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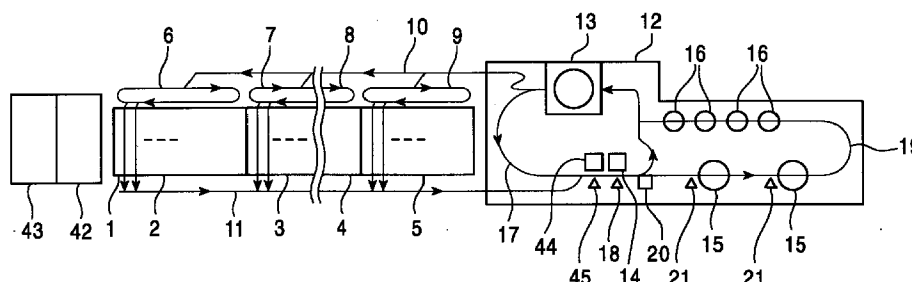
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(54) **Tray transfer system and tray storage apparatus**

(57) To store unwanted empty trays that may occur on a transfer path, as required to facilitate lot changes and to enable the number of trays to be adjusted optimally depending on the yarn count number or the winding speed. In a tray transfer system that supplies bobbins to an automatic winder composed of a plurality of winding units installed in parallel, a tray storage apparatus 15 for stacking a plurality of empty trays for stor-

age is located in the middle of an empty tray transfer path 19 in a bobbin processing section 12. When the lack of an installed bobbin in a bobbin installation apparatus 16 is detected, the tray storage apparatus 15 is activated to store all trays for a particular yarn type, these trays being transferred along the empty tray transfer path 19.

FIG. 1



EP 0 866 016 A2

Description

Field of the Invention

The present invention relates to a tray transfer system for supplying bobbins to an automatic winder composed of a plurality of winding units installed in parallel, as well as a tray storage apparatus used in the tray transfer system.

Background of the Invention

Conventionally, yarn produced by a spinning machine is generally wound around a yarn supplying bobbin (a bobbin for the spinning machine), which is rewound by an automatic winder in the subsequent step to obtain a package having a predetermined amount of yarn and a predetermined shape.

The automatic winder is composed of a plurality of winding units installed in parallel, and has a full bobbin input path on one side and an empty bobbin transfer path on the other side, each of the paths being laid along the corresponding winding unit. A tray for which rewinding has been completed by the winding unit is output from the winding unit, the empty bobbin is removed from the tray by a bobbin removal apparatus, and a yarn supplying bobbin is installed on the tray by a bobbin installation apparatus and supplied to the winding unit. In this manner, in a tray transfer system with the automatic winder, empty or full trays are constantly circulating along a predetermined transfer path.

In a conventional automatic winder, the winding unit section is divided into a plurality of zones so that different types of yarn supplying bobbins are rewound in the different zones. In this case, a circulating full bobbin input path is installed for each zone so that a yarn supplying bobbin for which the yarn end finding operation has been finished by a yarn end finding apparatus is supplied to a predetermined winding unit via the full bobbin input path corresponding to that type of the bobbin. In recent years, there has been an increasingly strong demand for high variety, low volume production in, for example, the wool industry, so the automatic winder is required to frequently change lots. When a lot is changed and when the yarn supplying bobbins of a certain type in the bobbin installation apparatus are used up, no yarn supplying bobbin of this type is installed and empty trays corresponding to this type are circulated idly on the transfer path.

When a large number of empty trays are circulated idly on the circulating transfer path, the extra operation of the yarn end finding apparatus or winding unit significantly affects the efficiency in transferring full trays, which are required by the winding units. In particular, as the number of remaining yarn supplying bobbins of a particular type to be rewound decreases, the number of empty trays and the amount of the useless operations of the yarn end finding apparatus and winding unit

increase.

In addition, the optimal number of trays that flow throughout the system varies with the yarn number count and the winding speed, thereby requiring the number of trays to be increased or reduced in keeping with production requirements. If an unnecessarily large number of trays are allowed to flow, transfer congestion may occur at junctions, thereby reducing the transfer efficiency.

This invention is designed to resolve these problem. It is an object of this invention to provide a tray transfer system capable of storing unwanted empty trays that may occur on the transfer path, as required, changing lots promptly, and optimally adjusting the number of trays depending on the yarn number count and the winding speed.

It is another object of this invention to provide a tray storage apparatus that can efficiently store and eject unwanted empty trays that may occur on the transfer path, as required, using a simple configuration and little small space.

Summary of the Invention

To achieve these objects, this invention provides a tray transfer system in which a bobbin installation apparatus for installing full bobbins on empty trays is disposed in front of a full-bobbin transfer path through which full bobbins are supplied to a plurality of winding units constituting an automatic winder, wherein a tray storage apparatus for stacking a plurality of empty trays for storage is disposed in the middle of a tray circulating transfer path that includes the winding units.

The tray storage apparatus may be provided on the transfer path along which only empty trays are transferred, and a plurality of empty trays may be stacked in the tray storage apparatus. When the absence of an installed bobbin in the bobbin installation apparatus is detected, the tray storage apparatus may be activated to store empty trays.

A tray storage apparatus according to this invention comprises a storage means for stacking a plurality of empty trays for storage and a lifting arm for stacking trays or sequentially ejecting the trays using the storage means, the apparatus includes a switching means for switching between the empty tray stacking operation and the ejecting operation depending on the presence of an empty tray that is lifted by the lifting arm.

The storage means is a locking jaw having a first side that enters a tray elevating path to lock trays and a second side that moves out from the tray elevating path to allow trays to be raised and lowered, the first and second sides being alternately formed in the direction of rotation so as to be supported in all directions. The switching means has two stable positions, including a position in which the first side is opposed to the elevating path in such a way that its upper and lower ends enter the elevating path, and a position in which the sec-

ond side is opposed to the elevating path in such a way that its upper end enters the elevating path, the switching means including an elastic holding mechanism using a rotation through a predetermined angle or more to rotate the rotating jaw from one of the stable positions to the other. The elastic holding mechanism for forming the two stable positions is constituted by shaping a rotating shaft for the locking jaw like a prism and allowing a plate spring to contact a surface of the prism.

Brief Description of the Drawings

Figure 1 is a schematic top view showing an overall configuration of a tray transfer system using an automatic winder according to this embodiment.

Figure 2 is a schematic side view showing an overall configuration of a tray storage apparatus located in the system in Figure 1.

Figure 3 is an explanatory drawing showing the starting condition of a storage operation.

Figure 4 is an explanatory drawing showing binges in the condition of the storage operation.

Figure 5 is an explanatory drawing showing the starting condition of an ejecting operation.

Figure 6 is an explanatory drawing showing changes in the condition of the ejecting operation.

Figure 7 is an explanatory drawing showing an operation for ejecting the last tray.

Detailed Description of the Preferred Embodiments

An embodiment of this invention is described below with reference to the drawings, but other embodiments are possible as long as they do not deviate from the spirits of this invention.

A tray transfer system using an automatic winder including a tray storage apparatus according to this invention is described with reference to Figure 1. In this description, the term "front" means the upper side of Figure 1, while the term "rear" means the lower side of this figure, and the term "right" means the right side of Figure 1, while the term "left" means the left side of the figure.

The automatic winder has a winding unit section 1 comprising a plurality of winding units installed in parallel to rewind yarn from yarn supplying bobbins (bobbins for the spinning machine) to packages having a predetermined amount of yarn and a predetermined shape. The winding unit section 1 is partitioned into four winding units 2 to 5 for yarn types A to D from left to right, and yarn supplying bobbins of types A to D are rewound in winding units 2 to 5, respectively.

Four full bobbin circulating paths 6 to 9 for yarn types A to D are located in front of winding unit sections 2 to 5 so as to correspond to the respective unit sections. Each of the full bobbin circulating paths 6 to 9 is connected to a full bobbin transfer passage 10 located along winding unit sections 2 to 5, and the upstream

end of the full bobbin input path 10 is connected to a yarn end finding apparatus 13, which is described below. In this configuration, a full bobbin that has been subjected to a yarn end finding operation at the yarn end finding apparatus 13 is supplied to a predetermined winding unit via the full-bobbin input path 10 and a particular full bobbin circulating path from among the full bobbin circulating paths 6 to 9.

An empty bobbin transfer path 11 is located behind the winding unit section 1 and along it so that an empty bobbin that has been rewound by the winding unit is returned to a bobbin processing section 12 described below. In addition, a blower box 42 and a control box 43 are located adjacent to the left of the winding unit section 1, and the bobbin processing section 12 for providing predetermined processing for each bobbin (tray) is located to the right of the winding unit section 1.

The yarn end finding apparatus 13, a remaining yarn removal apparatus 44, a bobbin removal apparatus 14, two tray storage apparatus 15, and four bobbin installation apparatuses 16 are located in the bobbin processing section 12. The yarn end finding apparatus 13 provides predetermined yarn end finding operations for full bobbins, and is composed of three stations including a bunch winding processing station, a back winding yarn processing station, and a yarn end finding station to finally remove the winding start point of the yarn and to insert the winding end point of the yarn into a top hole in the bobbin. If yarn end finding operation has been executed normally by the yarn end finding apparatus 13, the full bobbin is supplied to a predetermined winding unit via the full bobbin input path 10 and one of full bobbin circulating paths 6 to 9, as described above. If, however, the yarn end finding operation has failed, that full bobbin is again supplied to the yarn end finding apparatus 13 via a circulating path 17.

The empty bobbin transfer path 11 is combined with the middle of the circulating path 17. The remaining yarn removal apparatus 44 and the bobbin removal apparatus 14 are located on the downstream side of the junction of the circulating path 17 and the empty bobbin transfer path 11. The remaining yarn removal apparatus 44 has a sensor 45 for detecting the amount of yarn remaining in a bobbin in order to strip and remove the remaining yarn if it is very short. The bobbin removal apparatus 14 has a sensor 18 for determining whether the bobbin on the tray is full or empty in order to remove the empty bobbin from the tray based on the detection results.

An empty tray transfer path 19 branches from the circulating path 17 on the downstream side of the bobbin removal apparatus 14 and close thereto, and the tray storage apparatus 15 and the bobbin installation apparatus 16 are located on the empty tray transfer path 19. A gauge 20 that continues transferring full trays on the circulating path 17 while transferring empty trays to the empty tray transfer path 19 is located at the branching portion between the circulating path 17 and the

empty tray transfer path 19. Since the gauge 20 is located on the downstream side of the bobbin removal apparatus 14, only empty trays are supplied to the empty tray transfer path 19 without fail if a bobbin removal error occurs.

The tray storage apparatus 15 holds a plurality of empty trays above the empty tray transfer path 19 in such a way that they are stacked, and can sequentially stack empty trays from the transfer path 19 (a storage operation) and sequentially eject the stacked stored trays (an ejection operation). Each tray storage apparatus 15 has a type determination sensor 21, and particular trays are sequentially stacked in the predetermined tray storage apparatus 15 in response to the results of the determination. Various methods can be used to determine tray types, including determination based on the position of a groove formed on a side of the tray base and the reading of a marker or an information storage medium attached to the tray.

The four bobbin installation apparatuses 16 are continuously located in the transfer direction on the downstream side of the tray storage apparatus 15. Each installation apparatus 16 has a rotatable magazine (not shown in the drawing) for storing a plurality of installed bobbins, and the magazines are used for the yarn types A to D in the transfer direction (right to left). When a tray on the empty tray transfer path 19 passes through the bobbin installation apparatuses 16, the bobbin installation apparatus 16 corresponding to that type is activated to install that bobbin.

Although, according to this embodiment, the two tray storage apparatuses 15 are located if the automatic winder deals with four yarn supplying bobbin types, the number of tray storage apparatuses 15 may be changed as required, depending on the frequency of lot changes.

The downstream end of the empty tray transfer path 19 is again combined with the circulating path 17 on the downstream side of the bobbin installation apparatuses 16, and the yarn supplying bobbin installed by the bobbin installation apparatus 16 is transferred via the circulating path 17 to the yarn end finding apparatus 13, where it is subjected to yarn end finding operations.

As described above, in the tray transfer system according to this embodiment, the winding unit section 1, full bobbin circulating paths 6 to 9, full bobbin transfer path 19, empty bobbin transfer path 11, circulating path 17 and empty tray transfer path 19 constitute multiple circulating transfer paths, on which empty or full trays are for the most part constantly transferred (except those trays which are stored in the tray storage apparatus 15).

Next, the tray storage apparatus 15 is described in detail with reference to Figures 2 to 7.

A tray T has a peg extending vertically from the center of its disc-like base, and can be stacked on other trays T using the tip of the peg.

First, an overall configuration of the tray storage apparatus 15 is described with reference to Figure 2.

Figure 2 shows five empty stacked trays T wherein a cylindrical-shaped weight 22 having larger tiers at its top and bottom, that have diameters equal to that of tray T is placed on the top tray T. The weight 22 applies a sufficient weight to rotate a locking jaw 32 held elastically as described below against its elastic force in order to ensure an ejection operation even if only a few trays are remaining. The weight 22 uses a conical recessed portion formed in the bottom surface of the weight in order to center the top tray T, thereby all owing the trays T to be raised and lowered smoothly through a cylindrical guide body 31, which is described below.

The empty tray transfer path 19 is composed of a drive belt 23 and a guide 24, and a lifting arm 25 is located at the lifting position of the tray storage apparatus 15 to raise and lower the empty tray T, which is on the empty tray transfer path 19. The lifting arm 25 is composed of two plates 26 and 26 that sandwich the drive belt 23, and a supporting bracket 28 is fixed to the plate 26 which is closer to a body frame 27. The tip of a rod 30 running to a cylinder 29 attached to the body frame 27 in such a way that its axis extends in the vertical direction is fixed to the supporting bracket 28 so that the rod 30 moves back and forth to move the lifting arm 25 in the vertical direction. The moving stroke of the cylinder 29 is such that the upper end of the lifting arm 25 can rise above the locking jaw 32 described below. In addition, when the lifting arm 25 or the supporting bracket 28 is raised or lowered, it is prevented from interfering with the drive belt 23, guide 24, or body frame 27.

The transparent cylindrical guide body 31 having a vertical axis is disposed closer to the body frame 27 so as to be located directly above the lifting position of the empty tray transfer path 19. The inner diameter of the cylindrical guide body 31 is slightly larger than the outer diameter of the base of the tray T. The cylindrical guide body 31 is mounted on the body frame 27 via brackets as required in order to guide the stacked trays T in the vertical direction and to prevent the stacked trays from falling.

The locking jaw 32 that can be rotated to a position at which the tray T is locked or a position at which the tray T is ejected, a falling prevention member 37 for preventing the weight 22 located at the top from falling, and a switching means with an elastic holding mechanism, which is described below, are located at the lower end of the cylindrical guide body 31 and opposite to the body frame 27. A rotating shaft 33 for the locking jaw 32 is formed into a prism with a square cross section, and a plate spring 34 consisting of a pair of elastic plates abutting the corresponding surface of the prism is placed diagonally above the rotating shaft 33. Due to the action of the plate spring 34, the locking jaw 32 has four stable positions (positions in which that condition can be held stably under no external force) every 90 degrees (°) in the direction of rotation. Due to the elastic holding mechanism constituted by forming the rotat-

ing shaft 33 of the locking jaw 32 into a prism, the surfaces of which are abutted by the plate spring 34, the locking jaw 32 is held elastically in one of the four positions under no external force.

The locking jaw 32 is formed of a single metal plate and comprises two first sides 35 that are each tapered from their middle and that each have at their respective ends protruding portions with different amounts of protrusion, and two second sides 36 that each form a straight line so that the first and second sides are alternately provided. That is, the first side 35 enters an elevating path of the tray T to block the descent of the tray T and lock it, while the second side 36 moves out from the elevating path of the tray T and allows the tray T to slide upward or downward along the second side 36. The four stable positions are composed of two first and two second positions that are alternately disposed every 90° in the direction of rotation. In a first stable position, the first side 35 is opposed to the elevating path of the tray T in such a way that its upper end 35a and lower end 35b enter the elevating path of the tray T. In a second stable position, the second side 36 is opposed to the elevating path of the tray T in such a way that its upper end 36a (corresponding to the lower end 35b of the first side 35) enters the elevating path of the tray T. When located in the first or second stable position and rotated through a predetermined angle or more against the elastic holding force of the plate spring 34 by the elevating or lowering tray T, the locking jaw 32 is rotated from one of the stable positions to the other. The elevating path of the tray T is a region through which the tray T lifted by the lifting arm 25 passes and which is shaped like a cylinder formed by extending the cylindrical guide body 31 on to the empty tray transfer path 19.

The falling prevention member 37 that can oscillate between a state in which it enters the elevating path of the tray T and a state in which it moves out from the elevating path of the tray T is placed slightly above the locking jaw 32. The falling prevention member 37 has an abutting surface 38 and a locking section 39 and is constantly urged by a spring 40 in the direction in which it enters the elevating path of the tray T. If there is no tray T or weight 22 in the elevating path of the tray T at the height corresponding to the abutting surface 38, the abutting surface 38 and locking section 39 of the falling prevention member 37 enter the elevating path of the tray T. Notches (not shown in the drawings) are formed in the cylindrical guide body 31 constituting the elevating path of the tray T in order to allow the locking jaw 32 and the falling prevention member 37 to enter the elevating path of the tray T.

In addition, a guide surface 41 that continues from the inner circumferential surface of the cylindrical guide body 31 is formed opposite to the locking jaw 32. The guide surface 41 guides the elevating or lowering tray T in the vertical direction and sandwiches and holds the tray T between itself and the locking jaw 32. The lower end of the guide surface 41 is slightly tapered to allow

the elevating tray T to enter at the height of the guide surface 41 easily.

As described above, the tray storage apparatus 15 comprises the storage means having the locking jaw 32 at its lower end to store a plurality of trays T, and the lifting arm 25 that stacks the trays T or sequentially ejects the trays T using the storage means. The storage means in the tray storage apparatus 15 has, in addition to the locking jaw 32, cylindrical guide body 31, plate spring 34, falling prevention member 37, and guide surface 41.

The storing and ejecting operations of the tray storage apparatus 15 are described with reference to Figures 3 to 7.

First, a stopper (not shown in the drawings) stops and positions the tray T at the lifting position, and the lifting arm 25 lifts the tray T on the empty tray transfer path 19, as shown in Figure 3. The weight 22 is placed in the cylindrical guide body 31 in advance in such a way that its large diameter portion engages the locking section 39 of the falling prevention member 37. In addition, although in Figure 3, the locking jaw 32 is in its first stable position, it may be in its second stable position as the initial state of the storage operation.

Before the tray T in the position shown in Figure 3 is lifted above the locking jaw 32, the locking jaw 32 is rotated counterclockwise in the figure through a predetermined angle because the elevating tray T is caught on the locking jaw 32. Specifically, the tray T is caught on the elevating path side end of the second side 36 of the locking jaw 32 from below, then rises along the second side 36 (see Figure 4A), and is finally lifted above the locking jaw 32 (see Figure 4B). At this point, due to the action of the elastic holding mechanism the locking jaw 32 is in its second stable position in which the second side 36 is opposed to the elevating path in such a way that its upper end 36a enters the elevating path.

When the lifting arm 25 is then lowered, the lowering tray T is caught on the elevating path side end of the first side 35 of the locking jaw 32 (see Figure 4C) from above and then rotated counterclockwise in the figure through a predetermined angle as the tray T descends further. Once the tray T has descended to slightly above the rotating shaft 33, since the minimum interval between the first side 35 and the guide surface 41 is set smaller than the diameter of the tray T, the tray T is sandwiched and held between the locking jaw 32 and the guide surface 41 immediately before the locking jaw 32 is placed in its first stable position (see Figure 4D). In this state, the tray T is engaged with the locking jaw 32 and the lower end 35b of the first side 35, which is now protruding into the elevating path of the tray T, prevents the tray T from falling.

If there is a tray T on the lifting arm 25 as it rises, one set of raising and lowering operations of the lifting arm 25 enables the tray T to be stored. The second and subsequent trays T can be stored in the same manner.

The ejection operation, which is performed if there

are two stacked trays, is now explained.

First, the elevation of the lifting arm 25 is started with no tray T loaded, as shown, in Figure 5. When the lifting arm 25 rises above the locking jaw 32, the two stacked trays and the weight 22 are lifted above their holding positions to release the external force from the locking jaw 32, thereby allowing the locking jaw 32 to be placed in the first stable position due to the action of the elastic holding mechanism (see Figure 6A). When the lifting arm 25 is then lowered, the descending tray T is caught on the elevating path side end of the second side 36 from above to rotate the locking jaw 32 clockwise in the figure through a predetermined angle. The tray T then descends along the second side 36 (see Figure 6B), and once it has slightly passed the rotating shaft 33, the locking jaw 32 is placed in the second stable position prior to the tray T located above (see Figure 6C). As the lifting arm 25 descends further, the bottom tray T is lowered below the locking jaw 32 and down to above the empty tray transfer path 19, and the second tray T from the bottom is locked and held by the locking jaw 32 as in the storage operation (see Figure 6D).

If there is no tray T on the lifting arm 25, one set of rising and descending operations of the lifting arm 25 enables only the bottom tray T to be ejected onto the empty tray transfer path 19.

The operation performed to eject the top tray T (the last one) is now described.

If only one tray T is stored, the weight 22 placed on the tray T does not abut the abutting surface 38 of the falling prevention member 37, which thus enters the elevating path of the tray T. The lifting arm 25 with no tray T placed thereon is then elevated (see Figure 7A). When the lifting arm 25 rises above the locking jaw 32, the locking jaw 32 becomes free from the external force and is placed in the first stable position due to the action of the elastic holding mechanism. The large diameter portion of the weight 22 abuts the abutting surface 38 of the falling prevention member 37, which is then moved out from the elevating path of the tray T (see Figure 7B). When the lifting arm 25 is then lowered, the tray T descends along the second side 36 of the locking jaw 32 as in the ejection operation described above (see Figure 7C). Only one tray remains but the weight 22 applies a sufficient weight to rotate the locking jaw 32. When the lifting arm 25 is further lowered, the large diameter portion engages the locking section 39 to prevent the weight 22 from falling, enabling only the tray T to be ejected (see Figure 7D).

Since the weight 22 is located at the top, the ejection operation can be reliably performed even if the weight of the tray is insufficient to rotate the locking jaw 32 against the elastic force of the plate spring 34. In addition, since the falling prevention member 37 is located above the locking jaw 32, the weight 22 is prevented from falling even when the top tray T is ejected.

When a sensor (not shown in the drawings) located in the bobbin installation apparatus 16 to detect whether

or not a yarn supplying bobbin is present detects the absence of a yarn supplying bobbin to be placed on the tray T, the tray storage apparatus 15 configured as described above is automatically activated and stores all trays T for a particular yarn type which are subsequently transferred along the empty tray transfer path 19. In addition, operation buttons (not shown in the drawings) for the tray storage apparatus 15 are installed at appropriate positions in the bobbin processing section 12 to allow the operator to instruct the tray storage apparatus 15 to perform the storing and ejecting operations as required.

In the tray storage apparatus 15 according to this embodiment, the switching means including the elastic holding mechanism that elastically holds the prismatic rotating shaft 33 of the locking jaw 32 allows the locking jaw 32 to have a number of stable positions (four), and after the tray T has been lifted up to the top position (above the locking jaw 32), the switching means switches between the first stable position in which the descending tray T is ejected by the locking jaw 32 and the second stable position in which the descending tray T is locked by the first side 35 for storage, depending on whether or not the tray T lifted by the lifting arm 25 is caught on the locking jaw 32. Thus, one set of rising and descending operations of the lifting arm 25 within the same stroke enables a desired operation (stacking or ejection) to be performed without providing a special drive mechanism for switching the stable positions of the locking jaw 32 or a sensor for detecting the presence or height of the tray T on the lifting arm 25.

In addition, since the trays T are stacked and held above the empty tray transfer path 19 and only the empty trays T are transferred along the empty tray transfer path 19, the holding position provided by the locking jaw 32 can be set as low as possible unless the empty tray T interferes with this position, thereby reducing the elevating stroke of the lifting arm 25 during stacking and ejection to enable prompt storing and ejecting operations.

According to the invention, since unwanted empty trays can be stacked and stored in the tray storage apparatus as required, lots can be changed promptly and an optimal number of trays can be provided depending on the yarn number count or the winding speed, thereby enabling trays to be transferred efficiently. In addition, since the tray storage apparatus allows a plurality of trays to be stacked and stored, little plane space is required to store the trays, thereby allowing this apparatus to be easily integrated into any tray transfer system.

According to the invention, since only empty trays are transferred to the position at which the tray storage apparatus is installed, stacked trays can be stored at a low position without the need to consider the interference of full trays, thereby enabling the storage and ejecting operations to be preformed promptly between the transfer path and the storage position.

According to the invention, because the storage operation of the tray storage apparatus begins when the lack of an installed bobbin in the bobbin installation apparatus is detected, the tray storage apparatus can be automatically activated during a lot change without the need for manual intervention.

According to the invention, since the operation of the locking jaw is automatically switched in response to the presence of a tray on the lifting arm, the operator need not switch between the stacking or ejecting operation. Thus, only one set of raising and lowering operations of the lifting arm within the same stroke enables a desired operation to be selected to enable prompt stacking or ejection.

According to the invention, because the operation can be mechanically switched by shaping the locking jaw appropriately and setting the stable positions of the locking jaw appropriately, the switching means can be configured simply.

According to the invention, the elastic holding mechanism can be configured simply compared to, for example, a positioning mechanism using a combination of a rotating cam and a cam follower.

Claims

1. A tray transfer system in which a bobbin installation apparatus for installing full bobbins on empty trays is disposed in front of a full bobbin transfer path through which bobbins are supplied to a plurality of winding units constituting an automatic winder, characterized in that a tray storage apparatus for stacking a plurality of empty trays for storage is disposed in the middle of a tray circulating transfer path including said winding units.
2. A tray transfer system as in claim 1 wherein said tray storage apparatus is provided on a transfer path along which only empty trays are transferred and wherein a plurality of empty trays are stacked in said tray storage apparatus.
3. A tray transfer system as in claim 1 or claim 2 wherein when the lack of an installed bobbin in said bobbin installation apparatus is detected, and said tray storage apparatus is activated to store empty trays.
4. A tray storage apparatus comprising a storage means for stacking a plurality of empty trays for storage, and a lifting arm for stacking trays or sequentially ejecting the trays using the storage means, the apparatus including a switching means for switching between said empty tray stacking operation and said ejecting operation depending on the presence of an empty tray that is lifted by said lifting arm.
5. A tray storage apparatus as in claim 4 wherein said storage means is a locking jaw having a first side that enters a elevating path of the tray to lock trays and a second side that move out from the tray transfer path to allow trays to be raised and lowered, the first and second sides being alternately formed in the direction of rotation so as to be supported in all directions, and wherein said switching means has two stable positions, including a position in which said first side is opposed to said elevating path in such a way that its upper and lower ends enter said elevating path, and a position in which said second side is opposed to said elevating path in such a way that its upper end enters said elevating path, said switching means including an elastic holding mechanism that rotates through a predetermined angle or possibly more to rotate said rotating jaw from one of the stable positions to the other.
6. A tray storage apparatus as in claim 5 wherein said elastic holding mechanism for forming said two stable positions is constituted by shaping a rotating shaft for said locking jaw like a prism and allowing a plate spring to contact a surface of the prism.

FIG. 1

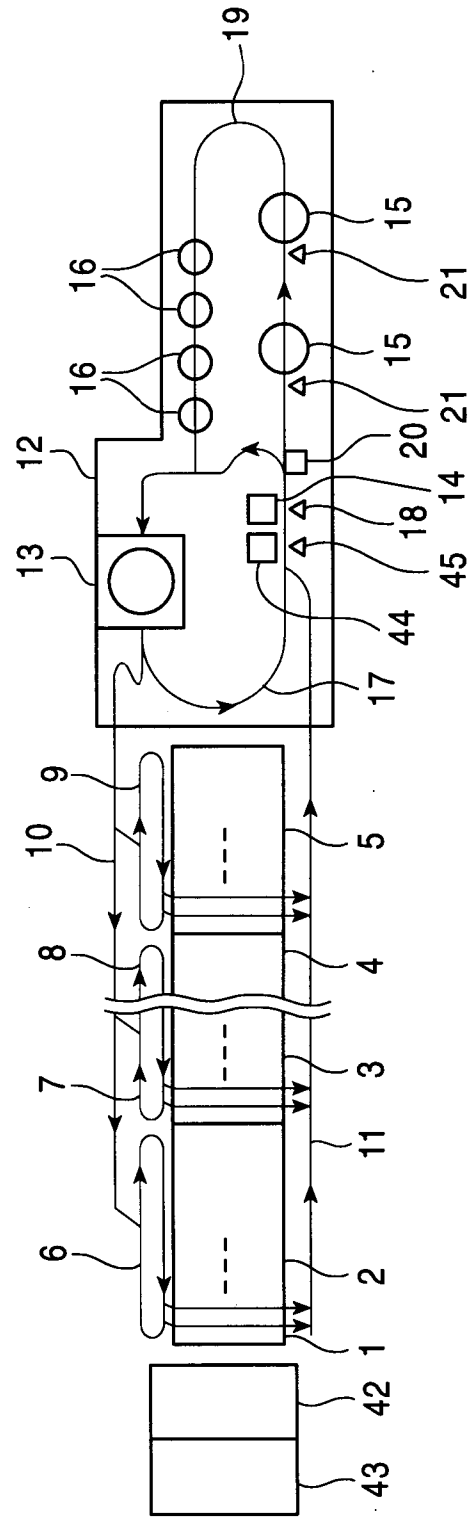


FIG. 2

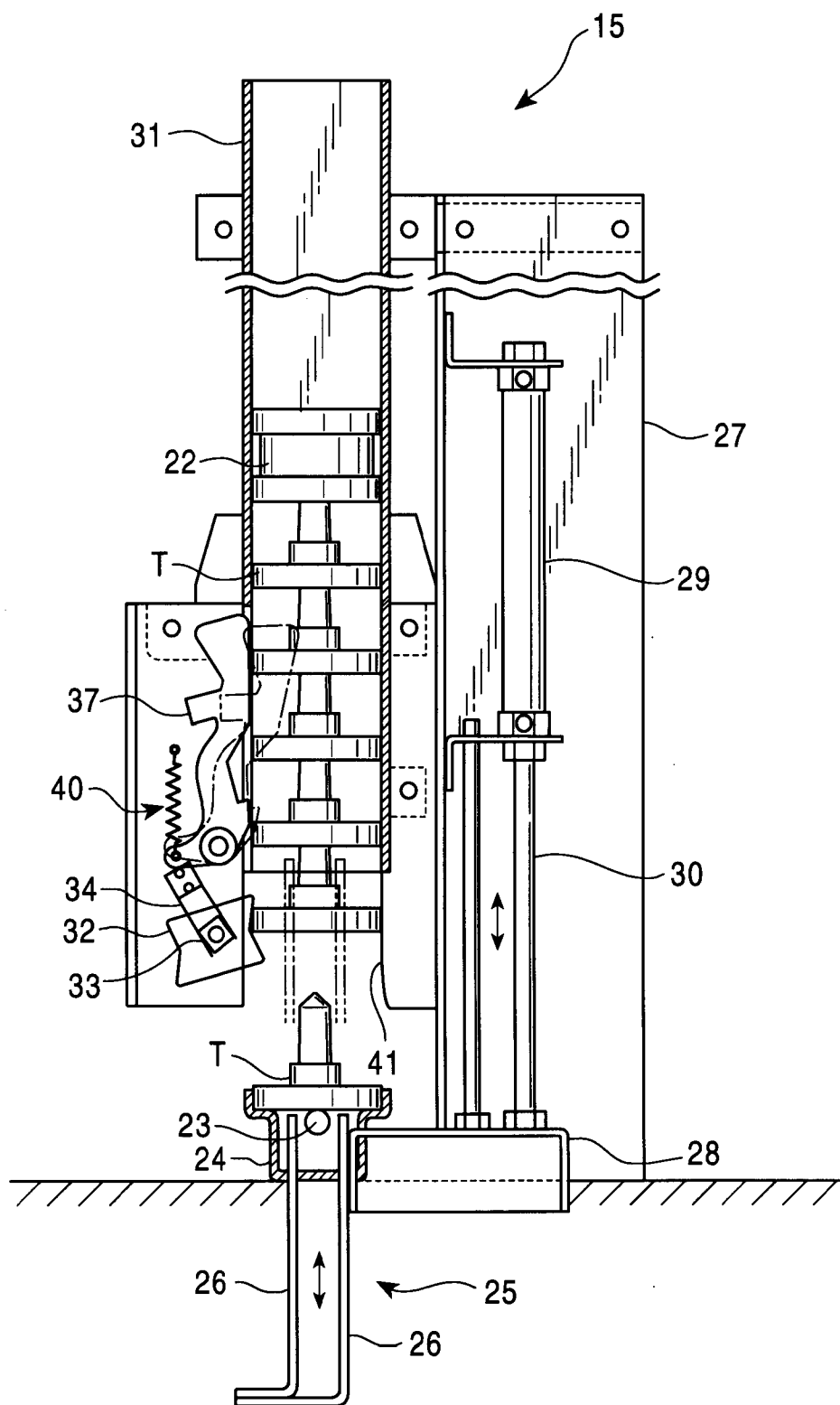


FIG. 3

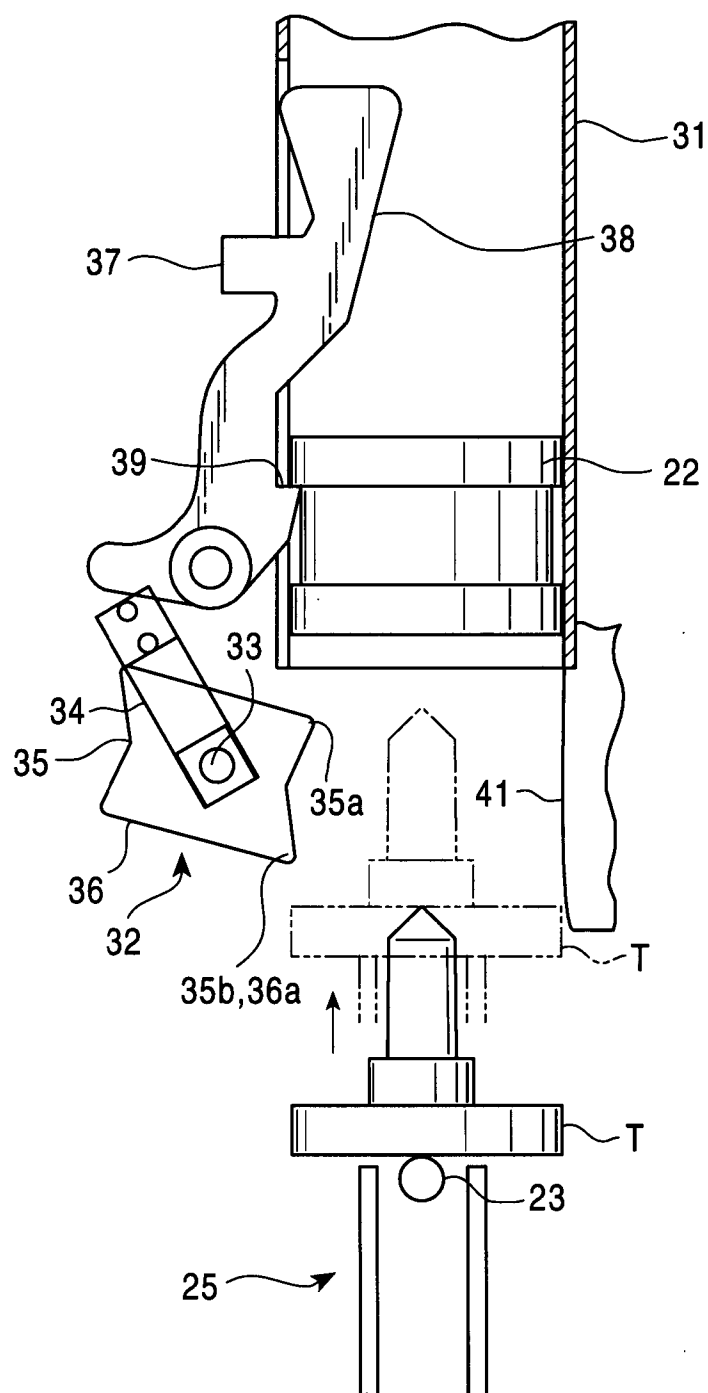


FIG. 4A

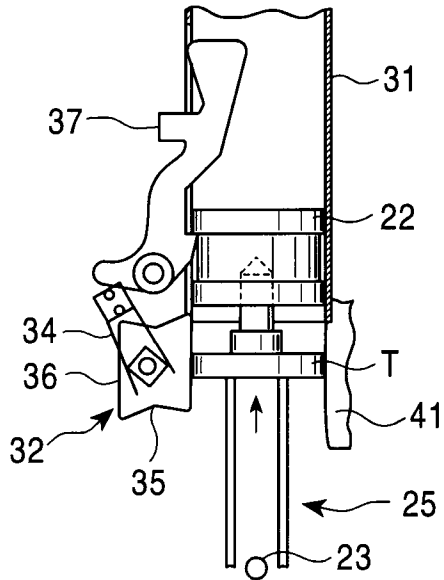


FIG. 4B

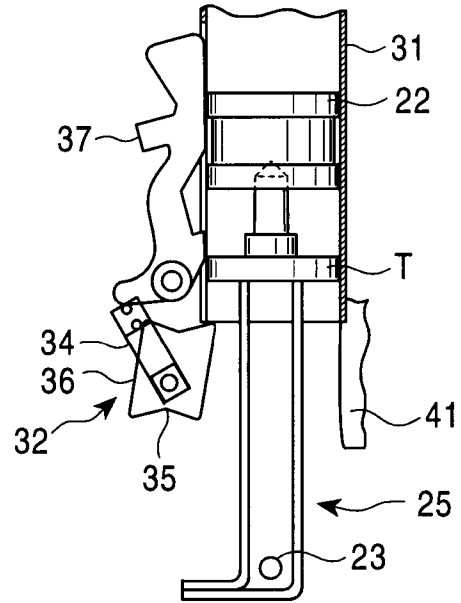


FIG. 4C

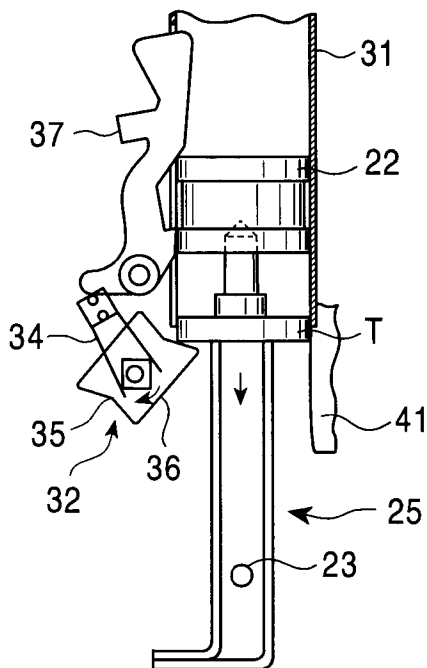


FIG. 4D

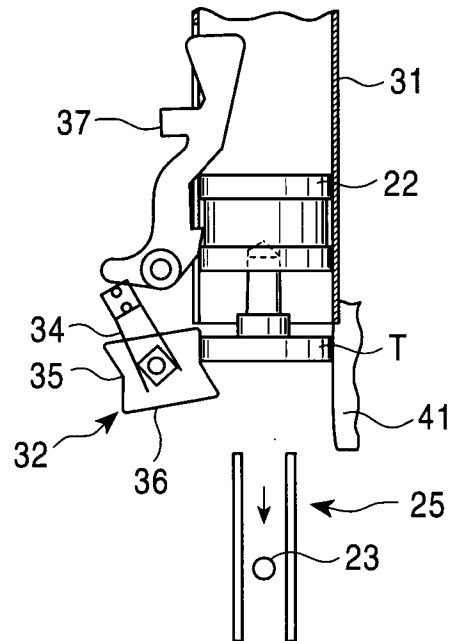


FIG. 5

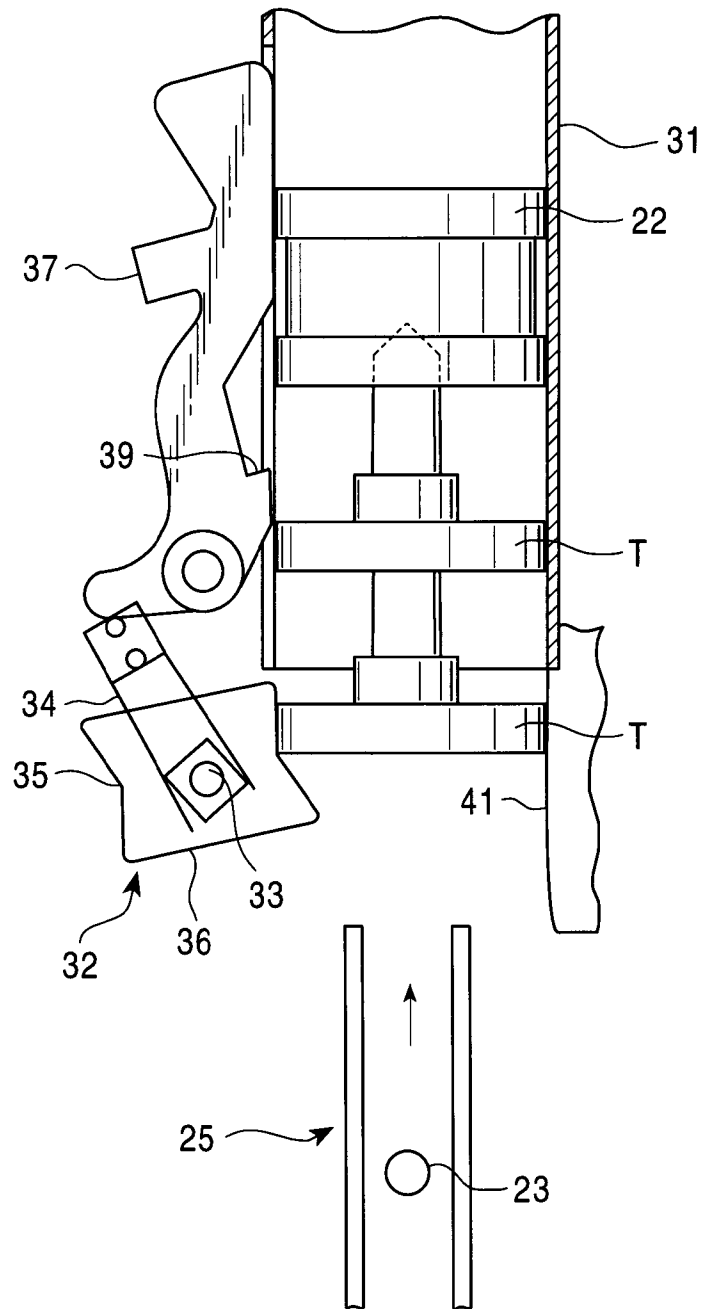


FIG. 6A

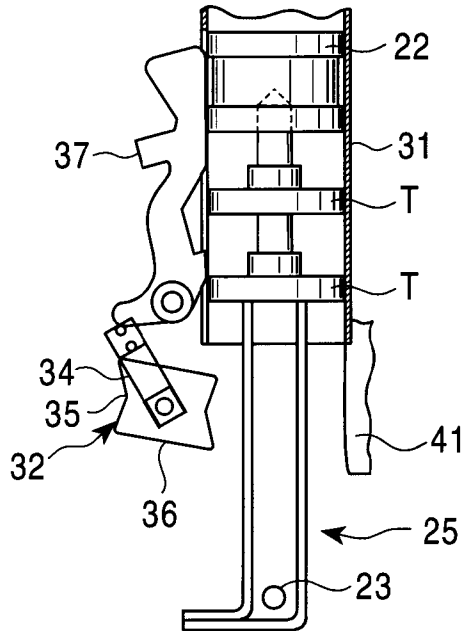


FIG. 6B

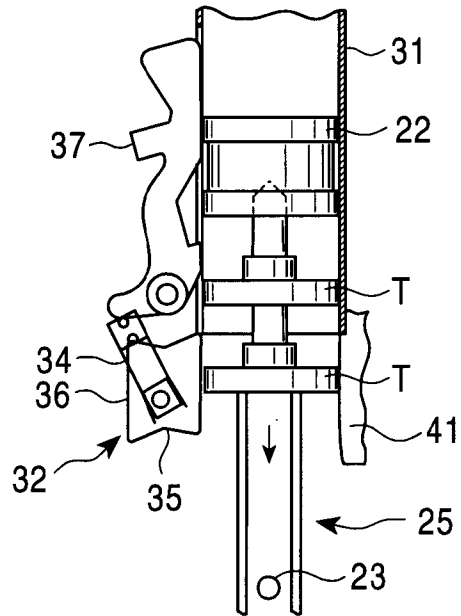


FIG. 6C

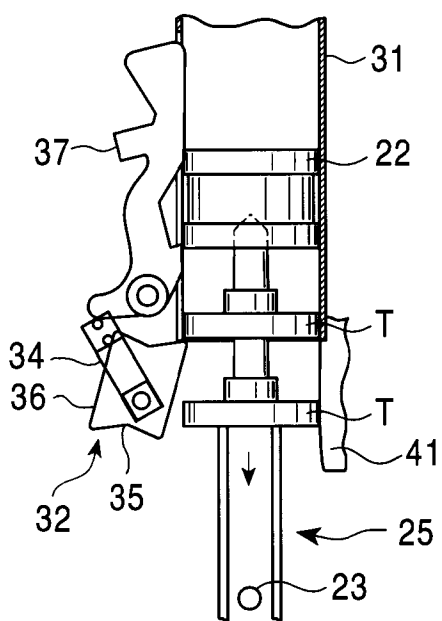


FIG. 6D

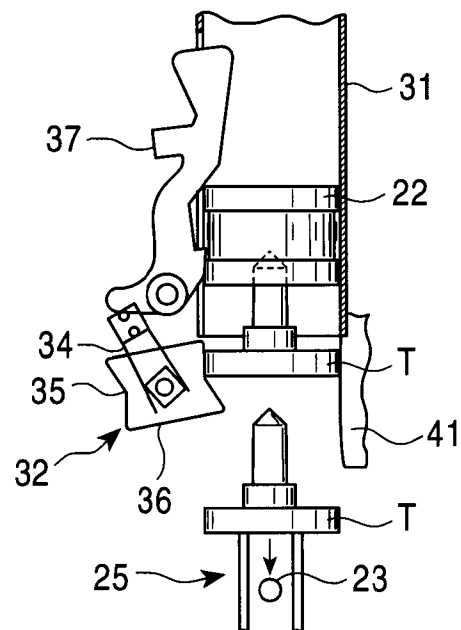


FIG. 7A

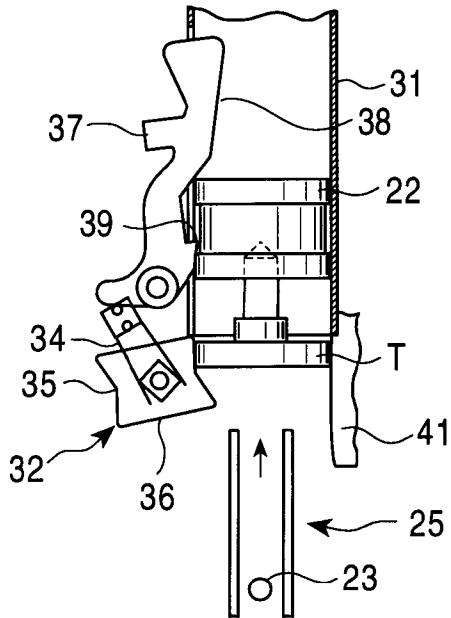


FIG. 7B

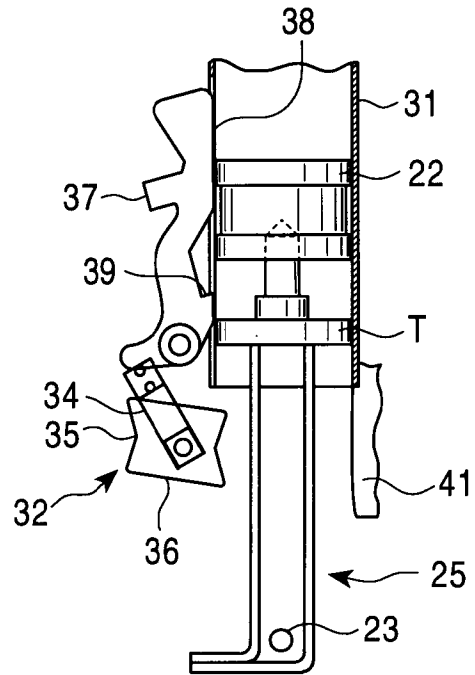


FIG. 7C

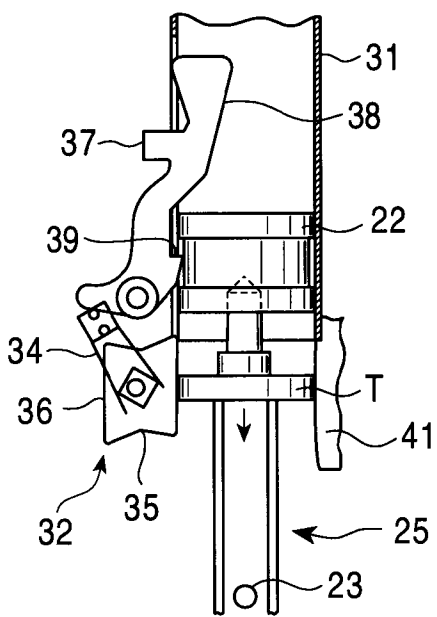


FIG. 7D

