing can be improved.

[0123] In the welting machine 10, the display/input means 85 (operating part) for performing a mode selection for determining a selection of a combination of corner knives is used, so that only by the setting operation of the display/input means 85, can the combination of corner knives be easily and quickly switched.

[0124] Another Embodiment

[0125] In each of the corner knife mechanisms 100A, 100B, for each of left and right corner knives, two mounting angles are prepared, and for preventing cutting of the welting patch B, for each of the left and right corner knives, corner knives with two large and small cutting edge angles θe may be prepared.

[0126] In other words, as shown in Fig. 14, first corner knives 101A and 102A having different cutting edge angles $\theta e1$ and $\theta e2$ ($\theta e1 < \theta e2$) are prepared as the right corner knives, and second corner knives 103A and 104A having different cutting edge angles $\theta e3$ and $\theta e4$ ($\theta e3 < \theta e4$) are prepared as the left corner knives, and these are held in the same manner as described above.

[0127] In this case, to prevent raised side end portions of the welting patch B from being unintentionally cut, preferably, the corner knives with the larger cutting edge angles $\theta e2$ and $\theta e4$ are combined and used, and when sewing a cloth which is hard and hardly cut, the sharper two corner knives with the smaller cutting edge angles $\theta e1$ and $\theta e3$ are combined and used.

[0128] Setting of the selection of the corner knives is performed by making a selection between the damage preventing mode for preventing cutting of the welting patch B and the cutting promotion mode for forming corner cuts in a cloth which is hardly cut, by the display/input means 85, and storing the contents of setting in the EEPROM 71.

[0129] With this configuration, it becomes possible to make a selection between a case where corner cuts are formed by a combination of the mounting angles which can prevent cutting of the welting patch B (the combination of the corner knives 102A and 104A), and a case where corner cuts are formed by a combination of the other mounting angles according to the kind of cloth to be used (the combination of the corner knives 101A and 103A). A selection between these is made by control of the index motor 121, so that the manual angle adjustments when switching the angles are not required, and therefore, the troublesomeness is eliminated, and the switching can be easily and quickly made.

[0130] With the combination of the corner knives 101A and 103A as the combination with the other mounting angles, a workpiece which is hardly cut due to its fabric quality can be more reliably cut, so that when this is greatly required, the quality of sewing can be improved.

[0131] In this example, the display/input means 85 (operating part) is used for making a mode selection for determining a selection of a combination of corner knives, so that only by a setting operation of the display/input means 85, can the combination of corner knives be easily and quickly switched.

Claims

1. A corner knife mechanism (100A, 100B) of a welting machine (10) which forms a corner cut having a pair of oblique slits (VFL, VFR; VRL, VRR) between an end of a linear slit (S) and adjacent ends of two straight seams (TL, TR), which are formed along a cloth feeding direction (F) on a body cloth (M) and a welting patch (B) on respective sides of the linear slit (S),
   characterized in that the corner knife mechanism (100A, 100B) comprises:

a plurality of first corner knives (101, 102, 101A, 102A) for forming one of the oblique slits, the plurality of first corner knives having different cutting edge angles (θe1, θe2), or different mounting angles (θ1, θ2) around respective axes perpendicular to a plane (11) on which the body cloth (M) is placed;
a plurality of second corner knives (103, 104, 103A, 104A) for forming the other of the oblique slits, the plurality of second corner knives having different cutting edge angles (θe3, θe4), or different mounting angles (θ3, θ4) around respective axes perpendicular to said plane (11);
a corner knife holder (105) on which the first and second corner knives are arranged along a direction (Y) which is parallel to said plane (11) and is orthogonal to the cloth feeding direction (F);
a knife selecting actuator (121) which moves the corner knife holder (105) in the direction (Y) along which of the first and second corner knives are arranged;
a cutting actuator (131, 132) which selectively moves up and down the first and second corner knives along a direction (Z) perpendicular to said plane (11); and
an operation control means (80) which controls the knife selecting actuator (121) and the cutting actuator (131, 132) to select a combination of one of the first corner knives and one of the second corner knives and to form the corner cut, wherein the first corner knife and the second corner knife of the combination are symmetrically oriented with respect to the cloth feeding direction (F) and have the same mounting angle (θ1, θ3; θ2, θ4) or the same cutting edge angle (θe1, θe3; θe2, θe4).

2. The corner knife mechanism (100A, 100B) according to claim 1, further comprising an operating part (85) from which the selection of the combination of the first and second corner knives is set.

FIG. 1

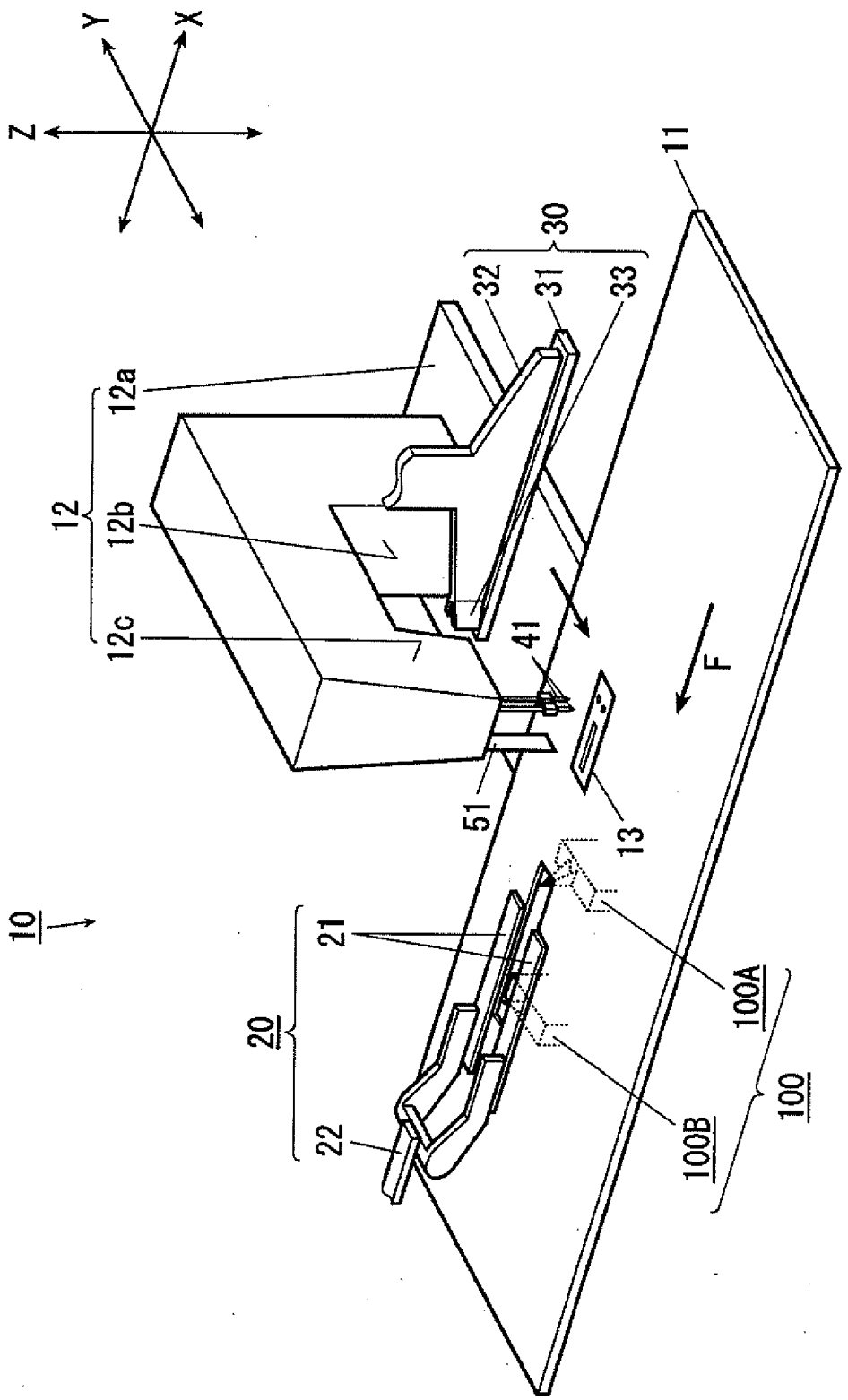

Y
X
Z
11
30
32
31
33
12a
12
12b
12c
41
F
51
13
10
21
20
22
100A
100B
100

FIG. 2

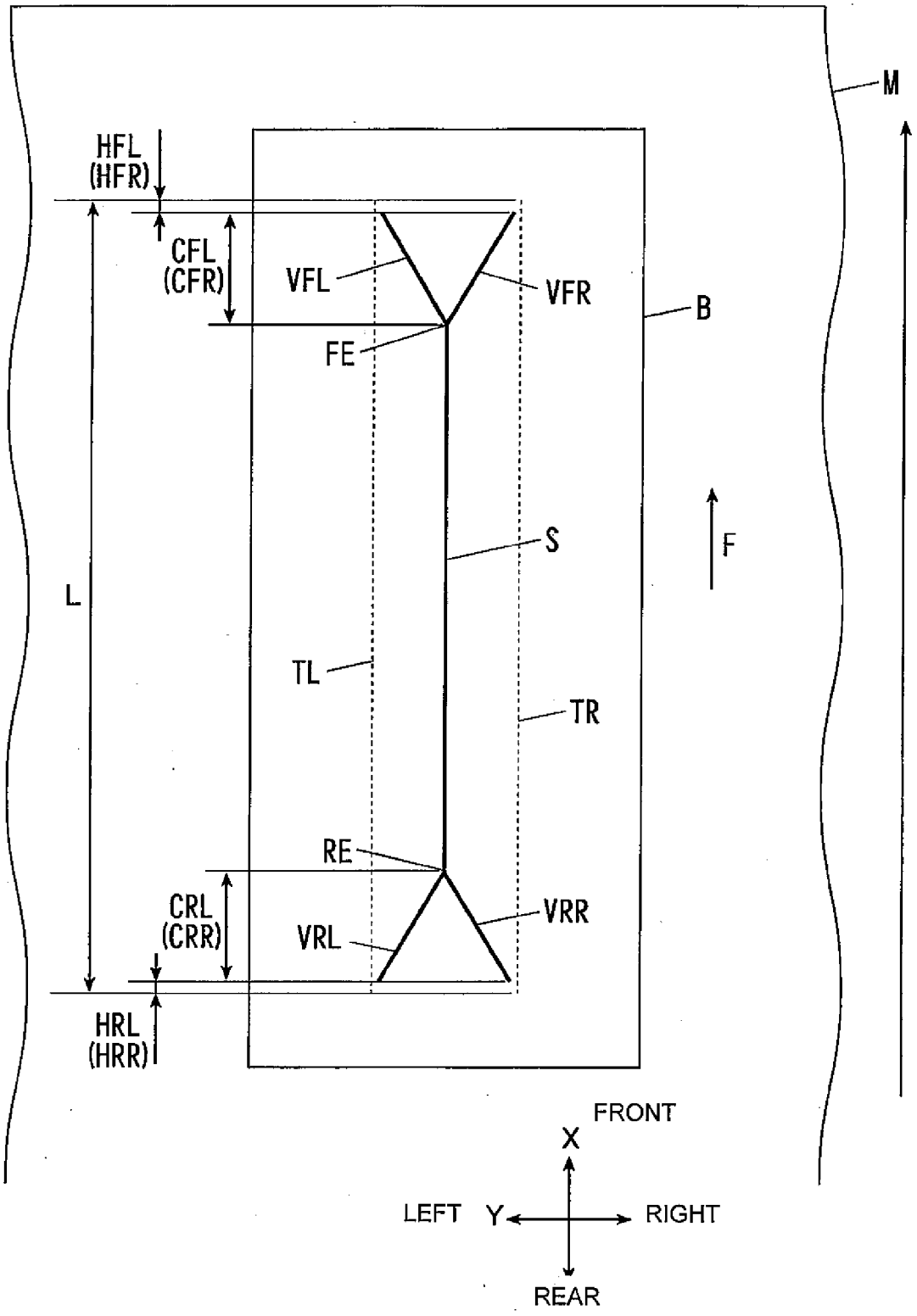
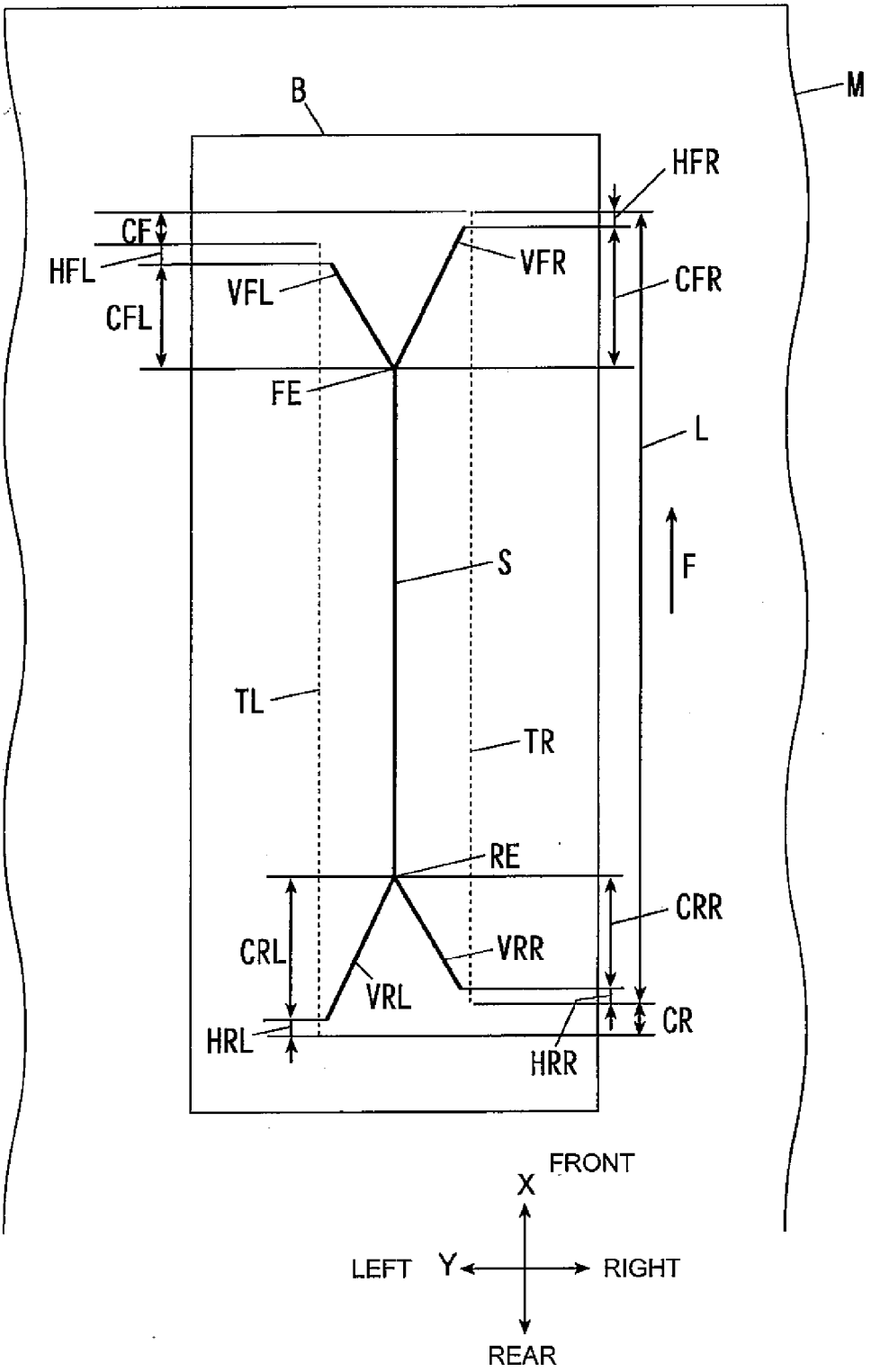

M
HFL
(HFR)
CFL
(CFR)
VFL
VFR
B
FE
S
F
L
TL
TR
RE
CRL
(CRR)
VRL
VRR
HRL
(HRR)
FRONT
X
LEFT
Y
RIGHT
REAR

FIG. 3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B
HFR
CF
HFL
VFL
VFR
CFR
CFL
FE
L
F
S
TL
TR
RE
CRR
CRL
VRR
VRL
CR
HRL
HRR
FRONT
X
LEFT
Y
RIGHT
REAR

FIG. 4

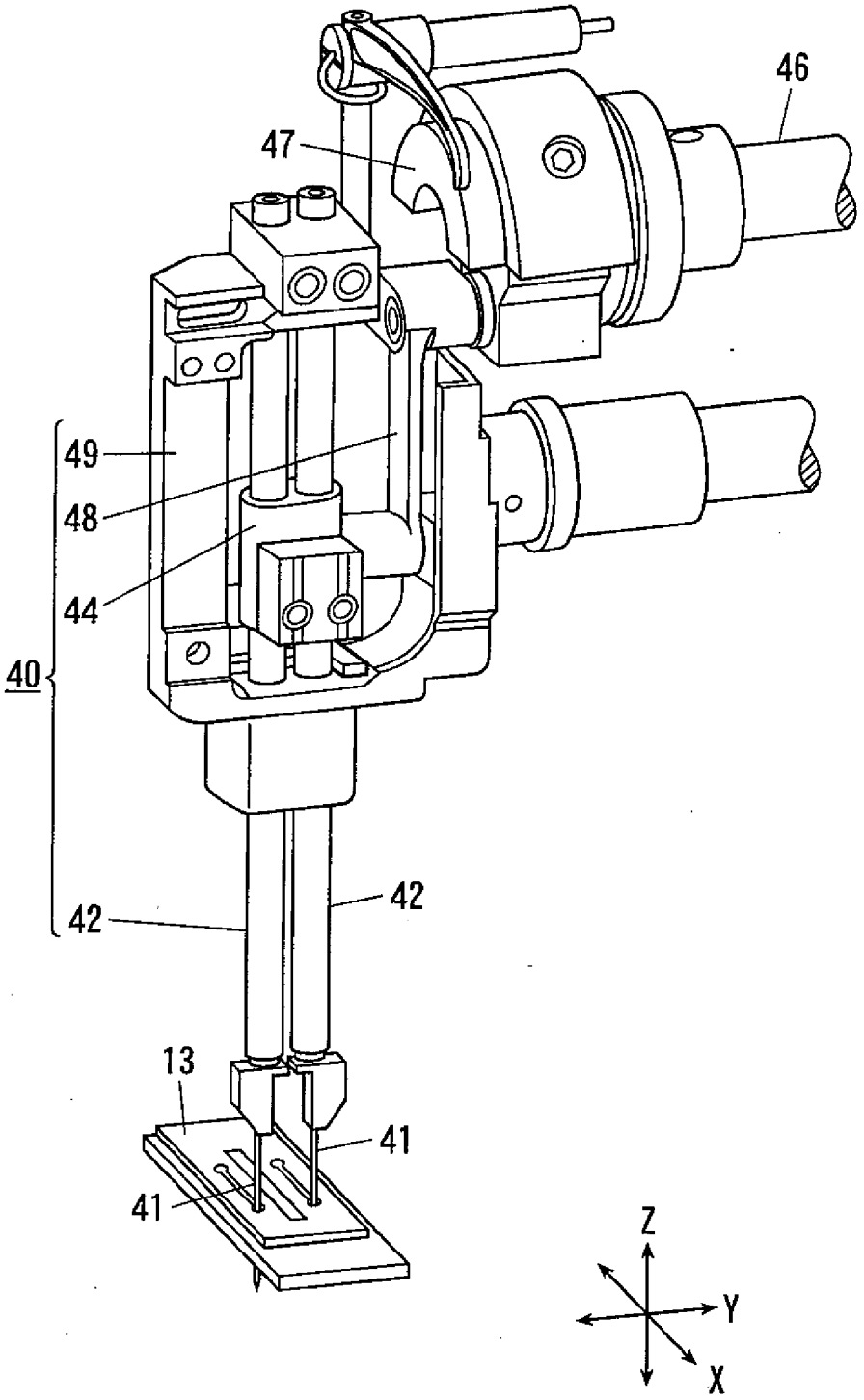


FIG. 5

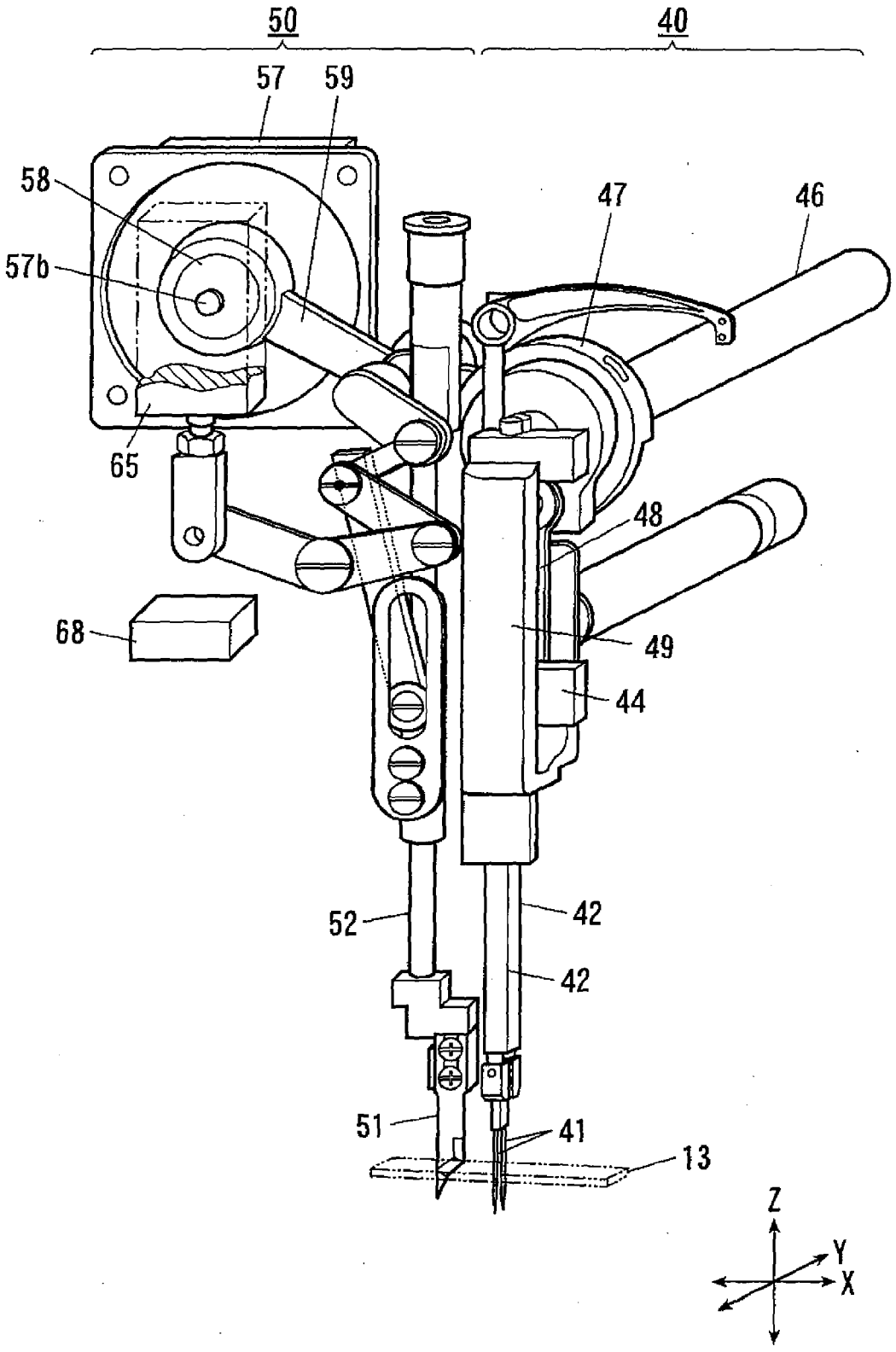


FIG. 6

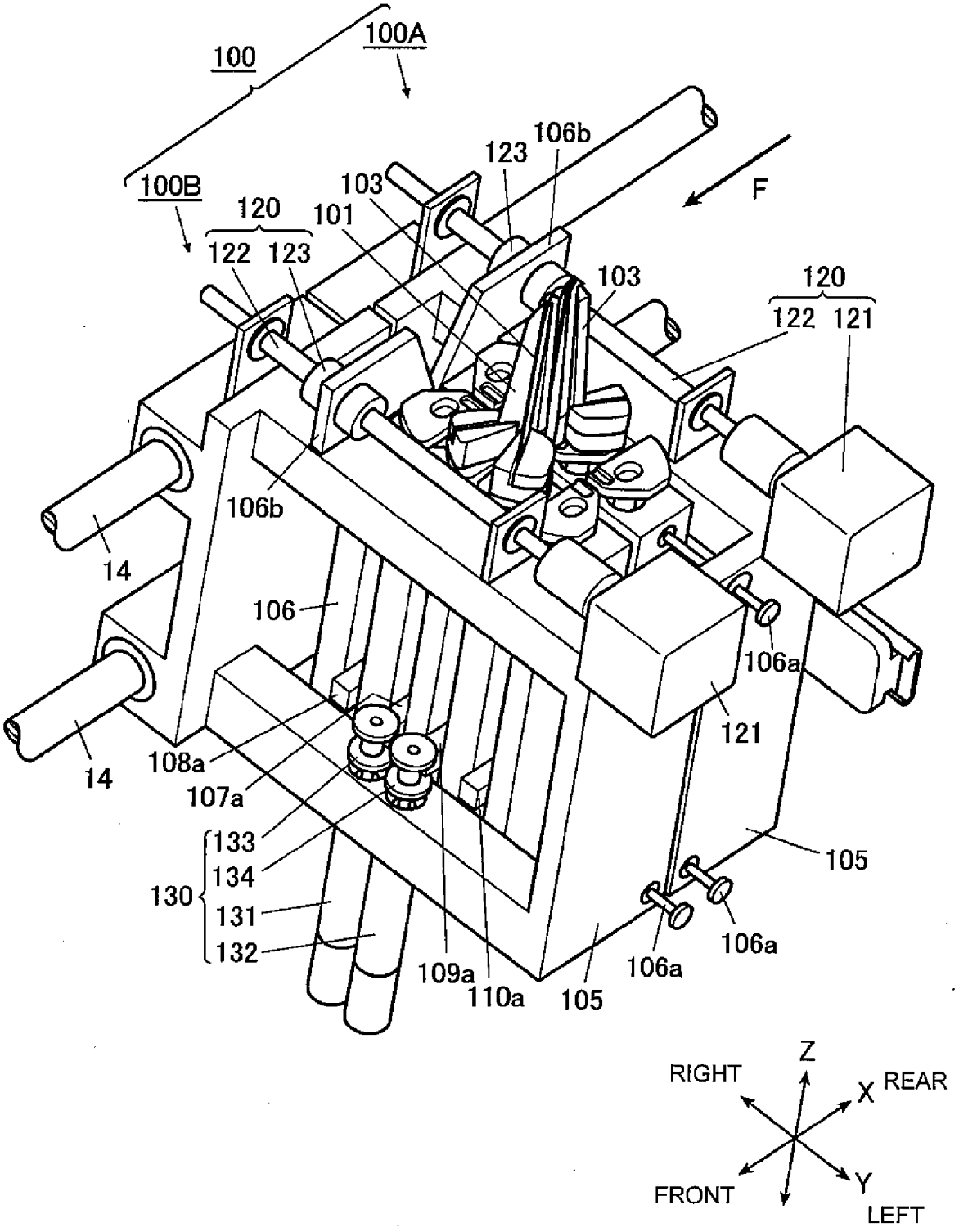

100
100A
100B
120
122 123
101
103
123
106b
F
103
120
122 121
106b
14
106
106a
121
14
108a
107a
133
134
130
131
132
109a
110a
105
106a
106a
105
Z
RIGHT
X REAR
FRONT
Y
LEFT

FIG. 7

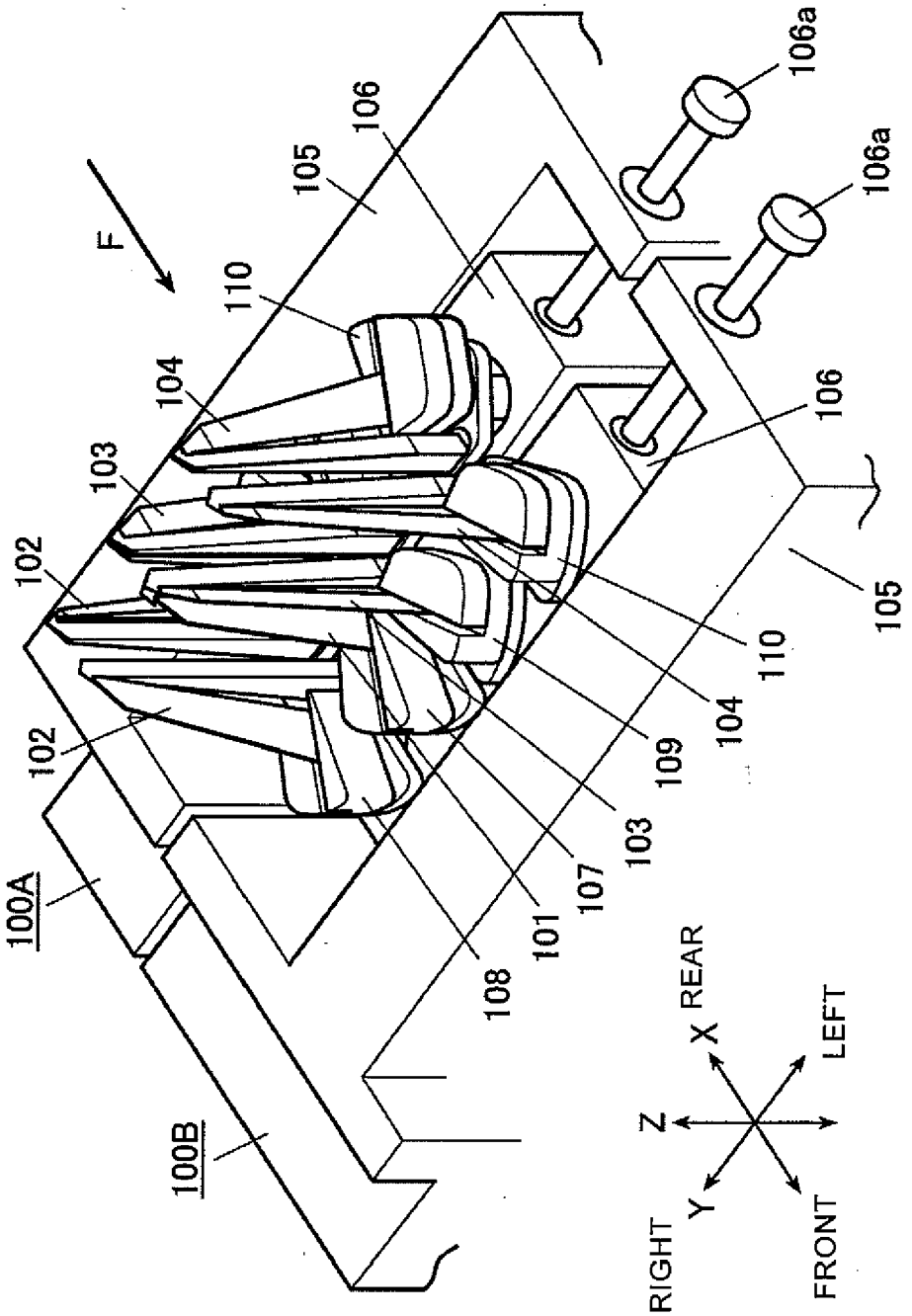

F
100A
100B
102
103
104
105
106
106a
107
108
109
110
101
REAR
LEFT
FRONT
RIGHT
X
Y
Z

FIG. 8A

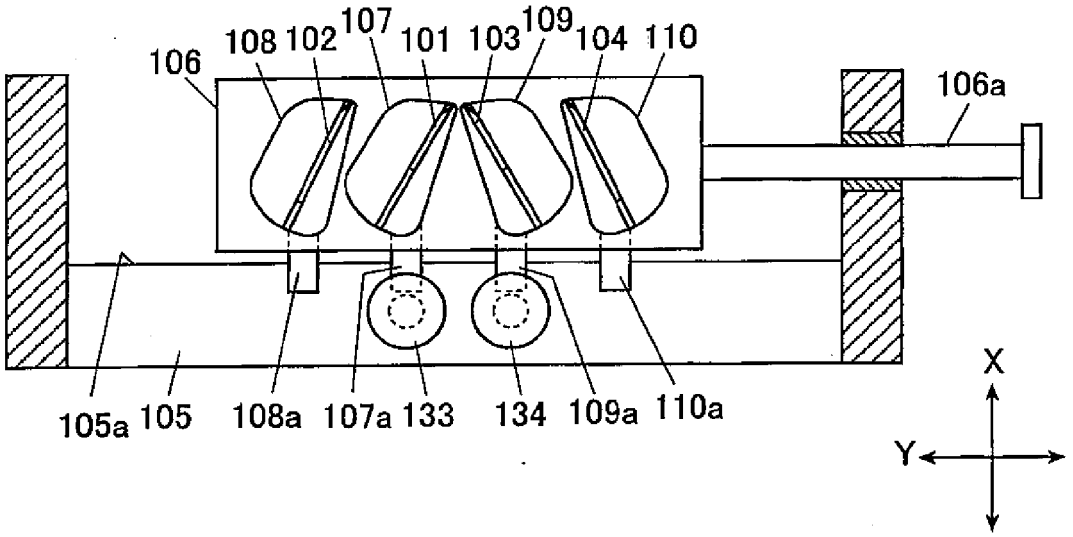


FIG. 8B

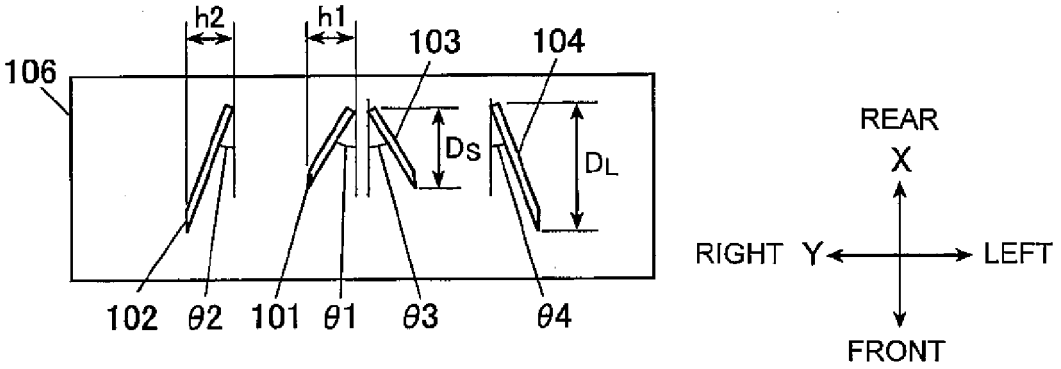


FIG. 8C

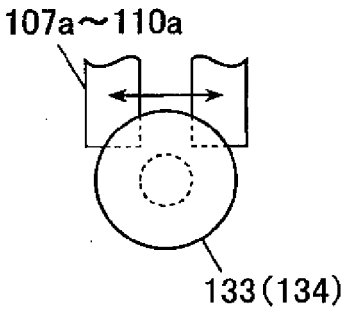


FIG. 9A

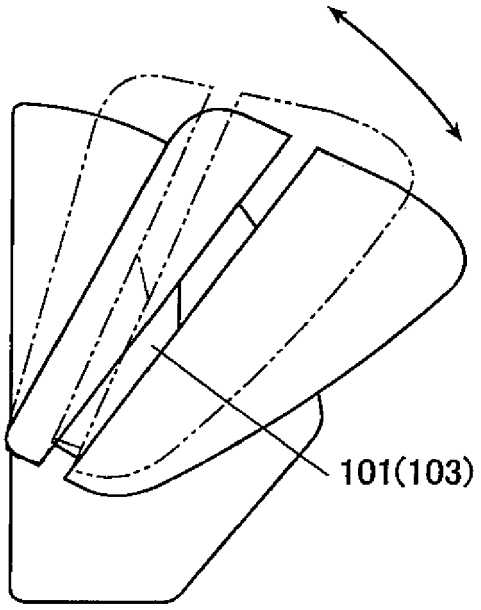


FIG. 9B

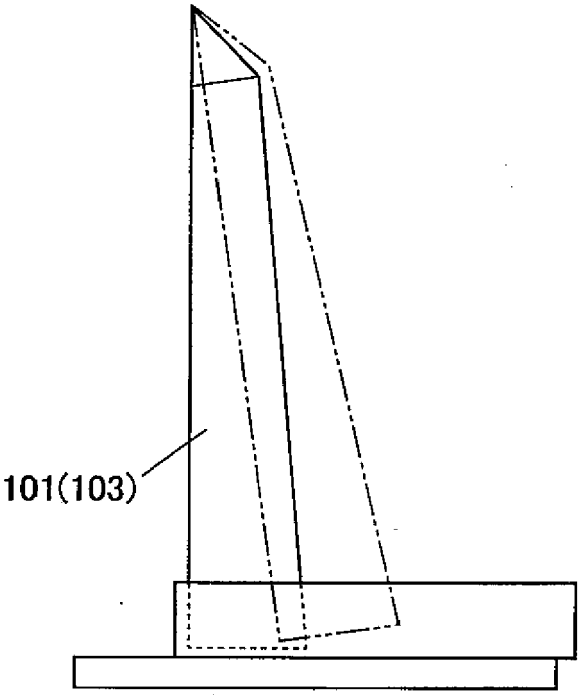


FIG. 10A

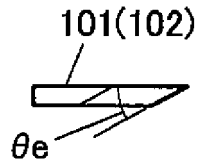


FIG. 10B

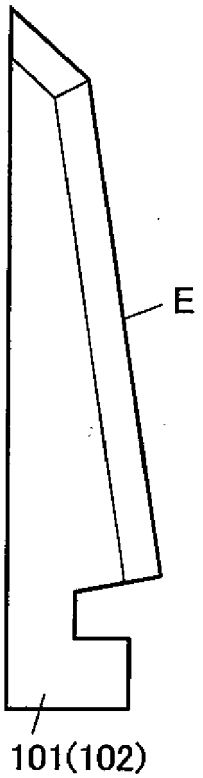


FIG. 11

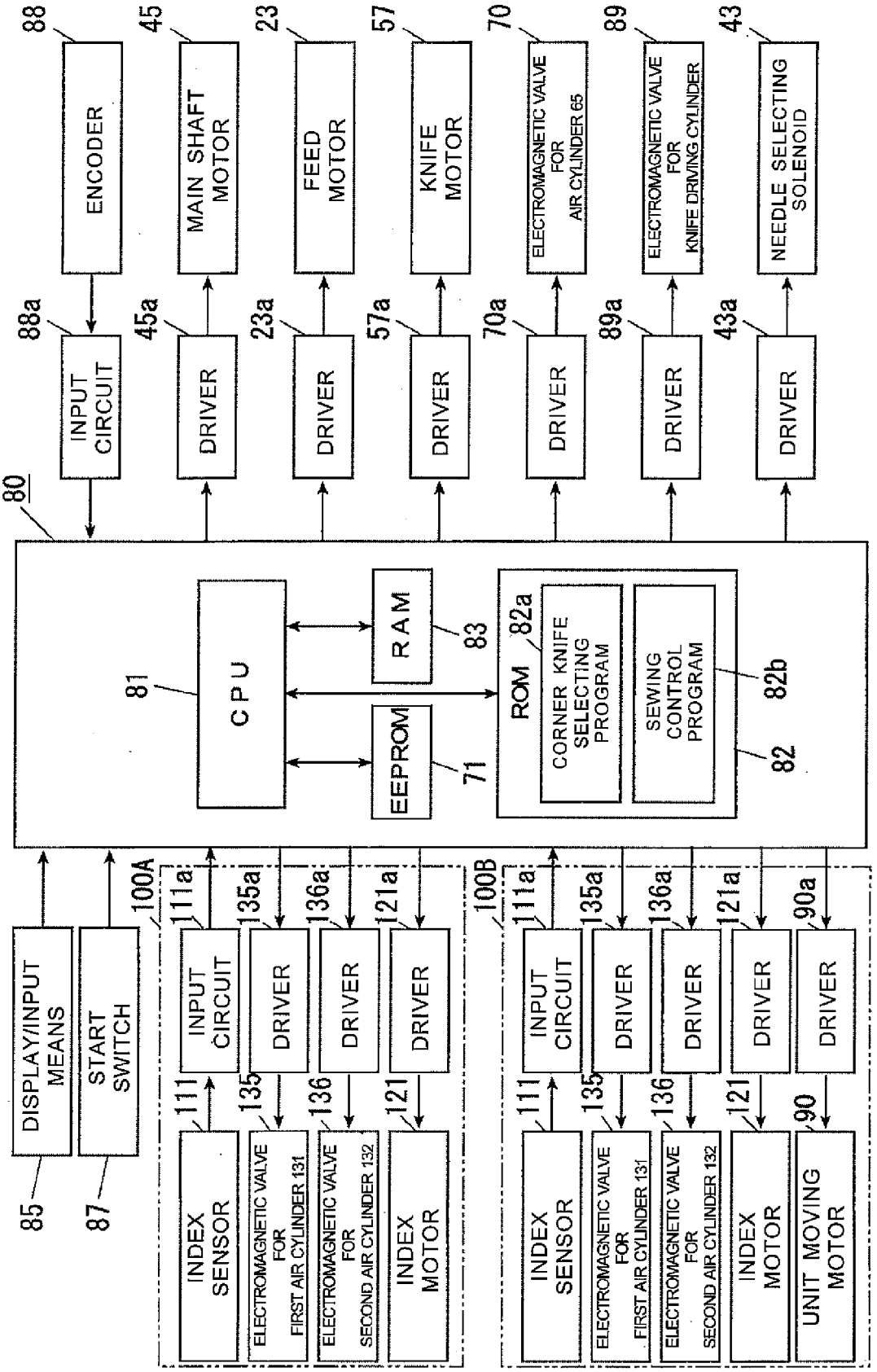

88
ENCODER
88a
INPUT CIRCUIT
45
MAIN SHAFT MOTOR
45a
DRIVER
23
FEED MOTOR
23a
DRIVER
57
KNIFE MOTOR
57a
DRIVER
70
ELECTROMAGNETIC VALVE FOR AIR CYLINDER 65
70a
DRIVER
89
ELECTROMAGNETIC VALVE FOR KNIFE DRIVING CYLINDER
89a
DRIVER
43
NEEDLE SELECTING SOLENOID
43a
DRIVER
80
81
CPU
RAM
83
EEPROM
71
ROM
82a
CORNER KNIFE SELECTING PROGRAM
SEWING CONTROL PROGRAM
82b
82
85
DISPLAY/INPUT MEANS
87
START SWITCH
100A
111a
INPUT CIRCUIT
135a
DRIVER
136a
DRIVER
121a
DRIVER
111
INDEX SENSOR
135
ELECTROMAGNETIC VALVE FOR FIRST AIR CYLINDER 131
136
ELECTROMAGNETIC VALVE FOR SECOND AIR CYLINDER 132
121
INDEX MOTOR
100B
111a
INPUT CIRCUIT
135a
DRIVER
136a
DRIVER
121a
DRIVER
90a
DRIVER
111
INDEX SENSOR
135
ELECTROMAGNETIC VALVE FOR FIRST AIR CYLINDER 131
136
ELECTROMAGNETIC VALVE FOR SECOND AIR CYLINDER 132
121
INDEX MOTOR
90
UNIT MOVING MOTOR

FIG. 12

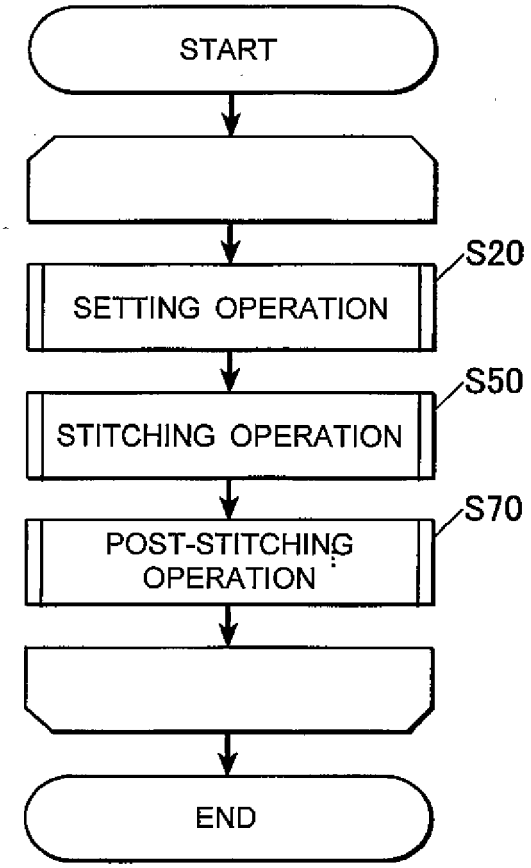

START
S20
SETTING OPERATION
S50
STITCHING OPERATION
S70
POST-STITCHING OPERATION
END

FIG. 13

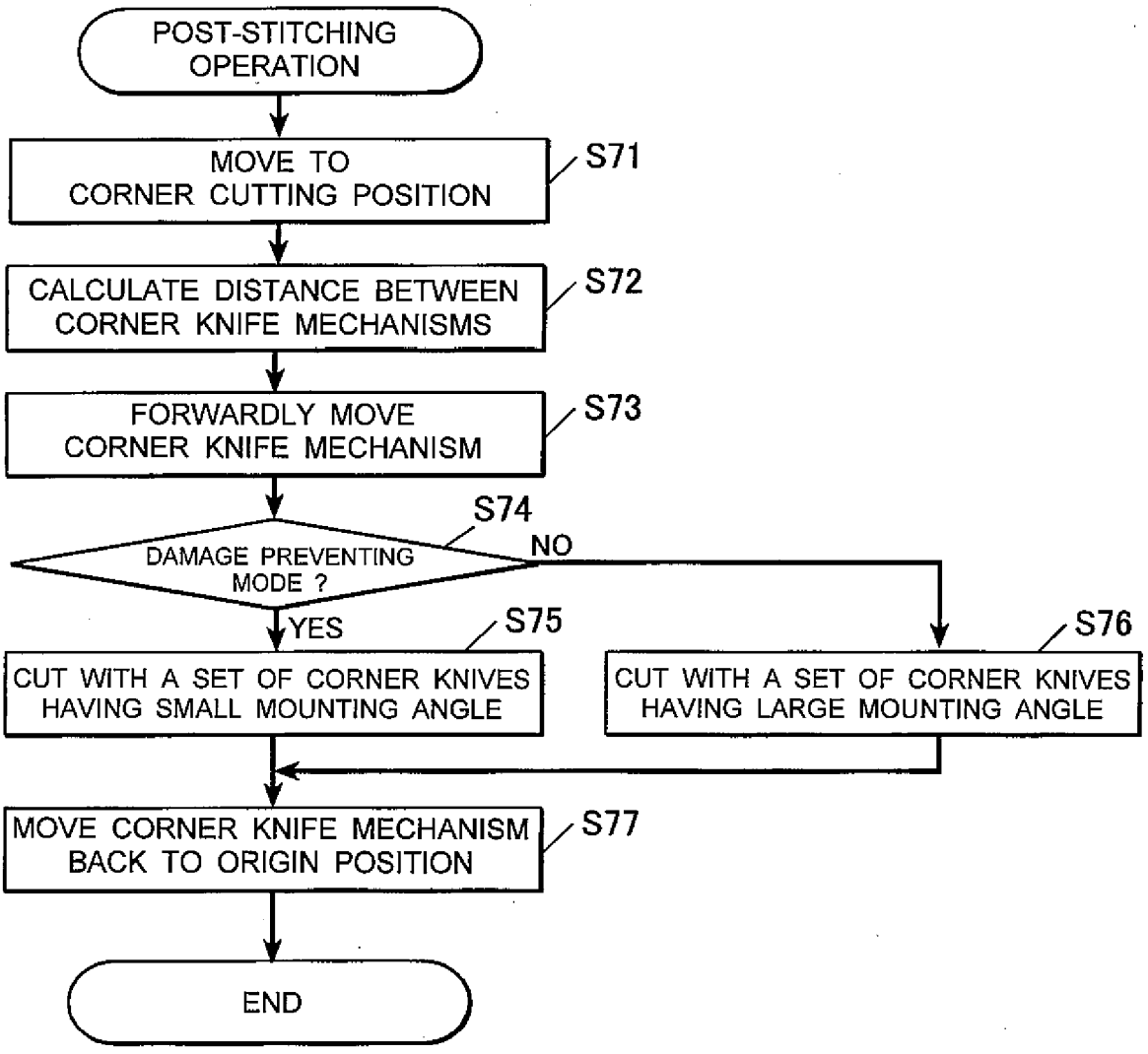

POST-STITCHING OPERATION
MOVE TO CORNER CUTTING POSITION
S71
CALCULATE DISTANCE BETWEEN CORNER KNIFE MECHANISMS
S72
FORWARDLY MOVE CORNER KNIFE MECHANISM
S73
S74
DAMAGE PREVENTING MODE ?
NO
YES
S75
CUT WITH A SET OF CORNER KNIVES HAVING SMALL MOUNTING ANGLE
S76
CUT WITH A SET OF CORNER KNIVES HAVING LARGE MOUNTING ANGLE
MOVE CORNER KNIFE MECHANISM BACK TO ORIGIN POSITION
S77
END

FIG. 14

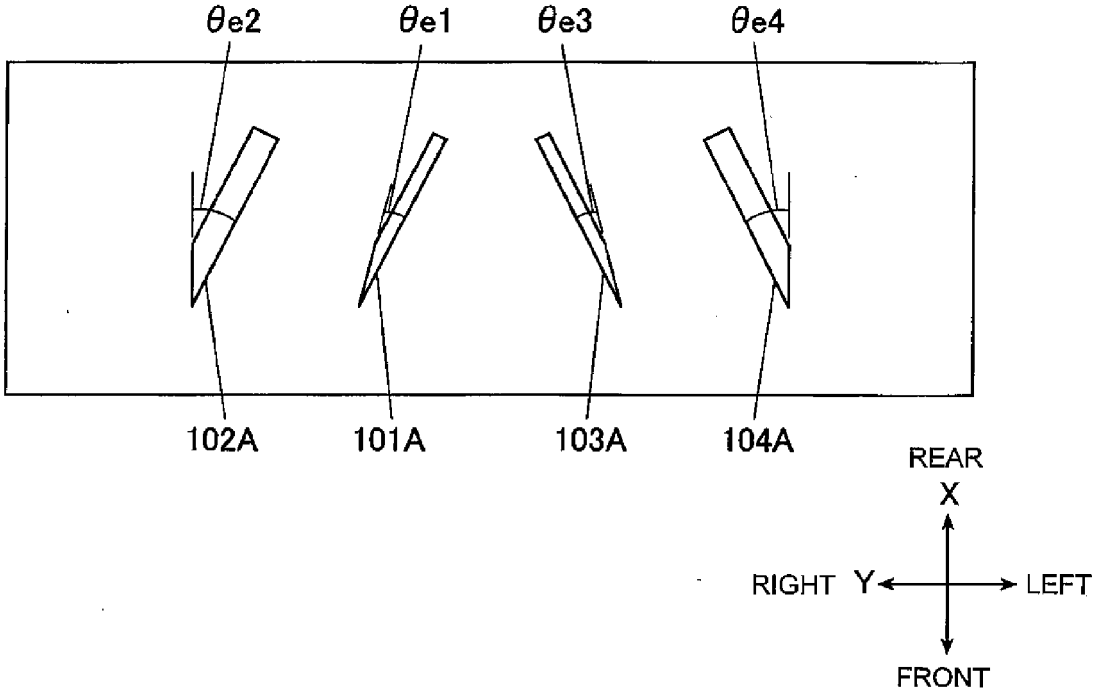

θe2
θe1
θe3
θe4
102A
101A
103A
104A
REAR
X
RIGHT
Y
LEFT
FRONT

FIG. 15

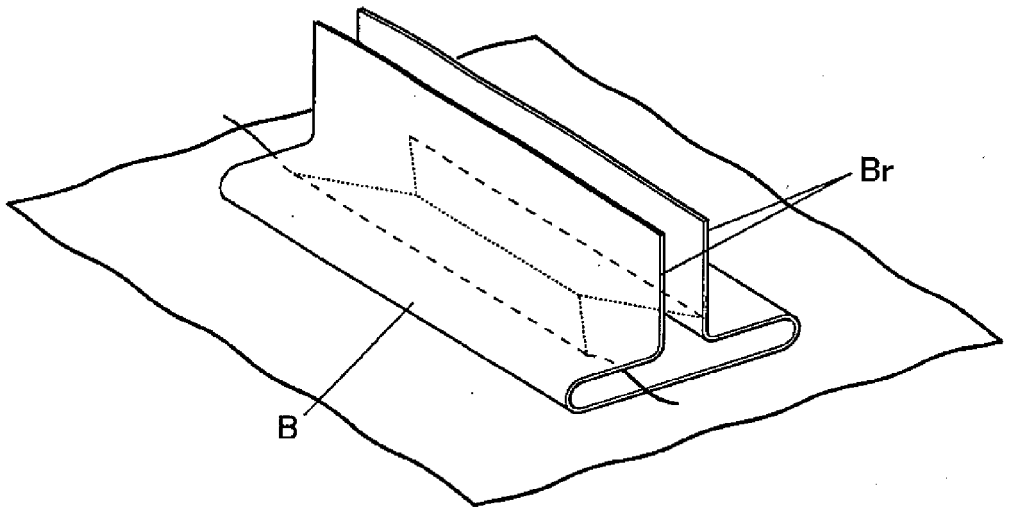

Br
B

FIG. 16A

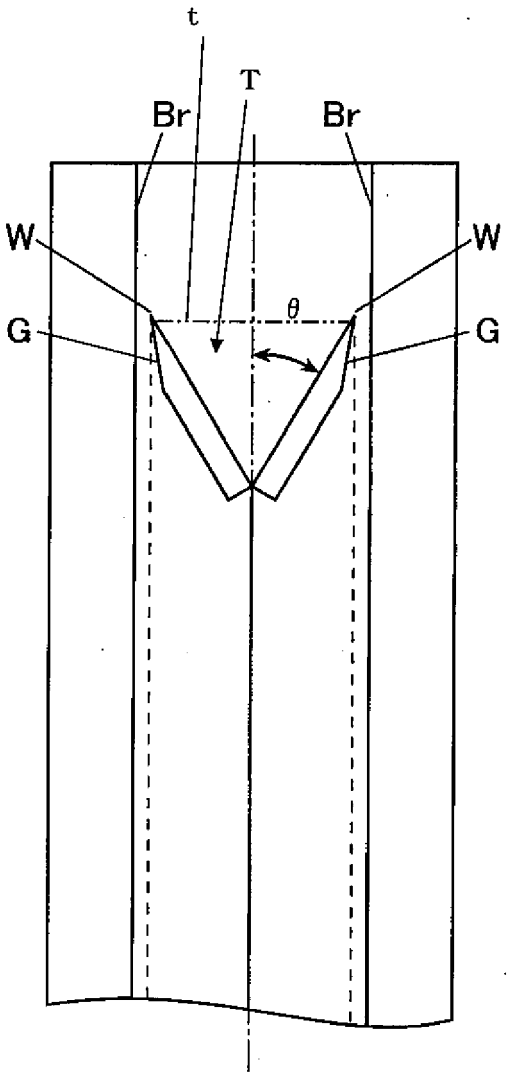


FIG. 16B

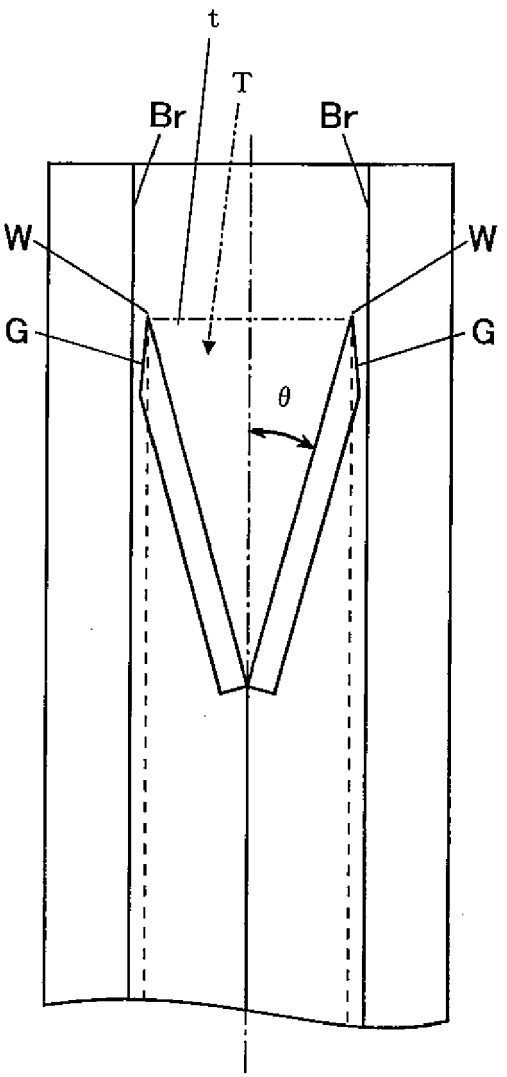


FIG. 17A

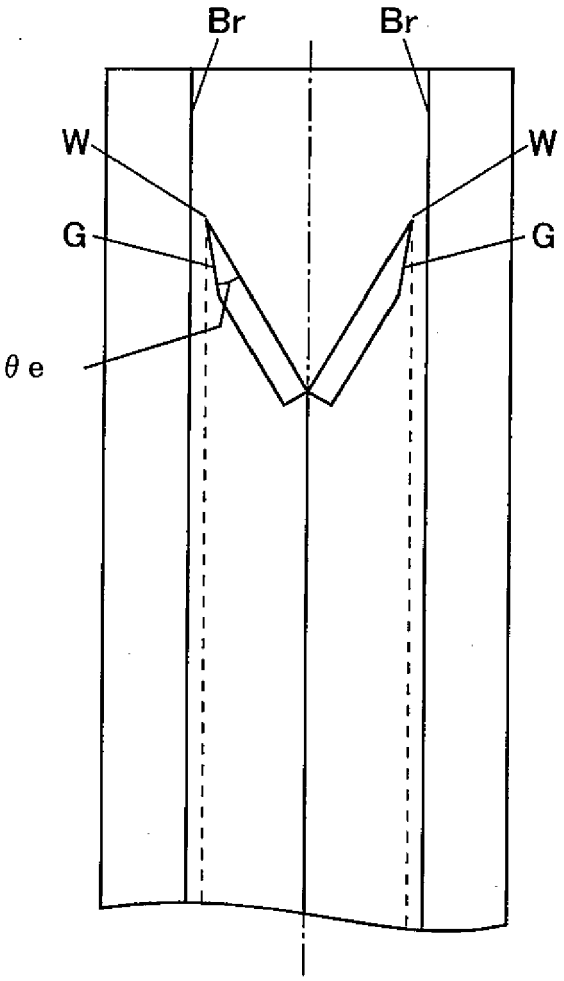
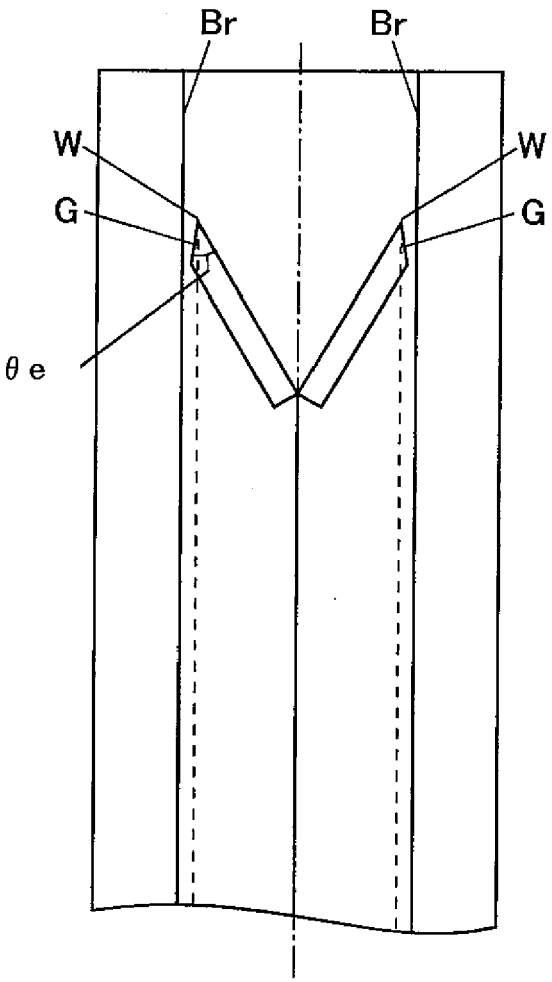


FIG. 17B



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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