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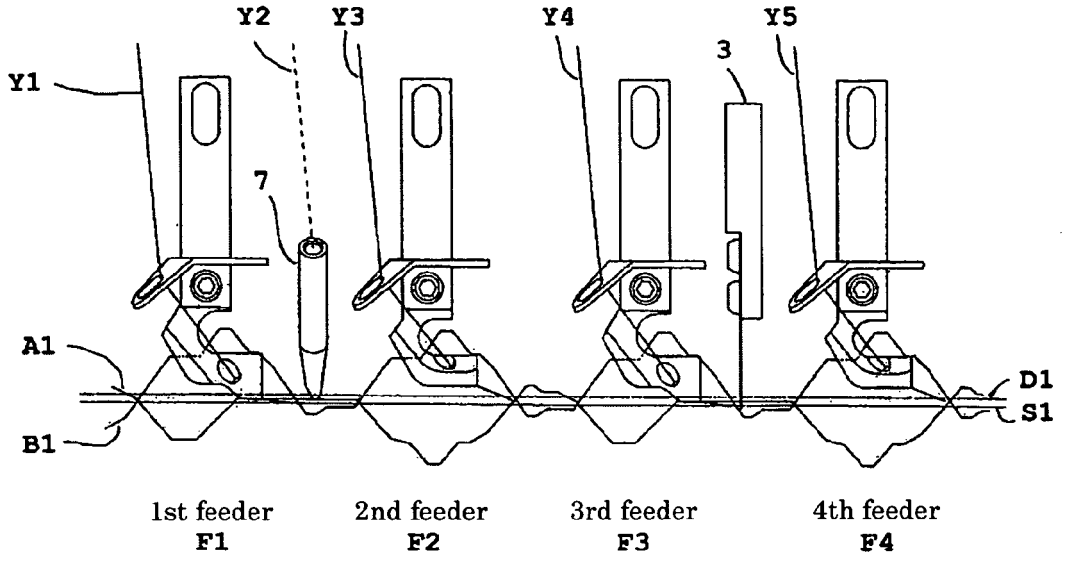
(54) **Yarn guide apparatus in circular knitting machine**

(57) The present invention prevents a yarn carrier from coming off a proper yarn feed position due to a large tensile force of a knitting yarn while a knitting machine operates. In a yarn guide apparatus in a circular knitting machine, a guide hole of a yarn guide is disposed facing a yarn feed port of a yarn carrier such that a distance from the guide hole to a shaft portion is substantially the same as a distance from the yarn feed port to the shaft portion, thereby providing at the yarn feed port an acting force equal to or greater than a force that acts so as to tilt the yarn carrier upward due to a knitting yarn. It is preferable that the yarn guide that surrounds a yarn carrier ring is attached together with a yarn carrier to a center portion of the shaft portion.

Fig.1



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a yarn guide apparatus in a knitting machine, and particularly relates to a guide apparatus that feeds a knitting yarn to a yarn carrier of a circular knitting machine.

2. Description of Related Art

[0002] When knitting a quilted knit fabric using a circular knitting machine, generally, knitting processes as shown in FIG. 1 are performed with a double-knit circular knitting machine set up for rib gating as described in JP 2009-203566A. A movement line B1 shown in FIG. 1 indicates an exemplary movement line of a cylinder needle, and a movement line A1 indicates an exemplary movement line of a dial needle. A knitting yarn is fed from a yarn guide (not shown) on the upper side disposed at an upper periphery of the circular knitting machine.

[0003] The knitting processes are performed as follows.

[0004] A first feeder F1 feeds a first yarn Y1 to cylinder needles 1 in a knit-welt state.

[0005] A yarn carrier 7 for an inlay yarn feeds a second yarn Y2, which is an inlay yarn for forming into stuffing, from a point between the first feeder F1 and a second feeder F2 to a point between a cylinder verge S1 and a dial verge D1.

[0006] The second feeder F2 feeds a third yarn Y3 to the cylinder needles 1 in a knit-welt state and to dial needles 2 in a knit state.

[0007] A third feeder F3 feeds a fourth yarn Y4 to the cylinder needles 1 in a knit-welt state.

[0008] A fourth feeder F4 feeds a fifth yarn Y5 to the cylinder needles 1 in a knit-welt state and to the dial needles 2 in a knit state.

[0009] A knit fabric obtained through the above-described knitting processes has a three-layered structure consisting of a front knit fabric N1 (see FIG. 6) knitted by the cylinder needles 1, a back knit fabric N2 (see FIG. 6) knitted by the dial needles 2, and the second yarn Y2 inserted between these knit fabrics. If the first to the fourth feeders F1 to F4 in FIG. 1 feed yarns in a knit state to all of the cylinder needles 1, the front knit fabric remains plain. However, in order to obtain a knit fabric with an intricate design, these feeders may perform jacquard knitting. That is to say, the first to the fourth feeders F1 to F4 perform knit-welt needle selection for the cylinder needles 1 according to a desired jacquard pattern.

[0010] FIGS. 2A and 2B specifically show a yarn carrier and a guide apparatus that feed a knitting yarn in the first feeder F1 in FIG. 1. That is to say, in FIGS. 2A and 2B, a yarn carrier 13 is supported by a yarn carrier holder 11, and the yarn carrier holder 11 is vertically suspended by a yarn carrier ring 10. As a guide apparatus that feeds a knitting yarn to the yarn carrier 13 of the circular knitting machine, commonly used is a yarn guide (not shown) that is attached to the yarn carrier itself at a position relatively near a yarn feed port of the yarn carrier or a yarn guide 221 (see FIGS. 2A and 2B) that is fixed to the yarn carrier ring 10.

[0011] As shown in FIGS. 2A and 2B, the yarn carrier 13 can be tilted with the finger from a yarn feed position outward by approximately 30 degrees to a tilt position when, for example, passing a yarn through a yarn feed port 131 of the yarn carrier 13. The center of the tilting corresponds to a shaft portion 17 of the yarn carrier holder 11, and a spring 18 provided inside the yarn carrier holder 11 presses against the shaft portion 17 and applies a force inward to the yarn carrier 13 fixed to the shaft portion 17. Furthermore, when the yarn carrier 13 has been tilted to the tilt position, the yarn carrier 13 can be held at that position (also known in JP H2-118784U).

[0012] However, in these conventional techniques, when the second yarn Y2, which is an inlay yarn for forming into stuffing, is fed from a point between the first feeder F1 and the second feeder F2 to a point between the cylinder verge S1 and the dial verge D1, filaments of the inlay yarn may spread apart and the inlay yarn may not be able to enter a point between the cylinder verge S1 and the dial verge D1. The knitting conditions at that time are such that the distance between the cylinder verge S1 and the dial verge D1 is set to approximately 1.5 mm to 2.0 mm, a thick polyester yarn of 660 dtex or more is used as the inlay yarn, and the tensile force in feeding the inlay yarn is small. Accordingly, it is necessary to set the tensile force of the inlay yarn Y2 to 30 g or more, thereby preventing the filaments of the inlay yarn from spreading apart.

[0013] In the case where the tensile force in feeding a yarn is increased in this manner, if the resisting force resulting from the tensile force of the knitting yard becomes larger than the spring force that is applied inward to the yarn carrier 13, the yarn carriers 7 and 13 may not be held at the proper knitting position and may be tilted in a tilt direction. Furthermore, although the yarn carriers 7 and 13 are to return to the yarn feed position after being tilted with the finger from the yarn feed position outward by approximately 30 degrees to the tilt position when, for example, passing a yarn through the yarn feed port 131 of the yarn carrier 13, the yarn carriers 7 and 13 may not completely return to the yarn feed position due to an excessive tensile force of the knitting yarn. In this manner, if the tensile force in feeding a yarn is too large at the yarn guide 221 or a yarn feed port 71 of the yarn carrier 7, the frictional force becomes large, and a resisting force acts at that position on a usually smoothly moving knitting yarn, and the yarn carriers 7 and 13 may move in an unexpected manner. In this case, the yarn carriers 7 and 13 are not at a proper yarn feed position, and, thus, a knit fabric or a knitting needle may be damaged.

[0014] In essence, the problems of the conventional

techniques are based on an acting force that tilts the yarn carriers 7 and 13 outward acting at the yarn feed port 71 of the yarn carrier 7 due to the frictional force with the knitting yarn and an acting force that tilts the yarn carriers 7 and 13 inward acting at a guide hole 231 of the yarn guide 221 due to the frictional force with the knitting yarn.

SUNIMARY OF THE INVENTION

[0015] It is an object of the present invention to provide a configuration in which an acting force for inward tilting is set larger than an acting force for outward tilting at the yarn feed port 71 of the yarn carrier 7. That is to say, the present invention is directed to a yarn guide apparatus in a circular knitting machine, comprising: a yarn carrier ring; a yarn carrier holder that is vertically suspended by the yarn carrier ring; a first yarn carrier that is provided with a yarn feed port and that guides a first yarn to a knitting needle; a yarn guide that is provided with a guide hole; and a second yarn carrier that is provided with a yarn feed port and that guides a second yarn to a knitting needle; the yarn carrier holder having a housing that accommodates the first yarn carrier in a tiltable manner, a shaft portion that corresponds to a center of the tilting, and a spring that is for pressing against the shaft portion; wherein the guide hole of the yarn guide is disposed facing the yarn feed port of the second yarn carrier such that a distance from the guide hole to the shaft portion is substantially the same as a distance from the yarn feed port to the shaft portion, thereby providing, at the yarn feed port, an acting force equal to or greater than a force that acts so as to tilt the second yarn carrier upward due to a knitting yarn (Claim 1).

[0016] It is preferable that the yarn guide that surrounds the yarn carrier ring is attached together with the first yarn carrier to a center portion of the shaft portion (Claim 2).

[0017] According to the present invention, relationships between a force (C) that acts on the yarn feed port of the second yarn carrier due to yarn feeding, a force (G) that acts on the guide hole of the yarn guide due to yarn feeding, and a force (S) that acts due to the spring are $C < G$ and $C < S$ (Claim 3).

[0018] With the above-described configuration, the yarn carrier can be prevented from coming off the proper yarn feed position due to a large tensile force of a knitting yarn while the knitting machine operates, and, thus, neither a knit fabric nor a knitting needle is damaged.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

FIG. 1 is a front view showing conventional knitting processes of quilt knitting.

FIG. 2A is a front view showing yarn carriers and a yarn guide apparatus according to a conventional example 2, and FIG. 2B is a right side view thereof.

FIG. 3A is a front view showing yarn carriers and a yarn guide apparatus according to an embodiment of the present invention, and FIG. 3B is a right side view thereof.

FIGS. 4A to 4C show forces that act on a yarn carrier at a yarn feed position, wherein FIG. 4A is a vector diagram according to a conventional example 1, FIG. 4B is according to the conventional example 2, and FIG. 4C is according to the present invention.

FIGS. 5A and 5B show forces that act on the yarn carrier tilted to a tilt position, wherein FIG. 5A is a vector diagram according to the conventional example 1, FIG. 5B is according to the conventional example 2, and FIG. 5C is according to the present invention.

FIG. 6 is a knit structure diagram for quilt knitting according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Hereinafter, an embodiment of the present invention will be described with reference to the drawings.

[0021] In FIGS. 3A and 3B, four to six yarn carrier ring supports (not shown) are arranged at constant intervals on a dial cap ring of a double-knit knitting machine, and a yarn carrier ring 10 is fixed with a screw to tip ends of the yarn carrier ring supports.

[0022] A yarn carrier holder 11 is vertically suspended by a screw 12 on the lower portion of the yarn carrier ring 10. A first yarn carrier 13 that guides a first yarn Y1 to knitting needles is supported by a screw 14 on the yarn carrier holder 11. A second yarn carrier 7 for an inlay yarn that feeds an inlay yarn Y2 is attached via an attachment member 15 to the first yarn carrier 13.

[0023] The yarn carrier holder 11 is configured by a housing 16 that accommodates the first yarn carrier 13 in a tiltable manner, a shaft portion 17 that functions as a center of the tilting, and a torsion spring 18 for pressing against the shaft portion 17 positioned behind the shaft portion 17 (on the inner side of the machine with respect to the shaft portion 17).

[0024] A pin 19 is inserted into a coiled portion of the torsion spring 18, and both ends of the pin are supported on the housing 16.

[0025] Both ends of the shaft portion 17 are cylindrical, and are supported in a rotatable manner on the housing 16. Furthermore, the center portion of the shaft portion 17 has a flat face for attachment of the first yarn carrier 13, and the first yarn carrier 13 is supported by the screw 14 on that center portion. Ayarn guide 20 for the inlay yarn Y2 that surrounds the yarn carrier ring 10 positioned above the yarn guide 20 is attached together with the first yarn carrier 13 by the screw 14 to the center portion of the shaft portion 17. The yarn guide 20 is provided with a guide hole 21 that guides the inlay yarn Y2.

[0026] The guide hole 21 is preferably made of ceramic material such as alumina in order to prevent the guide hole 21 from being abraded by a knitting yarn.

[0027] In FIG. 3B, the solid line indicates a state in which the first yarn carrier 13 is at a yarn feed position (A), and the broken line indicates a state in which the first yarn carrier 13 has been tilted upward to a tilt position (B). If a problem such as yarn breaking occurs when the first yam carrier 13 is at the yarn feed position, the operation of the knitting machine has to be stopped and the knitting yarn has to be passed through the yarn carrier again. At that time, the first yarn carrier 13 is lifted with the finger, and the yarn is passed therethrough. In order to return the lifted first yard carrier 13 to the ymrn feed position (A), the first yarn carrier 13 is passed down with the finger resisting the pressure of the torsion spring 18.

[0028] In FIGS. 4A to 4C, the symbol C denotes a force that acts on the yale feed port 71 of the second yarn carrier 7 due to yarn feeding, the symbol G', G", G denotes a force that acts on the guide hole 21, 231 of the yarn guide 20, 221 due to yarn feeding, the symbol S denotes a force that acts due to the torsion spring 18, and the symbol J denotes a fulcrum at the center portion of the shaft portion 17. The knitting yarn Y2 is fed firom the yarn guide 20, 221 on the upper side disposed at an upper periphery of the circular knitting machine. Here, the tensile force in feeding the knitting yarn Y1 that acts on the yarn feed port 131 of the first yarn carrier 13 is not large enough to exert influence, and, thus, is not considered for the sake of convenience.

[0029] FIG. 4A is a vector diagram showing forces that act on the yarn carrier according to the conventional example 1. At the yarn feed port 71 of the second yarn carrier, "an acting force (C) that tilts the yarn carrier outward (O) due to the frictional force with the knitting yarn" acts, and, moreover, "an acting force (G') that acts in the same direction at the guide hole 231 of the yarn guide 221 disposed near the yard feed port of the yarn carrier" is added, and, thus, a force is obtained that is larger than "a force (S) that acts due to the torsion spring 18". Accordingly, the yarn carrier 13 is tilted in the tilt direction from the yarn feed position (A).

[0030] FIG. 4B is a vector diagram showing forces that act on the yarn carrier according to the conventional example 2. A force (G") acts at the guide hole 231 of the yarn guide 221 that is fixed to the yarn carrier ring 10 shown in FIGS. 2A and 2B, and is fixed at a position where no influence is made on the yax-n carrier. At the yarn feed pox-t 71 of the second yarn carrier, if "the acting force (C) that tilts the yarn carrier outward (O) due to the frictional force with the knitting yarn" that is larger than "the force (S) that acts due to the torsion spring 18" acts, the yarn carrier 13 is tilted in the tilt direction from the yarn feed position (A).

[0031] FIG. 4C is a vector diagram showing forces that act on the yarn carrier according to the present invention. The symbol G denotes a force that acts on the guide hole 21 of the yarn guide 20 fixed to the shaft portion 17 of the yarn carrier holder 11 shown in FIGS. 3A and 3B. At the yarn feed port 71 of the second yarn carrier, "the acting force (C) that tilts the yarn carrier outward (O) due to the frictional force with the knitting yarn" is smaller than "an acting force (G) that tilts the yarn carrier inward (I) due to the frictional force with the knitting yarn at the guide hole 21 of the yarn guide" and "the force (S) that acts due to the torsion spring 18". Accordingly, the yarn carrier can be kept at the yarn feed position (A).

[0032] FIGS. 5A, 5B, and 5C show states in which the yarn carrier is tilted with the finger from the yarn feed position outward by approximately 30 degrees to the tilt position when, for example, passing a yarn through the yarn feed port of the yarn carrier, respectively corresponding to FIGS. 4A, 4B, and 4C.

[0033] The comparison between FIGS. 5A and 5B and FIGS. 4A and 4B shows that the bending angle of the knitting yarn Y2 increases, so that an acting force that is larger than that when the yarn carrier is at the yarn feed position (A) acts, and, thus, it is difficult for the yarn carrier to return to the yarn feed position (A). On the other hand, the comparison between FIG. 5C and FIG. 4C of the present application shows that an acting force that is significantly larger than that when the yarn carrier is at the yarn feed position (A) acts, and, thus, it is easy for the yarn carrier to return to the yarn feed position (A).

[0034] The second yarn carrier 7 for an inlay yarn is attached so as to be branched from the first yarn carrier 13 via the attachment member 15, but may be independently attached via the yarn carrier holder 11 to the yarn carrier ring 10 in a similar manner as the first yarn carrier 13.

[0035] Furthermore, the shape of the yarn feed port 71 of the second yarn carrier 7 for an inlay yarn is not limited to a hole, and may be preferably a slot that is open on the front side such that a yarn can easily pass therethrough.

[0036] The present invention is not limited to the foregoing embodiment, and is generally applicable to circular knitting machines that knit a quilted knit fabric.

[0037] The invention may be embodied in other forms without departing from the spirit or essential characteristics thereof. The embodiments disclosed in this application are to be considered in all respects as illustiative and not limiting. The scope of the invention is indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are intended to be embraced therein.

Claims

1. A yarn guide apparatus in a circular knitting machine, comprising:

   a yarn carrier ring;
   a yarn carrier holder that is vertically suspended by the yarn carrier ring;
   a first yarn carrier that is provided with a yarn feed port and that guides a first yarn to a knitting

needle;
a yarn guide that is provided with a guide hole; and
a second yarn carrier that is provided with a yarn feed port and that guides a second yarn to a knitting needle;
the yarn carrier holder having a housing that accommodates the first yarn carrier in a tiltable manner, a shaft portion that corresponds to a center of the tilting, and a spring that is for pressing against the shaft portion;
wherein the guide hole of the yarn guide is disposed facing the yarn feed port of the second yarn carrier such that a distance from the guide hole to the shaft portion is substantially same as a distance from the yarn feed port to the shaft portion., thereby providing at the yarn feed port an acting force equal to or greater than a force that acts so as to tilt the first yarn carrier upward due to a knitting yarn.

2. The apparatus according to claim 1, wherein the yarn guide that surrounds the yarn carrier ring is attached together with the first yarn carrier to a center portion of the shaft portion.

3. The apparatus according to claim 1 or 2, wherein relationships between a force (C) that acts on the yarn feed port of the second yarn carrier due to yarn feeding, a force (G) that acts on the guide hole of the yarn guide due to yarn feeding, and a force (S) that acts due to the spring are $C < G$ and $C < S$.

4. The apparatus according to any one of claims 1 to 3, wherein the second yarn carrier for the second yarn is attached so as to be branched from the first yarn carrier via an attachment member, the first yarn carrier being attached via the yarn carrier holder to the yarn carrier ring.

5. The apparatus according to any one of claims 1 to 3, wherein the second yarn carrier for the second yarn is directly attached via the yarn carrier holder to the yarn carrier ring.

Fig.1

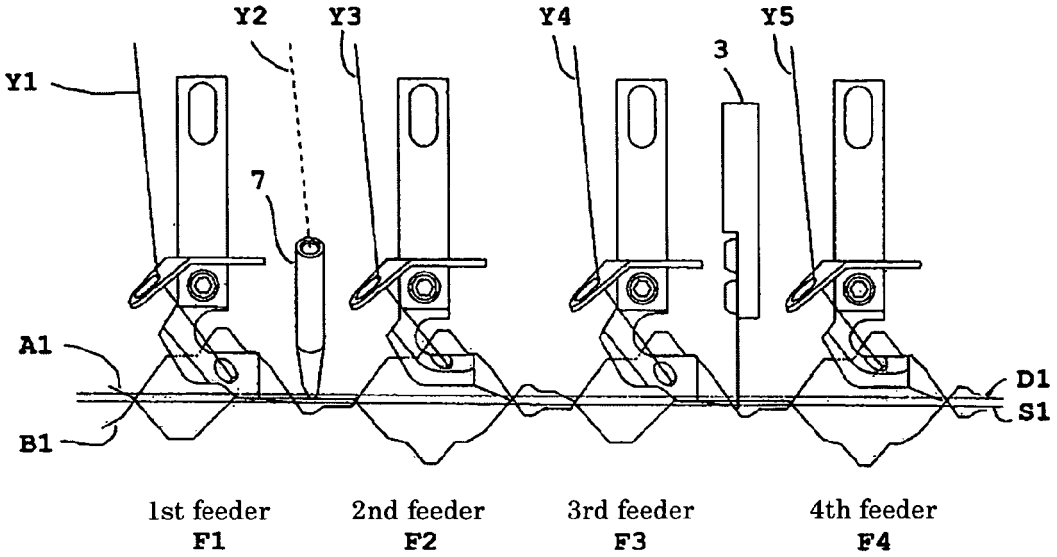

Y2
Y3
Y4
Y5
3
Y1
7
A1
B1
D1
S1
1st feeder
F1
2nd feeder
F2
3rd feeder
F3
4th feeder
F4

Fig.2

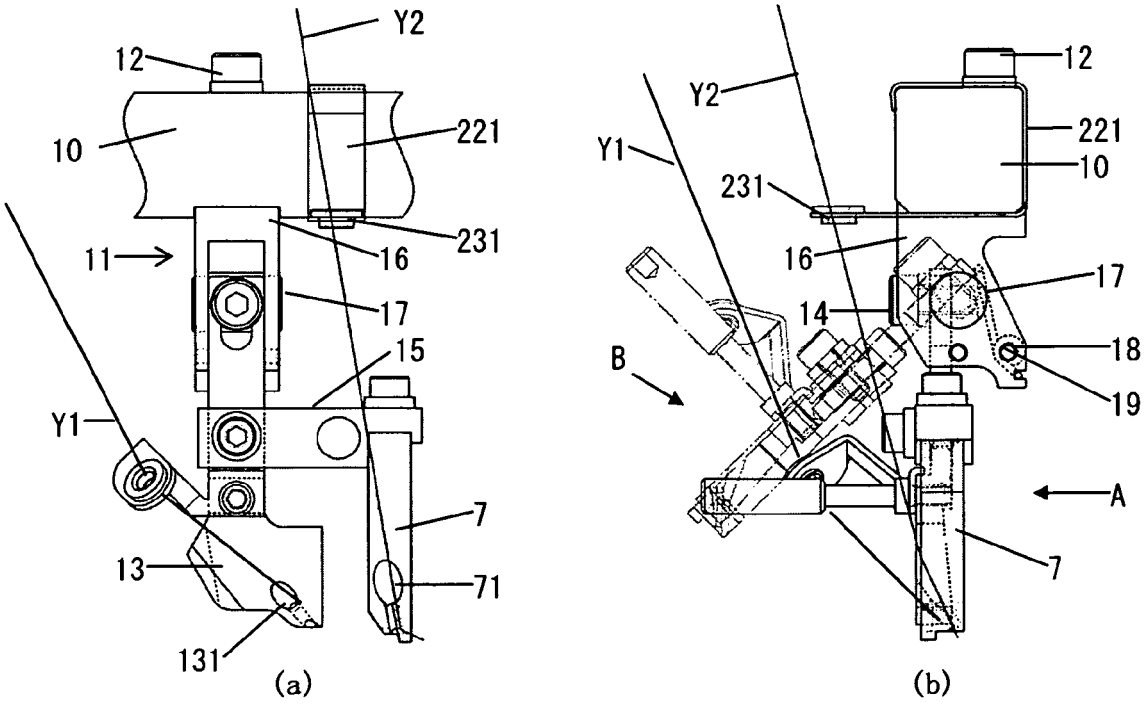

Y2
12
10
221
231
11
16
17
15
Y1
7
13
71
131
(a)
12
Y2
Y1
221
10
231
16
17
14
B
18
19
A
7
(b)

Fig.3

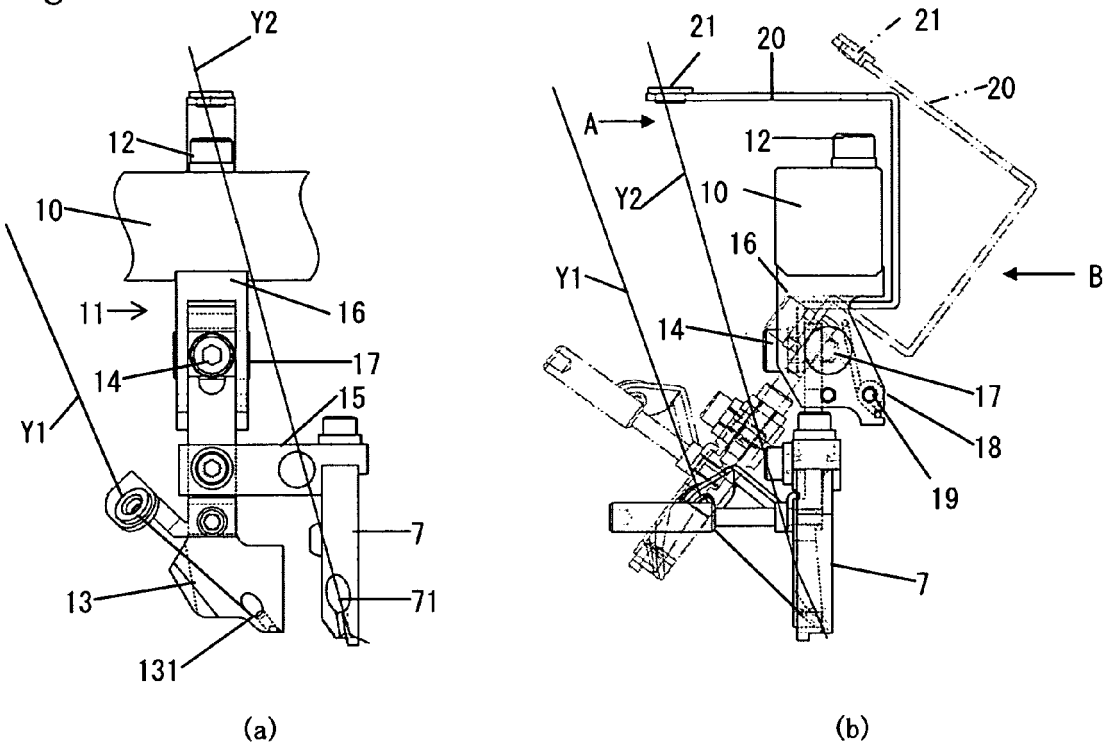

Y2
12
10
11
16
14
17
15
Y1
7
13
71
131
(a)
21
20
21
20
A
12
Y2
10
16
Y1
B
14
17
18
19
7
(b)

Fig.4

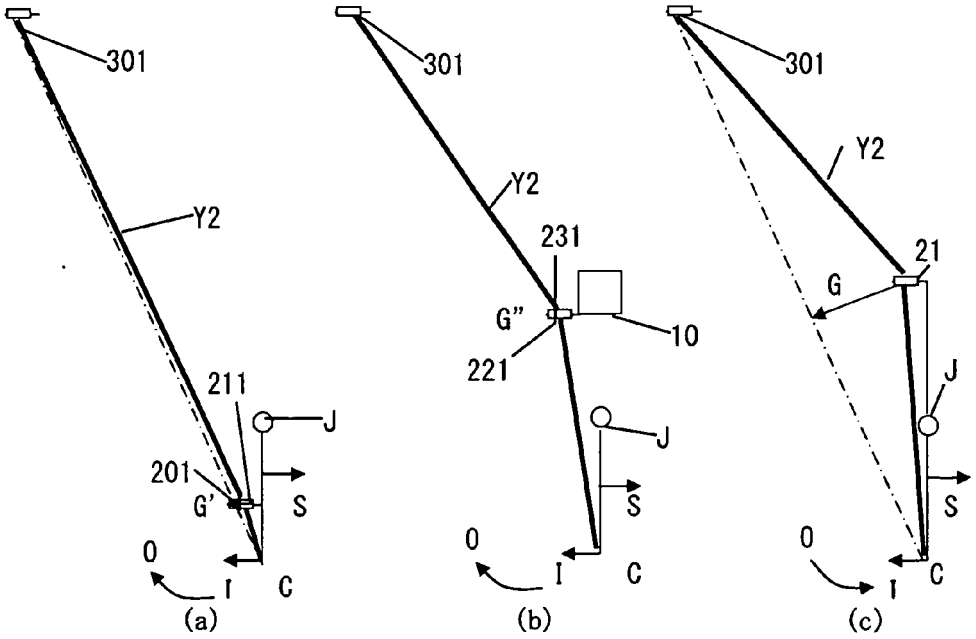
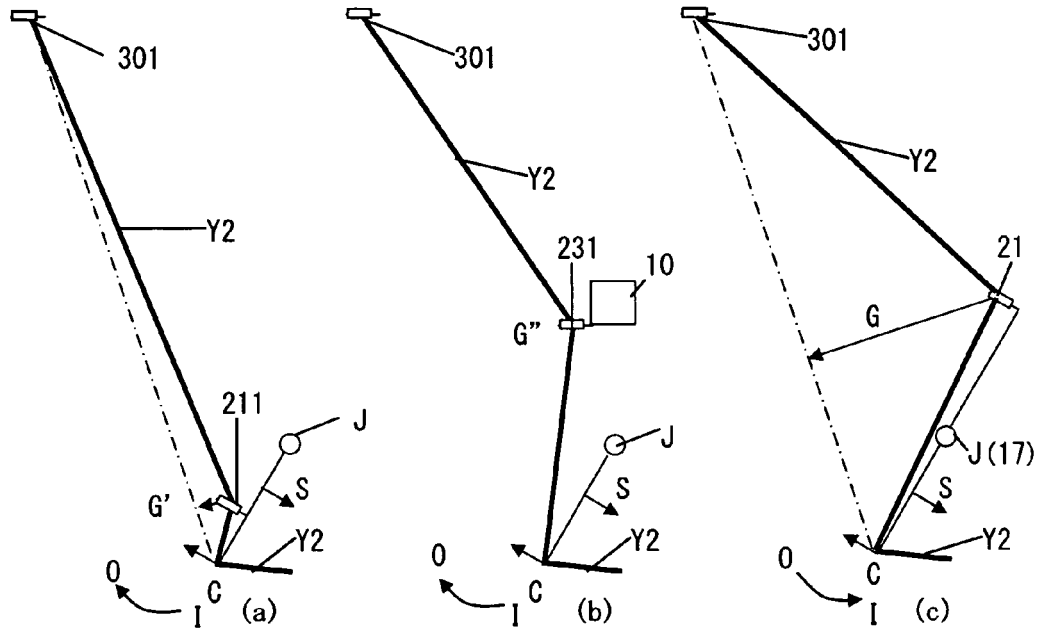

301
Y2
211
J
201
G'
S
0
I
C
(a)
301
Y2
231
G"
10
221
J
S
0
I
C
(b)
301
Y2
21
G
J
S
0
I
C
(c)

Fig.5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Y2
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G'
Y2
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C
I
(a)
301
Y2
231
10
G"
J
S
Y2
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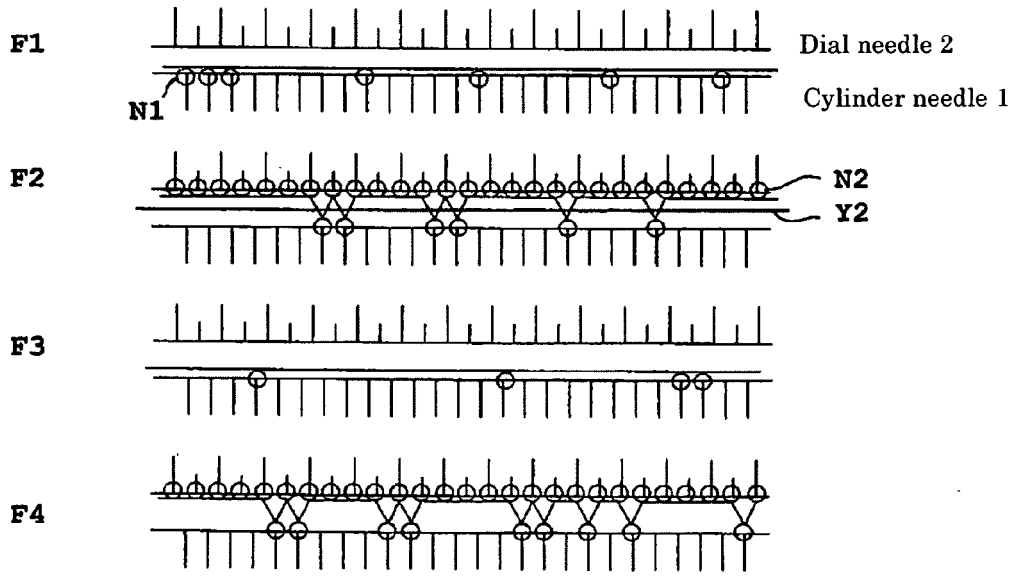
21
G
J (17)
S
Y2
0
C
I
(c)

Fig.6


F1
Dial needle 2
N1
Cylinder needle 1
F2
N2
Y2
F3
F4

REFERENCES CITED IN THE DESCRIPTION

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- JP 2009203566 A **[0002]**
- JP H2118784 U **[0011]**