(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 778 366 A1

(12) EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(43) Date of publication:
11.06.1997 Bulletin 1997/24

(21) Application number: **96917697.3**

(22) Date of filing: **14.06.1996**

(51) Int. Cl.[6]: **D04C 3/24**

(86) International application number:
PCT/JP96/01647

(87) International publication number:
WO 97/00343 (03.01.1997 Gazette 1997/02)

(84) Designated Contracting States:
DE ES IT

(30) Priority: **14.06.1995 JP 147251/95**

(71) Applicant: **NIPPON MAYER CO., LTD.**
Fukui 910 (JP)

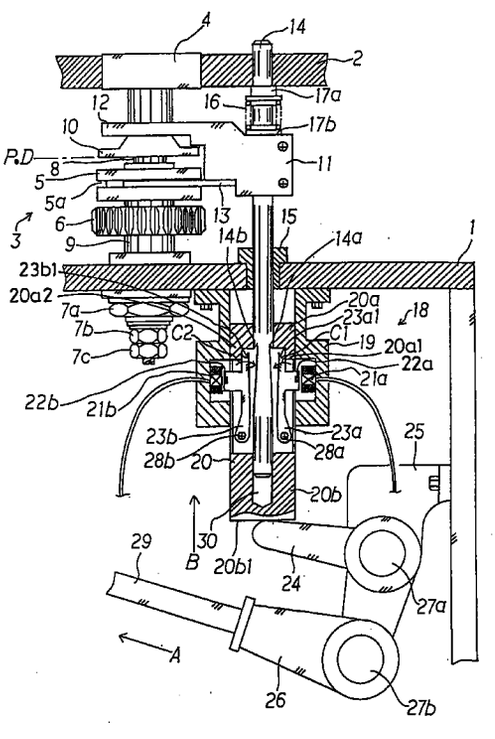
(72) Inventors:
- **KOBAYASHI, Yoshitsugu,**
  Nippon Mayer Co., Ltd.
  Fukui-shi, Fukui 910 (JP)
- **YAMAGATA, Shigeo,**
  Nippon Mayer Co., Ltd.
  Fukui-shi, Fukui 910 (JP)
- **MATSUDA, Hiroyuki,**
  Nippon Mayer Co., Ltd.
  Fukui-shi, Fukui 910 (JP)

(74) Representative: **Strehl Schübel-Hopf Groening & Partner**
Maximilianstrasse 54
80538 München (DE)

(54) OPERATION SELECTING CONTROL METHOD AND APPARATUS FOR SHIFTER FORK OF TORCHON LACE MACHINE

(57) The present invention provides operation selecting control method and apparatus for shifter fork of a torchon lace machine in such a way that the shifter fork can sufficiently follow high-speed rotation without erroneous function. The switching apparatus is simple in structure. Pawls 23a and 23b acting as selector rods are pivoted to an elevatable member 20 that is a part of a driving means. The pawls can act on parts of a fork shaft 14 or shifter fork 11. Permanent magnets 22a and 22b are attached to the pawls, respectively. Solenoids 21a and 21b are mounted close to the pawls 23a and 23b, respectively, so that the solenoids can magnetically act on the pawls, respectively. When the pawls are moved into their operated positions or unoperated positions where they do or do not, respectively, act on the fork shaft 14 or shifter fork 11, the solenoids are energized to produce a repulsive magnetic field between each solenoid and the corresponding permanent magnet because of similar magnetic poles. Thus, the pawls which are selector rods are moved. When the pawls are not moved, the solenoids are deenergized. In this way, selecting operation are controlled.

FIG.1



EP 0 778 366 A1

Description

[TECHNICAL FIELD]

The present invention relates to operation selecting control method and apparatus for shifter fork of torchon lace machine and, more particularly, to such method and apparatus using a separate electronic control portion producing a signal according to which the mode of operation of the shifter fork is selected or switched.

[BACKGROUND ART]

A torchon lace machine in which the mode of operation of the shifter fork is selected according to a signal from an electronic control portion as described above has been well known. In this torchon lace machine, the shifter fork is fitted over a fork shaft. Vertical movement of this shifter fork is induced by a driving means. One example of this driving means uses a spindle plate for rotating a spindle over which a bobbin is fitted. A threaded, driven wheel is fitted over the rotating shaft of the spindle plate. A cam is fitted over the driven wheel. A driving lever produces a driving force by making use of displacement of this cam. This structure is disclosed, for example, in JP-B-60028702 (UTILITY MODEL) and JP-B-61038941(UTILITY MODEL) (Utility Model Examined Publication Nos. 28702/1985 and 38941/1986).

In the structure disclosed in the JP-B-60028702(UTILITY MODEL), a selector rod is rotatably mounted to a lower portion of a fork shaft. The selector rod is connected to the plunger of a solenoid which, in turn, is secured to the housing of the machine. The JP-B-61038941(UTILITY MODEL) discloses a structure where a plurality of levers utilizing displacement of the aforementioned cam rotate a shaft in which a selector rod is slidably fitted. A control rod protruding from this shaft is rotated at the same time and brought close to a magnet coil. Then, the control rod is either attracted or unattracted. Thus, the mode of operation can be selected.

In another known structure, a selector rod utilizing rotation of the shaft of a rotary solenoid is mounted between a fork shaft and the end of a driver lever to which a driving force is transmitted, the end being located in a diametrically opposite relation to the side of the driver lever on which the cam acts.

In all the constructions of the apparatuses described in the above-cited literatures, when the selector rod is made to or not to act on the fork shaft, the control rod collides or presses against the magnet. Therefore, during the operation, there is a possibility of occurrence of collision or strong contact resistance. This can cause a erroneous function. When a braiding operation is being performed at a high speed, good responsiveness is not obtained. Furthermore, troubles such as breaking of coils may take place. These may be obstacles to normal braiding motion. Additionally, any of these apparatuses is made up of many components and complex in structure. Hence, they are not easy to service. Moreover, they are expensive to fabricate.

In view of the foregoing problems, the present invention has been made. It is an object of the invention to provide operation selecting control method and apparatus for shifter fork of torchon lace machine which is free of the foregoing problems and capable of sufficiently following up high-speed rotation without erroneous function and which is preferably simple in constitution.

[DISCLOSURE OF THE INVENTION]

In an operation selecting control method for a shifter fork in accordance with the present invention, a selector rod is made to be movably held by a part of driving means. The selector rod is so mounted as to act on a part of a fork shaft or the shifter fork. The selector rod is equipped with a permanent magnet. A solenoid is mounted close to the selector rod so that the solenoid can magnetically act on the selector rod. When the selector rod is moved into its operated or unoperated position where the rod does or does not, respectively, act on the fork shaft or shifter fork, the solenoid is electrically energized to develop a magnetic field which repels the permanent magnet because of similar magnetic poles. Thus, the selector rod is moved. When the selector rod is not moved, the solenoid is not energized. In this way, the mode of operation

In the present invention, the mode of operation of the selector rod can be quickly and precisely selected by energizing or deenergizing the solenoid. In the former case, a repelling action occurs with the permanent magnet, thus moving the selector rod. In the latter case, the selector rod is kept at rest.

When the selector rod is not moved as described above, the solenoid is energized to produce an attracting magnetic field with the permanent magnet by dissimilar poles. In consequence, the selector rod can be maintained stationary. In this case, the selector rod can be maintained in its unoperated state more certainly.

When the solenoid is energized to move the selector rod into its operated or unoperated position as described above, the selector rod is preferably kept out of contact with a member on the side of the solenoid. This circumvents collision or strong abutment during the operation. Hence, an erroneous function is prevented. As a result, the machine can accommodate itself to high-speed rotation without difficulty.

After the selector rod has been moved as described above, it is desired to return the rod to the side of the solenoid by a returning means. This assures that the selector rod goes back to its home position.

Especially, where the above-mentioned returning means is a returning member acting on a lower portion of the selector rod, engagement with the inclined surface of the returning member forces the selector rod

Where the above-described returning means is a separate solenoid mounted on the opposite side of the

selector rod from the first-mentioned solenoid, the two solenoids attract and repel coordinately. The coordinate action further enhances the responsiveness of the selector rod.

An operation selecting control apparatus for shifter fork in accordance with the present invention comprises an elevatable member, a retaining member, a displacement-imparting member, a pawl, and an actuator. The elevatable member extends in the axial direction of a fork shaft to which the shifter fork is mounted, the shifter fork being moved back and forth. The retaining member is firmly mounted to the housing of the machine. The elevatable member is slidably held to the retaining member. The displacement-imparting member imparts a displacement to the elevatable member to drive it. The pawl is pivoted to a part of the elevatable member and mounted so as to be swingable. Thus, the pawl can come into and out of engagement with the shifter fork or fork shaft. The shifter fork or fork shaft has an engaging portion. The actuator brings the pawl into or out of engagement with the engaging portion of the shifter fork or fork shaft by swinging the pawl.

In this apparatus according to the invention, the actuator acts to bring the pawl into engagement with the engaging portion of the shifter fork or fork shaft or to keep the pawl out of engagement. In this way, upward and downward movement of the shifter fork can

In the apparatus described above, the actuator preferably makes use of interaction between a permanent magnet and the solenoid capable of appropriately acting on the permanent magnet which is mounted to the pawl.

In this case, when the solenoid of the actuator is electrically energized, a repulsive force is produced, which brings the pawl into engagement with the engaging portion of the shifter fork or fork shaft. When the solenoid is not energized, the attracting force of the permanent magnet fitted to the pawl or the attracting force of the solenoid of the actuator assures that the pawl is kept at its unoperated position. In consequence, it is possible to select upward and downward movement of the shift fork without erroneous function. In this manner, the above-described method can be practiced well.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is a front elevation partially in cross section of a first embodiment of an operation selecting control apparatus for shifter fork according to the present invention and its associated parts;

Fig. 2 is a fragmentary enlarged cross section of Fig. 1;

Fig. 3 is a side elevation of only an elevatable member of components incorporated in the apparatus shown in Fig. 1;

Fig. 4 is a front elevation partially in cross section of a second embodiment of an operation selecting invention;

Fig. 5 is a front elevation partially in cross section of a third embodiment of an operation selecting control apparatus for shifter fork according to the invention;

Fig. 6 is an enlarged fragmentary cross section taken perpendicularly to Fig. 5, showing a retaining member and an elevatable member; and

Fig. 7 is a schematic diagram of an embodiment in which a solenoid is used as a returning means.

[BEST MODE FOR CARRYING OUT THE INVENTION]

Embodiments of method and apparatus for operation selecting control method and apparatus for shifter fork of torchon lace machine in accordance with the present invention are hereinafter described by referring to the drawings.

Fig. 1 is a fragmentary front elevation partially in cross section of a first embodiment of operation selecting control apparatus for a shifter fork according to the present invention and its associated parts. Fig. 2 is a fragmentary enlarged view of Fig. 1. Fig. 3 is a side elevation showing only an elevatable member of the apparatus.

A first embodiment of an operation selecting control apparatus for a shifter fork according to the invention is described by referring to Figs. 1-3.

There are shown a disklike machine housing 1, an annular upper machine housing 2, and a spindle-driving 1 and the upper machine housing 2. The spindle-driving member 3 is composed of a spindle plate 4, a clutch 5, and a drive gear 6. This drive gear 6 is rotatably and loosely mounted on a shaft 8, which is firmly secured to the machine housing 1 by nuts 7a, 7b, and 7c. The clutch 5 is slidably and rotatably inserted in a tubular shaft 9 that is formed integrally with the drive gear 6. The clutch 5 can come into and out of engagement with a clutch-engaging member 10 that is formed integrally with a lower part of the spindle plate 4.

Indicated by 11 is a shifter fork to which upper fork 12 and lower fork 13 having bifurcate shape are firmly mounted. The clutch 5 is provided with a peripheral groove 5a and rotatably held by the lower fork 13. The shifter fork 11 is fitted over a fork shaft 14. The fork shaft 14 passed through the machine housing 1 with a bush 15 between them. Both ends of a compression spring 16 are positioned by washers 17a and 17b between the upper housing 2 and the shifter fork 11. The spring 16 is loosely inserted over the fork shaft 14 so as to bias the shifter fork 11 downward.

An operation selecting control apparatus 18 for shift fork is constructed in the manner described below.

This selecting control apparatus comprises a retaining member 19 affixed to the machine housing 1 by a screw means or the like, an elevatable member 20 held inside the retaining member 19 so as to be slidable vertically, solenoids 21a and 21b attached to the inner side surface of the retaining member 19 to form an rods, and permanent magnets 22a and 22b mounted on the pawls 23a and 23b, respectively. These pawls 23a and

23b are held by pivots 28a and 28b in a face-to-face relation to the solenoids 21a and 21b, respectively. These permanent magnets 22a and 22b are fitted on an opposite relation to the solenoids 21a and 21b, respectively, so that these solenoids can magnetically act on the magnets, respectively. These permanent magnets 22a and 22b are so arranged that during energization of the solenoids 21a and 21b to move the pawls, the magnets are magnetized with the same magnetic poles as their respective geometrically opposite magnetic poles of the solenoids. Normally, each of the solenoids 21a and 21b has an iron core.

The operation selecting control apparatus further includes a substantially L-shaped displacement-imparting member 24 kept in abutment with the bottom surface 20b1 of the elevatable member 20 and a support member 25 mounted to the machine housing 1. The displacement-imparting member 24 is rotatably held by the support member 25 via a bearing (not shown) and a support pin 27a.

The solenoids 21a and 21b are connected with a control portion (not shown) by electric wires to permit energization of the solenoids. It is also possible to eliminate the wires by supplying an induced electromotive force to the solenoids and supplying a control signal to a receiving portion by radio.

The elevatable member 20 has an upper portion 20a upper and lower portions are centrally provided with holes to permit sliding movement of the fork shaft 14. A hole 30 in the lower portion 20b of the elevatable member is so formed that it is not affected by the fork shaft 14 regardless of the way the elevatable member 20 moves upward or downward.

A rod end 26 is rotatably attached to the lower end of the displacement-imparting member 24 via a bearing (not shown) and a pivotal pin 27b. When a shifter fork-driving displacement-transmitting member 29 which is screwed over the rod end 26 is pulled in the direction indicated by the arrow A, the displacement-imparting member 24 rotates to push up the elevatable member 20 in the direction indicated by the arrow B.

The shifter fork-driving displacement-transmitting member 29 is so constructed that it is reciprocated in the direction indicated by the arrow A in Fig. 1, for example, in synchronism with rotation of the main shaft of the torchon lace machine.

In the operation selecting control apparatus 18 for shifter fork constructed as described above, when the solenoids 21a and 21b are not energized, the permanent magnets 22a and 22b pass through a slot 32 formed in the side surface of the elevatable member 20 and are attracted and about to be stuck to the cores of the solenoids 21a and 21b. However, protrusions 20a1 and 20a2 on the upper portion of the elevatable member 20a hinder the sticking and maintain the permanent in Figs. 1 and 2. The pawls 23a and 23b move upward without acting on the fork shaft 14 and so the fork shaft 14 remains stationary.

When energized, the solenoids 21a and 21b are magnetized with the same poles as their respective geometrically opposite south and north poles of the permanent magnets 22a and 22b. The resulting magnetic field repulses the pawls 23a and 23b in the directions indicated by the arrows C1 and C2 in Figs. 1 and 2 because of similar magnetic poles. In this state, engaging portions 23a1 and 23b1 of the pawls 23a and 23b, respectively, can be engaged in notches 14a and 14b formed in the fork shaft. The elevatable member 20 is raised by the displacement-imparting member 24. The engaging portions 23a1 and 23b1 are engaged in the notches 14a and 14b, respectively. As a result, the fork shaft 14 is raised.

Thus, the shifter fork 11 fitted in the fork shaft 14 moves upward together with the fork shaft 14. The upper fork 12 and lower fork 13 firmly mounted to the shifter fork 11 follow the shaft 14. The clutch 5 whose peripheral groove 5a is rotatably held by the lower fork 13 is shifted into a position P.D where the clutch can come into engagement with the clutch-engaging member 10 which is formed integrally with the spindle plate 4.

Under this condition, when the drive gear 6 turns, the clutch 5 follows. The rotating force is transmitted to the spindle plate 4 via the clutch-engaging member

In the above description, the combination of the permanent magnets and solenoids brings the pawls into or out of engagement with the engaging portions of the shifter fork or fork shaft. Instead, the amount of displacement may be controlled or selected directly or via a lever or the like, using piezoelectric devices.

A second embodiment of the operation selecting control method and apparatus for shifter fork according to the invention is next described by referring to Fig. 4. It is to be noted that like components are indicated by like reference numerals in both embodiments, such as the spindle-driving member 3.

Referring to Fig. 4, the shifter fork 11 and a collar 54 to be engaged are fitted over a fork shaft 141. The collar 54 forms an engaging portion bearing against the bottom of the shifter fork 11. The fork shaft is slidably fitted in an upper portion 202a of the elevatable member, which is slidably held within a retaining member 191 screwed to the machine housing 1. Both ends of the compression spring 16 are positioned by washers 17a and 17b between the upper machine housing 2 and the shifter fork 11. The spring 16 is loosely inserted over the fork shaft 141 so as to bias it downward.

Indicated by 181 is an operation selecting control apparatus for shifter fork of the second embodiment and constructed as follows.

This apparatus comprises the retaining member 191 affixedly mounted to the machine housing 1 by a screw to be slidable vertically inside the retaining member 191, a pawl 231 acting as a selector rod, and a permanent magnet 221 mounted on the pawl 231 which can be swung. The pawl 231 is rotatably held by a pivot 281 in a notch formed in the upper portion 202a of the elevatable member. The apparatus further includes a

compression spring 161 located under the retaining member 191, a roller 272 bearing against the bottom surface 202c of the elevatable member, a displacement-imparting member 241 rotatably held by a pivotal pin 271a, a transmission roller 47 connected with the displacement- imparting member 241, a cam 46 fitted over the tubular shaft 9, a nonmagnetic L-shaped member 53 screwed to the machine housing 1, and a solenoid 212 acting as an actuator. The lower portion 202b of the elevatable member is inserted in the compression spring 161. The roller 272 is rotatably mounted to the displacement-imparting member 241 via a pivotal pin 271b. The profile of the cam 46 bears against the transmission roller. The solenoid 212 is rigidly mounted to the L-shaped member 53 and is disposed in face-to-face (geometrically opposite) position to the permanent magnet 221 so as to magnetically act on the permanent magnet 221. The solenoid 212 is so set up that when it is energized to move the pawl, the solenoid is magnetized with the same magnetic poles as the north and south poles of the permanent magnet 221.

A hole 300 is formed in the center of the upper portion 202a of the elevatable member in such a way that shaft 141 regardless of the way in which the elevatable member 200 is moving upward or downward.

The cam 46 is designed to follow the tubular shaft 9 when it is rotating. When the convex portion of the profile of the cam reaches the surface where it bears against the transmission roller 47, the roller 47 is pushed in the direction indicated by the arrow A2, and the displacement- imparting member 241 shifts the elevatable member 202 in the direction indicated by the arrow B2.

In the operation selecting control apparatus 181 for shifter fork of this embodiment, when the solenoid 212 is not energized, if the elevating member 202 is moving downward, the right side 231a1 of a downwardly protruding end of the pawl 231 comes into contact with the inner surface of a notch 191a formed in the retaining member 191 that is a returning means. The pawl 231 is urged to tilt toward the solenoid 212. At the same time, the permanent magnet 221 is attracted and about to be stuck to the core of the solenoid 212. However, when the permanent magnet 221 comes close to the solenoid 212, the left side 231a2 of the downwardly protruding end of the pawl 231 bears against an inclined surface 202a1 defining a notch in the upper portion 202a of the elevatable member. This hinders further inclination of the pawl 231. Consequently, the pawl 231 is kept close to the L-shaped member 53. Under this condition, the pawl 231 does not act on the collar 54 to be engaged that is an engaging portion fitted over the fork shaft the fork shaft 141, the shaft 141 remains at rest.

When energized, the solenoid 212 is energized with the same magnetic poles as the south and north poles of the permanent magnet 221, thus producing a repulsive magnetic field. This repels the pawl 231 in the direction indicated by the arrow C4, thus permitting the pawl 231 to act on the collar 54 to be engaged fitted over the fork shaft 141. As the elevatable member 202 is raised by the displacement-imparting member 241, the pawl 231 comes into engagement with the collar 54, thus elevating the fork shaft 141.

As a result, in the same manner with the first embodiment the shifter fork 11 fitted over the fork shaft 141 shifts the clutch 5 into a position where it can engage the clutch-engaging member 10. Under this condition, if the drive gear 6 rotates, the rotating force is transmitted to the spindle plate 4 via the clutch-engaging member 10.

Figs. 5 and 6 illustrate a third embodiment of operation selecting control method and apparatus for shifter fork in accordance with the present invention. Again, those components and structures which are common to their counterparts of the first embodiment, such as spindledriving member 3, are indicated by the same reference numerals as used in the first embodiment.

Referring to Fig. 5, a shifter fork 11 is fitted over a fork shaft 143, which is slidably fitted in the top portion 193a of a retaining member 193 rigidly fixed to the machine housing 1 by a screw means or the like. washers 17a and 17b between an upper housing 2 and the shifter fork 11. The spring 16 is loosely inserted over the fork shaft 143 so as to bias the shifter fork 11 downward.

Indicated by 183 is an operation selecting control apparatus for shifter fork of the third embodiment. This apparatus is constructed in the manner described below.

An elevatable member 204 is vertically slidably held inside the retaining member 193 that is securely mounted to the machine housing 1. As also shown in Fig. 6, a cam member 54 forming a returning means is inserted in recesses 57 and 60. The recess 57 reaches the depth of the inner bottom 204a of the elevatable member 204. The recess 60 is formed at the bottom of the retaining member 193. The cam member 54 is firmly held against the retaining member 193 by a snap ring 58. A pawl 233 acting as a selector rod is rotatably mounted in the recess 57 in the elevatable member 204 by a pivot 283. The pawl 233 is mounted so as to be swingable. A permanent magnet 223 is mounted on the pawl 233.

A compression spring 164 is disposed between a washer 61 and a step portion of the retaining member 193, the washer being mounted at the lower end of the elevatable member 204 which is inserted in the spring 164. This spring biases the elevatable member 204 downward. A roller 274 abutting against the bottom surface 204b of the elevatable member is rotatably mounted to the displacement-imparting member 242 via 242 is rotatably mounted via a pivotal pin 273a. A transmission roller 470 is connected to the displacement- imparting member 242.

The cam 46 is fitted over the tubular shaft 9. The profile of the cam bears against the transmission roller 470. A solenoid member 56 firmly mounted to the retaining member 193 by a screw means or the like has a solenoid 214 which is located opposite to the perma-

nent magnet 223 so as to be capable of acting magnetically on the magnet. This solenoid 214 is so set up that when it is energized to move the pawl, the solenoid is magnetized with the same magnetic poles as their respective geometrically opposite north and south poles of the permanent magnet 223.

A stopper pin 53 is mounted in the recess 57 in the elevatable member 204 so that when the pawl 233 is repelled by the solenoid 214, the pin 53 maintains the pawl 233 in an appropriate position. Obviously, other stopper means such as a protrusion performing the same function may be mounted instead of the stopper pin.

The cam member 54 is so mounted that it not affected by the inner bottom 204a of the elevatable member 204 regardless of the way in which the elevatable member 204 is moving upward or downward.

In the operation selecting control apparatus for shifter fork of this embodiment, the cam 46 follows the tubular shaft 9 when it is rotating. When the convex portion of the contour of the cam reaches the surface at which the cam bears against the transmission roller by the arrow A5. The displacement- imparting member 242 displaces the elevatable member 204 in the direction indicated by the arrow B4.

When the solenoid 214 is not energized, if the elevatable member 204 is moving downward, the bottom of the pawl 233 comes into contact with the inclined surface 54a of the cam member 54 that is a returning means. This causes the pawl 233 to tilt toward the solenoid 214. At the same time, the permanent magnet 223 is attracted and about to be stuck to the core of the solenoid 214. However, when the permanent magnet 223 comes close to the solenoid 214, the central portion of the pawl 233 comes into contact with a part 193b of the retaining member 193. In consequence, the pawl 233 is kept close to the solenoid 214. Under this condition, the front end (top end) of the pawl 233 moves upward without acting on the lower end of the fork shaft that is an engaging portion. Therefore, the fork shaft 143 is kept at rest.

When the solenoid 214 is energized, it is magnetized with the same magnetic poles as their respective geometrically opposite north and south poles of the permanent magnet 223, thus producing a repulsive magnetic field. This repulses the pawl 233 in the direction indicated by the arrow C6. Thus, the pawl 233 rotates until it bears against the stopper pin 53, and then the pawl can act on the fork shaft 143. As the elevatable member 204 is moved upward by the displacement-imparting member 242, the pawl raises the

The shifter fork 11 shifts the clutch 5 into a position where the clutch can engage the clutch-engaging member 10. Under this condition, the drive gear 6 is rotated. The rotating force is transmitted to the spindle plate 4 via the clutch-engaging member 10.

With respect to the means to keep the pawl 233 close to the solenoid 214 when the solenoid 214 is not energized, a bush can be fitted over the outer surface of the elevatable member 204 so as to cover the recess 57 in the elevatable member 204 or so as to close up the recess 57 partially. Alternatively a stopper ring can be fitted in the recess 57 near its top side. Thereby, the pawl 233 is kept out from touching the retaining member 193.

In each of the first through third embodiments described above, when the pawls 23a, 23b or 231, 233 which are selector rods are not moved, i.e., when they are close to the solenoids 21a, 21b or 212, 214, the solenoids are electrically energized to produce an attracting magnetic field with the permanent magnets 22a, 22b or 221, 223 because of dissimilar magnetic poles. The resulting attraction can hold the pawls at rest. In this case, the pawls are locked with greater certainty. Where each solenoid has no core, the pawls may be kept deactivated by means other than permanent magnets.

A returning means is used to return the pawls (selector rods) to their home positions close to the solenoids. In the first embodiment, the returning means makes use of the magnetic forces of permanent member against which the lower end of each pawl bears during downward movement of an elevatable member is used as a part of a returning member. In the third embodiment, the inclined surface of a cam member against which the lower end of each pawl bears is used as the inclined surface of a returning member. As a further embodiment, as shown in Fig. 7, a second solenoid is mounted on the opposite side of a selector rod from the aforementioned solenoid used for operation of the selector rod, and returning action is obtained utilizing this second solenoid.

Referring to Fig. 7, an elevatable means (not shown) can be elevated and lowered by an appropriate displacement- imparting means in the directions indicated by the arrows B5. A pawl 235 acting as a selector rod is held to this elevatable means by a pivot 285 so as to be swingable in the directions indicated by the arrows C5. As the pawl is swung forward or backward, it comes into or out of engagement with a fork shaft 145. A permanent magnet 225 is attached to this pawl 235. Two solenoids 215a and 215b are mounted on opposite sides of the pawl 235. When the solenoids are energized to move the pawls, the solenoids are magnetized with the similar magnetic poles as their respective geometrically opposite north and south poles of the permanent magnet 225.

When the pawl 235 does not act on the fork shaft 145 as shown in Fig. 7, the attraction by the magnetic force of the permanent magnet 225 tilts the pawl toward solenoid without energizing the solenoids 215a, 215b. When the pawl 235 is moved into its operated position where the pawl acts on the fork shaft 145, the solenoid 215a is energized so that it is magnetized with the similar magnetic poles as their respective geometrically opposite north and south poles of the permanent magnet 225. A repulsive magnetic field is produced with the permanent magnet because of the dissimilar magnetic

poles. The pawl 235 is moved into engagement with the fork shaft 145. The pawl is brought close to the solenoid 215b. This condition is maintained by the magnetic force of the permanent magnet 225.

When the pawl 235 is returned to its unoperated position, the solenoid 215b is energized to produce a repulsive magnetic field with the permanent magnet 225 because of the similar magnetic poles. The pawl 235 is tilted toward the solenoid 215a.

In order to maintain the pawl 235 deactivated after it has tilted or to maintain it activated, it is also possible to produce an attracting magnetic field between the solenoid 215a or 215b and the permanent magnet by dissimilar magnetic poles.

Referring also to Fig. 7, stoppers 65a and 65b restrict movement of the pawl 235 to a certain amount in order that the pawl 235 be kept close to the solenoid 215a or 215b.

A plurality of torchon lace machines of the construction described above can be operated under braiding are all managed by this central-processing unit. That is, a group control system can be accomplished. In this way, manufacturing operations of the torchon lace machines can be managed more efficiently.

[INDUSTRIAL APPLICABILITY]

In the operation selecting control method and apparatus for shifter fork in accordance with the present invention, a selector rod is made to act on the shifter fork or fork shaft by a repulsive magnetic field of a solenoid. Therefore, the selector rod can sufficiently follow rapid rotation without erroneous function. Especially advantageously, the selector rod neither collides nor presses against the solenoid. Furthermore, it is easy to cause the selector rod to act on the solenoid in a non-contacting manner. Consequently, less troubles such as breaking of coils take place, and excellent durability is obtained. Also, the reliability of the switching operation is improved.

Furthermore, the apparatus is made up of a fewer number of components and simpler in structure than conventional. Therefore, the apparatus can be fabricated at lower cost. Furthermore, the apparatus can be adjusted quickly. In addition, the apparatus can be serviced readily and hence can be treated easily.

Claims

1. An operation selecting control method for a shifter fork mounted to a fork shaft of a torchon lace machine having an electronic control portion producing a selection signal and a driving means for selecting the mode of operation of the shifter fork according to the selection signal, said driving means being provided with selector rods, said method comprising the steps of:

   attaching the selector rods to parts of the driving means such that the selector rods are movable and can act on parts of the fork shaft or the shifter fork;

   attaching permanent magnets to said selector rods, respectively;

   mounting solenoids close to the selector rods such that the solenoids can magnetically act on the selector rods, respectively;

   electrically energizing said solenoids to produce a repulsive magnetic field between said solenoids and the permanent magnets by similar magnetic poles when the selector rods are moved into their operated positions where the rods act on the fork shaft or shifter fork or into their unoperated positions where the rods do not; and

   deenergizing said solenoids when the selector rods are not moved, whereby selecting operation are controlled.

2. The method of claim 1, wherein when the selector rods are not moved, the solenoids are energized solenoids and the permanent magnets by dissimilar magnetic poles to thereby maintain the selector rods stationary.

3. The method of claim 1 or 2, wherein when the selector rods are moved into their operated or unoperated positions by energizing the solenoids, the selector rods are kept out of contact with members on sides of the solenoids.

4. The method of any one of claims 1-3, wherein after the selector rods have been shifted, they are returned to their home positions close to the solenoids by returning means.

5. The method of claim 4, wherein said returning member are returning members acting on lower parts of the selector rods.

6. The method of claim 4, wherein said returning means are second solenoids each of which is located on the opposite side of the corresponding one of the selector rods from the corresponding one of the first-mentioned solenoids.

7. An operation selecting control apparatus for shifter fork of a torchon lace machine having a housing, said operation selecting control apparatus comprising:

   a fork shaft to which the shifter fork reciprocated is mounted;

   an elevatable member mounted axially of said fork shaft;

   a retaining member firmly mounted to the housing of the torchon lace machine and acting to hold said

a displacement-imparting member for imparting a displacement to said elevatable member to drive it;

an engaging portion formed by a part of said shifter fork or said fork shaft;

a pawl pivotally mounted to a part of said elevatable member so as to be swingable and selectively engageable with said engaging portion in swing-forth or swing-back position; and

an actuator for selecting engagement or disengagement of said pawl with said engaging portion.

8. An operation selecting control apparatus for shifter fork of a torchon lace machine having a housing as set forth in claim 7, wherein said actuator relies on interaction between a permanent magnet mounted to said pawl and a solenoid which is so mounted that it can appropriately act on said permanent magnet.

FIG.1

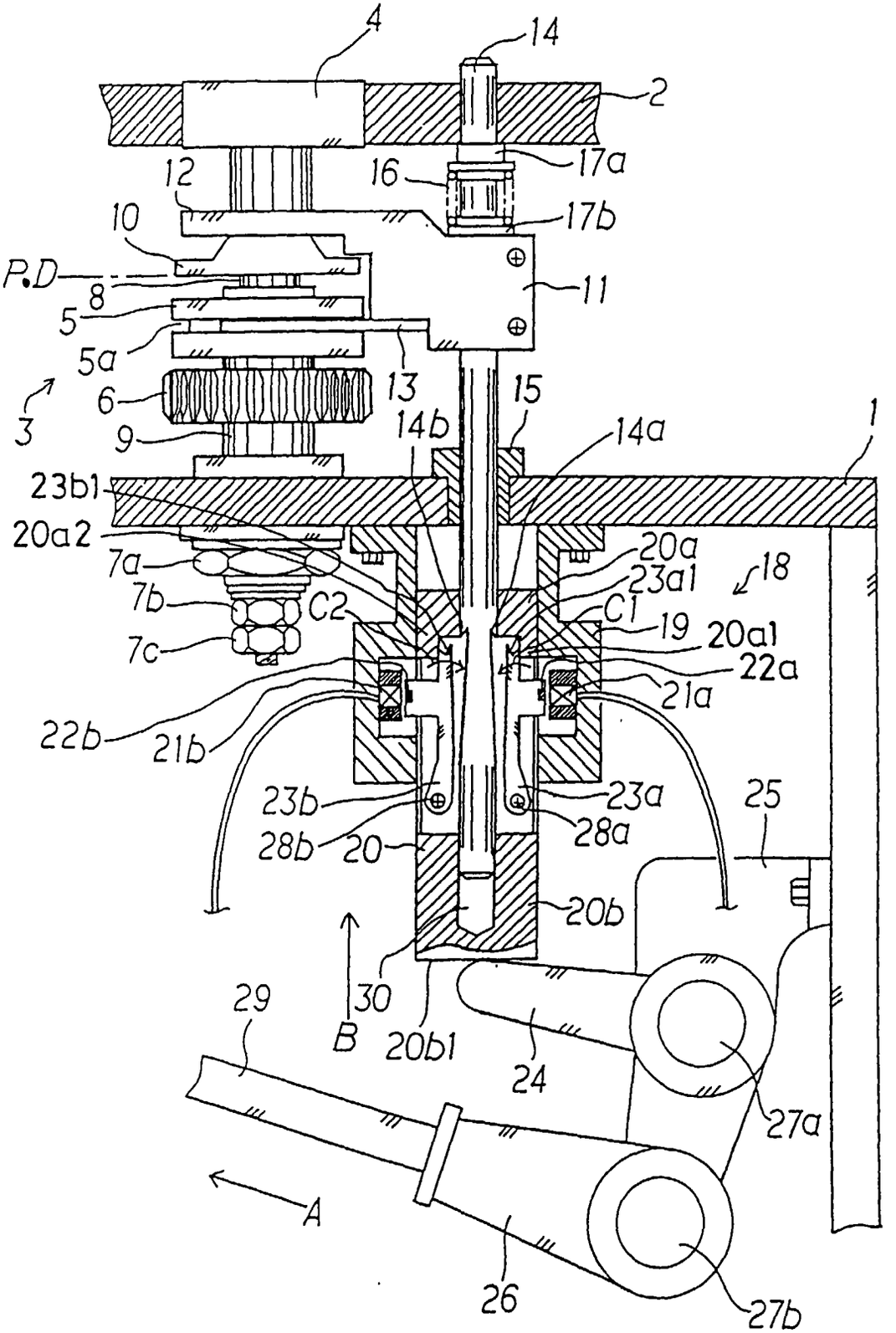

4
14
2
12
16
17a
17b
10
P.D
8
11
5
5a
13
15
6
3
9
14b
14a
1
23b1
20a2
7a
20a
23a1
18
7b
C2
C1
19
20a1
7c
22a
21a
22b
21b
23b
23a
25
28b
20
28a
20b
29
30
B
20b1
24
27a
A
26
27b

FIG.2

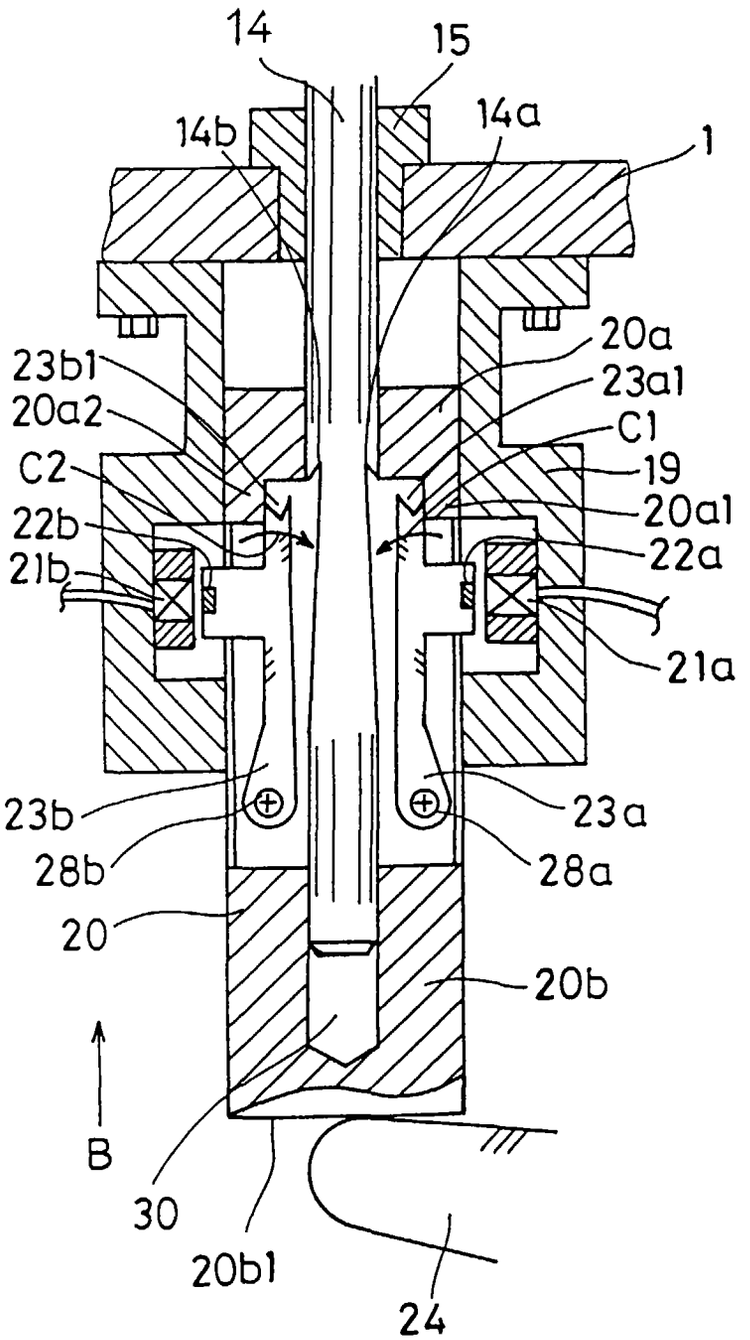

14
15
14b
14a
1
20a
23b1
23a1
20a2
C1
C2
19
20a1
22b
22a
21b
21a
23b
23a
28b
28a
20
20b
B
30
20b1
24

FIG.3

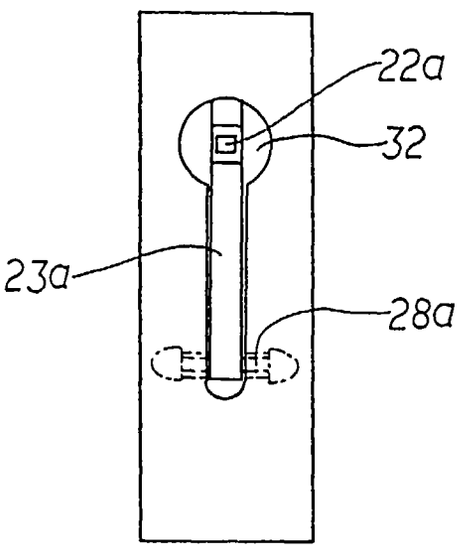


FIG.4

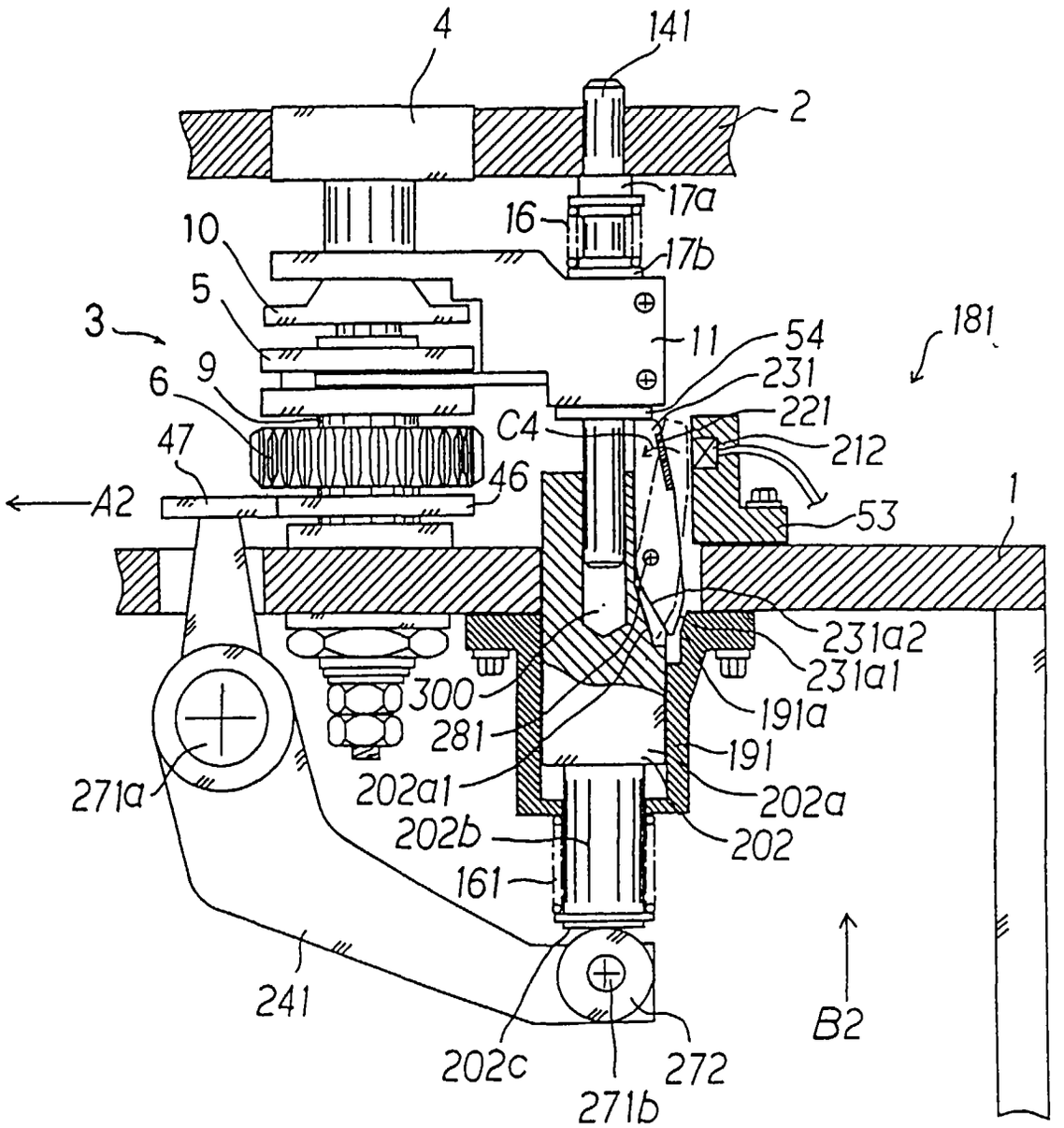

4
141
2
17a
16
17b
10
5
3
11
54
181
231
9
6
221
C4
212
47
46
A2
53
1
231a2
231a1
300
191a
281
191
271a
202a1
202a
202b
202
161
241
B2
202c
272
271b

FIG.5

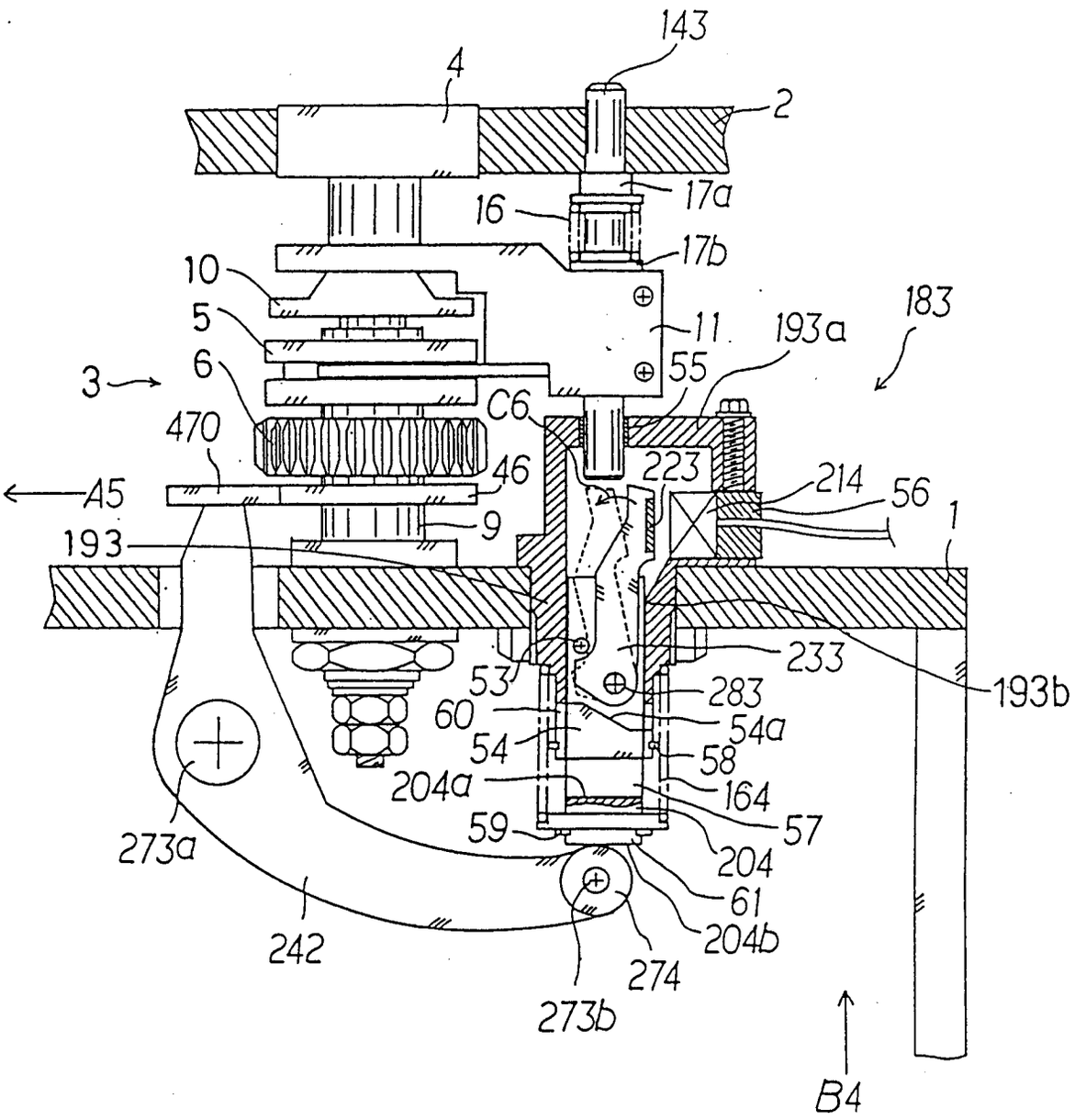

143
4
2
17a
16
17b
10
5
11
193a
183
3
6
55
C6
470
46
223
214
56
A5
9
1
193
233
193b
53
283
60
54a
54
58
204a
164
59
57
204
61
204b
273a
242
274
273b
B4

FIG.6

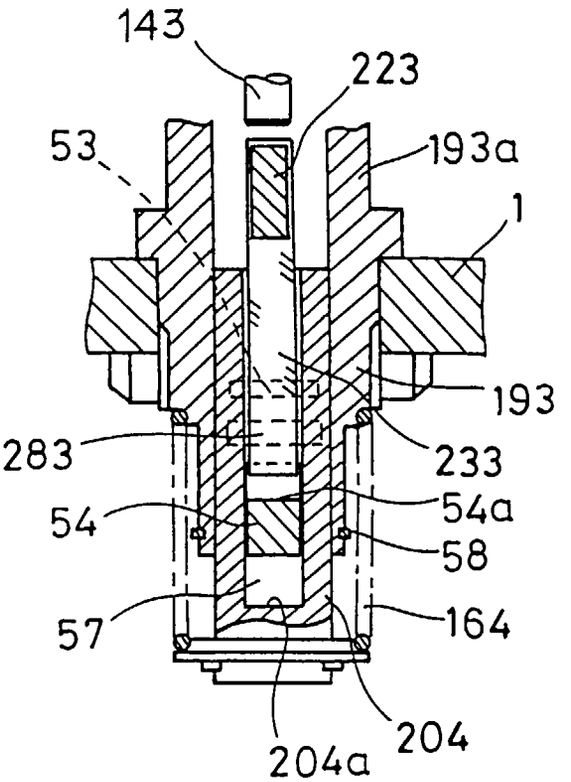
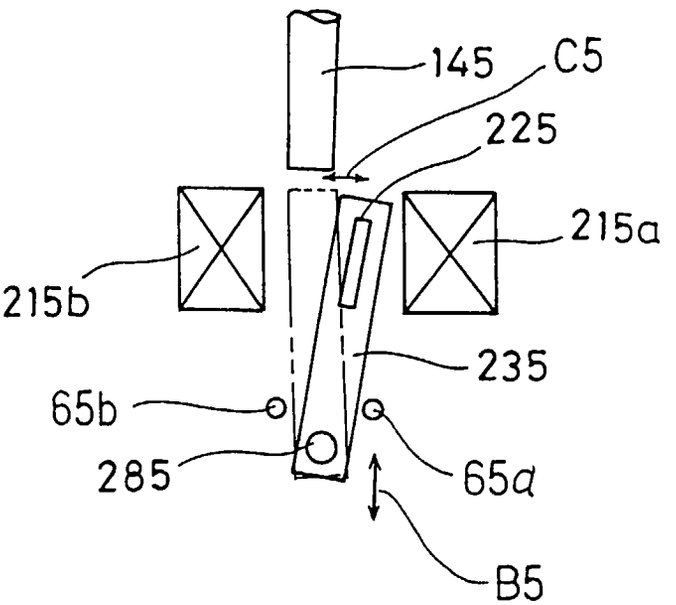

143
223
53
193a
1
193
283
233
54
54a
58
57
164
204a
204

FIG.7


145
C5
225
215a
215b
235
65b
285
65a
B5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP96/01647

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 D04C3/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^6 D04C3/00-48

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1911 - 1996
Kokai Jitsuyo Shinan Koho	1971 - 1995
Toroku Jitsuyo Shinan Koho	1994 - 1996

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 57-66161, A (Klemzrar Feawarzungs GmbH.), April 2, 1982 (22. 04. 82), Full descriptions & DE, 3038343, A & IT, 1139077, B	1 - 8
X	JP, 60-28702, Y (Nippon Mayer Co., Ltd.), August 30, 1985 (30. 08. 85),	7
A	Fig. 1 (Family: none)	1-6, 8
A	JP, 61-458, B (Takeda Mayer K.K.), January 8, 1986 (08. 01. 86), Column 5, line 36 to column 6, line 6 (Family: none)	1 - 8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
September 6, 1996 (06. 09. 96)	September 17, 1996 (17. 09. 96)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)