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(54) **Sewing machine with upper thread cutting and holding mechanisms**

(57) A sewing machine includes an upper thread cutting mechanism (35) having an upper thread movable blade (40) cutting an upper thread (14) extending from workpiece cloth (W) through an eye (9a) of a needle (9) above a needle plate (5), an upper moving mechanism (36) reciprocally moving the upper thread movable blade (40) between a first upper thread take-up position and a second upper thread take-up position, an upper thread holding mechanism holding an end of the upper thread

(14) cut by the upper thread cutting mechanism (35) when the upper thread movable blade (40) is moved reciprocally by the upper moving mechanism (36), an upper thread direction adjusting mechanism (33) located on the upper moving mechanism (36) and the upper thread holding mechanism (31) for adjusting a direction in which the upper thread (14) extending through the needle eye (9a) to the upper thread holding mechanism (31) is drawn.

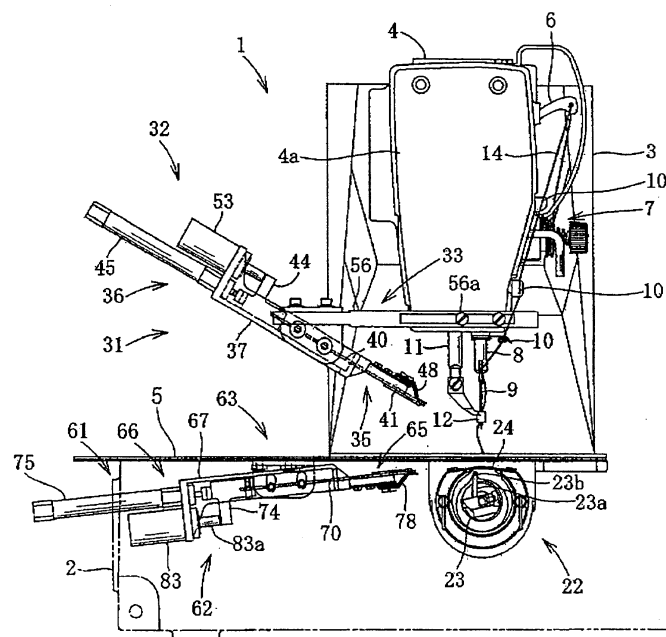


FIG. 3

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Description

[0001] The present invention relates to a sewing machine provided with an upper thread cutting mechanism which cuts an upper thread upon completion of sewing and an upper thread holding mechanism which holds an end of the upper thread cut by the upper thread cutting mechanism.

[0002] Some types of conventional sewing machines have been provided with a thread cutting device which cuts upper and lower threads both extending to workpiece cloth. Furthermore, the conventional sewing machines have also been provided with an upper thread holding device which holds ends of the upper and lower threads cut by the thread cutting device. The thread cutting device cuts the upper and lower threads over or below workpiece cloth automatically or in response to instructions to cut threads by an operator upon completion of sewing.

[0003] For example, JP-A-H04-26490 discloses an upper thread cutting device for a sewing machine, comprising an upper thread cutting device including an upper thread holding mechanism, a cutting member, a fixed plate and a cylinder. The upper thread cutting device is provided on an upper side of a sewing bed. Upon completion of sewing, the upper thread cutting mechanism causes the cutting member to generate heat which is used to cut an upper thread located between a cloth presser and workpiece cloth. Subsequently, the upper thread holding mechanism is returned to an original position while holding an end of the upper thread at the needle side. A sewing operation of the needle applies a drawing force to the upper thread end held by the upper thread holding mechanism. As a result, the upper thread end is drawn to the needle side thereby to drop out of the upper thread holding mechanism.

[0004] JP-A-H02-213385 discloses a thread cutting device for a sewing machine, comprising a pair of needle thread cutters and a holder each located above workpiece cloth, a fixed cutter, a movable-cutter pivoting arm and a bobbin-thread pulling plate each located below the workpiece cloth. Upon completion of sewing, the needle thread is cut by the paired needle thread cutters and thereafter, an end of the needle thread is held between one of the needle thread cutters and the holder. The movable-cutter pivoting arm and the bobbin-thread pulling plate are caused to pivot simultaneously so that the bobbin thread is cut by the fixed cutter. When the movable-cutter pivoting arm and the bobbin-thread pulling plate pivot to return to original positions after the bobbin thread has been cut, an end of the bobbin thread is held between the bobbin-thread pulling plate and a distal end of the movable cutter.

[0005] The end of the needle thread cut by the needle-thread cutting mechanism is held in the upper thread cutting device described in JP-A-H04-26490. The upper thread end dropped out of the thread holding mechanism is located at a predetermined sewing location on work-

piece cloth when a direction in which the end of the thread extending through an eye of the needle is held agrees to a sewing direction upon start of a subsequent sewing operation. As a result, the upper thread end is sewn onto the workpiece cloth in the subsequent sewing operation, whereupon stitches become bad-looking.

[0006] The ends of the needle and bobbin threads are also held individually after thread cutting in the above-referenced JP-A-H02-213385. As a result, when a sewing direction at the time of start of subsequent sewing agrees to a direction in which the end of the needle or bobbin thread is held, the needle and bobbin thread ends dropped out of the respective holders are sewn onto the workpiece cloth at the time of start of the subsequent sewing operation.

[0007] Therefore, an object of the present invention is to provide a sewing machine which can prevent the end of the upper thread cut by an upper thread cutting mechanism from being sewn at the time of start of the subsequent sewing.

[0008] The present invention provides a sewing machine which comprises a sewing machine frame, a needlebar on which a needle having an eye is mounted, a hook, an upper thread cutting mechanism having an upper thread movable blade cutting an upper thread extending from workpiece cloth W through an eye of the needle above a needle plate, an upper moving mechanism which reciprocally moves the upper thread movable blade between a first upper thread take-up position where the upper thread is hooked beneath the needle and a second upper thread take-up position which is spaced away from the first upper thread take-up position by a predetermined distance, and an upper thread holding mechanism which holds an end of the upper thread cut by the upper thread cutting mechanism when the upper thread movable blade is moved reciprocally by the upper moving mechanism, characterized by an upper thread direction adjusting mechanism provided on the upper moving mechanism and the upper thread holding mechanism for adjusting a direction in which the upper thread extending through the eye of the needle to the upper thread holding mechanism is drawn.

[0009] According to the above-described construction, the upper thread movable blade is moved to the upper thread take-up position by the upper moving mechanism and then returned to the upper thread cutting position while hooking the upper thread. In this case, the upper thread is cut by the upper thread cutting mechanism, and the end of the upper thread extending from the workpiece cloth has a predetermined length and is held by the upper thread holding mechanism. The upper thread direction adjusting mechanism is operated so that the drawing direction of the upper thread end held by the upper thread holding mechanism is adjusted. More specifically, the drawing direction of the upper thread end is adjusted so as not to agree to a sewing direction at the time of start of a subsequent sewing operation. When the thread end dropped out of the upper thread holding mechanism after

start of the sewing operation is located on workpiece cloth, the direction of thread end differs from the sewing direction. Consequently, the thread end can be prevented from being sewn onto the workpiece cloth.

[0010] In a first preferred form, the sewing machine further comprises an upper guide member which guides a reciprocal movement of the upper thread movable blade, wherein the upper thread direction adjusting mechanism includes an upper overhang member extending horizontally from the upper guide member, an upper arc groove formed in the upper overhang member, and a support member fixed to the sewing machine frame and connected via the upper arc groove to the upper overhang member, and wherein the upper guide member has a needle side end and another end opposed to the needle side end and is inclined so that the needle side end is located higher than the opposed end and moveable along the upper arc groove.

[0011] According to the above-described construction, since the upper guide member is vertically inclined, the sewing machine can be rendered smaller in size as compared with the case where the upper guide member is disposed horizontally. Furthermore, the upper thread holding mechanism changes along the upper arc groove the drawing direction of the end of the upper thread held by the upper thread holding mechanism. Consequently, the drawing direction of the upper thread end can be adjusted easily and quickly.

[0012] In a second preferred form, the sewing machine further comprises a cloth presser which presses the workpiece cloth W, wherein the upper arc groove provided with a movement limit position of the upper guide member, the movement limit position being set so as to be prevented from interference with the cloth presser.

[0013] According to the above-described construction, the drawing direction of the upper thread end can be adjusted while interference with the cloth presser is avoided.

[0014] In a third preferred form, the sewing machine frame has an arm, and the upper thread cutting mechanism and the upper thread holding mechanism are disposed opposite a path of the upper thread with the arm being located therebetween.

[0015] According to the above-described construction, the upper thread is drawn from a thread spool so that the sewing machine is threaded to the needle. This threading work is carried out by the operator at a side. This side is located opposite the side where the upper thread cutting mechanism and the upper thread holding mechanism are provided with the arm being located between both sides. Consequently, the threading work is not blocked by the upper thread cutting mechanism or the upper thread holding mechanism, whereby the working efficiency can be improved.

[0016] In a fourth preferred form, the sewing machine further comprises a lower moving mechanism having a lower thread movable blade cutting a lower thread extending from the workpiece cloth to the hook below the

needle plate, a lower moving mechanism which reciprocally moves the lower thread movable blade between a first lower thread take-up position where the lower thread is hooked below the needle plate and a second lower thread take-up position which is spaced away from the first lower thread take-up position by a predetermined distance, and a lower thread holding mechanism which holds an end of the lower thread cut by the lower thread cutting mechanism when the lower thread movable blade is moved reciprocally by the lower moving mechanism.

[0017] According to the above-described construction, the lower thread movable blade is moved to the lower thread take-up position and returned to the former lower thread cutting position by the lower moving mechanism while the lower thread is being hooked on the blade. In this case, the lower thread is cut by the lower thread cutting mechanism, and the end of the upper thread extending from the workpiece cloth has a predetermined length and is held by the upper thread holding mechanism.

[0018] In a fifth preferred form, the hook includes a bobbin case having a thread guide hole guiding the lower thread, the sewing machine further comprising a lower thread direction adjusting mechanism provided on the lower moving mechanism and the lower thread holding mechanism for adjusting a drawing direction in which the lower thread extending through the thread guide hole of the bobbin case to the lower thread holding mechanism is drawn.

[0019] According to the above-described construction, the drawing direction in which the lower thread end is drawn is adjusted to a direction in which the end is not sewn into workpiece cloth upon start of subsequent sewing, whereupon the thread end can reliably be prevented from being sewn into workpiece cloth.

[0020] In a sixth preferred form, the drawing direction of the lower thread is adjusted by the lower thread direction adjusting mechanism so as to be the same as a direction in which the lower thread is directed through the needle eye to the thread guide hole of the bobbin case.

[0021] According to the above-described construction, the end of the lower thread dropped out of the lower thread holding mechanism can be prevented from being sewn into workpiece cloth upon start of sewing.

[0022] In a seventh preferred form, the sewing machine further comprises a lower guide member which guides a reciprocal movement of the lower thread movable blade, wherein the lower thread direction adjusting mechanism includes a lower overhang member extending horizontally from the lower guide member, a lower arc groove formed in the lower overhang member, and a connecting member which connects the lower overhang via the lower arc groove to an underside of the needle plate.

[0023] According to the above-described construction, the direction of the lower guide member (the direction in which the end of the lower thread held by the lower thread holding mechanism is drawn) can be adjusted easily and

quickly.

[0024] The invention will be described, merely by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of a sewing machine in accordance with one embodiment of the present invention;

FIG. 2 is a partially enlarged perspective view of the sewing machine;

FIG. 3 is a partial front view of the sewing machine;

FIG. 4 is a partial enlarged front of the sewing machine;

FIG. 5 is a plan view of an upper thread cutting mechanism, an upper thread holding mechanism and an upper thread releasing mechanism;

FIG. 6 is a partial front view of the upper thread holding mechanism;

FIG. 7 is a partial bottom view of a first body frame;

FIG. 8 is a partial plan view of a sewing bed of the sewing machine;

FIG. 9 is a front view of the sewing bed;

FIG. 10 is a bottom view of a needle plate of the sewing machine;

FIG. 11 is a partial front view of the lower thread holding mechanism;

FIG. 12 is a partial bottom view of a second body frame;

FIG. 13 is a block diagram showing a control system of the sewing machine;

FIG. 14 shows data formation of sewing data;

FIG. 15A is a schematic circuit diagram showing an air supply system for an upper thread cutting cylinder;

FIG. 15B is a schematic circuit diagram showing an air supply system for an upper releasing cylinder;

FIG. 15C is a schematic circuit diagram showing an air supply system for a lower thread cutting cylinder;

FIG. 16 is a time chart showing cutting and release of upper and lower threads;

FIG. 17 is a view similar to FIG. 4, showing a thread take-up operation by an upper thread cutting mechanism;

FIG. 18 is a view similar to FIG. 4, showing an upper thread releasing operation;

FIG. 19 is a view similar to FIG. 5, showing a condition where a drawing direction of the upper thread differs;

FIG. 20 is a view similar to FIG. 9 showing a thread take-up operation by a lower thread cutting mechanism;

FIG. 21 is a view similar to FIG. 9, showing a condition where the lower thread is released; and

FIG. 22 is a view similar to FIG. 20, showing a condition where a drawing direction of the lower thread differs.

[0025] One embodiment of the invention will be de-

scribed with reference to the accompanying drawing. Referring to FIG. 1, an overall sewing machine 1 of the embodiment is shown. The sewing machine 1 includes a sewing bed 2 constituting a sewing machine body, a sewing pillar 3 continuous from the bed 2 and an sewing arm 4 extending from an upper part of the pillar 3 in parallel to the bed 2 all of which are mounted on a table 13. The bed 2 has a needle plate 5 and a cloth presser 15 on an upper surface thereof. The needle plate 5 has a needle hole 5a (see FIG. 5) through which a needle 9 is capable of passing. The bed 2, pillar 3 and arm 4 constitute a sewing machine frame. Further referring to FIG. 1, the side of the sewing machine where the pillar 3 is located will hereinafter be referred to as "the rear" of the sewing machine and the side of the sewing machine where a cloth presser 16 is located as will be described later will be referred to as "the front" of the sewing machine, as viewed in FIG. 1.

[0026] The arm 4 has a main shaft (not shown) extending in a front-back direction. The arm 4 is provided with a needle bar 8 reciprocated vertically and a thread take-up lever 6 (see FIG. 3). The needlebar 8 has a lower end to which the needle 9 is attached. A presser bar 11 is provided on the left of the needlebar 8 so as to be vertically moveable as viewed in FIG. 3. The presser bar 11 has a lower end to which a cylindrical cloth presser 12 is fixed. The needle 9 is inserted through the cloth presser 12. An upper thread 14 extending from a thread spool (not shown) serving as an upper thread supply passes through a thread tension disc assembly 7, the thread take-up lever 6 and a plurality of thread guides 10 sequentially, further extending through an eye 9a of the needle 9 (see FIG. 4).

[0027] A vertical rotating hook 22 (see FIG. 3) is provided on the bed 2. The vertical rotating hook 22 forms stitches in cooperation with the needle 9. The vertical rotating hook 22 has a bobbin case 23 accommodating a lower thread bobbin (not shown). The bobbin case 23 has a horn portion 23a protruding to the needle plate 5 side. The horn portion 23a has an upper end having a thread guide hole 23b for guiding a lower thread 21. The lower thread 21 extending from the lower thread bobbin passes through the thread guide hole 23b, a thread guide plate 24 and the needle hole 5a of the needle plate 5 sequentially, further extending to an upper part of the bed 2. Thus, a sewing mechanism is comprised of the needlebar 8 with the needle 9 attached, the thread take-up lever 6 and the hook 22.

[0028] The cloth presser 15 holds workpiece cloth W to be sewn in cooperation with a cloth pressing plate 16 and a feed plate 17. X and Y drive mechanisms (neither shown) move the cloth presser 15. The X drive mechanism includes an X-axis drive motor 98 (see FIG. 13) which moves the feed plate 17 in a horizontal direction (X direction) perpendicular to a main shaft (not shown). The Y drive mechanism includes a Y-axis drive motor 99 (see FIG. 13) which moves the feed plate 17 in the front-back direction (Y direction) parallel to the main shaft. The

cloth presser 15 comprises the feed plate 17, a presser arm 18 and the cloth presser plate 16 as shown in FIG. 2. The feed plate 17 is moved on the needle plate 5 back and forth and right and left. The presser arm 18 is mounted on the Y drive mechanism. The cloth presser plate 16 is formed into a rectangular frame and mounted on a front end of the presser arm 18 so as to be movable upward and downward,

[0029] The cloth presser plate 16 is normally away from the feed plate 17 and is moved upward and downward via a connecting part (not shown) by a pressing solenoid 20 provided on the arm 4. During sewing, the cloth presser plate 16 is moved downward by the pressing solenoid 20 to a location where the cloth presser plate 16 is brought into contact with the feed plate 17, whereupon the workpiece cloth W is held between the cloth presser plate 16 and the feed plate 17. The cloth presser plate 16 and the feed plate 17 with the workpiece cloth W being held therebetween are moved in the X and Y directions synchronously.

[0030] A control box 26 is mounted under the table 13 as shown in FIG. 1. The control box 26 houses a control device 90 (see FIG. 13) which will be described later and a drive section of a pressurized air supply system. A pedal-type start/stop switch 27 is provided below the table 13. The operator operates the start/stop switch 27 to enter signals instructing start and stop of a sewing operation and signals instructing upward and downward movement of the cloth presser plate 16.

[0031] An upper thread path of the upper thread 14 starting from the thread spool and leading to the needle 9 is located on the right of the arm 4 as viewed in FIG. 3. Opposite the upper thread path are located an upper thread holding mechanism 31, an upper thread releasing mechanism 32, an upper thread direction adjusting mechanism 33, an upper thread cutting mechanism 35 and an upper moving mechanism 36 with the arm 4 being located between these mechanisms and the upper thread path. Consequently, when the operator threads the sewing machine up to the needle 9, the threading work is not blocked by the upper thread cutting mechanism 35 etc., whereupon higher working efficiency can be achieved. The upper thread cutting mechanism 35 is operated to cut the upper thread 14 extending from the workpiece cloth W through the eye 9a of the needle 9. An end 14b of the upper thread 14 cut by the upper thread cutting mechanism 35 is held by the upper thread holding mechanism 31. The end 14a of the upper thread 14 is released from the held state by the upper thread releasing mechanism 32.

[0032] The upper thread cutting mechanism 35 comprises a first body frame 37 (upper guide member), a first movable blade 40 (upper thread movable blade) and a first fixed blade 41. The first movable blade 40 has a length corresponding at least to a distance from the upper thread cutting position to the upper thread take-up position as will be described later. The first body frame 37 includes a bottom wall 37a, a side wall 37b, a distal end

wall 37c, a rear end wall 37e and a holding wall 37d, all of which are formed integrally as shown in FIGS. 4 to 7. The holding wall 37d has in a lower end thereof a guide groove 37f (see FIG. 7) which guides a lengthwise movement of the first movable blade 40.

[0033] The first movable blade 40 comprises a plate member with a predetermined width and is movable between an upper side thread take-up position (see FIG. 17) and an upper side thread cutting position (see FIGS. 3 and 4). The upper thread 14 is hooked beneath the needle 9 at the upper side thread take-up position. The upper side thread cutting position is spaced away by a predetermined distance from the upper side thread take-up position. A distance from the upper side thread take-up position to the upper side thread cutting position is longer than a distance from the eye 9a of the needle 9 to the needle plate 5. The first movable blade 40 has a blade portion 40b (see FIG. 7) formed on a distal hook portion 40a thereof. The first fixed blade 41 includes a fixed portion 41a and a blade portion 41b. The fixed portion 41a has a larger width than the blade portion 41b and is fixed to the underside of the holding wall 37d by a fixing screw 42. The blade portion 41b is mounted at the distal end side of the fixed portion 41a so as to be inclined.

[0034] The upper moving mechanism 36 will be described. Referring to FIGS. 3 to 5, the upper moving mechanism 36 includes the first body frame 37, a first movement block 44 and an upper side thread cutting cylinder 45 (a first air cylinder). The first movement block 44 is connected to a rear end of the first movable blade 40. The first movable blade 40 is reciprocally moved via the first movement block 44 by the upper side thread cutting cylinder 45. The first movement block 44 has a body 44a and a connection 44b as shown in FIGS. 4 and 5. The body 44a is formed into the shape of an axially extending block. The connection 44b protrudes upward from the body 44a. The first movement block 44 is moved along an upper surface of the bottom wall 37a of the first body frame 37. The upper side thread cutting cylinder 45 includes a movable piston rod 45a. The piston rod 45a has a distal end connected to the rear end of the body 44a. The body 44a has a front end connected to the rear end of the first movable blade 40.

[0035] The upper thread holding mechanism 31 will be described. Referring to FIGS. 4 to 6, the upper thread holding mechanism 31 includes a first holding spring 47 (an upper thread holding spring), a first leaf spring 48 and an adjusting screw 49. The first holding spring 47 is located on an upper surface of the holding wall 37d, and the first leaf spring 48 is located on an upper surface of the first holding spring 47. The first holding spring 47 comprises a rectangular elastic plate-shaped member. The first leaf spring 48 also comprises a rectangular elastic plate-shaped member and has substantially the same shape as the first holding spring 47. Both springs 47 and 48 have respective rear ends fixed to an upper surface of the holding wall 37d by fixing screws 50. The first hold-

ing spring 47 has a downwardly bent front end which presses a front end of the first movable blade 40 from above. The adjusting screw 49 is threadingly engaged with the holding wall 37d through the springs 47 and 48. The adjusting screw 49 is operated to adjust a force pressing the first leaf spring 48 against the first holding spring 47, namely, a force holding the thread end 14b between the first movable blade 40 and the first holding spring 47.

[0036] The upper thread releasing mechanism 32 will be described. Referring to FIGS. 4 and 5, the upper thread releasing mechanism 32 includes an upper releasing cylinder 53 (a second air cylinder), the first movement block 44 and the first movable blade 40. The upper releasing cylinder 53 is fixed to an upper part of the rear wall 37e and has a movable piston rod 53a. The movable piston rod 53a has a distal end which is connectable to the connection 44b of the first movement block 44. The piston rod 53a of the upper releasing cylinder 53 has a narrower range of movement than the piston rod 45a of the upper thread cutting cylinder 45. The upper releasing cylinder 53 has a larger inner diameter than the upper side thread cutting cylinder 45. When air pressurized by the same pressure is applied to the upper releasing cylinder 53 and the upper side thread cutting cylinder 45, a driving force of the upper releasing cylinder 53 is stronger than a driving force of the upper side thread cutting cylinder 45. As a result, the upper releasing cylinder 53 can be moved forward with the piston rod 45a of the upper side thread cutting cylinder 45 being stepped backward.

[0037] The piston rod 53a of the upper releasing cylinder 53 is moved forward when the end 14b of the upper thread 14 is held between the first movable blade 40 and the first holding spring 47. Consequently, the piston rod 45a of the upper side thread cutting cylinder 45 is also moved forward together with the first movement block 44. Upon forward movement of the first movement block 44, the first movable blade 40 is moved forward to the upper releasing position (see FIG. 18). The end 14b of the upper thread 14 is released from hold of the upper side thread holding mechanism 31 by the movement of the first movable blade 40. Accordingly, the upper releasing position is located nearer to the upper side thread cutting position side than the upper side thread take-up position.

[0038] The following describes the upper thread direction adjusting mechanism 33 which adjusts a direction in which the upper thread 14 extending through the eye 9a of the needle 9 is drawn. Referring to FIGS. 4 to 7, the upper thread direction adjusting mechanism 33 includes the first body frame 37, a first overhang plate 55 (an upper overhang member) and a support member 56. The first overhang plate 55 is curved as viewed in FIG. 5 and has two curved or arc grooves 55a (upper arc grooves) formed with a predetermined distance. The first overhang plate 55 has a rear end having a downwardly bent fixing portion 55b formed integrally therewith. The fixing portion 55b is fixed to the side wall 37b of the first body frame

37 by a fixing bolt 57. The first body frame 37 is disposed so that the rear end wall 37e is located higher than the distal end wall 37c. The support member 56 extending in the right-left direction is fixed to the distal end of the arm 4 by a fixing bolt 56a. The first overhang plate 55 is fixed to the support member 56 by a fixing bolt 58 extending through the arc groove 55a.

[0039] The first body frame 37 is located in the left rear of the needle hole 5a of the needle plate 5 as viewed in FIGS. 5 and 8. Furthermore, the first body frame 37 is located in front of the presser arm 18 of the cloth presser 15 as viewed in FIG. 8. Thus, the first body frame 37 is located so as not to interfere with the presser arm 18. The direction of the first body frame 37 (the direction in which the upper thread 14 is drawn) is adjustable from a rear limit position as shown in FIG. 8 to a forward limit position where the first body frame 37 is parallel to the support member 56, as shown in FIG. 19. The movement limit position of the first body frame 37 is set by the arc grooves 55a so as not to interfere with the cloth presser 15. When the direction of the first body frame 37 is adjusted by the upper thread direction adjusting mechanism 33, the fixing bolts 58 are loosened so that the first body frame 37 is moved to a desired position. Subsequently, the fixing bolts 58 are tightened up against the support member 56. Since the center of each arc groove 55a is on the axis line of the needle 9, the distal end of the first body frame 37 is necessarily directed to the needle 9 by the arc grooves 55a.

[0040] Referring to FIGS. 9 to 12, the sewing machine 1 further comprises a lower thread cutting mechanism 65, a lower moving mechanism 66, a lower thread holding mechanism 61, a lower thread releasing mechanism 62 and a lower thread direction adjusting mechanism 63. The mechanisms 65, 66, 61 and 62 are located on the left of the vertical rotating hook 22 below the needle plate 5 as viewed in FIG. 9. The lower thread 21 extending from the workpiece cloth W to the vertical rotating hook 22 is cut by the lower thread cutting mechanism 65. An end 21b of the lower thread 21 is held by the lower thread holding mechanism 61. The end 21b of the lower thread 21 is released from hold by the lower thread holding mechanism 61. The lower thread cutting mechanism 65 includes a second body frame 67 (a lower guide member), a second movable blade 70 (lower thread movable blade) and a second fixed blade 71. The second movable blade 70 has a length corresponding at least to a distance from the lower side thread cutting position to the lower side thread take-up position as will be described later. The second body frame 67 includes a bottom wall 67a, a side wall 67b, a distal end wall 67c, a rear end wall 67e and a holding wall 67d, all of which are formed integrally, as shown in FIGS. 9 to 12. The holding wall 67d has in an upper end thereof a guide groove 67f (see FIG. 12) which guides a lengthwise movement of the second movable blade 70.

[0041] The second movable blade 70 comprises a plate member with a predetermined width and is movable

between a lower side thread take-up position (see FIG. 20) and a lower thread cutting position (see FIGS. 3 and 9). The lower thread 21 is hooked beneath the needle plate 5 at the lower side thread take-up position. The lower side thread cutting position is spaced away by a predetermined distance from the lower side thread take-up position. A distance from the lower side thread take-up position to the lower side thread cutting position is longer than a distance from the eye 9a of the needle 9 to the needle plate 5. The second movable blade 70 has a blade portion 70b (see FIG. 12) formed on a distal hook portion 70a thereof. The second fixed blade 71 includes a fixed portion 71a and a blade portion 71b. The fixed portion 71a has a larger width than the blade portion 71b and is fixed to the upper surface of the holding wall 67d by a fixing screw 72. The blade portion 71b is mounted at the distal end side of the fixed portion 71a so as to be inclined.

[0042] The lower moving mechanism 66 will be described. Referring to FIGS. 3, 9 and 10, the lower moving mechanism 66 includes a second movement block 74 and a lower side thread cutting cylinder 75 (a third air cylinder). The second movement block 74 is connected to a rear end of the second movable blade 70. The second movable blade 70 is reciprocally moved via the second movement block 74 by the lower side thread cutting cylinder 75. The second movement block 74 has a body 74a and a connection 74b as shown in FIGS. 9 and 10. The body 74a is formed into the shape of an axially extending block. The connection 74b protrudes downward from the body 74a. The second movement block 74 is moved along the bottom wall 67a of the second body frame 67. The lower side thread cutting cylinder 75 is fixed to the upper surface of the rear end wall 67e. A lower side thread cutting cylinder 75 includes a piston rod 45a which is movable forward. The piston rod 75a has a distal end connected to the rear end of the body 74a.

[0043] The lower thread holding mechanism 61 will be described. Referring to FIGS. 9 to 11, the lower thread holding mechanism 61 includes a second holding spring 77 (a lower thread holding spring), a second leaf spring 78 and an adjusting screw 79. The second holding spring 77 is located on an underside of the holding wall 67d, and the second leaf spring 78 is located on an underside of the second holding spring 77. The second holding spring 77 comprises a rectangular elastic plate-shaped member. The second leaf spring 78 also comprises a rectangular elastic plate-shaped member and has substantially the same shape as the second holding spring 77. Both springs 77 and 78 have respective rear ends fixed to an underside of the holding wall 67d by fixing screws 80. The second holding spring 77 has a bent front end which presses a front end of the second movable blade 70 from below. The adjusting screw 79 is threadingly engaged with the holding wall 67d through the springs 77 and 78. The adjusting screw 79 is operated to adjust a force pressing the second leaf spring 78

against the second holding spring 77, namely, a force holding the thread end 21b of the lower thread 21 between the second movable blade 70 and a second holding spring 77.

[0044] The lower thread releasing mechanism 62 will be described. Referring to FIGS. 9 and 10, the lower thread releasing mechanism 62 includes a lower releasing cylinder 83 (a fourth air cylinder), the second movement block 74 and the second movable blade 70. The lower releasing cylinder 83 has a front end fixed to a lower part of the rear end wall 67e of the second body frame 67. The lower releasing cylinder 83 also has a movable piston rod 83a. The movable piston rod 83a has a distal end which is connectable to the connection 74b of the second movement block 74. The piston rod 83a of the lower releasing cylinder 83 has a narrower range of movement than the piston rod 75a of the lower thread cutting cylinder 75. The lower releasing cylinder 83 has a larger inner diameter than the lower side thread cutting cylinder 75. When air pressurized by the same pressure is applied to the lower releasing cylinder 83 and the lower side thread cutting cylinder 75, a driving force of the lower releasing cylinder 83 is stronger than a driving force of the lower side thread cutting cylinder 75. As a result, the lower releasing cylinder 83 can be moved forward with the piston rod 75a of the lower side thread cutting cylinder 75 being stepped backward.

[0045] The piston rod 75a of the lower side thread cutting cylinder 75 is moved forward together with the second movement block 74 in the case where the lower releasing cylinder 83 is moved forward when the end 21b of the lower thread 21 is held between the second movable blade 70 and the second holding spring 77. Upon forward movement of the second movement block 74, the second movable blade 70 is moved forward to the lower releasing position (see FIG. 21). The end 21b of the lower thread 21 is released from hold of the lower side thread holding mechanism 61. Accordingly, the lower releasing position is located nearer to the lower side thread cutting position side than the lower side thread take-up position.

[0046] The following describes the lower thread direction adjusting mechanism 63 which adjusts a direction in which the lower thread 21 extends from the thread guide hole 23b of the bobbin case 23 of the vertical rotating hook 23 to the lower thread holding mechanism 61. Referring to FIGS. 9 to 12, the lower thread direction adjusting mechanism 63 includes the second body frame 67, a second overhang plate 85 (a lower overhang member) and a fixing bolt 86 (a fastening member). The second overhang plate 85 is curved as viewed in FIG. 10 and has two curved or arc grooves 85a (lower arc grooves) formed with a predetermined distance therebetween. The second overhang plate 85 has a front end having a downwardly bent fixing portion 85b formed integrally therewith. The fixing portion 85b is fixed to the side wall 67b of the second body frame 67 by a fixing bolt 87. The second body frame 67 is inclined so that the

distal end wall 37c side is higher (the needle 9 side is located higher). The second overhang plate 85 is fixed to the underside of the needle plate 5 by the fixing bolts 86 extending through the arc grooves 85a respectively.

[0047] The second body frame 67 is located obliquely in front of the needle hole 5a of the needle plate 5 to the left as viewed in FIG. 10. A direction in which the lower thread 21 is drawn can be set to the same direction in which the lower thread 21 extends from the needle hole 5a of the needle plate 5 to the thread guide hole 23b of the bobbin case 23. The direction of the second body frame 67 (the direction in which the lower thread 21 is drawn) is adjustable from a forward limit position as shown in FIG. 10 to a rear limit position where the second body frame 67 is parallel to the X axis as shown in FIG. 22. An adjusting manner is similar to the adjusting manner in the case of the upper thread direction adjusting mechanism 33 and accordingly the description of the adjusting manner will be eliminated.

[0048] The control system of the sewing machine 1 will now be described. Referring to FIG. 13, a control device 90 comprises a computer composed of a CPU 91, a ROM 92 and a RAM 93. A start/stop switch 94, a presser switch 95, a rotation angle sensor 96 and drive circuits 100 to 103 are connected to the control device 90. The presser switch 95 is operated to switch the presser plate 16 between a press position and a release position. The rotation angle sensor 96 is provided for detecting a rotation angle of a main shaft. The drive circuit 100 controls drive of a sewing machine motor 97. The drive circuit 101 controls drive of the pressing solenoid 20 switching the cloth presser plate 16 to the press position. The drive circuit 102 controls drive of the X-axis drive motor 98. The drive circuit 103 controls drive of the Y-axis drive motor 99.

[0049] The ROM 92 stores various control programs for control of the sewing machine 1, a plurality of types of sewing data for execution of sewing and the like. The sewing data includes needle location data, a lower thread release command code and an upper thread release command code. The needle location data indicates needle locations of first to last n-th stitches as shown in FIG. 14. The lower thread release command code is provided for releasing the lower thread 21. The upper thread release command code is provided for releasing the upper thread 14. The sewing data includes, next to the needle location data of the n-th stitch, an upper thread cutting command code for cutting the upper thread 14 and a lower thread cutting command code for cutting the lower thread 21.

[0050] The RAM 93 temporarily stores the results of computing executed by the CPU 91. To the control device 90 are further connected drive circuits 110 to 113 which drive a first electromagnetic switching valve 104, a first release electromagnetic switching valve 105, a second electromagnetic valve 106 and a second release electromagnetic switching valve 107. The first and second electromagnetic switching valves 104 and 105 and the first and second release electromagnetic switching

valves 105 and 107 incorporate exhaust throttle valves 104A to 107A and 104B to 107B respectively (see FIG. 15).

[0051] The following briefly describes a pressurized air supply system to the upper side thread cutting cylinder 45 and the lower side thread cutting cylinder 75. The upper and lower side thread cutting cylinders 45 and 75 comprise respective double-acting air cylinders as shown in FIGS. 15A and 15C. The upper side thread cutting cylinder 45 has a forward movement air feed port 45b and a rearward movement air feed port 45c. The lower side thread cutting cylinder 75 has a forward movement air feed port 75b and a rearward movement air feed port 75c. The first electromagnetic switching valve 104 switches a supply route of pressurized air to be supplied from an air source 115 to the upper side thread cutting cylinder 45. The second electromagnetic switching valve 106 switches a supply route of pressurized air to be supplied from the air source 115 to the lower side thread cutting cylinder 75. The piston rod 45a is moved forward when the first electromagnetic switching valve 104 is operated so that pressurized air is supplied to the forward movement air feed port 45b of the upper side thread cutting cylinder 45. The piston rod 75a is moved forward when the second electromagnetic switching valve 106 is operated so that pressurized air is supplied to the forward movement air feed port 75b of the lower side thread cutting cylinder 75. The piston rod 45a is moved rearward when the first electromagnetic switching valve 104 is operated so that pressurized air is supplied to the rearward movement air feed port 45c of the upper side thread cutting cylinder 45. The piston rod 75a is moved rearward when the second electromagnetic switching valve 106 is operated so that pressurized air is supplied to the rearward movement air feed port 75c of the lower side thread cutting cylinder 75.

[0052] The exhaust throttle valves 104A and 106A (upper and lower moving speed adjusting mechanisms) have respective larger air flow rates than the exhaust throttle valves 104B and 106B (upper and lower moving speed adjusting mechanisms). As a result, the speed of the first movable blade 40 moving to the upper side thread cutting position is lower than the speed of the first movable blade 40 moving to the upper side thread take-up position. Furthermore, the speed of the second movable blade 70 moving to the lower side thread cutting position is lower than the speed of the second movable blade 70 moving to the lower side thread take-up position.

[0053] The upper and lower side release cylinders 53 and 83 comprise respective double-acting air cylinders as shown in FIGS. 15B and 15D. The upper release cylinder 53 has a forward movement air feed port 53b and a rearward movement air feed port 53c. The lower side release cylinder 83 has a forward movement air feed port 83b and a rearward movement air feed port 83c. The first release electromagnetic switching valve 105 switches supply of pressurized air to be supplied from the air source 115 to the upper release cylinder 53. The second

release electromagnetic switching valve 107 switches supply of pressurized air to be supplied from the air source 115 to the lower release cylinder 83. The piston rod 53a is moved forward when the first release electromagnetic switching valve 105 is operated so that pressurized air is supplied to the forward movement air feed port 53b of the upper release cylinder 53. The piston rod 83a is moved forward when the second release electromagnetic switching valve 107 is operated so that pressurized air is supplied to the forward movement air feed port 83b of the lower release cylinder 83. The piston rod 53a is moved rearward when the first release electromagnetic switching valve 105 is operated so that pressurized air is supplied to the rearward movement air feed port 53c of the upper release cylinder 53. The piston rod 83a is moved rearward when the second release electromagnetic switching valve 107 is operated so that pressurized air is supplied to the rearward movement air feed port 83c of the lower release cylinder 83.

[0054] The exhaust throttle valves 105A and 107A (upper and lower release speed adjusting mechanisms) have respective smaller air flow rates than the exhaust throttle valves 105B and 107B (upper and lower release speed adjusting mechanisms). As a result, the speed of the first movable blade 40 moving toward the upper side thread cutting position is higher than the speed of the first movable blade 40 moving to the upper release position. Furthermore, the speed of the second movable blade 70 moving to the lower side thread cutting position is higher than the speed of the second movable blade 70 moving to the lower release position. In particular, the exhaust throttle valve 105A (upper thread release speed adjusting mechanism) has a smaller air flow rate than the exhaust throttle valve 107A (lower thread release speed adjusting mechanism). As a result, the upper thread 14 drops out of the upper thread holding mechanism 31 even when the speed of the upper thread 14 is lower than the speed of the lower thread 21.

[0055] Based on the upper thread release command code, the CPU 91 drives the first release electromagnetic switching valve 105 so that pressurized air is supplied to the forward movement air feed port 53b. Subsequently, upon lapse of a predetermined time (130 msec), the CPU 91 drives the first release electromagnetic switching valve 105 so that pressurized air is supplied to the forward movement air feed port 53c. Since the foregoing is also applied to the upper thread release command code, the description thereof will be eliminated. Based on the upper thread cutting command code, the CPU 91 drives first electromagnetic switching valve 104 so that pressurized air is supplied to the forward movement air feed port 45b. Subsequently, upon lapse of a predetermined time (700 msec), the CPU 91 drives the first electromagnetic switching valve 104 so that pressurized air is supplied to the rearward movement air feed port 45c. When the sewing machine 1 is connected to the electric power supply, the CPU 91 delivers signals to the respective drive circuits 110 to 113 so that all the piston rods 45a, 53a, 75a

and 83a are moved rearward.

[0056] The operation and advantages of the sewing machine 1 will now be described with reference to FIGS. 14 and 16. At time T1 when the sewing based on the needle location data of the last or n-th stitch is completed, the upper thread 14 (as shown by a chain line in FIG. 16) is cut by the upper thread cutting mechanism 35 in conformity with the read upper thread cutting command code. The end 14b of the cut upper thread 14 is held by the upper thread holding mechanism 31. At time T2, the lower thread 21 (as shown by two-dot chain line in FIG. 16) is cut by the lower thread cutting mechanism 65 based on the read lower thread cutting command code. The end 21b of the lower thread 21 is held by the lower thread holding mechanism 61.

[0057] The cutting and holding of the upper thread 14 will be described. As described above with reference to FIG. 15A, the CPU 91 delivers a signal to the drive circuit 110 at time T1 so that pressurized air is supplied to the forward movement air feed port 45b by the first electromagnetic switching valve 104. The piston rod 45a of the upper thread cutting cylinder 45 is moved to the needle 9 side. As the result of forward movement of the piston rod 45a, the first movable blade 40 is quickly moved from the upper side thread cutting position as shown in FIG. 4 to the upper side thread take-up position as shown in FIG. 17. The hook 40a of the first movable blade 40 is moved beneath the needle 9 to hook the upper thread 14 extending from the workpiece cloth w through the eye 9a.

[0058] Upon lapse of 700 msec after output of the signal to the drive circuit 110, the CPU 91 delivers a signal to the drive circuit 110 so that pressurized air is supplied to the rearward movement air feed port 95c by the first electromagnetic switching valve 104. When the piston rod 45a of the upper side thread cutting cylinder 45 is moved rearward, the first movable blade 40 is quickly moved rearward to the upper side thread cutting position in FIG. 4 at time T3. As the result of the rearward movement of the first movable blade 40, the upper thread 14 is cut by the cooperation of the blade 40b of the hook 40a and the first fixed blade 41. Simultaneously, the end 14b of the cut upper thread 14 continuous to the eye 9a of the needle 9 is held by the first movable blade 40 and the first holding spring 47. The upper thread 14 is drawn out of the thread spool by the first movable blade 40 and cut at the upper side thread cutting position spaced away by a predetermined distance from the upper side thread take-up position. The end 14a of the upper thread 14 extending from the workpiece cloth W has a length corresponding to the distance from the upper side thread take-up position to the upper side thread cutting position. Accordingly, the long end 14a of the upper thread 14 can easily be picked by fingers. The operator can easily carry out a ravel preventing work using a heated iron, for example.

[0059] The cutting and holding of the lower thread 21 will be described. As described above with reference to

FIG. 15C, the CPU 91 delivers a signal to the drive circuit 112 at time T2 so that pressurized air is supplied to the forward movement air feed port 75b by the second electromagnetic switching valve 106. The piston rod 75a of the lower thread cutting cylinder 75 is moved forward as the result of supply of pressurized air by the second electromagnetic switching valve 106. As the result of forward movement of the piston rod 75a, the second movable blade 70 is quickly moved from the lower side thread cutting position as shown in FIG. 9 to the lower side thread take-up position as shown in FIG. 20. The hook 70a of the second movable blade 70 is moved beneath the needle 9 to hook the lower thread 21 extending from the workpiece cloth W to the vertical rotating hook 22.

[0060] Upon lapse of 700 msec after output of the signal to the drive circuit 112, the CPU 91 delivers a signal to the drive circuit 112 so that pressurized air is supplied to the rearward movement air feed port 75c by the second electromagnetic switching valve 106. When the piston rod 75a of the lower side thread cutting cylinder 75 is moved rearward as the result of supply of pressurized air by the second electromagnetic switching valve 106, the second movable blade 70 is quickly moved rearward to the lower side thread cutting position in FIG. 9 at time T4. As the result of rearward movement of the second movable blade 70, the lower thread 21 is cut by the cooperation of the blade 70b of the hook 70a and the second fixed blade 71. Simultaneously, the end 21b of the cut lower thread 21 continuous to the vertical rotating hook 22 is held by the second movable blade 70 and the second holding spring 77. The lower thread 21 is drawn out by the second movable blade 70 and cut at the lower side thread cutting position spaced away by a predetermined distance from the lower side thread take-up position. The end 21a of the lower thread 21 extending from the workpiece cloth W has a length corresponding to the distance from the lower side thread take-up position to the lower side thread cutting position. Accordingly, the long end 21a of the lower thread 21 can easily be picked by fingers. The operator can easily carry out a ravel preventing work using a heated iron, for example.

[0061] The following describes, with reference to FIGS. 14 and 16, the operation and advantages of the sewing machine 1 in the case where upon start of sewing, the held upper thread 14 is released from the held state by the upper thread releasing mechanism 32 and simultaneously, the held lower thread 21 is released from the held state by the lower thread releasing mechanism 62. Shortly after the sewing is started based on the sewing data as shown in FIG. 14, the CPU 91 loads the lower thread release command code next to the needle location data for the first and second stitches. At time T11 in FIG. 16, the end 21b of the lower thread 21 is released from the held state by the upper thread releasing mechanism 62. The CPU 90 loads the upper thread release command code, and the end 14b of the upper thread 14 is released from the held state by the upper thread release mechanism 32 at time T12.

[0062] The release of the lower thread 21 will now be described. As described above with reference to FIG. 15D, the CPU 91 delivers a signal to the drive circuit 113 at time T11 so that pressurized air is supplied to the forward movement air feed port 83b by the second release electromagnetic switching valve 107. As the result of the supply of pressurized air by the second release electromagnetic switching valve 107, the piston rod 83a of the lower release cylinder 83 is moved against the rearward drive force of the lower side thread cutting cylinder 75. As the result of movement of the piston rod 83a, the second movable blade 70 is quickly moved from the lower side thread cutting position as shown in FIG. 9 to the lower release position as shown in FIG. 21. The held end 21b of the lower thread 21 is released from the held state by the second movable blade 70 and the second holding spring 77. Upon lapse of 100 msec after output of the signal to the drive circuit 113, the CPU 91 delivers a signal to the drive circuit 113 so that pressurized air is supplied to the rearward movement air feed port 83c by the second release electromagnetic switching valve 107. As the result of supply of pressurized air by the second release electromagnetic switching valve 107, the piston rod 83a of the lower release cylinder 83 is moved rearward.

[0063] The release of the upper thread 14 will be described. As described above with reference to FIG. 15B, the CPU 91 delivers a signal to the drive circuit 111 at time T12 so that pressurized air is supplied to the forward movement air feed port 53b by the first release electromagnetic switching valve 105. As the result of the supply of pressurized air by the second release electromagnetic switching valve 107, the piston rod 53a of the upper release cylinder 53 is moved against the rearward drive force of the upper side thread cutting cylinder 45. As the result of forward movement of the piston rod 53a, the first movable blade 40 is quickly moved from the upper side thread cutting position as shown in FIG. 4 to the upper release position as shown in FIG. 18. The held end 14b of the upper thread 14 is released from the held state by the first movable blade 40 and the first holding spring 47. Upon lapse of 130 msec after output of the signal to the drive circuit 111, the CPU 91 delivers a signal to the drive circuit 111 so that pressurized air is supplied to the rearward movement air feed port 53c by the first release electromagnetic switching valve 105. As the result of supply of pressurized air by the first release electromagnetic switching valve 105, the piston rod 53a of the upper release cylinder 53 is moved rearward.

[0064] The sewing machine 1 is provided with the upper thread direction adjusting mechanism 33. When the direction of the first body frame 37 is adjusted, the drawing direction in which the upper thread 14 is to be drawn can be adjusted in a range from the rearward limit position as shown in FIG. 8 to the forward limit position as shown in FIG. 19. In execution of sewing, the drawing direction of the upper thread 14 is changed by the upper thread direction adjusting mechanism 33 so as to differ from the sewing direction at the sewing start time. Consequently,

the end 14b of the upper thread 14 released from the held state by the upper thread releasing mechanism 32 can be prevented from being sewn.

[0065] The sewing machine 1 is provided with the lower thread direction adjusting mechanism 63. When the direction of the second body frame 67 is adjusted, the drawing direction in which the lower thread 21 is to be drawn can be adjusted in a range from the position as shown in FIG. 10 to the position as shown in FIG. 22. As shown in FIG. 10, the drawing direction of the lower thread 21 can be set so as to be the same as the direction in which the lower thread 21 extends from the needle hole 5a to the thread guide hole 23b of the bobbin case 23. Consequently, as compared with the case where the drawing direction of the lower thread 21 differs from the above-described direction, the sewing machine 1 of the embodiment can reduce the possibility that the end 21b of the lower thread 21 released from the held state by the lower thread releasing mechanism 62.

[0066] The upper thread cutting and holding mechanisms 35 and 31 are disposed opposite the path of the upper thread 14 from the thread spool to the needle 9 with the arm 4 being located therebetween. Consequently, a working efficiency can be improved since the threading work for the section from the thread spool to the needle 9 by the operator is not blocked.

[0067] The drawing direction of the upper thread 14 is adjusted by the upper thread direction adjusting mechanism 33 within the range in which the first body frame 37 does not interfere with the cloth presser pressing the workpiece cloth W. Consequently, the drawing directions of the upper moving mechanism 36 and the upper thread holding mechanism 31 can be adjusted while the interference with the cloth presser 15 is avoided.

[0068] The lower thread direction adjusting mechanism 63 includes the second body frame 67 guiding the second movable blade 70 of the lower thread cutting mechanism 65, the horizontal second overhang plate 85 extending from the second body frame 67, the arc grooves 85a formed in the second overhang plates 85 and the fixing bolts 86 connecting the second overhang plate 85 via the arc grooves 85a to the underside of the needle plate 5. Consequently, the direction of the second body frame 67 via the arc grooves 85a of the second overhang plates 85 easily and quickly.

Claims

1. A sewing machine which comprises:

a sewing machine frame;
a needlebar (8) on which a needle (9) having an eye (9a) is mounted;
a hook (22);
an upper thread cutting mechanism (35) having an upper thread movable blade (40) cutting an upper thread (14) extending from workpiece

cloth W through an eye (9a) of the needle (9) above a needle plate (5);

an upper moving mechanism (36) which reciprocally moves the upper thread movable blade (40) between a first upper thread take-up position where the upper thread is hooked beneath the needle (9) and a second upper thread take-up position which is spaced away from the first upper thread take-up position by a predetermined distance; and

an upper thread holding mechanism (31) which holds an end (14a) of the upper thread (14) cut by the upper thread cutting mechanism (35) when the upper thread movable blade (40) is moved reciprocally by the upper moving mechanism (36), **characterized by:**

an upper thread direction adjusting mechanism (33) provided on the upper moving mechanism (36) and the upper thread holding mechanism (31) for adjusting a direction in which the upper thread (14) extending through the eye (9a) of the needle (9) to the upper thread holding mechanism (31) is drawn.

2. The sewing machine according to claim 1, further comprising an upper guide member (37) which guides a reciprocal movement of the upper thread movable blade (40), wherein the upper thread direction adjusting mechanism (33) includes an upper overhang member (55) extending horizontally from the upper guide member (37), an upper arc groove (55a) formed in the upper overhang member (55), and a support member (56) fixed to the sewing machine frame and connected via the upper arc groove (55a) to the upper overhang member (55), and wherein the upper guide member (37) has a needle side end and another end opposed to the needle side end and is inclined so that the needle side end is located higher than the opposed end and moveable along the upper arc groove (55a).

3. The sewing machine according to claim 2, further comprising a cloth presser (15) which presses the workpiece cloth (W), wherein the upper arc groove (55a) provided with a movement limit position of the upper guide member (37), the movement limit position being set so as to be prevented from interference with the cloth presser (15).

4. The sewing machine according to one of claims 1 to 3, wherein the sewing machine frame has an arm (4), and the upper thread cutting mechanism (35) and the upper thread holding mechanism (31) are disposed opposite a path of the upper thread (14) with the arm (4) being located therebetween.

5. The sewing machine according to any one of claims 1 to 4, further comprising:

a lower thread cutting mechanism (66) having a lower thread movable blade (70) cutting a lower thread (21) extending from the workpiece cloth (W) to the hook (22) below the needle plate (5);
 a lower moving mechanism (36) which reciprocally moves the lower thread movable blade (70) between a first lower thread take-up position where the lower thread is hooked below the needle plate (5) and a second lower thread take-up position which is spaced away from the first lower thread take-up position by a predetermined distance; and
 a lower thread holding mechanism (61) which holds an end (21b) of the lower thread (21) cut by the lower thread cutting mechanism (65) when the lower thread movable blade (70) is moved reciprocally by the lower moving mechanism (66).

6. The sewing machine according to claim 5, wherein the hook (22) includes a bobbin case (23) having a thread guide hole (23b) guiding the lower thread (21), the sewing machine further comprising a lower thread direction adjusting mechanism (63) provided on the lower moving mechanism (66) and the lower thread holding mechanism (61) for adjusting a drawing direction in which the lower thread extending through the thread guide hole (23b) of the bobbin case (23) to the lower thread holding mechanism (61) is drawn.
7. The sewing machine according to claim 6, wherein the drawing direction of the lower thread (21) is adjusted by the lower thread direction adjusting mechanism (63) so as to be the same as a direction in which the lower thread 21 is directed through the needle eye (9a) to the thread guide hole (23b) of the bobbin case (23).
8. The sewing machine according to claim 7, further comprising a lower guide member (67) which guides a reciprocal movement of the lower thread movable blade (70), wherein the lower thread direction adjusting mechanism (63) includes a lower overhang member (85) extending horizontally from the lower guide member (67), a lower arc groove (85a) formed in the lower overhang member (85), and a connecting member (86) which connects the lower overhang member (85) via the lower arc groove (85a) to an underside of the needle plate (5).

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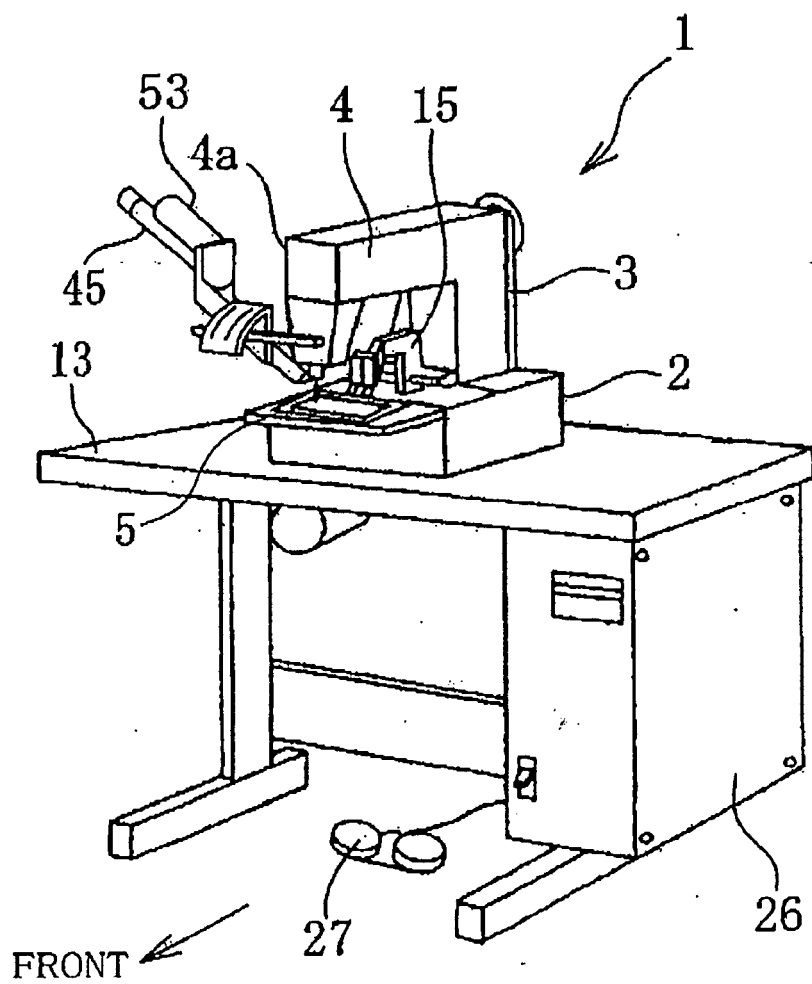


FIG. 1

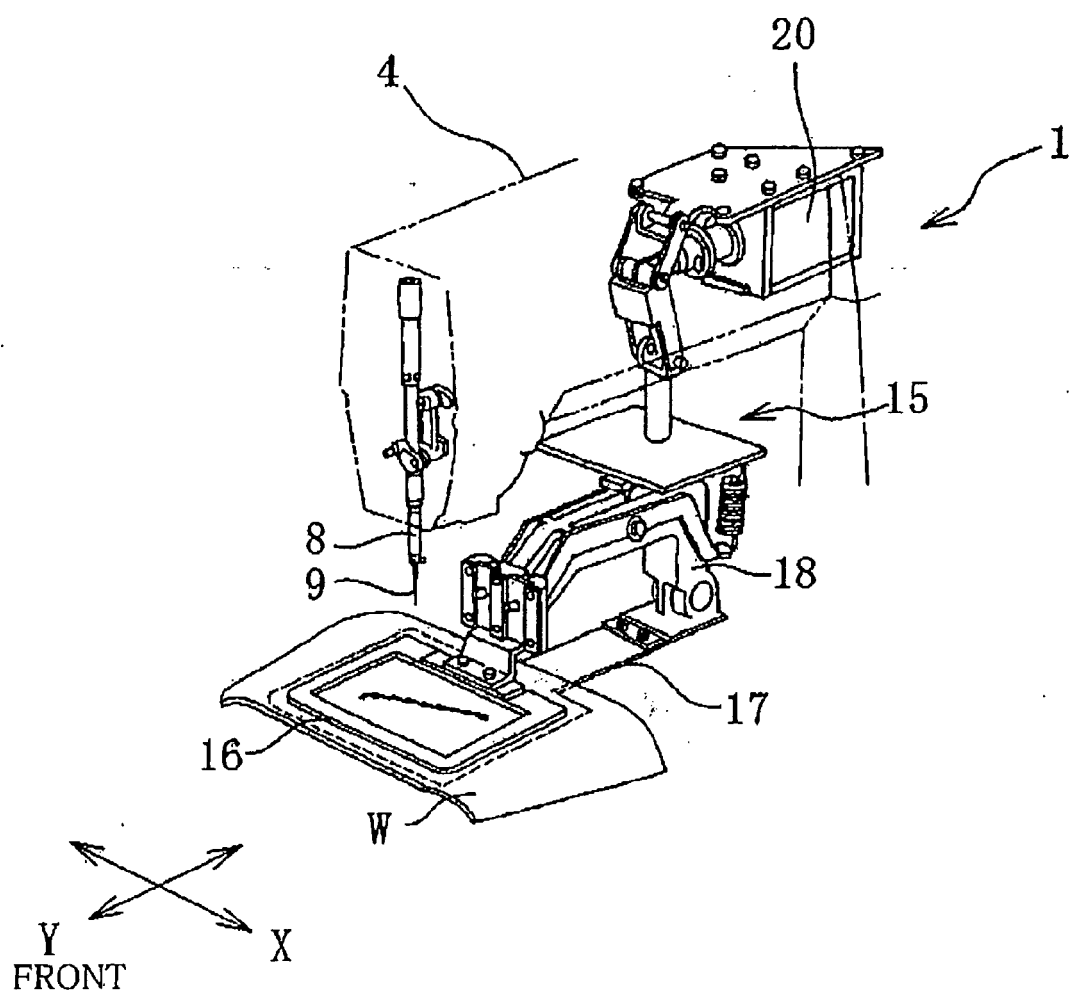


FIG. 2

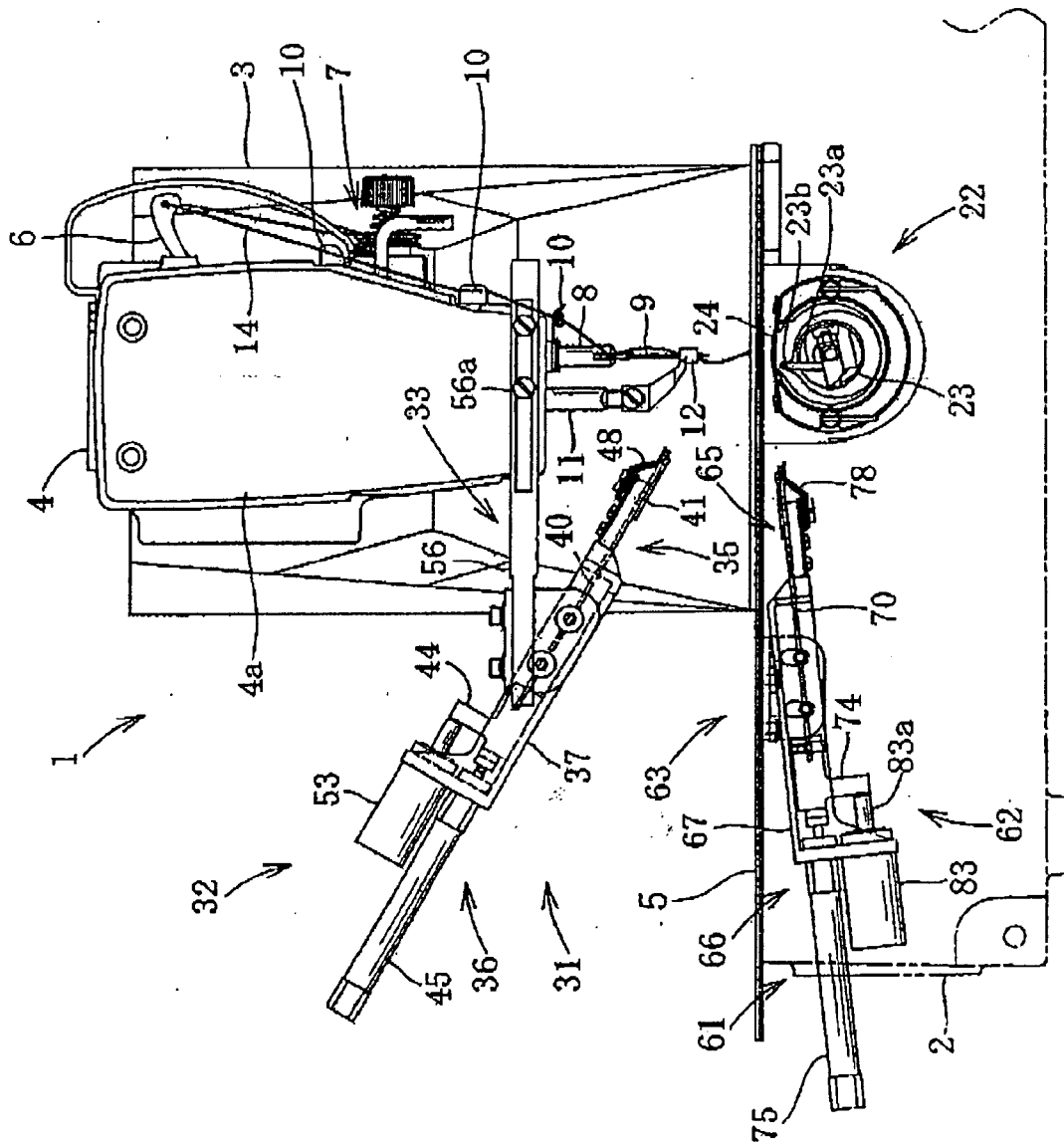


FIG. 3

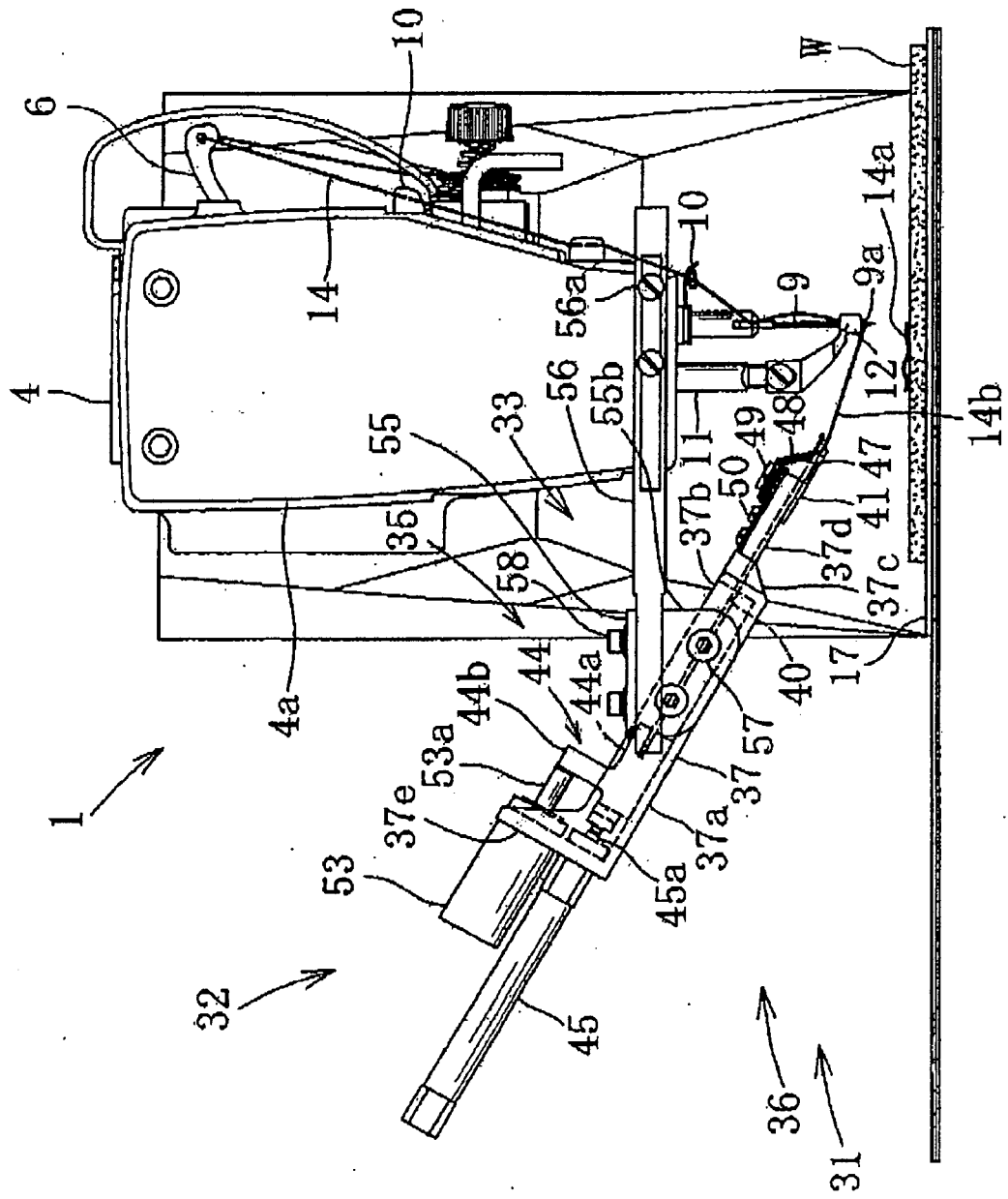
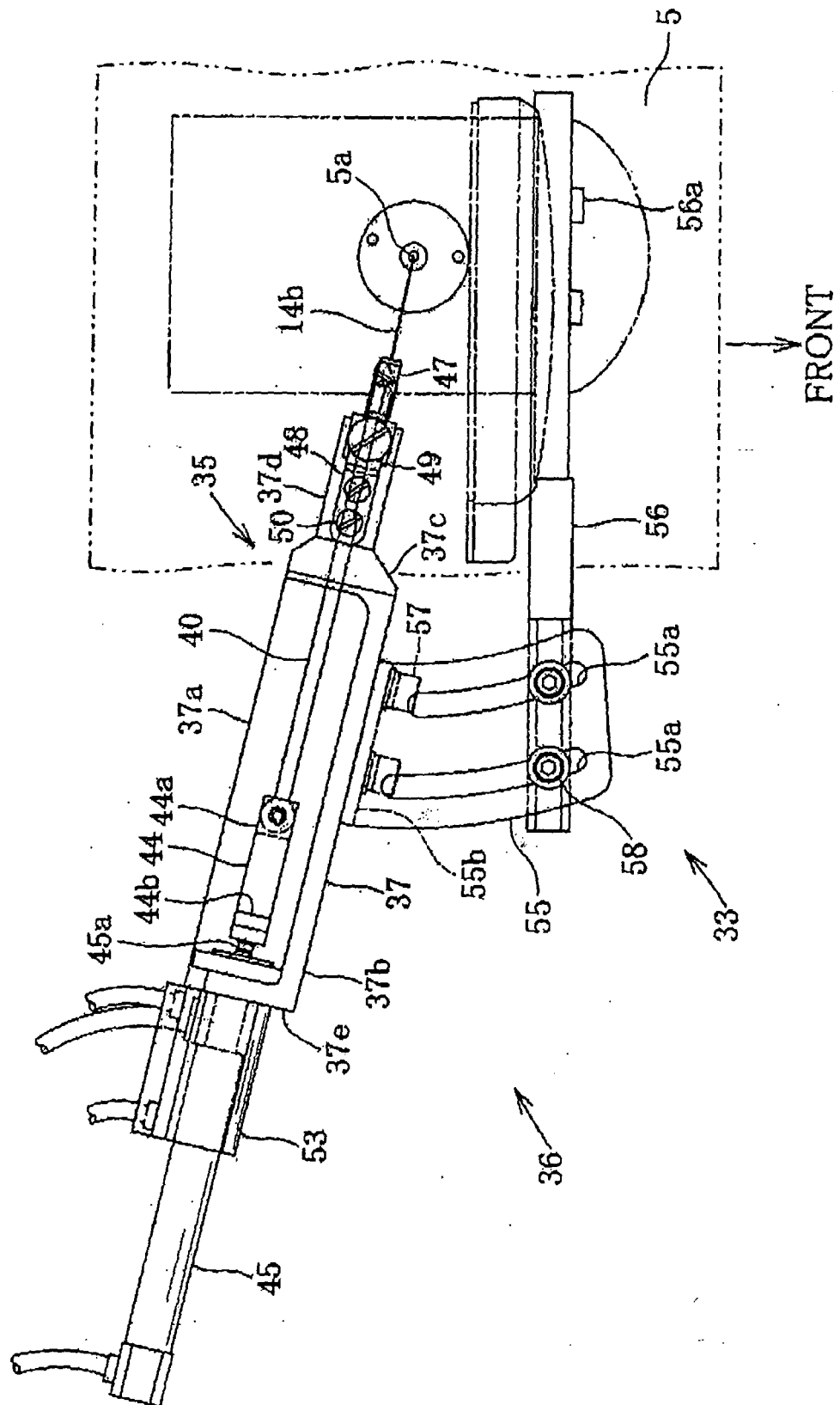


FIG. 4



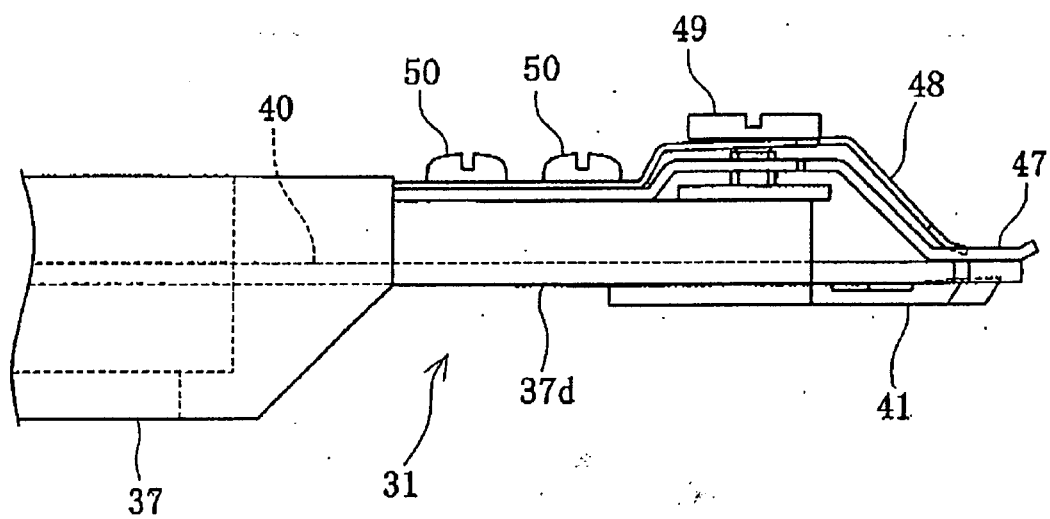
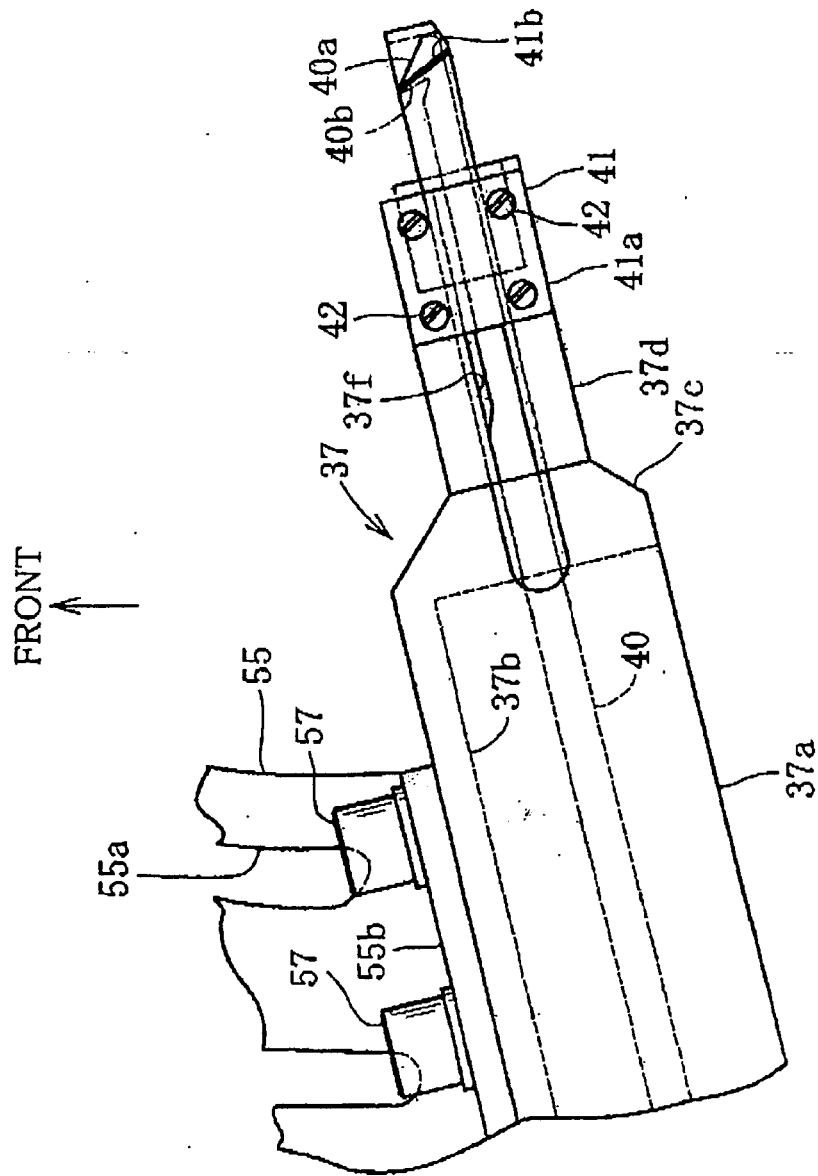


FIG. 6



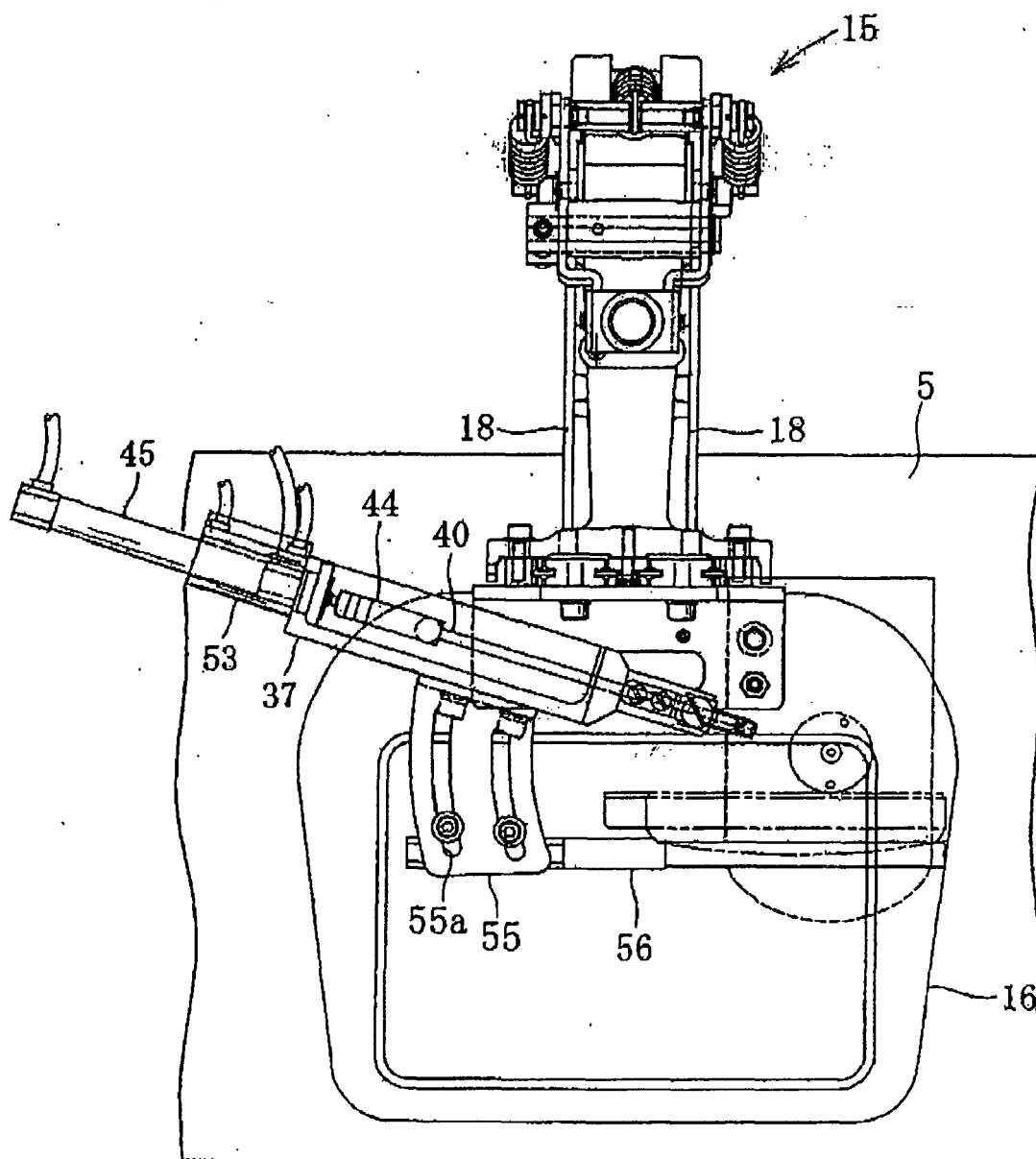


FIG. 8

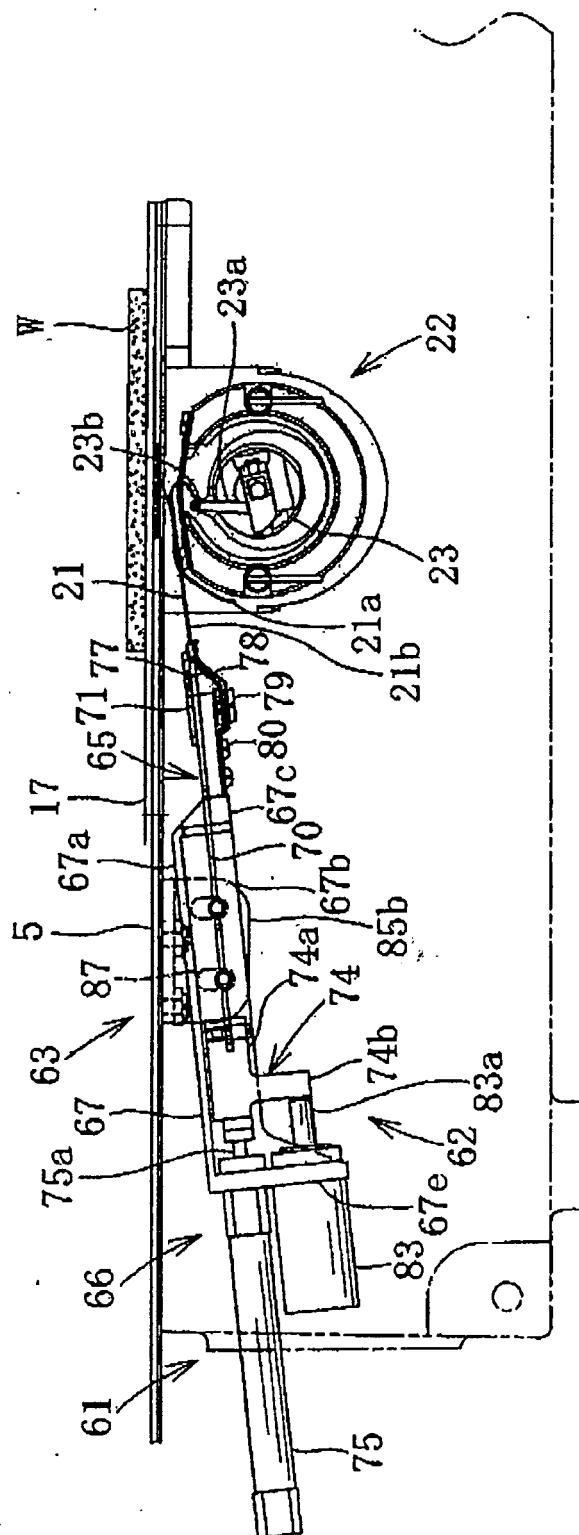


FIG. 9

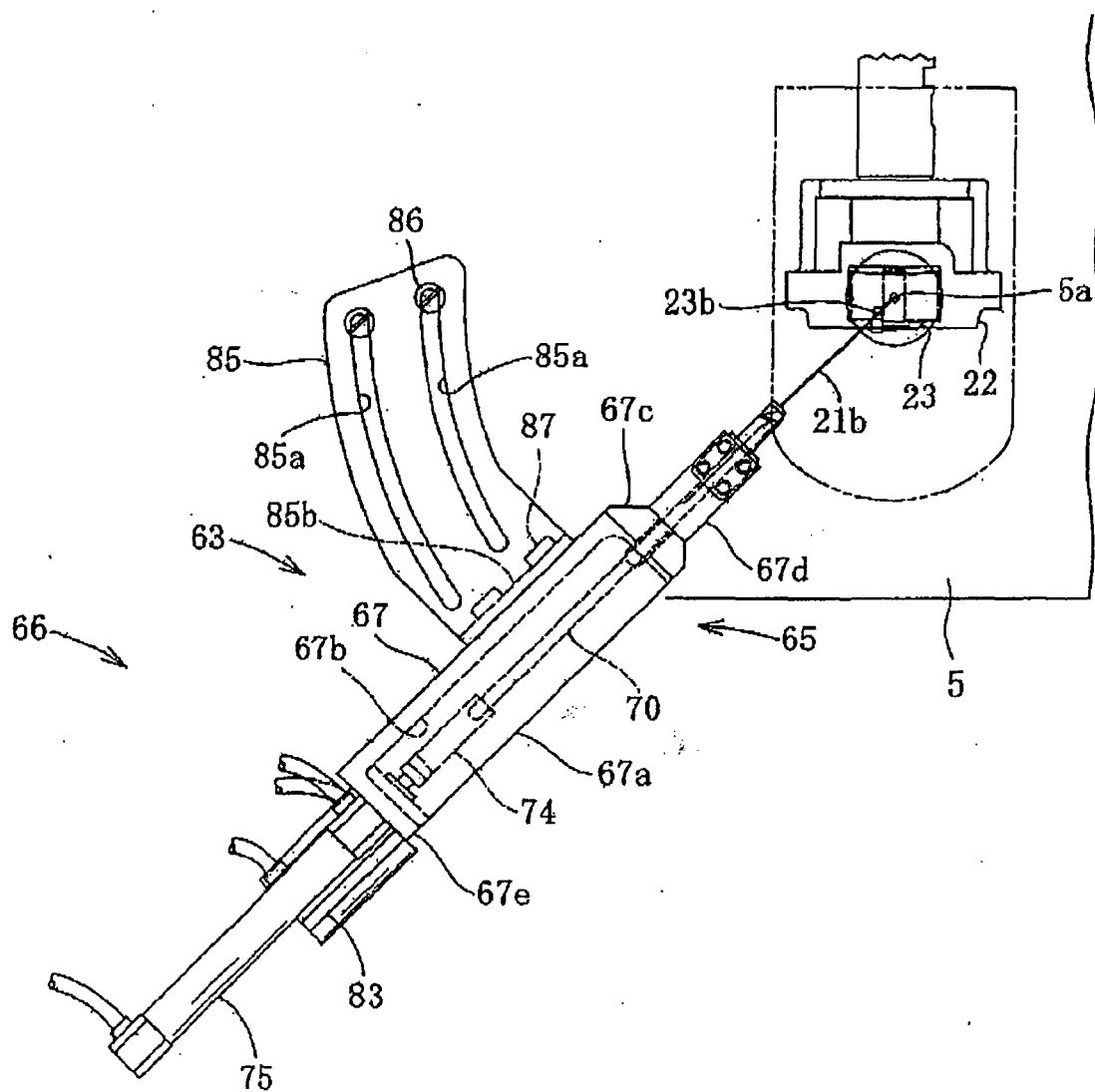


FIG. 10

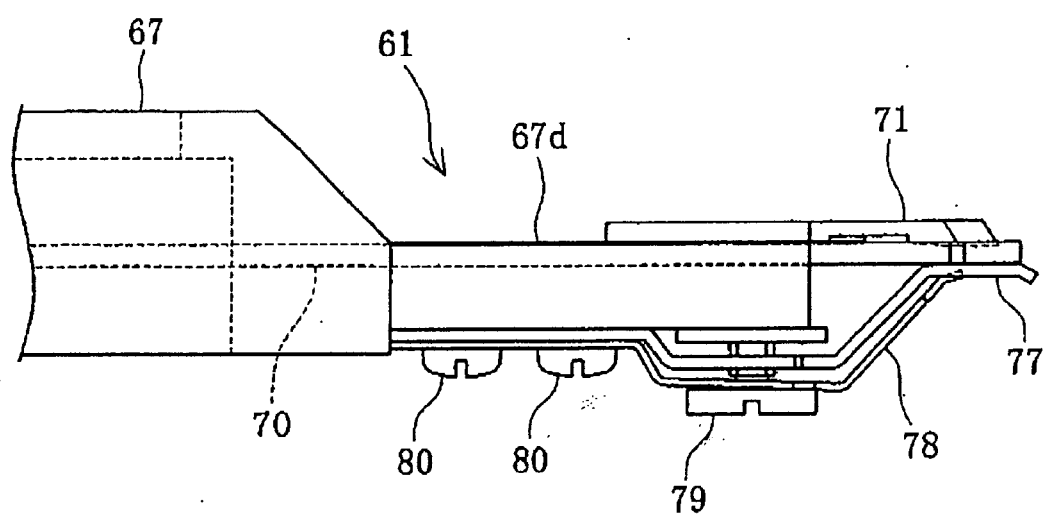


FIG. 11

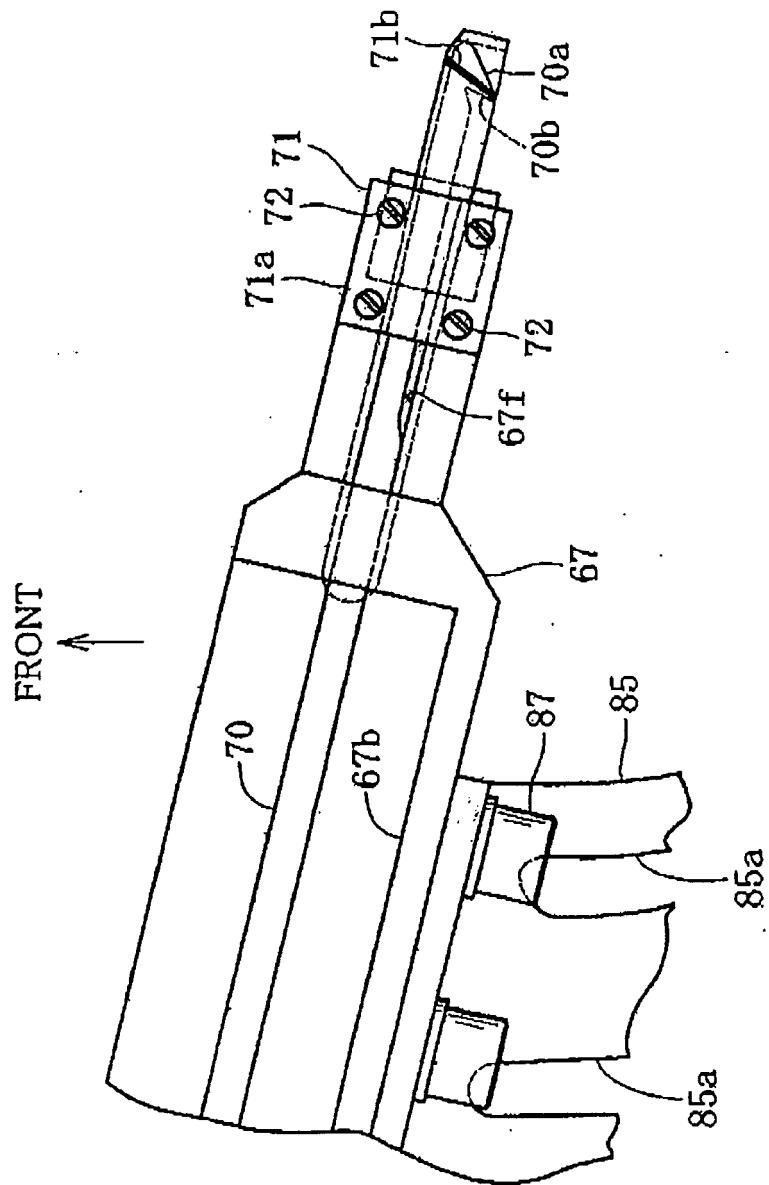


FIG. 12

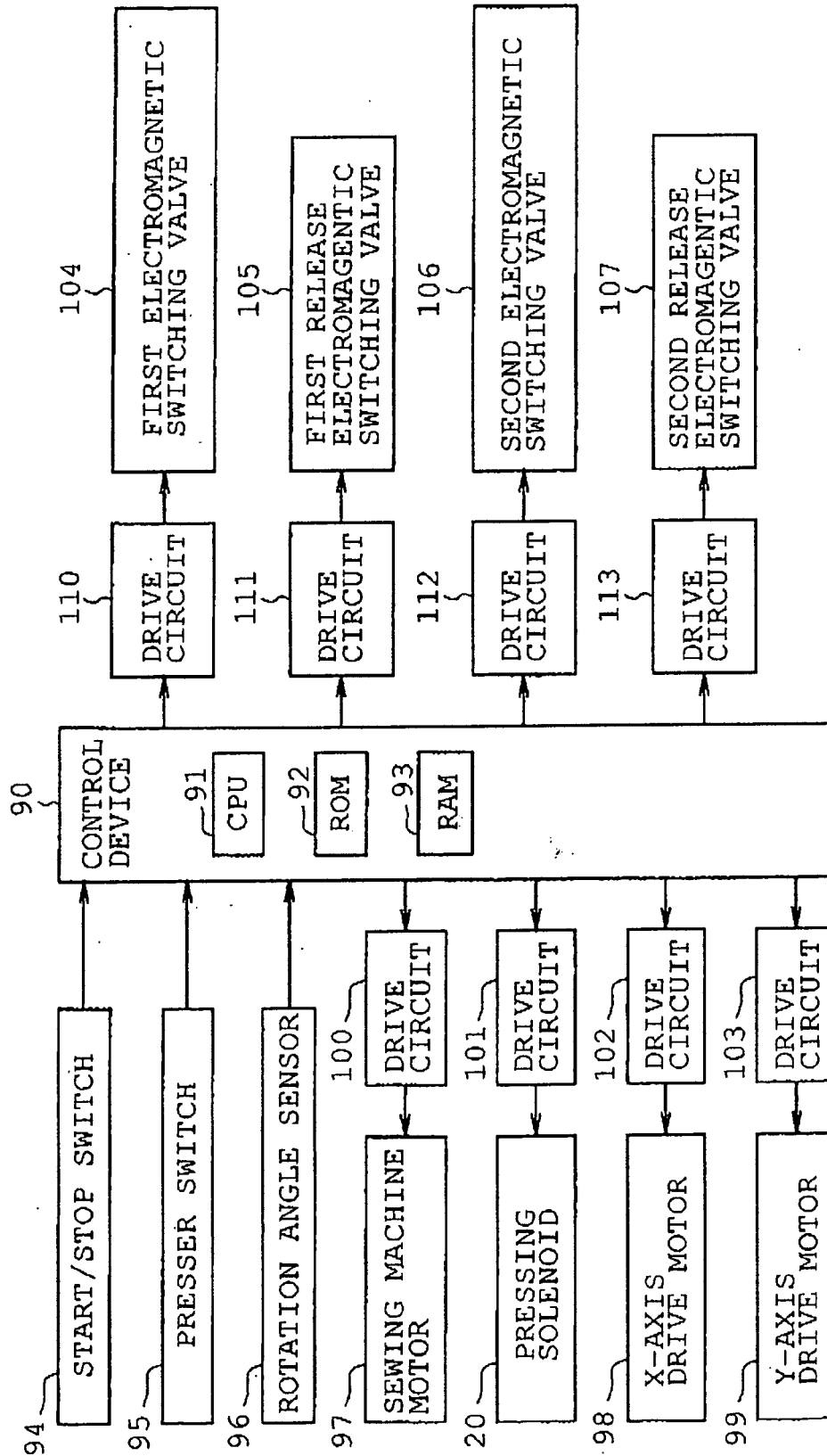


FIG. 13

NEEDLE LOCATION DATA OF FIRST STITCH
NEEDLE LOCATION DATA OF SECOND STITCH
LOWER THREAD RELEASE COMMAND CODE
UPPER THREAD RELEASE COMMAND CODE
NEEDLE LOCATION DATA OF THIRD STITCH
NEEDLE LOCATION DATA OF FOURTH STITCH
• • • • • • • • • • •
NEEDLE LOCATION DATA OF n-TH STITCH
UPPER THREAD CUTTING COMMAND CODE
LOWER THREAD CUTTING COMMAND CODE

FIG.14

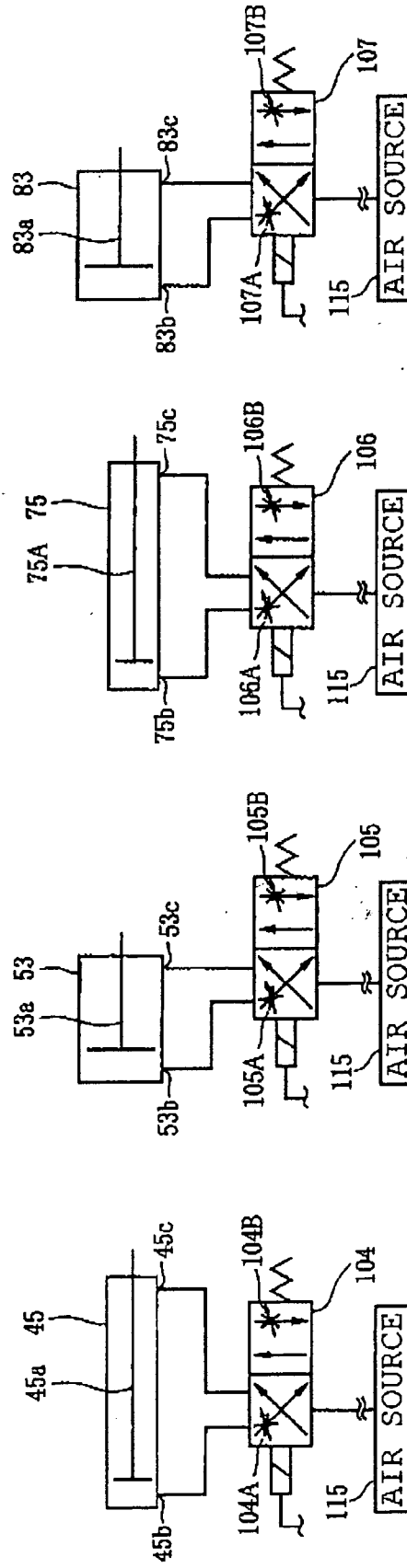


FIG. 15A

FIG. 15B

FIG. 15C

FIG. 15D

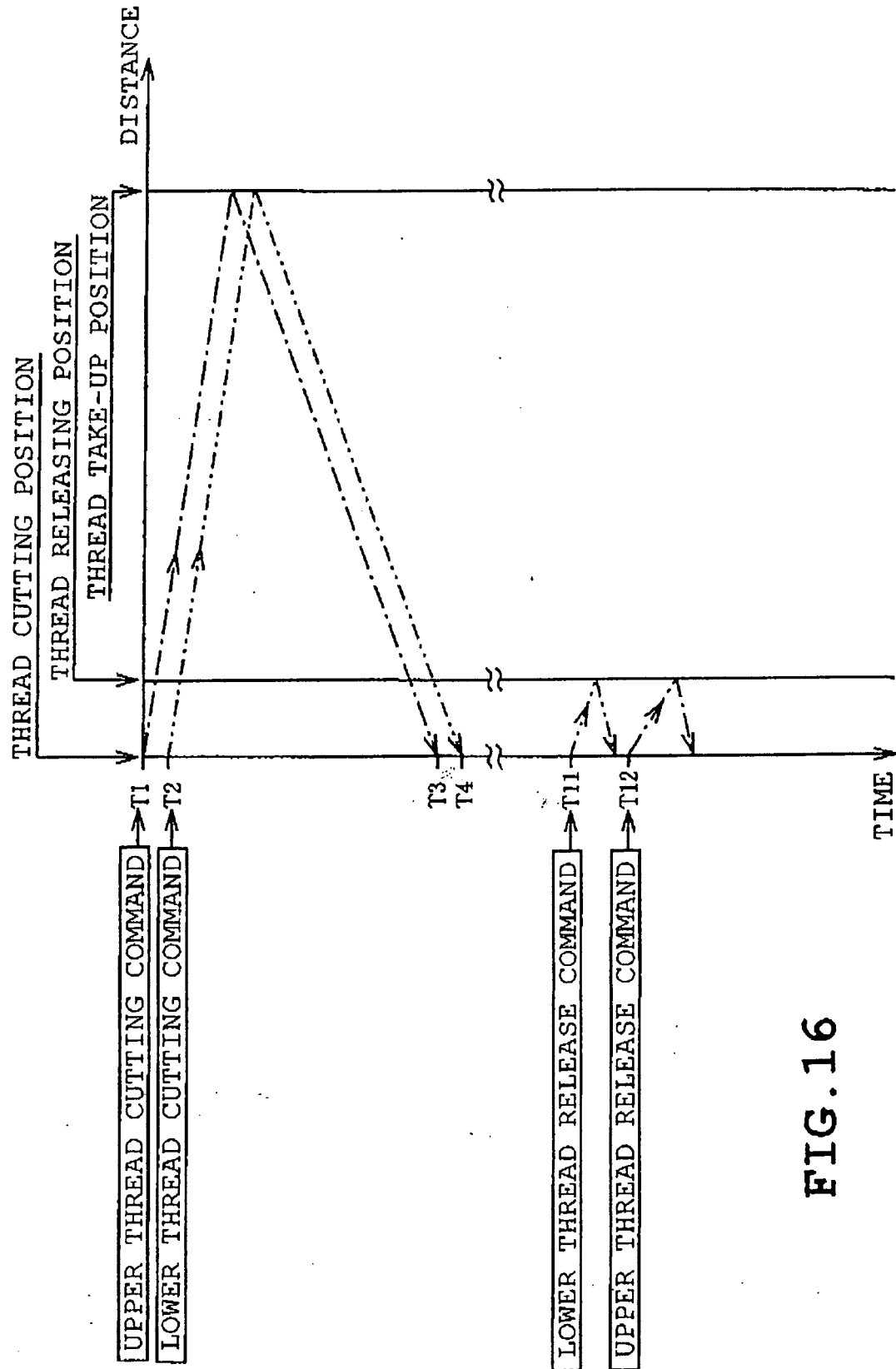


FIG. 16

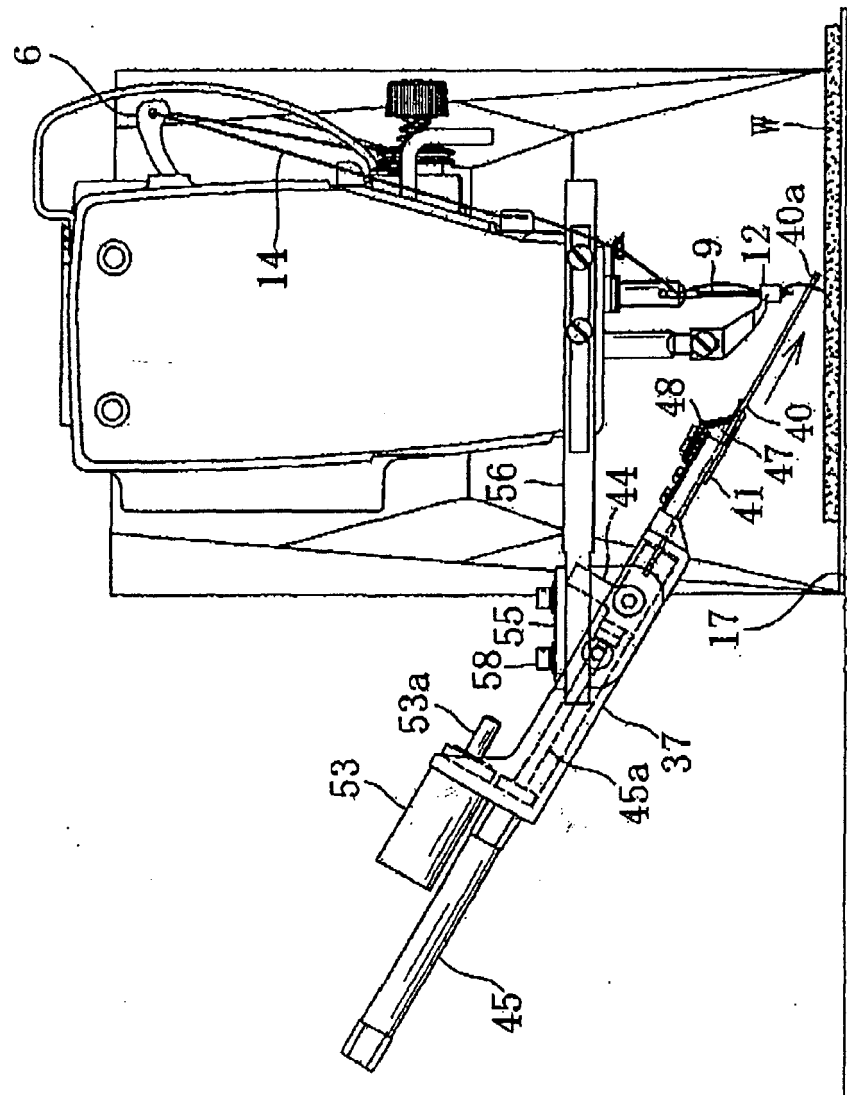


FIG. 17

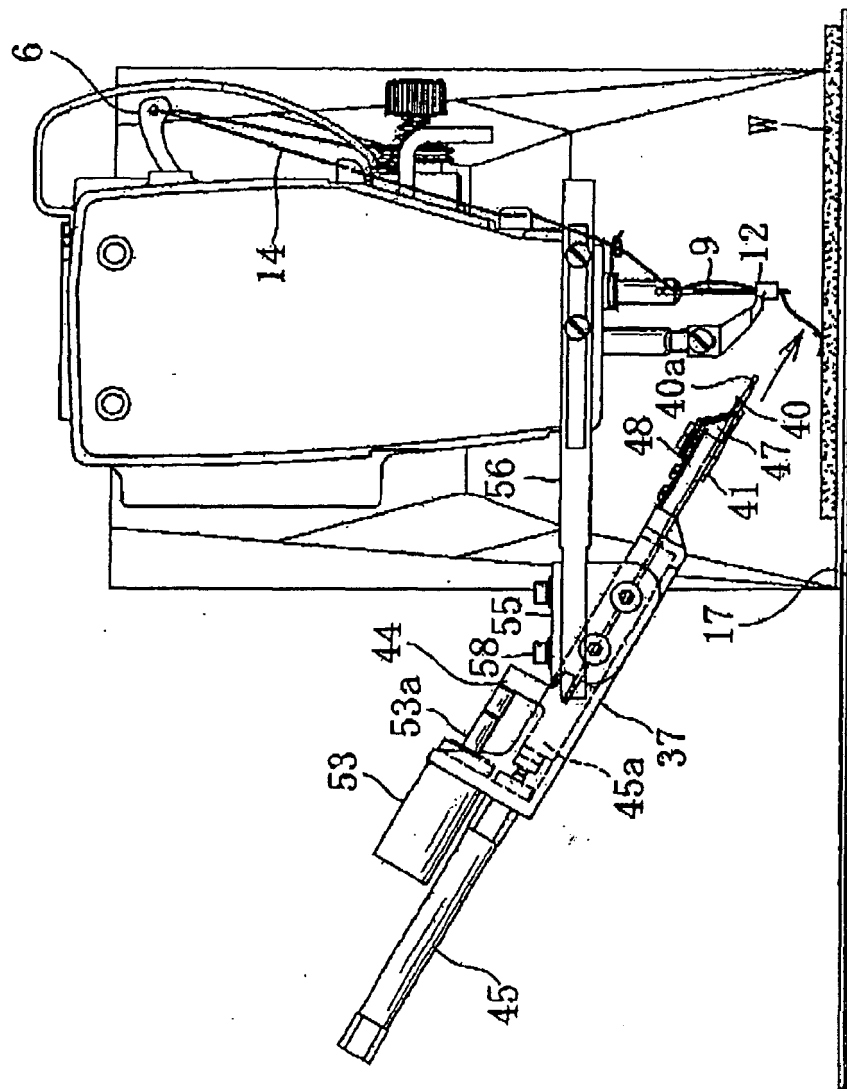


FIG. 18

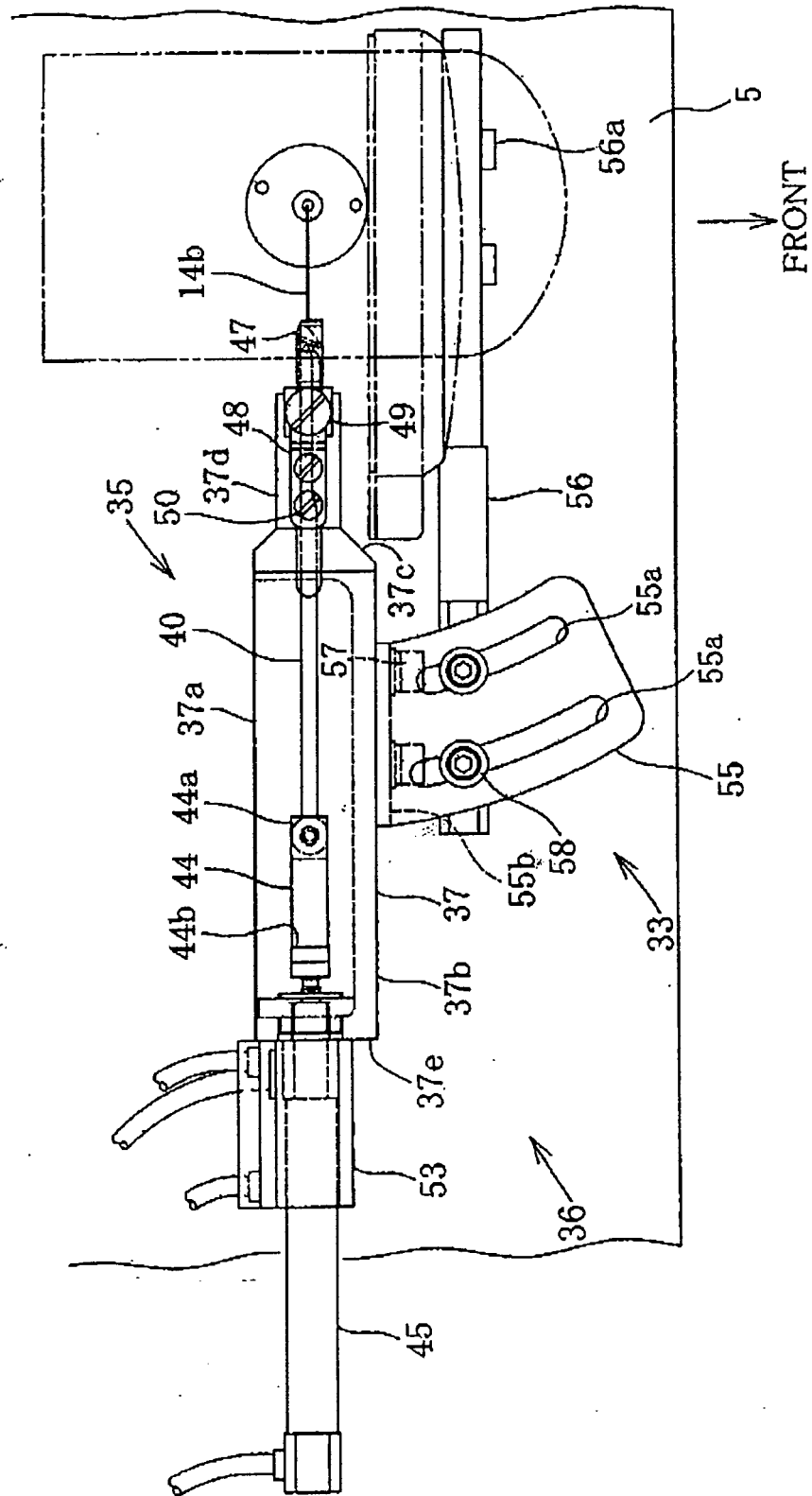


FIG. 19

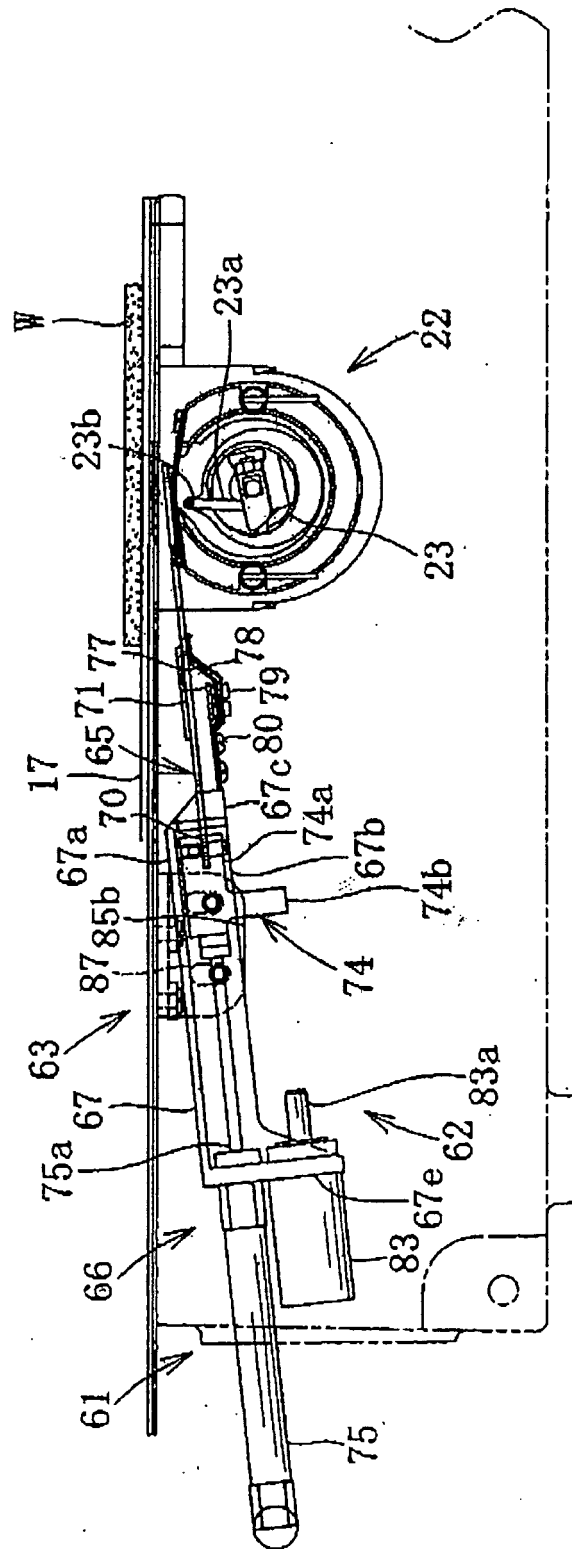


FIG. 20

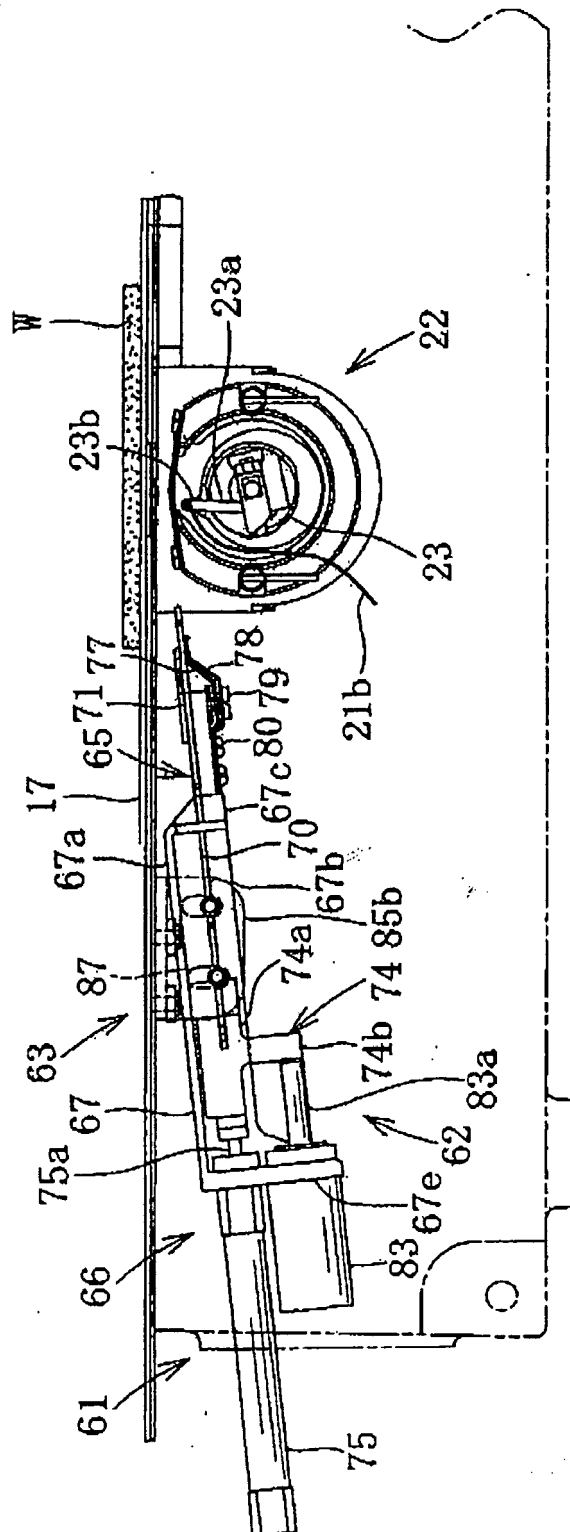


FIG. 21

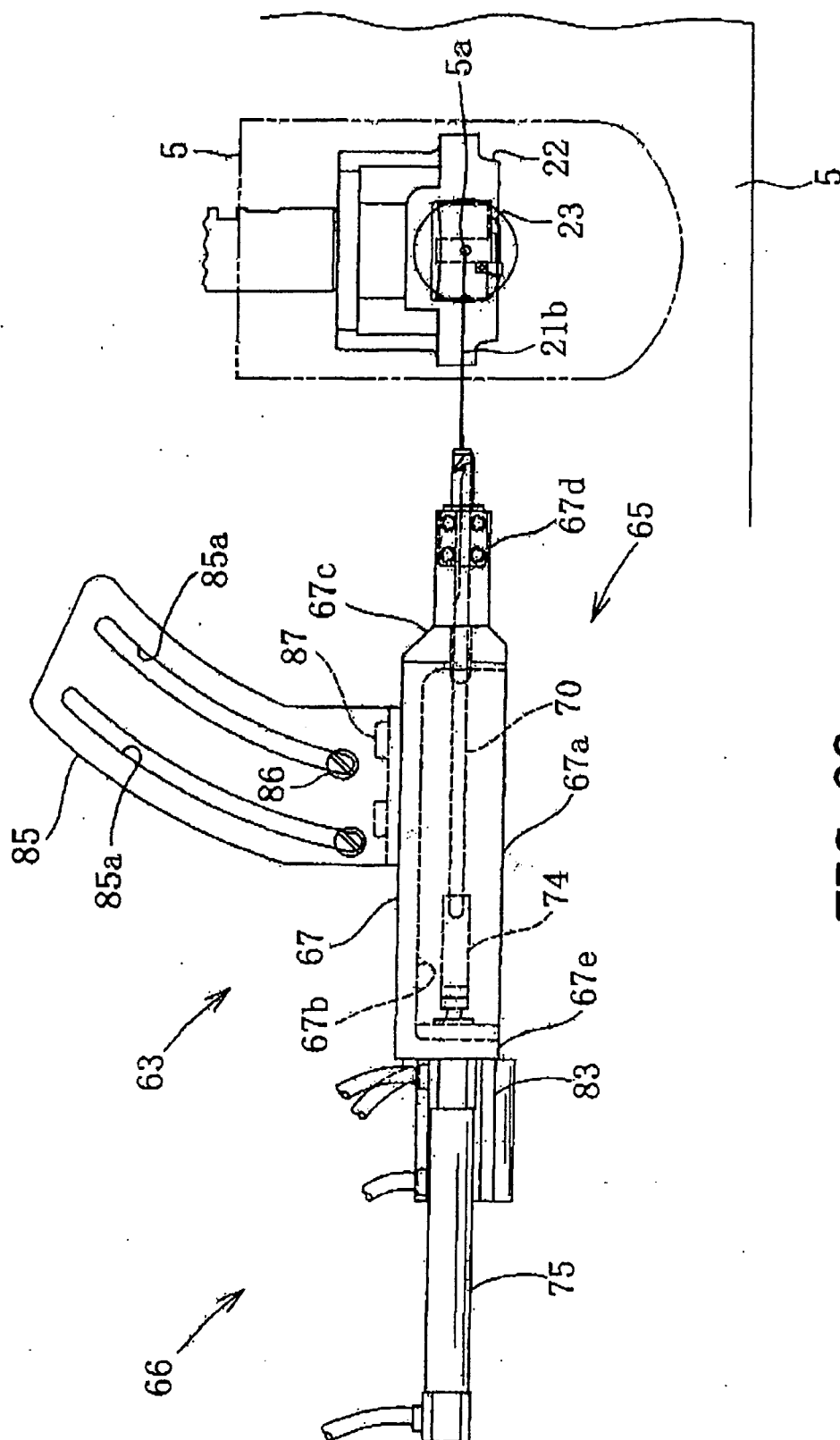


FIG. 22



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 08 00 4152

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