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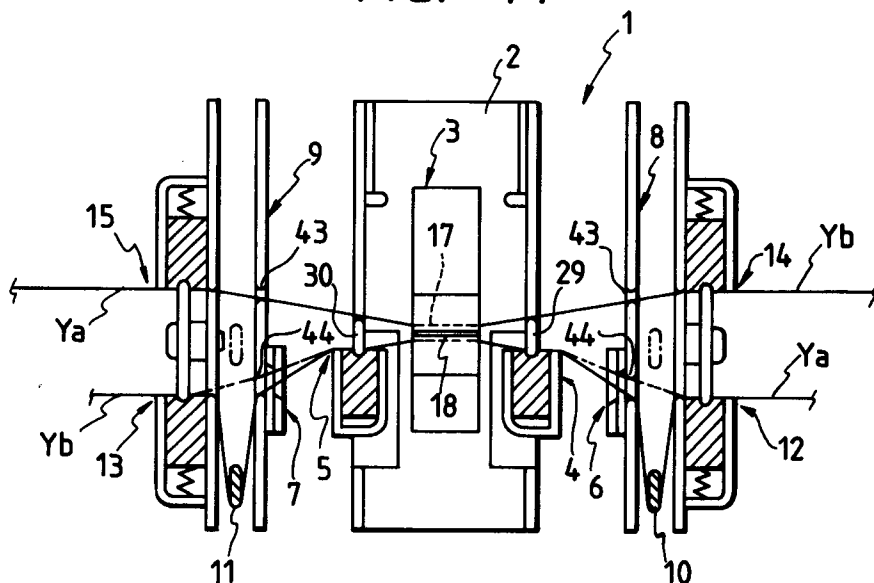
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(54) **Yarn splicing apparatus.**

(57) To provide a splicer which can form a spliced yarn portion having a fixed strength by yarn splicing of yarn ends after being drawn.

The splicer (1) includes a mechanism for drawing two yarn end portions, a mechanism for cutting the two drawn portions of the yarns to a predeter-

mined length, a mechanism for arranging the yarn ends (Ya, Yb) of the predetermined length and guiding them into a yarn splicing member (3) having a yarn splicing chamber (17) for entangling both ends of the yarns by air flows.

FIG. 11**EP 0 641 734 A2**

This invention relates principally to a yarn splicing apparatus for splicing supply yarns when a spent yarn supply package or bobbin is exchanged for a new one in a drawing and false twisting machine such as a draw-texturizing machine.

In a conventional drawing and false twisting machine a running filament yarn unwound and supplied from a yarn supply package is drawn or stretched in a heated condition and false twisted, and then taken up onto a take-up package by way of the steps of heat setting, oiling and so forth.

In order to secure a sufficient yarn supplying capacity, taking a balance of operation of the machine with that of automatic doffing by an automatic doffer into consideration, a plurality of yarn supply packages are mounted on a creel stand, and the last end of a yarn of a yarn supply package from which the yarn is being released is spliced in advance to the beginning end of a spare yarn supply package so that the yarn may be released from the packages successively.

If the yarn splicing of the yarns is performed while the yarns remain as non-drawn yarns, then the spliced portion produces a yarn defect after the yarns have been processed in the drawing and false twisting operation, and accordingly it is necessary to draw each beginning end to be spliced in advance and then to splice such drawn yarn ends to each other by means of a yarn splicing apparatus. In this instance, since it is not only inefficient but also likely to cause unevenness of the extent of drawing to perform the drawing of each beginning end manually, various devices for performing such drawing mechanically have been investigated. However, they have disadvantages in that defects of yarn joints such as abnormal thickness or insufficient strength appear or that the operation is not satisfactory.

In view of the disadvantages of prior art such as mentioned above, it is an object of the present invention to provide a yarn splicing apparatus of improved operation for performing yarn splicing to produce yarn joints of sufficient strength.

According to the present invention, this object is achieved by the subject matter of the patent claims.

A yarn splicing apparatus, hereunder also referred to as a splicer, of the present invention includes a mechanism for drawing or stretching two yarn end portions and a mechanism for guiding the two drawn ends into a splicing chamber of a yarn splicing member and positioning the yarn ends for entanglement of both yarns ends by means of air flows. The splicer may include a mechanism for cutting the two drawn end portions of the yarns to a predetermined length.

The splicer may be so constructed that a pair of first clamps, a pair of yarn cutters, a pair of yarn

drawing and pulling levers, and a pair of second clamps are disposed in order across and on the opposite ends of the yarn splicing chamber inside which whirling air flows can be produced.

The two yarn end portions to be spliced to each other are introduced into the yarn splicing chamber, and while their extremities are held grasped at two locations outside the chamber by the first clamps and the second clamps, the yarns are pressed sideways and drawn by the yarn drawing and pulling levers, whereafter the drawn yarn portions are cut to a predetermined length by the yarn cutters. Then the first clamps at the opposite ends of the yarn splicing chamber are opened and the yarns are pressed sideways by the yarn drawing and pulling levers to pull back and position the cut drawn yarn ends in an overlapping relationship within the yarn splicing chamber, whereafter whirling air flows are produced within the yarn splicing chamber to entangle and integrate fibers of the drawn yarn ends with one another and twist the drawn yarn ends to splice the yarns to each other.

The operations of the various mechanisms mentioned above for yarn splicing can be coordinated readily with a simple reciprocating motion produced by a single driving means by setting the directions of the operations parallel to each other and suitably interposing a cam mechanism.

Figure 1 is a plan view showing a splicer of an embodiment of the present invention.

Figure 2 is a side elevational sectional view showing the splicer of the embodiment of the present invention.

Figure 3 is a view showing a yarn splicing member and an air cylinder.

Figure 4 is a view showing an operation condition of the air cylinder.

Figure 5 is a view showing a cam for operating a first clamp and a cutter.

Figure 6 is a view showing the first clamp.

Figure 7 is a view showing the cutter.

Figure 8 is a view showing a cam for operating a yarn drafting drawing near lever.

Figure 9 is a view showing the yarn drafting drawing near lever.

Figure 10 is a view showing the first clamp and a third clamp.

Figure 11 is a plan view of essential part illustrating a yarn drawing process in the splicer of the embodiment of the present invention.

Figure 12 is a plan view of essential part illustrating a yarn cutting and pulling process in the splicer of the embodiment of the present invention.

Figure 13 is a sectional view of an end face of another embodiment of a splicer of the present invention.

Figure 14 is a top plan view of the splicer shown in Figure 13.

Figure 15 is a sectional view taken along line X-X of Figure 13.

Figure 16 is a top plan view of a cam plate.

Figure 17 is an operation diagram of the splicer of the present invention shown in Figure 13.

An embodiment will be described with reference to the drawings.

Referring to Figures 1 and 2, a yarn splicing apparatus 1 of a first embodiment of the present invention includes a pair of first clamps 4 and 5, a pair of cutters 6 and 7, a pair of fork guides 8 and 9, a pair of yarn drawing and pulling levers 10 and 11, and a pair of second clamps 12 and 13 arranged in order across and on the opposite ends of a yarn splicing member 3 secured at the center of a plate 2, and further includes a pair of third clamps 14 and 15 arranged in a juxtaposed relationship with the second clamps 12 and 13.

The yarn splicing member 3 has, as shown in Figures 1, 2, 3 and 4, a cylindrical yarn splicing chamber 17 passing through a nozzle block 16 between the opposite end walls thereof, and a slit 18 formed in the nozzle block 16 to extend along the whole length of the yarn splicing chamber 17, the slit 18 being expanded in a V-shape in the direction towards the outside of the nozzle block 16 in order to facilitate the insertion of yarns into the splicing chamber 17. A pair of air jetting or injection nozzles 20 and 21 are drilled in the nozzle block 16 to pass from an air supply path 19 extending in U-shape around the yarn splicing chamber 17 to the yarn splicing chamber 17, the air jetting nozzles 20 and 21 entering the yarn splicing chamber 17 in a direction tangential to the inner peripheral face of the yarn splicing chamber 17. An air supply pipe 23 is connected to the air supply path 19 by way of a joint 22. Further, the air supply pipe 23 is connected to another air supply pipe 25 by way of a mechanical valve 24. It is to be noted that the two air jetting nozzles 20 and 21 are offset from each other along the lengthwise direction of the yarn splicing chamber 17 so that compressed air is jetted from the air jetting nozzles 20 and 21 to create air flows whirling around the yarn splicing chamber 17 in opposite directions to each other within the opposite end portions of the yarn splicing chamber 17.

As shown in Figures 1, 2 and 6, the second clamps 4 and 5 include a pair of separation guides 29 and 30 formed on a pair of clamp plates 27 and 28 provided opposite to each other on the plate 2 and perpendicularly to the plate 2, and a pair of clamp members 34 and 35 provided on a pair of clamp levers 32 and 33 supported for swivelling motion by means of a pair of support shafts 31 provided on the clamp plates 27 and 28. A spring 37 for biasing each of the clamp levers 32 and 33 in the counterclockwise direction in Figure 6 is

provided between an end of the clamp lever 32 or 33 and a support shaft 36.

Meanwhile, a pair of rollers 38 are provided at lower end portions of the clamp levers 32 and 33, and the rollers 38 serve as followers for a pair of cams 39 formed inwardly at ends of a pair of cam levers 40 secured to a rotatable shaft 41.

The cutters 6 and 7 are each provided on the inner side of one 44 of two guide notches 43 and 44 for each of the fork guides 8 and 9 formed by cutting a guide plate 45 or 46, which is provided in parallel to the clamp plate 27 or 28 on the outer side of the clamp plate 27 or 28, in a W-shape, and is constituted from a fixed blade 49 supported on a support shaft 47 and a pin 48 on the guide plate 45 or 46 and a movable blade 50 supported for pivotal motion on the support shaft 47. The movable blade 50 is connected to a lever 42 integral with the aforementioned cam lever 40 by way of a link 51.

The rotatable shaft 41 to which the cam levers 40 are secured is supported for rotation by means of the clamp plate 27 and the guide plates 45 and 46 as shown in Figure 2, and a cam lever 52 is secured to an end of the rotatable shaft 41. The cam lever 52 has a roller 53 provided at an end thereof as shown in Figure 5, and the roller 53 is held in engagement with a cam slot 54 formed in a sectoral cam 55 which is secured to a rotatable shaft 56 so that it is rotated together with the rotatable shaft 56, and serves as a follower to the cam 55.

The cam 55 is a positive motion cam, and the cam slot 54 is constituted from a beginning end portion 54a positioned on a base circle of the cam, a flat portion 54b making a little lower stage than the beginning end portion 54a, a valley portion 54c contiguous to the flat portion 54b, and a last end portion 54d positioned on the base end.

The rotatable shaft 56 is supported, similarly to the rotatable shaft 41 described above, for rotation on the clamp plate 27 and the guide plates 55 and 56, and a lever 57 integral with a dog lever 58 is secured substantially at the center of the rotatable shaft 56 in its lengthwise direction. The lever 57 is connected at an end thereof to a piston rod 60 of an air cylinder 61 by way of a link 59 as shown in Figures 3 and 4. Meanwhile, the dog lever 58 has a cam 62 formed downwardly at a folded back portion of an end thereof, and at a terminal end when the dog lever 58 is rocked in the counterclockwise direction as shown in Figure 4 together with the lever 57, the cam 62 is abutted with a switch roller 63 of the mechanical valve 24 to operate the mechanical valve 24.

Subsequently, description will be given of the yarn drawing and pulling levers 10, 11, the second clamps 12 and 13, and the third clamps 14 and 15.

Each of the yarn drawing and pulling levers 10 and 11 has a pair of yarn arresting portions 64 and 65 formed on the opposite sides of an end portion thereof, and the yarn drawing and pulling levers 10 and 11 are secured at base end portions thereof to the opposite ends of a rotatable shaft 66 supported for rotation on the clamp plate 27 and the guide plates 45 and 46. And, a lever 67 shown in Figure 8 is secured to that end portion of the rotatable shaft 66 on which one 11 of the yarn drawing and pulling levers 10 and 11 is provided. A roller 68 is supported at an end of the lever 67, and the roller 68 is held in engagement with an elongate hole 70 perforated at one of the opposite end portions of a substantially V-shaped rocking lever 69 which is supported for pivotal motion at an end of the rotatable shaft 41. Further, a roller 71 is supported at the other end portion of the rocking lever 69, and the roller 71 is held in pressure engagement with a sectoral cam 72 secured to an end portion of the rotatable shaft 56 described hereinabove since the rocking lever 69 is biased by a biasing member not shown.

The cam 72 is constituted from a flat beginning end portion 72a positioned on a base circuit of the cam, a lobe portion 72b contiguous to the beginning end portion 72a, a flat portion 72c making a little lower stage than a lobe portion 72b, another flat portion 72d on the base circle making a further lower stage than the flat portion 72c, and a last end portion (valley portion) 72e contiguous to the flat portion 72d and inclined downwardly.

Each of the second clamps 12 and 13 and the third clamps 14 and 15 is constituted from a separation guide 75 provided at the center between a pair of clamp plates 73 and 74, and a pair of clamp members (movable pieces) 76 and 77 on the opposite sides of the separation guide 75. The clamp members 76 and 77 are supported for sliding movement between the clamp plates 73 and 74 and a pair of holders 78 and 79 provided on the clamp plates 73 and 74 as shown in Figure 10, and the directions of the sliding movements of the clamp members 76 and 77 are restricted to transverse directions by way of a pair of pins 80 which are provided between the clamp members 76 and 77 and the holders 78 and 79 and held in engagement with elongate holes 81.

Further, a pair of springs 84 and 84 are interposed between two pins 82 and 82 provided uprightly on each of the holders 78 and 79 and two holes 83 and 83 provided in each of the clamp members 76 and 77, and the clamp members 76 and 77 are contacted under pressure in an opposing relationship with the separation guide 75 by biasing forces of the respective springs 84 and 84 so that a yarn can be grasped between them.

It is to be noted that the second clamps 12 and 13 and the third clamps 14 and 15 do not include any compulsory opening and closing mechanism and always remain in a closed condition, and by introducing yarns into them along inclined guide edges 85, 86 and 87 formed on the upper clamp members 76 and 77 and the separation guide 75, they grasp the yarns, but by drawing out the yarns upwardly, they release the yarns from the grasped condition. However, an opening and closing mechanism similar to those of the first clamps 4 and 5 shown in Figures 1 and 6 may be provided either one or both of them.

The clamp plates 73 and 74, the guide plates 45 and 46, and the clamp plates 27 and 28 are secured to folded back portions 27a, 27b, 28a and 28b on the opposite ends of the plate 2 by means of four screws 88 and pairs of spacers 89 and 90, and they are integrated with each other to construct the body of the splicer 1. Meanwhile, a bracket 91 for securing the air cylinder 61 is provided at side end portions of the guide plates 45 and 46.

Meanwhile, a side frame 92 serving also as a grasping portion of the splicer 1 is provided on a side portion of the air cylinder 61, and a mechanical valve 95 (shown in Figures 3 and 4) for operating the air cylinder 61 is accommodated in the inside of the side frame 92 together with a pair of speed control valves 93 and 94 for the air cylinder 61 while a start button 97 connecting to a switch 96 for the mechanical valve 95 is provided at an upper portion of the side frame 92. It is to be noted that a compressed air supply pipe not shown is connected to the mechanical valve 95, and an operation valve (not shown) for changing over the supply of air to the speed control valves 93 and 94 to move the piston rod 60 back and forth is interposed between the mechanical valve 95 and the speed control valves 93 and 94.

And, if the start button 97 is depressed to push in the switch 96 of the mechanical valve 95 so that compressed air is supplied to the operation valve, then the compressed air flows into the rear side of the piston in the air cylinder 61 while the flow pressure thereof is controlled by the one speed control valve 93 so that the piston rod 60 of the air cylinder 61 is extended. When the piston rod 60 completes the extension of a fixed stroke thereof, the air flowing direction is changed over at the operation valve by a back pressure of the compressed air, and the compressed air flows into the front side of the piston in the air cylinder 61 by the other speed control valve 94 so that the piston rod 60 is contracted while the air on the rear side of the piston comes from the speed control valve 93 to the operation valve, at which it is exhausted. It is assumed that the air cylinder 61 makes only one

back and forth movement of the one stroke described above by one operation.

Subsequently, operation and a yarn splicing process of the splicer 1 will be described with reference to the embodiment.

First, a last end Ya (hereinafter referred to as released side yarn end Ya) of a yarn of a yarn supply package from which the yarn is being released and a beginning end Yb (hereinafter referred to as spare side yarn end Yb) of another yarn of a spare yarn supply package are grasped and set in position onto the splicer 1 as shown in Figure 11. In particular, the yarn end Ya is, after it is clamped by the third clamp 15 at a left upper location in Figure 11, threaded through the one guide groove 43 of the fork guide 9 and the separation guide 30 and inserted into the yarn splicing chamber 17 through the slit 18 of the yarn splicing member 3 and is further threaded through the first clamp 4 and the one guide notch 44 of the fork guide 8 as indicated by an alternate long and two short dashes line in Figure 11 and is clamped by the second clamp 12 at a right lower location in Figure 11. Similarly, the yarn end Yb is threaded, after it is clamped by the third clamp 14 at a right upper location in Figure 11, through the one guide notch 43 of the fork guide 8, the separation guide 29 and the yarn splicing chamber 17 and further through the first clamp 5 and the one guide notch 44 of the fork guide 9 as shown by an alternate long and two short dashes line in Figure 11 and is clamped by the clamp 13 at a left lower location in Figure 11. In this condition, the released side yarn end Ya and the spare side yarn end Yb cross each other in the yarn splicing chamber 17 at the center of the splicer 1 so that they are positioned in an X-shape condition as shown in Figure 11.

After setting of the yarn ends Ya and Yb is completed, the start button 97 will be depressed to operate the air cylinder 61 to perform yarn splicing of the yarn ends Ya and Yb.

In particular, as the piston rod 60 of the air cylinder 61 is extended, the lever 57 is pivoted in the clockwise direction in Figure 4 by the link 59 as shown in Figure 4, and thereupon, also the rotatable shaft 56 and the cam 55 and the cam 72 at the opposite ends of the rotatable shaft 56 are rotated in the same direction.

Consequently, the roller 53 held in engagement with the cam slot 54 of the cam 55 shown in Figure 5 is first pushed down by the beginning end 54a of the cam slot 54 to the flat portion 54b at the little lower stage so that the cam lever 52 is pivoted a little in the clockwise direction in Figure 5, and together with such pivotal motion, the rotatable shaft 41 is rotated a little in the same direction. Simultaneously, the cam lever 40 shown in Figure 6 is pivoted a little in the same direction so that the

roller 38 of the clamp lever 32 which has been in engagement with the cam 39 is disengaged from the cam 39. Consequently, the clamp lever 32 is pivoted in the counterclockwise direction in Figure 6 around the support shaft 31 by the biasing force of the spring 37 so that the second clamps 4 and 5 are closed.

Subsequently, when the rotatable shaft 56 is further rotated as the piston rod 60 is extended, the roller 71 held in contact under pressure with the cam 72 shown in Figure 8 moves from the beginning end 72a of the cam 72 to and is pushed up by the lobe 72b so that the rocking lever 69 is rocked in the counterclockwise direction in Figure 8. Simultaneously, the roller 68 held in engagement with the elongate hole 70 of the rocking lever 69 and the lever 67 supporting the roller 68 thereon are rocked in the clockwise direction in Figure 8 to rotate the rotatable shaft 66 in the same direction. Upon such rotation, the yarn drawing and pulling levers 10 and 11 secured to the opposite ends of the rotatable shaft 66 arrest and draw, while being rocked in the clockwise direction in Figure 9 to the positions of 10' and 11', each at the one yarn arresting portion 64 thereof, the yarn ends Ya and Yb extending between the first clamps 4 and 5 and the second clamps 12 and 13 to draw them as indicated by solid lines in Figure 11.

Subsequently, when the rotatable shaft 56 is further rotated and the cam 55 is rotated to the position indicated at 55' in Figure 5, the roller 53 reaches the cam groove valley portion 54c of the cam 55, and thereupon, since the roller 53 is pushed down, the cam lever 52 is rocked in the clockwise direction in Figure 5 to the position of 52' while the rotatable shaft 41 and the cam levers 40 secured to the rotatable shaft 41 are simultaneously rocked in the same direction to the position indicated at 40' in Figure 7. Upon such rocking motion, the movable blades of the cutters 6 and 7 connected to the levers 42 integral with the cam levers 40 by way of the links 51 are pivoted as at 50' to cut the yarn ends Ya and Yb in a predetermined length at the drafted portions described above.

In this instance, the yarn drawing and pulling levers 10 and 11 are retracted, as the roller 71 held in contact under pressure with the cam 72 shown in Figure 8 reaches the flat portion 72c past the lobe portion 72b of the cam 72, to the left side a little from the position shown at 11' (10') in Figure 9 so that the drafted yarn ends Ya and Yb are put into a rather loosened condition. This is intended to cut the yarn ends in a condition wherein yarn tension acts upon the yarn ends Ya and Yb in order to prevent fibers at the cut portions from being disordered or leaping out.

Subsequently, when the rotatable shaft 56 is further rotated by extension of the piston rod 60, the roller 53 held in engagement with the cam slot 54 of the cam 55 shown in Figure 5 reaches the last end portion 54d past the valley portion 54c of the cam slot 54, and the roller 53 and the cam lever 52 are pivoted in the counterclockwise direction in Figure 5 to return to their original positions. Upon such returning movement, also the cam levers 40 shown in Figures 6 and 7 are pivoted upwardly so that the movable blades 50 of the cutters 6 and 7 return to their initial positions while at the same time the cams 39 at the ends of the cam levers 50 are abutted with the rollers 38 to pivot the clamp levers 32 and 33 in the clockwise direction in Figure 6 so that the first clamps 4 and 5 are opened (condition indicated by an alternate long and two short dashes line in Figure 12).

Then, when the rotatable shaft 56 is further rotated, the cam 72 shown in Figure 8 is rotated as indicated at 72", and upon such rotation, the roller 71 reaches the last end portion (valley portion) 72e of the cam 72, whereupon the roller 71 is pulled down by the biasing force of the biasing member not shown and the rocking lever 69 is rocked in the clockwise direction in Figure 8 to the position of 69". Simultaneously, also the lever 67 having the roller 68 held in engagement with the elongate hole 70 of the rockable lever 69 is rocked in the counterclockwise direction in Figure 8 to the position of 67". Upon such rocking motion, also the yarn drawing and pulling levers 10 and 11 shown in Figure 9 arrest and pull, while being rocked in the counterclockwise direction in Figure 8 to the position of 11" (10"), each at the yarn arresting portion 65 thereof, the yarn ends Ya and Yb positioned as indicated by alternate long and two short dashes lines in Figure 12 between the third clamps 14 and 15 and the guide grooves 43 and 43 of the fork guides 8 and 9, and position the cut yarn ends Ya and Yb in the drawn condition, which have been positioned in the proximities of the cutters 6 and 7, in an overlapping relationship with each other within the yarn splicing chamber 17.

If, from this condition, the piston rod 60 is further extended to its full stroke, the cam 62 of the dog lever 58 integral with the lever 57 is abutted with the switch roller 63 of the mechanical valve 24 to open the mechanical valve 24 so that compressed air is supplied into the air supply path 19 in the yarn splicing member 3 by way of the air supply pipes 25 and 23 shown in Figure 3, and the compressed air is jetted into the yarn splicing chamber 17 through the compressed air jetting or injection nozzles 20 and 21.

Consequently, the cut yarn ends Ya and Yb are united with each other and provided with false twists as envelopes of the drawn filaments are

produced by the action of whirling air streams created by the jetted compressed air, so that the yarns are spliced together. Following the splicing of the yarns, the piston rod 60 of the air cylinder 61 is retracted, the various elements are returned to their original positions, and the operation of the splicer 1 is stopped. Thereafter, the spliced yarns are removed from the third clamps 14 and 15 and the yarn splicing chamber 17, thereby completing the yarn splicing operation.

In the yarn splicing operation described above, the individual steps taking place after the yarn ends Ya and Yb have been positioned in the splicer 1 are performed successively and automatically in a very short time together with the reciprocating motion of one stroke of the piston rod 60. It is to be noted that the time required for one step can be adjusted appropriately by means of a speed controller provided in an exhaust system of the air cylinder 61. The extent to which the yarns ends Ya and Yb are drawn can be adjusted by changing the profile of the last end portion 72e of the cam 72.

Next, a second embodiment of the present invention will be described with reference to Figures 13 to 17.

A yarn splicing apparatus of the second embodiment, also referred to as a splicer, includes a yarn splicing member to be described below, a mechanism for drawing two yarn portions, a mechanism for cutting the two drawn portions to a predetermined length, and a mechanism for arranging the two ends of predetermined lengths in order in the opposite directions and introducing them, oppositely directed, into a yarn splicing chamber of the yarn splicing member, where the two yarn ends are entangled by means of air flows.

After the drawing mechanism has drawn the two yarn end portions and the cutting mechanism has cut off excessive lengths to make the drawn portions of equal predetermined lengths, and the introducing mechanism has arranged the drawn yarn end portions of predetermined lengths in order in the opposite directions and introduced the drawn portions into the yarn splicing chamber, where their two oppositely directed ends remain in free condition, twisting of the yarn ends is performed sufficiently for necessary entanglements to be formed to splice the yarns to each other. The drawing mechanism, the cutting mechanism, the introducing mechanism and the yarn splicing member can be constructed so that they are operated in a predetermined order by a cam mechanism which is driven by a single driving means, and in this instance, they operate automatically.

Figure 13 is a sectional side view of a splicer, Figure 14 is a plan view, Figure 15 is a sectional view taken along the line X-X of Figure 13, and Figure 16 is a plan view of a cam plate.

As shown in Figures 13 and 14 a splicer 101 is constructed so that a pneumatic cylinder 103 serving as a single driving means and a cam plate 104 are accommodated in a body case 102 of the splicer 101, and a first lever 105, a pair of cutters 106 and 107, a fixed yarn guide 108, a pair of clamps 109 and 110, a yarn splicing member 111, a pair of second levers 112 and 113, and a push-button 114 are disposed on an upper face of the body case 102.

The first lever 105 can grasp, on the upper side thereof, a yarn by means of a chuck which is biased in a closing direction by a coil spring 121, and is supported for rocking motion by a shaft 123 on the lower side thereof. The first lever 105 is biased to its solid line position by a spring 124 and has a roller 126 at the end of an arm 125. When the roller 126 rides on an inclined portion 161a of a cam 161 of the cam plate 104, the first lever 105 is rocked as indicated by an alternate long and two short dashes line.

As shown in Figure 14, the two cutters 106 and 107 and the yarn guide 108 define a yarn path between the first lever 105 and the yarn splicing member 111, allowing two yarn ends Y1 and Y2 grasped by the first lever 105 to pass through the yarn splicing member 111 in opposite directions. As shown in Figure 15, the yarn guide 108 has two guide notches 127 and 128, and a pair of fixed blades 129 and 130 are securely provided along the guide notches 127 and 128. A pair of movable blades 132 and 133 are supported for pivotal motion on a pair of pivots 131 fixed to the fixed blades 129 and 130. A spherical roller 134 is supported for rotation on an arm 132a of the one movable blade 132, and the other movable blade 133 is connected to the movable blade 132 by way of a connecting bar 135. The spherical roller 134 is guided by a pair of guide slots 162a and 162b of a second cam 162, and when it is guided by the guide slot 162a in Figure 16, the cutters 106 and 107 are open. At an intermediate stage, while the spherical roller 134 is guided by the guide slot 162b, the cutters 106 and 107 are closed to cut the yarns.

The clamps 109 and 110 of Figure 14 are constructed such that arms 141 and 142 having L-shaped bent portions 139 and 140 for contacting the upper and lower notches 137 and 138 on the opposite end faces of a housing 136 of the yarn splicing member 111 to press yarns are supported for pivotal motion by means of a pivot 143 and are biased in their closing directions by a spring 146. Horizontal rollers 144 and 145 are supported for rotation on the arms 141 and 142 and are guided so that they hold the opposite sides of a third cam 163 of Figure 16. When the horizontal rollers 144 and 145 are guided to a pair of thin portions 163a, the clamps 109 and 110 in Figure 14 press the

yarns Y1 and Y2 against the notches 137 and 138 as shown by alternate long and two short dashes lines to clamp the yarns Y1 and Y2.

The second levers 112 and 113 of Figure 13 have plates 147 and 148 for holding a yarn in a condition wherein they are biased in their closing directions by compression springs 149 and 150, and are supported for rocking motion by means of a pivot 151 and biased to their solid line positions by a spring 152. The second lever 113 on the interior side in the drawing has an arm 153 which has a roller 154 supported for rotation at an end thereof. It is to be noted that the second levers 112 and 113 are connected by a connecting bar 155. When the roller 154 rides on an inclined portion 164a of a fourth cam 164, the second levers 112 and 113 are rocked as shown by alternate long and two short dashes lines.

Similar to that of the first embodiment, the yarn splicing member 111 has a cylindrical or tubular yarn splicing chamber 157 provided below a slit 156 for inserting the yarns, and a pair of air jetting or injection nozzles 158 open into the yarn splicing chamber 157. A source of compressed air for the air jetting nozzles 158 is connected by way of a connector 170 and a valve switch 172. When a roller 173 of the valve switch 172 rides over the inclined portion 164a at an end of the fourth cam 164, the valve switch 172 is turned on and compressed air is supplied into the yarn splicing chamber 157. It is to be noted that an air source for the pneumatic cylinder 103 is connected from the connector 172 by way of an operation valve (pneumatic pressure change-over valve) 171. While the push-button 114 is held depressed, the on-state wherein the operation valve 171 supplies a pneumatic pressure to a cylinder chamber is entered and the pneumatic cylinder 103 is extended. If the hand is released from the push-button 114, then an off-state wherein the operation valve 171 supplies a pneumatic pressure to a rod side chamber is entered and the piston of the pneumatic cylinder 103 is retracted as shown in the Figure.

As shown in Figures 15 and 16, the cam plate 104 includes a base 175 which has the first cam 161, the second cam 162, the third cam 163 and the fourth cam 164 integrally mounted thereon, and is restricted to horizontal movement by means of a guide 176 on a side face of the base 175 and an elongate hole 177 on a side face of the body case 102. And, the base 175 is connected at a mounting portion 175a thereof to an end of the rod of the pneumatic cylinder 103.

In particular, when the push-button 114 of Figure 13 is depressed, the entire cam plate 104 of Figure 16 is moved leftwardly in the drawings by extension of the pneumatic cylinder 103. And, the horizontal rollers 144 and 145 first enter the thin

portions 163a of the third cam 163, and then the roller 126 rides over the inclined portion 161a of the first cam 161, whereafter the spherical roller 134 comes from the guide slot 162a of the second cam 162 to the guide slot 162b and then the horizontal rollers 144 and 145 come out from the thin portion 163a of the third cam 163. Thereafter, the roller 154 rides over the inclined portion 164a of the fourth cam 164, and then the roller 173 rides over the lobe 164b of the fourth cam 164.

Subsequently, operation of the splicer 101 of the structure described above will be described with reference to Figures 14 and 17. Figure 14 illustrates a first setting condition which is performed by hand. Yarn ends of two yarns Y1 and Y2 are grasped holding them between the ends of the first lever 105. The one yarn end Y1 is inserted into the second guide groove 127 of the yarn guide 108 and further inserted into the slit 156 of the yarn splicing member 111 and then held between the ends of the second lever 113. The other yarn end Y2 is inserted into the guide groove 128 of the yarn guide 108 and inserted into and arranged parallel to the yarn end Y1 in the slit 156 of the yarn splicing member 111, and then held between the ends of the second lever 122 so that the condition shown in the Figure is established. If the push-button 114 is depressed, then yarn splicing is performed automatically as described below.

Referring to Figure 17A, the clamp 110 is first closed as indicated by an arrow mark a to fix the yarn ends Y1 and Y2 between the clamp 110 and the housing 106 so that they may not slip. Subsequently, if the push-button 114 is kept depressed, then the first lever 105 is rocked as indicated by an arrow mark b in Figure 17B to pull the yarn ends Y1 and Y2 extending from the clamp 110 to the first lever 105 to draft them. And, in Figure 17C, the cutters 106 and 107 are closed as indicated by an arrow mark c to cut the drafted yarn ends Y1 and Y2 extending to the clamp 110. And, in Figure 17D, the clamp 110 is opened as indicated by an arrow mark d and the second levers 112 and 113 are rocked as indicated by an arrow mark e so that the drafted yarn ends Y1 and Y2 are arranged in order in the yarn splicing member 111. The cut portions of the drawn ends Y1 and Y2 are adjusted to the extent that they project slightly from the yarn splicing chamber 157. By operation of the valve switch not shown, the yarn splicing chamber 157 is communicated with the compressed air source and filaments of the drafted free yarn ends Y1 and Y2 are twisted around each other by air flows jetted into the yarn splicing chamber 157, so that the yarns are spliced together by entanglement.

Thereafter, if the hand is released from the push-button 114, the condition of Figure 14 is restored. By manual operation, the spliced yarn is

brought out of the yarn splicing member 111 and the yarns Y1 and Y2 are removed from the second levers 112 and 113, thereby completing the yarn splicing operation. In this manner, except for the setting operations at the beginning and at the end, a series of steps are automatically initiated and performed by the mere manual operation of depressing and releasing the push-button 114.

Since a splicer of the present invention is constructed so that a pair of first clamps, a pair of yarn cutters, a pair of yarn drawing and pulling levers, and a pair of second clamps are disposed in order across and at the opposite ends of a yarn splicing member inside which whirling air streams can be produced, by such a simple operation as setting yarns and depressing a button, yarn splicing to produce a yarn joint of constant strength can be performed by rapid and simple operation by a back and forth movement of one stroke of a single cylinder.

Since a splicer of the present invention is constructed so that a drawing mechanism and an introducing mechanism are separate from each other and drawn yarn ends of a predetermined length corresponding to the length of a spliced yarn portion are arranged in order to splice the yarns to each other in a yarn splicing member in which both yarn ends are free, unnecessary drawn portions in front and in the rear of the spliced yarn portion are reduced to the utmost, and besides, a spliced yarn portion which exhibits a small amount of degradation in strength and a small amount of dispersion can be formed by performing sufficient twisting and further by operation of the same conditions.

Further, since the construction wherein the drawing mechanism, the cutting mechanism, the introducing mechanism and the yarn splicing member are automatically operated in a predetermined order by a cam mechanism which is driven by a single driving means can be adopted readily, only an operation of a button is required except for the manual operations of setting yarns at a first stage and removing the yarns after yarn splicing, and superior operability can be achieved.

Claims

1. A yarn splicing apparatus, including a mechanism for drawing two yarn end portions to be spliced, a mechanism for arranging the two drawn yarn ends in order and guiding them into a yarn splicing member (3; 111), with a yarn splicing chamber (17; 157) for forming entanglements at both end portions of the yarns by air flows.

2. An apparatus as claimed in claim 1, wherein a mechanism for cutting the two drawn portions of the yarn ends to a predetermined length, said two yarn ends of the predetermined length being arranged in order in the opposite directions and being guided into the yarn splicing member (3; 111). 5
3. An apparatus as claimed in claim 2, wherein a pair of first clamps (4, 5), a pair of yarn cutters (6, 7), a pair of yarn drawing and pulling levers (10, 11), and a pair of second clamps (12, 13) are disposed in order across and on the opposite ends of the yarn splicing member (3, 111) in the inside of which whirling air flows can be produced. 10 15
4. An apparatus as claimed in claim 3, wherein drawing means which act upon clamped yarn end portions to draw the yarn ends serve also as yarn pulling means for drawing near the cut yarn ends in the drawn condition and placing the cut yarn ends one on the other in said yarn splicing member (3, 111). 20 25
5. An apparatus as claimed in claim 3, wherein ends of two yarns to be spliced to each other are introduced into said yarn splicing member (3); while extremity sides of the yarn ends are grasped at two locations of said first clamps (4, 5) and said second clamps (12, 13), the yarns thus grasped are pressed are drawn by said yarn drawing and pulling levers (10, 11); the yarns at the thus drawn portions are cut to a predetermined length by said yarn cutters (6, 7); said first clamps (4, 5) on the opposite ends of said yarn splicing member (3) are opened; the yarns are pressed and pulled by said yarn drawing and pulling levers (10, 11) to position the cut drawn yarn ends in an overlapping relationship within the yarn splicing chamber (17); and then whirling air flows are produced in the yarn splicing chamber (17) to entangle and integrate fibers or filaments of the drawn yarn ends with one another and twist the drawn yarn ends to splice the yarns to each other. 30 35 40 45
6. An apparatus as claimed in claim 2, including a mechanism for fixing two yarn end portions by means of a first lever (105) and a pair of clamps (109, 110) and rocking said first lever (105) to draw the two yarn end portions, a pair of cutters (106, 107) for cutting the two yarn ends at the drawn portions to a predetermined length, a mechanism for arranging both ends of the predetermined length of the two yarns after being cut in order in the opposite directions by rocking motion of a pair of second levers (112, 113) while both ends are free and drawing the yarn ends into a cylindrical chamber (157) of a yarn splicing member, and said yarn splicing member (111) for jetting air flows into said cylindrical chamber (157) in response to a change-over signal of a valve switch (172) to sufficiently open filaments of the free yarn ends after being drawn and form entanglements to splice the yarn to each other, and said mechanism for fixing, said cutters (6, 7), said mechanism for arranging, and said splicing member (111) are successively operated by a mechanism having a plurality of cams driven by a pneumatic cylinder (103) which is one of driving means in accordance with the necessity. 50 55
7. A yarn splicing method including steps of drawing two yarn end portions to be spliced, cutting the two drawn portions of the yarn ends to a predetermined length, arranging the two drawn yarn ends in order, guiding the yarn ends into a yarn splicing member, and forming entanglements at both ends of the yarns by air flow, characterized in that, when a drawn yarn end is cut to a predetermined length, the drawn yarn end portion is cut in a rather loosened condition.

FIG. 1

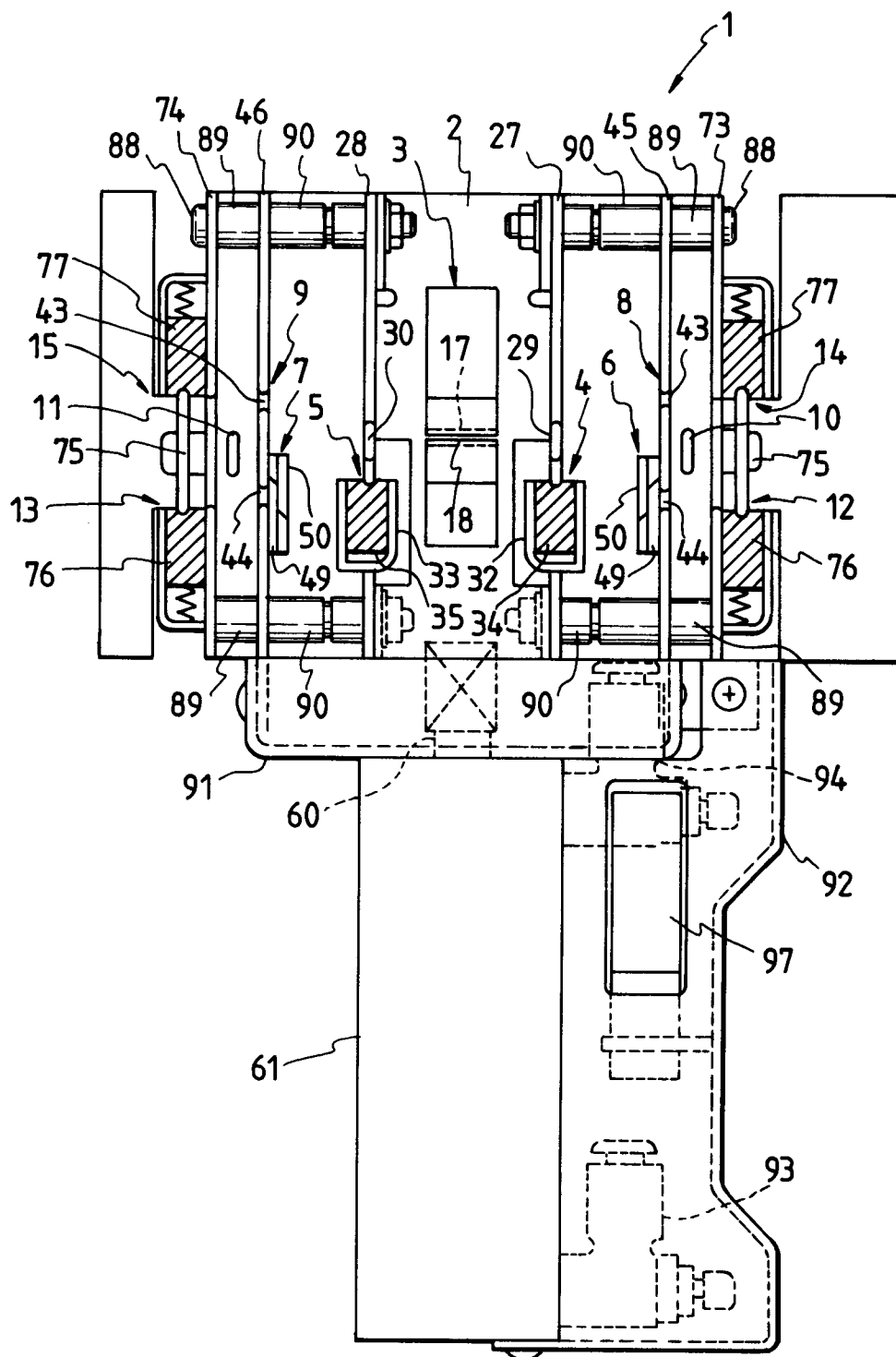


FIG. 2

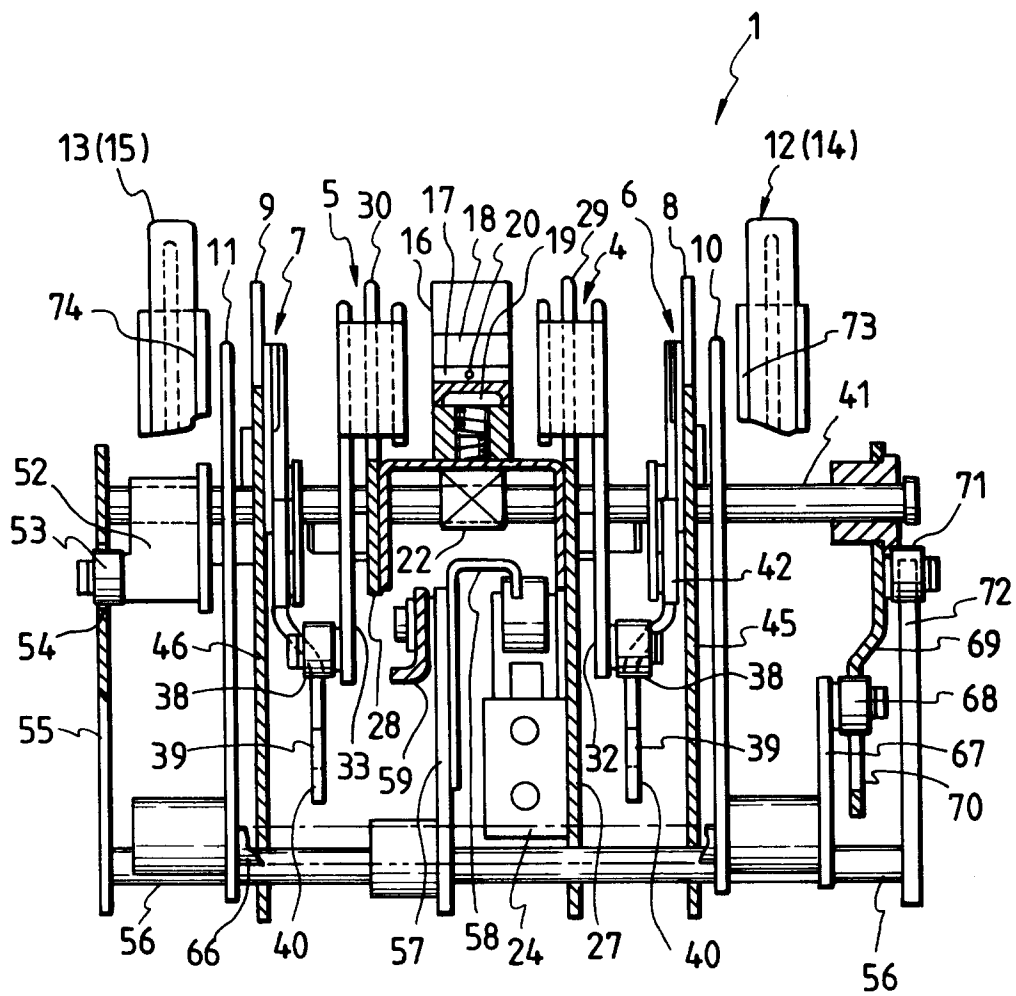


FIG. 3

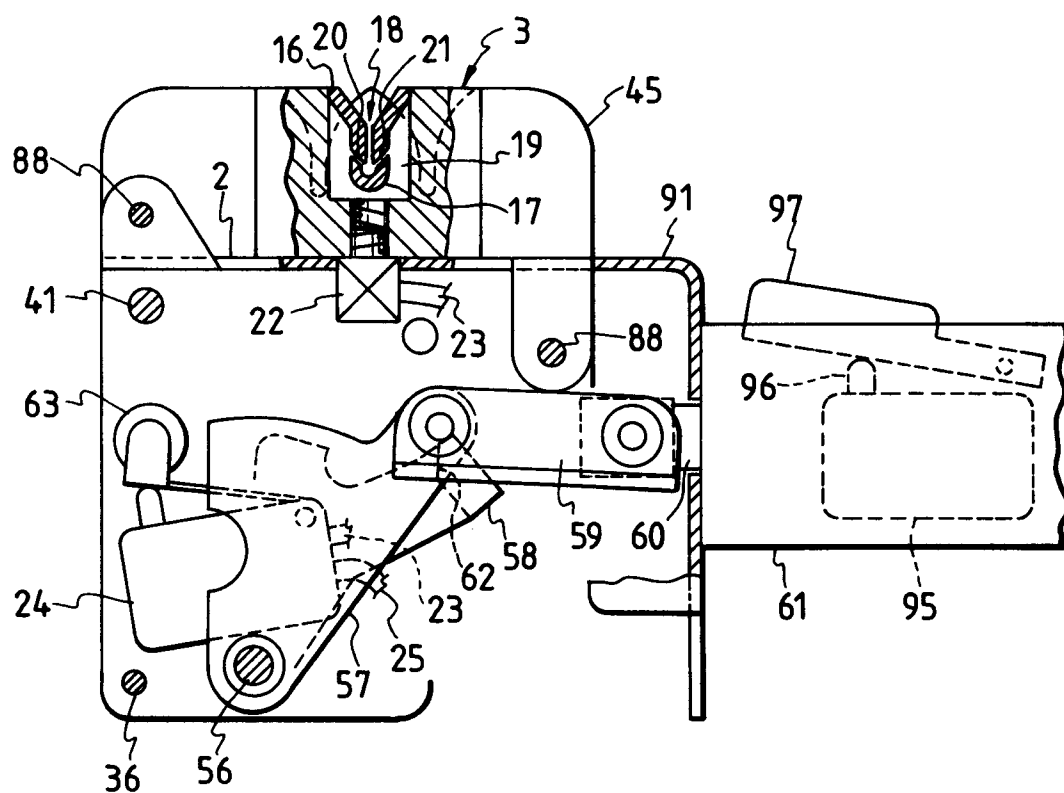


FIG. 4

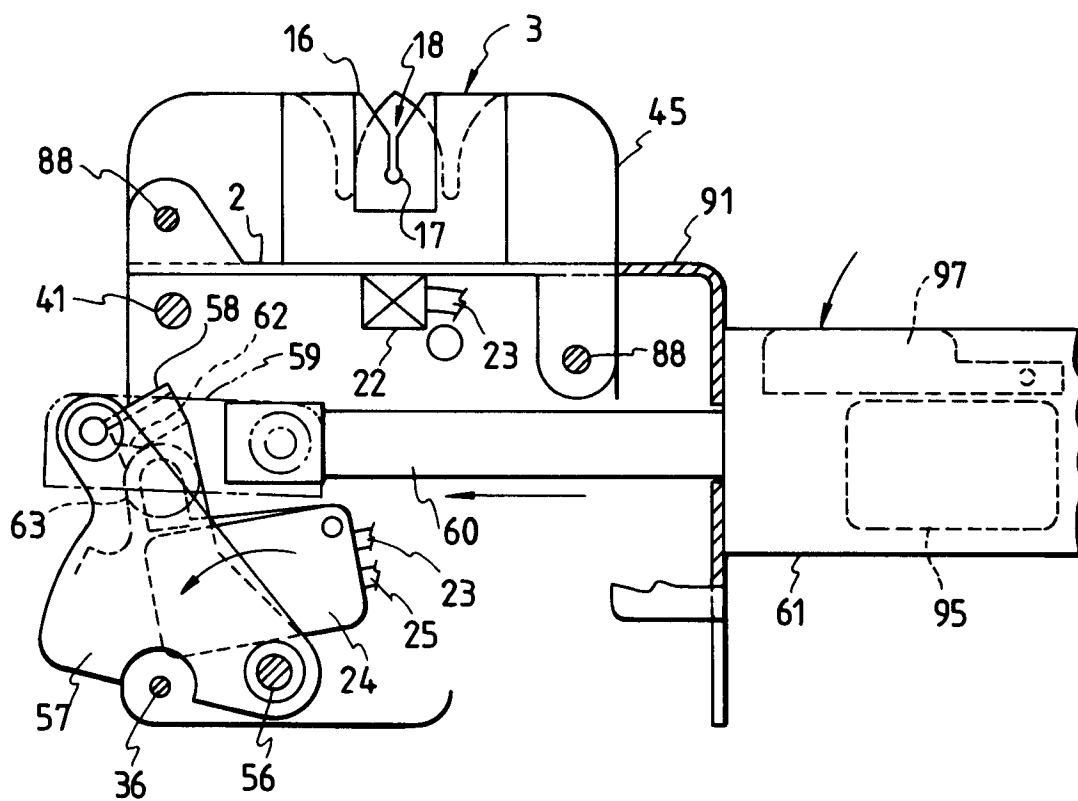


FIG. 5

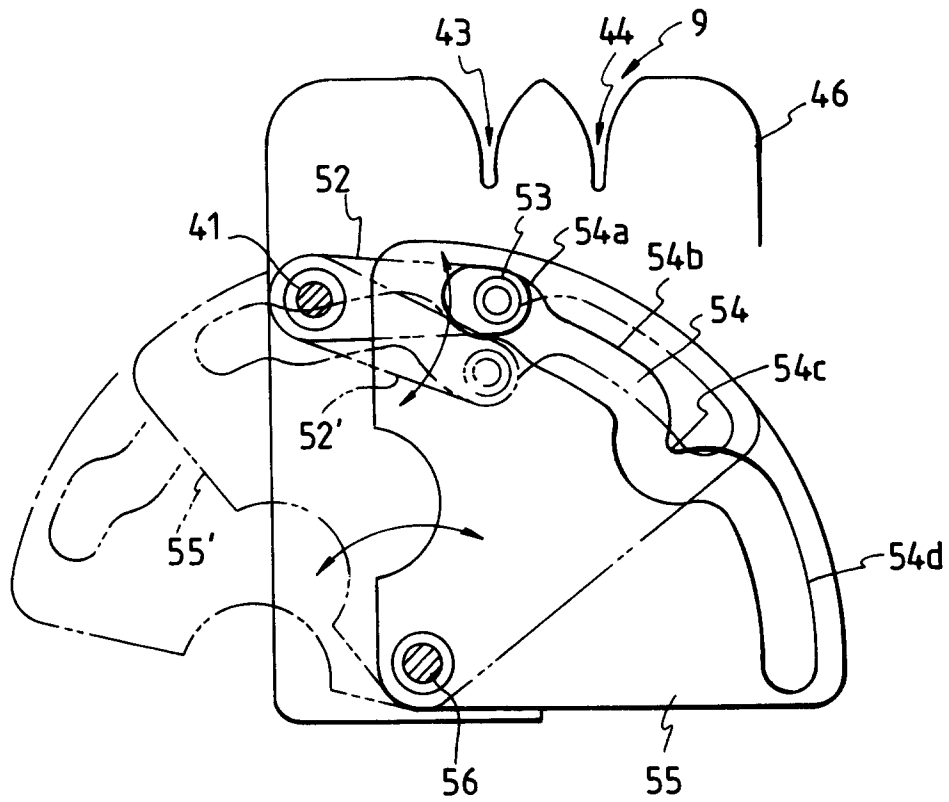


FIG. 6

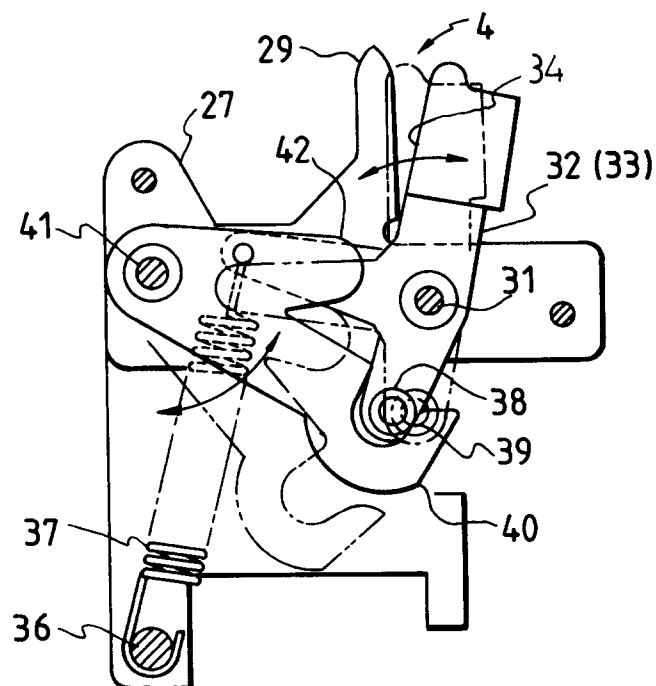


FIG. 7

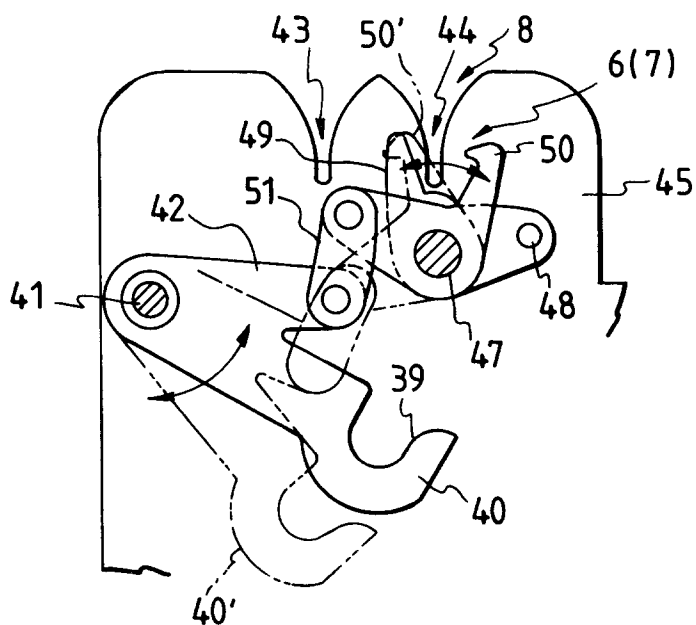


FIG. 8

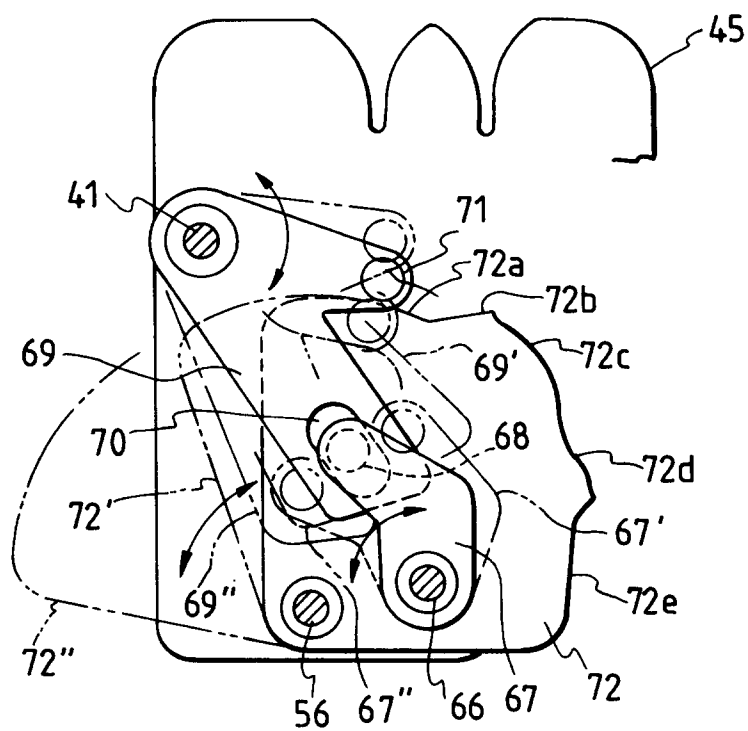


FIG. 9

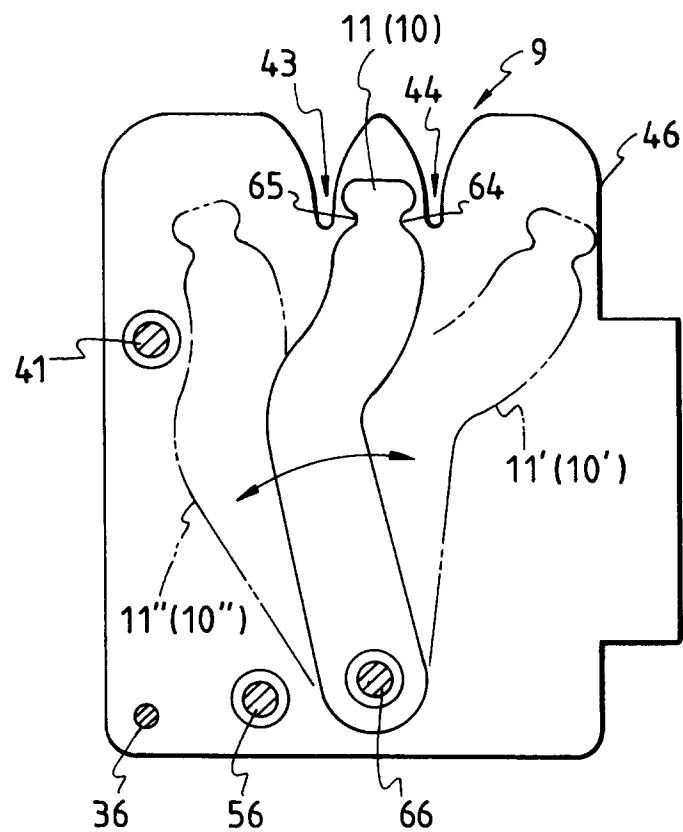


FIG. 10

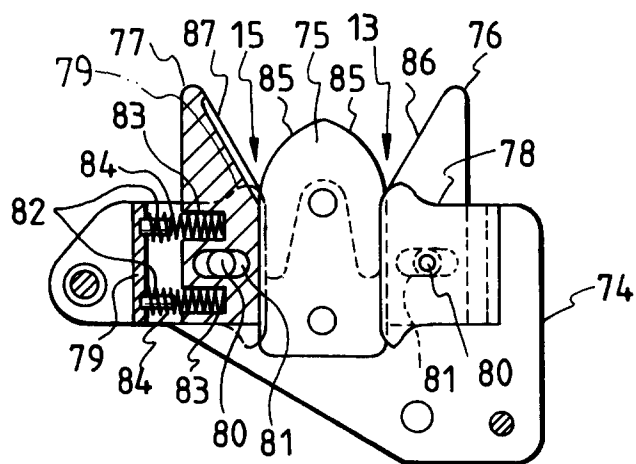


FIG. 11

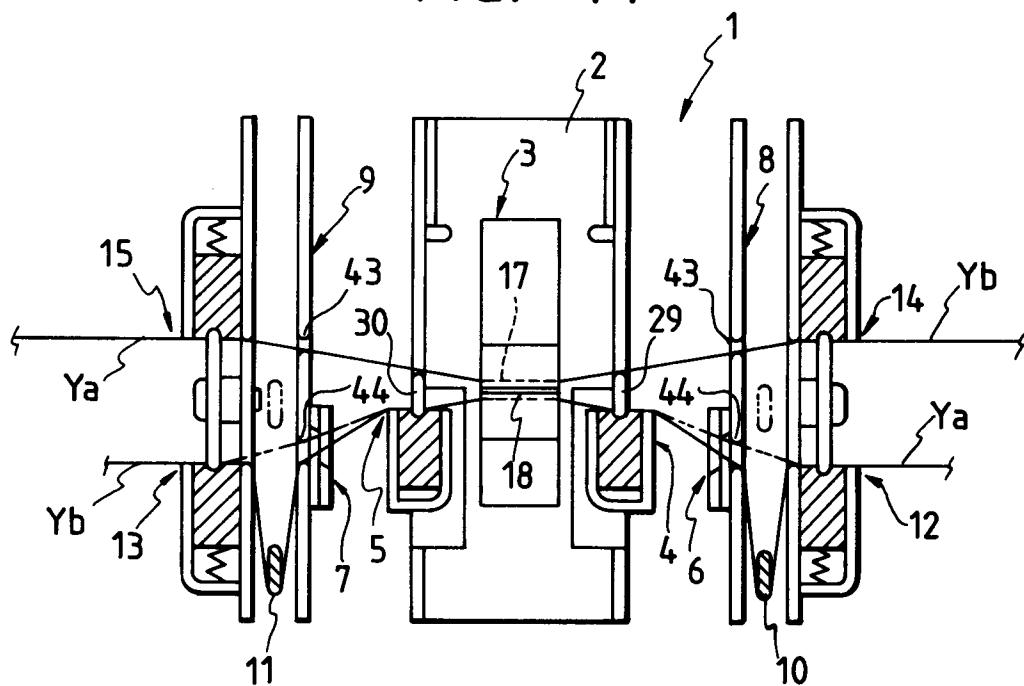


FIG. 12

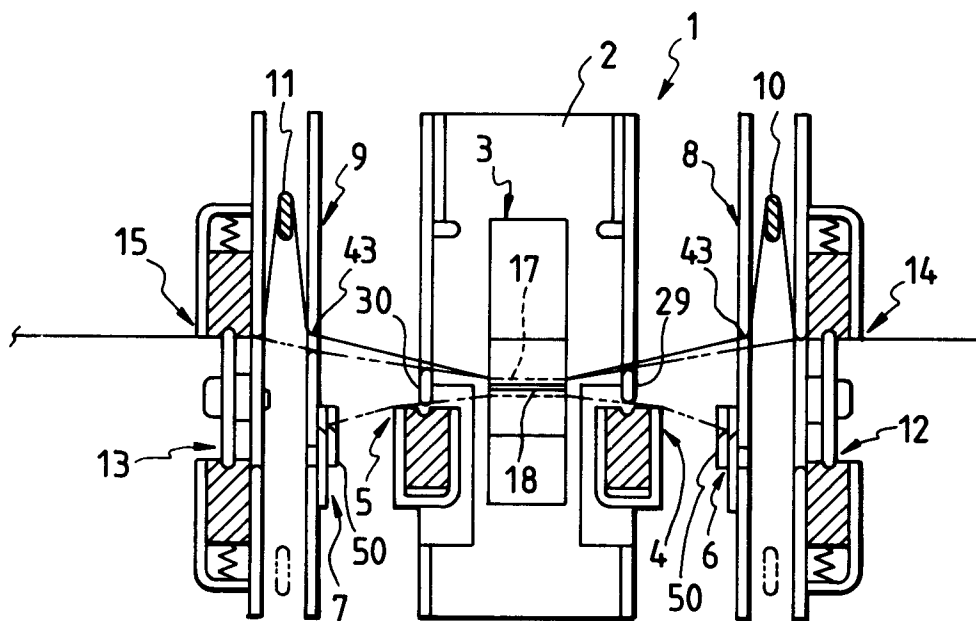


FIG. 13

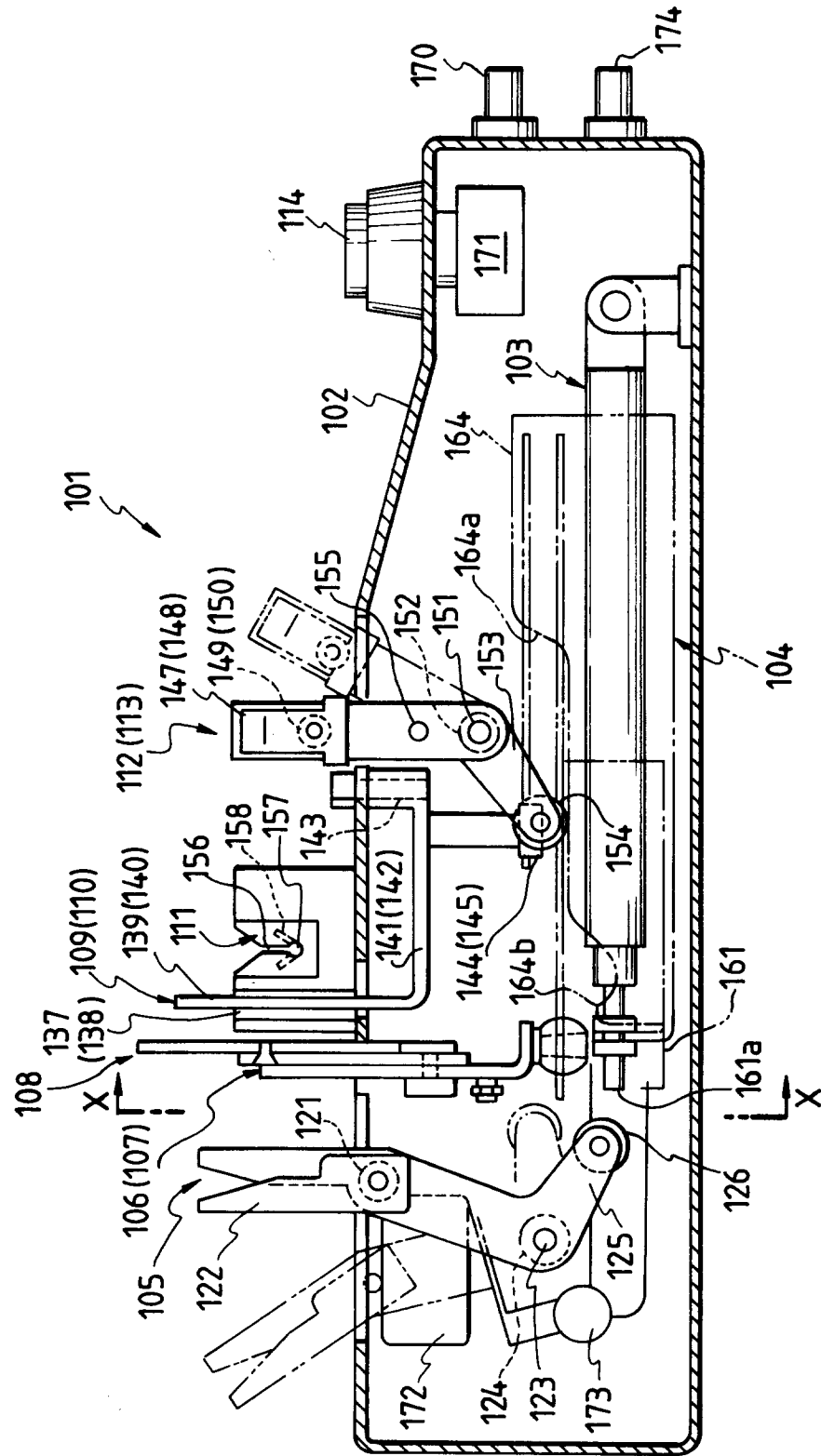


FIG. 14

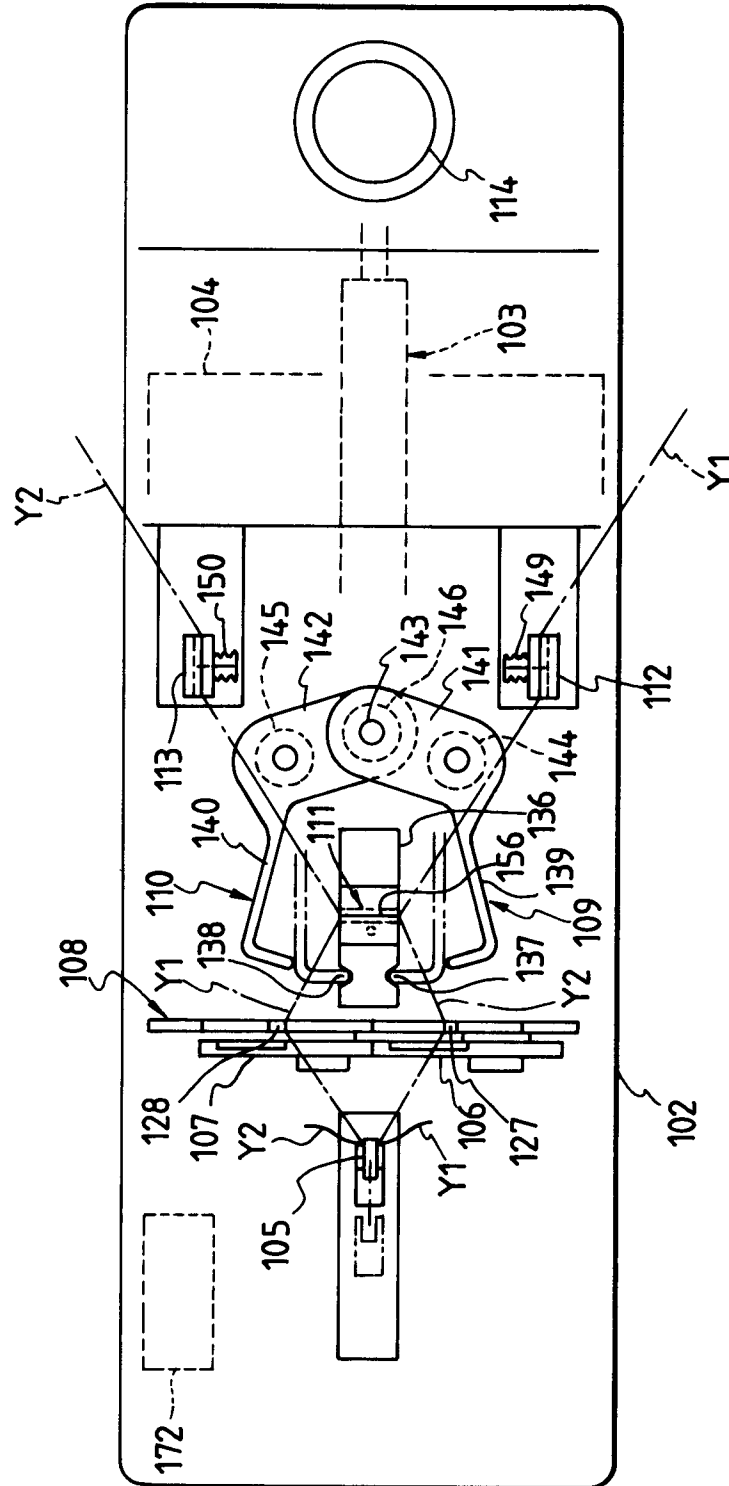


FIG. 15

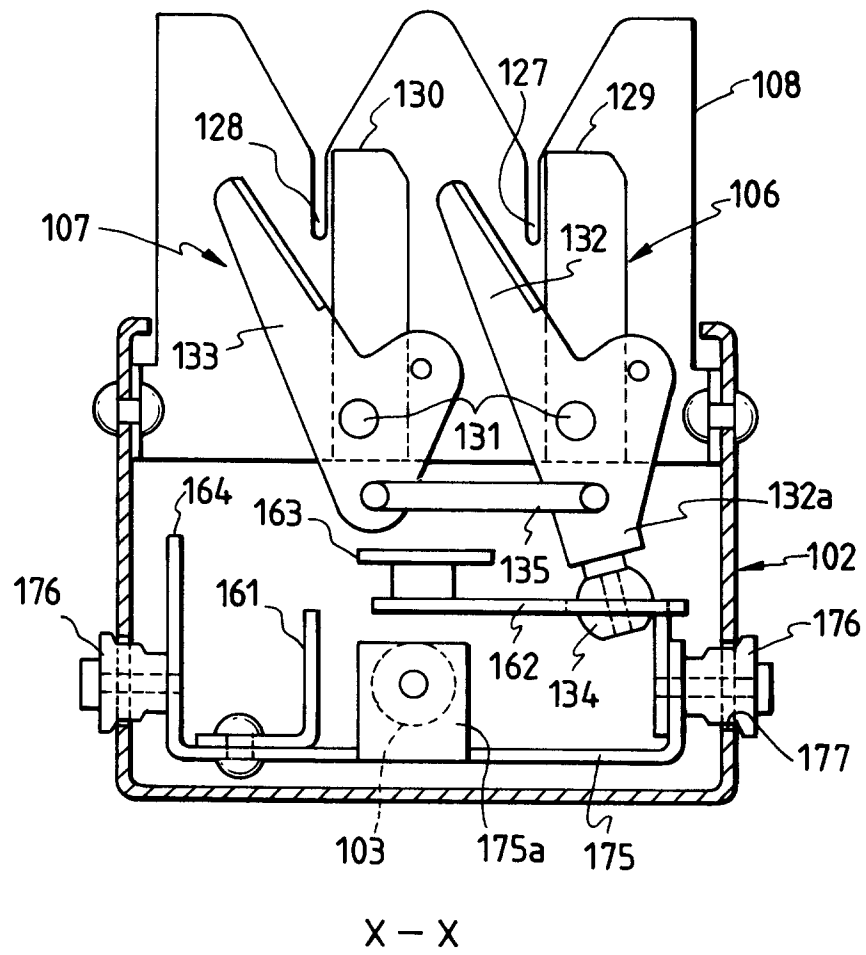


FIG. 16

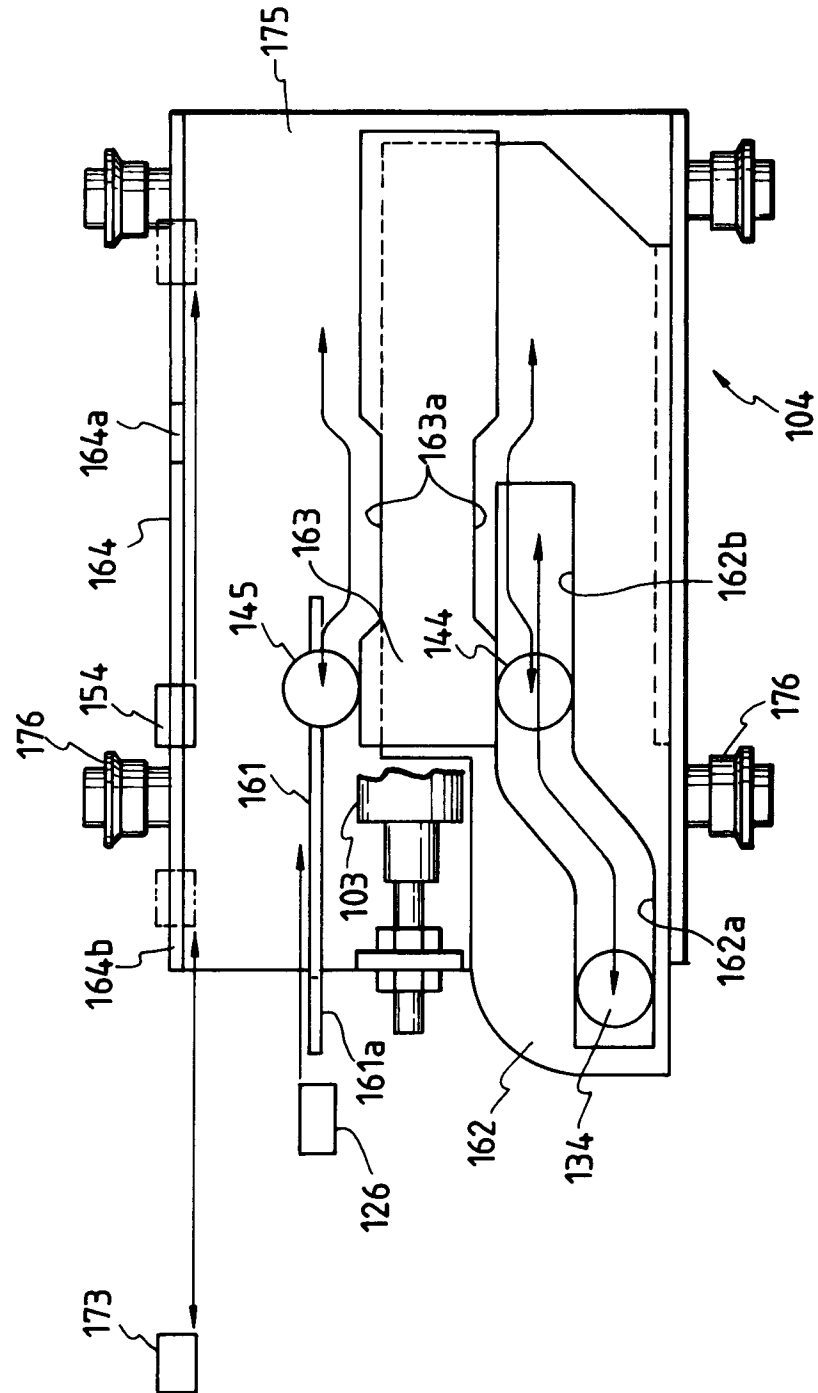


FIG. 17A

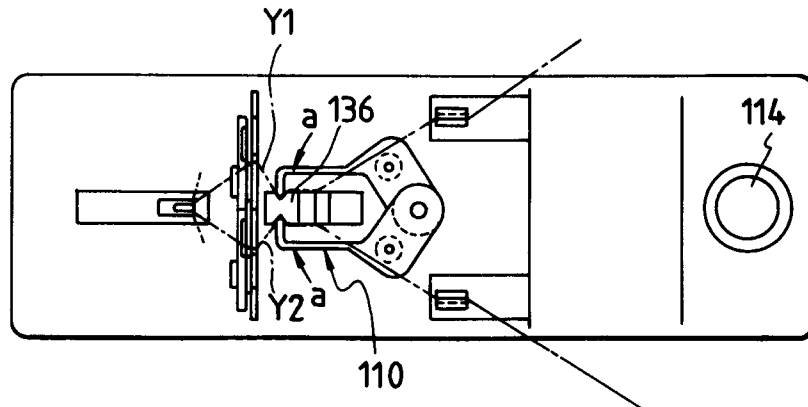


FIG. 17B

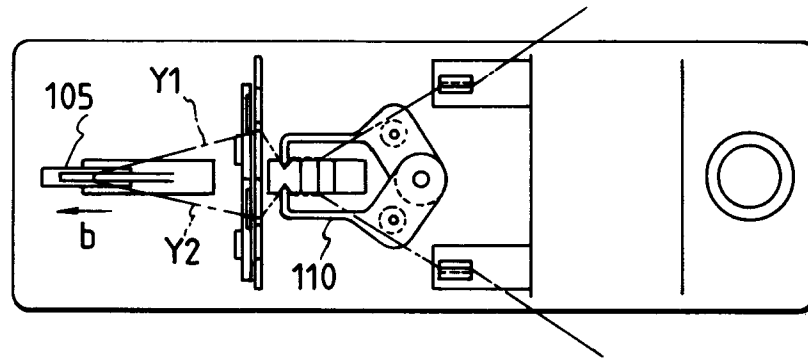


FIG. 17C

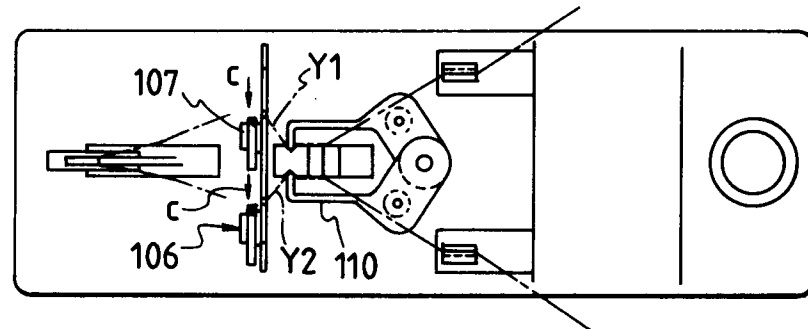


FIG. 17D

