



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.10.2004 Bulletin 2004/43

(51) Int Cl.7: **D04B 9/06, D04B 15/32**

(21) Application number: **04252069.2**

(22) Date of filing: **07.04.2004**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL HR LT LV MK

(72) Inventors:
• **Onishi, Yasushi**
Nishi-ku, Kobe, Hyogo 651-2103 (JP)
• **Watanabe, Hiroyuki**
Nishi-ku, Kobe, Hyogo 651-2243 (JP)

(30) Priority: **17.04.2003 JP 2003112517**

(74) Representative: **Johnstone, Douglas Ian et al**
Baron & Warren,
19 South End,
Kensington
London W8 5BU (GB)

(71) Applicant: **Precision Fukuhara Works, Ltd.**
Kobe, Hyogo 658-0012 (JP)

(54) **A circular knitting machine equipped with a knitting timing switching device**

(57) Circular knitting machine comprising at least cylinder needles (23) or dial needles (24) which include a set of needles each having a first butt and a second butt and a switching device for switching between two needle butt engaging stitch cams (13a, 13b) each of which is for one of synchronous and delayed timing. Electromagnetic actuators (12) on a rotary cylinder (10) selectively advance one of a lowering cam (11a) and a raising cam (11b) to engage a butt of a vertically displaceable lever having grooves therein engaged by pins connected to the stitch cams (13a, 13b) whereby raising and lowering of the lever selectively advances one of the stitch cams (13a, 13b) into engagement with corresponding ones of the dial needle butts. This provides switching of the stitch timing.

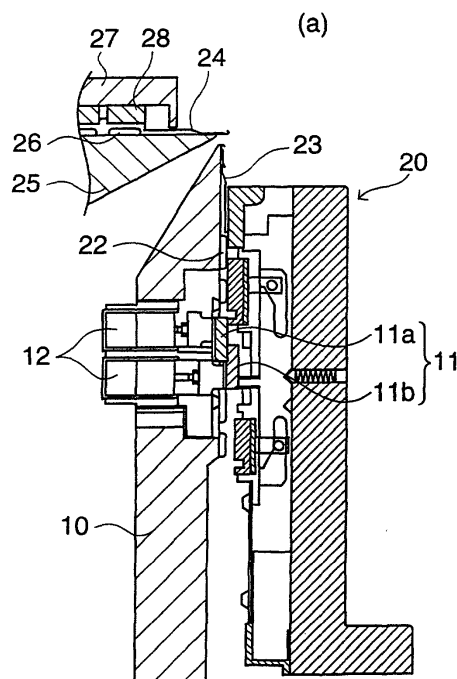


FIG. 1

Description

[0001] The present invention relates to a double knit circular knitting machine having a cylinder and a dial and further equipped with a device for switching the stitch cam timings.

[0002] In a double knit circular knitting machine, the cam timings for the cylinder stitch cam and the dial stitch cam are switched between the synchronous timing and the delayed timing as appropriate according to the type of knit. In the synchronous timing, the lowest points of the cylinder and dial stitches, i.e., the points at which the needles are most retreated from the top of the cylinder and the points at which the needles are most retreated from the periphery of the dial, are on the same straight line. In the delayed timing, they are on different lines from each other.

[0003] In the knitting method called "garment length knitting", in particular, the insertion of a drawn thread creates a separation in the fabric, making it possible to knit a high quality and value-added fabric with a united cuff and body. In this knitting method, however, knitting a rib stitch for the cuff requires the synchronous timing while knitting an interlock stitch for the body requires the delayed timing, and these timings have to be selectively switched between each other.

[0004] The following methods are known as methods for switching these timings.

(1) The entire cam box on the dial side is rotated and shifted between left and right. According to this method, all yarn feeders feed yarn at the same time.

(2) The methods described in Patent Document JP-B-2881651 and Patent Document JP-A-58-136860. According to these methods, timing can be set individually for each yarn feeder. The position of a stitch cam at a certain yarn feeder is horizontally adjusted independent of another stitch cam at another yarn feeder.

[0005] In both of the prior art techniques (1) and (2), stitch cams can also move vertically, so that the amount of the retraction of the needles can be changed to obtain the appropriate amount of yarn and size of the stitch.

[0006] In the invention according to Patent Document JP-B-2881651, a stitch cam is fastened with a set screw after manually adjusting it to a desired position. In the invention according to Patent Document JP-A-58-136860, the position of a stitch cam is precision adjusted automatically by a step motor. The former invention entails delicate manual operation and requires skill. The latter invention involves a precision position-adjustment mechanism, which leads to increased manufacturing cost. Both inventions employ only one type of stitch cam that is moved and adjusted.

[0007] In the present invention, two types of stitch cams are used. One type is for synchronous timing, and the other type is for delayed timing. The objective of the

present invention is to provide a reliable and low cost device for switching the timings by selectively using at least two types of stitch cams as appropriate.

[0008] By applying the device of the present invention, it is possible not only to switch stitch cams between the synchronous timing and the delayed timing, but also to provide at least two cams of the same type and switch between them as appropriate. More specifically, it is possible to switch between at least two stitch cams for the synchronous timing as well as between at least two stitch cams for the delayed timing. This makes it possible to knit a fabric having different stitch amounts. Such a device is also covered by the present invention.

[0009] An aspect of the present invention is a double knit circular knitting machine having a device for switching stitch cams between those for the synchronous timing and those for the delayed timing, comprising a rotary cylinder that slidably houses cylinder needles, control cams that control the movement of the cylinder needles, a rotary dial that is above the cylinder and slidably houses dial needles, and control cams that control the movement of the dial needles, in which at least either the cylinder needles or the dial needles are provided with at least two types of butts, one for synchronous timing stitch cams and the other for the delayed timing stitch cams, and at least either the cylinder needle control cams or the dial needle control cams are provided with synchronous timing stitch cams and delayed timing stitch cams that oppose at least either type of knitting needles and are arranged so as to selectively engage with either of the butts.

[0010] An aspect of the present invention is a double knit circular knitting machine having a device for switching between at least two stitch cams for the synchronous timing, comprising a rotary cylinder that slidably houses cylinder needles, control cams that control the movement of the cylinder needles, a rotary dial that is above the cylinder and slidably houses dial needles, and control cams that control the movement of the dial needles, in which at least either the cylinder needles or the dial needles are provided with at least two types of butts for synchronous timing stitch cams, and at least either the cylinder needle control cams or the dial needle control cams are provided with at least two types of synchronous timing stitch cams that oppose the knitting needles having the at least two types of butts and are arranged so as to selectively engage with either of the butts.

[0011] An aspect of the present invention is a double knit circular knitting machine having a device for switching between at least two stitch cams for the delayed timing, comprising a rotary cylinder that slidably houses cylinder needles, control cams that control the movement of the cylinder needles, a rotary dial that is above the cylinder and slidably houses dial needles, and control cams that controls the dial needles, in which at least either the cylinder needles or the dial needles are provided with at least two types of butts for delayed timing stitch cams, and at least either the cylinder needle con-

trol cams or the dial needle control cams are provided with at least two types of delayed timing stitch cams that oppose the knitting needles having at least two types of butts and are arranged so as to selectively engage with either of the butts.

[0012] To select either of the two types of stitch cams, the following selecting mechanism, for example, can be employed. This mechanism comprises a selecting cam that is carried on at least either of the cylinder and the dial, a lever having a butt that can contact the selecting cam and a linkage to a stitch cam, and two types of stitch cams that can move by engaging with this linkage.

[0013] Preferably, the selecting cam comprises a raising cam and a lowering cam and is mounted in such a way that it can project outwardly with respect to the rotary cylinder. The selecting cam is operated, for example, by an electromagnetic actuator.

[0014] Preferably, the linkage comprises two pin grooves extending in opposite directions. Portions of the two types of stitch cams fit into these grooves in such a way that when one of the two types of stitch cams retracts, the other sticks out.

[0015] Embodiments of the present invention will now be described with reference to the accompanying drawings, in which:

FIG. 1 (a) is a sectional view and (b) is a front view of a rotary cylinder, both showing selecting cams and their surroundings;

FIG. 2 shows two types of stitch cams. (A) shows a stitch cam for synchronous timing, and (B) shows a stitch cam for delayed timing. In both (A) and (B), (a) is a front view, and (b) is a side view;

FIG. 3 shows a lever, which is a selecting means that controls the projection and retraction of the stitch cam. (a) is a side view, and (b) is a front view; FIG. 4 illustrates the operation of a raising cam. (a) is a front view of a cam holder. (b) and (c) are sectional views of the cam holder for illustrating the movement of the stitch cams;

FIG. 5 illustrates the operation of a lowering cam. (a) is a front view of a cam holder. (b) and (c) are sectional views of the cam holder for illustrating the movement of the stitch cams; and

FIG. 6 (a) is a front view of cam holder 20, and (b) is a sectional view of the cam holder for illustrating the stitch-amount adjuster.

First Embodiment

[0016] This is a device for switching the stitch cams between the synchronous timing and the delayed timing. FIG. 1 (a) is a sectional view and (b) is a front view of a rotary cylinder 10, both showing a selecting cam 11 and its surroundings.

[0017] In the periphery of the rotary cylinder 10, a cylinder needle 23 is housed in such a way that it can slide freely inside a needle groove 22 that extends axially.

[0018] When knitting, a dial needle 24, which cooperates with the cylinder needle 23, is arranged horizontally in such a way that it can slide freely inside a needle groove 26 of the dial 25.

[0019] The cylinder needle 23 is operated and controlled in an ordinary method by a cam 13 that is fastened on a cylinder cam holder 20. The dial needle 24 is operated and controlled in an ordinary method by a cam 28 that is fastened on a dial cam holder 27.

[0020] The selecting cam 11 comprises a lowering cam 11a on the left-hand side of the rotary cylinder and a raising cam 11b on the right-hand side of the rotary cylinder. The positions of the lowering cam and the raising cam can be reversed. On the back of each cam, an electromagnetic actuator 12 is provided. The electromagnetic actuator is controlled by a knit-pattern controlling device (not shown).

[0021] FIG. 2 shows two types of stitch cams. (A) shows a stitch cam 13a for synchronous timing, and (B) shows a stitch cam 13b for delayed timing. In both (A) and (B), (a) is a front view, and (b) is a side view. On the front surfaces of these two types of stitch cams 13a and 13b, cam races 14a and 14b are provided respectively. On the back surfaces, shafts 15a and 15b are fastened in such a way that they protrude from the back surfaces. At the tips of the shafts, pins 16a and 16b are provided respectively.

[0022] FIG. 3 shows a lever 17, which is a selecting means that controls the projection and retraction of the stitch cams. (a) is a side view, and (b) is a front view. A butt 18 is positioned in the middle of the lever. When the butt 18 touches the selecting cam 11, the lever respectively moves up and down. This lever is provided with link grooves 19a, 19b for pins. These grooves are used for projection and retraction of the stitch cam 13a for synchronous timing and the stitch cam 13b for delayed timing.

[0023] FIG. 4 illustrates the operation of the raising cam 11b. (a) is a front view of a cam holder 20. (b) and (c) are sectional views of the cam holder for illustrating the movement of the stitch cams. When raising cam 11b acts on butt 18 of lever 17, lever 17 ascends (FIG. 4 (b)). The ascent of the lever causes link grooves 19a, 19b to act on pins 16a, 16b of the stitch cams, retracting the upper cam 13a and projecting the lower cam 13b (FIG. 4 (c)).

[0024] FIG. 5 illustrates the operation of the lowering cam 11a. (a) is a front view of a cam holder 20. (b) and (c) are sectional views of the cam holder for illustrating the movement of the stitch cams. When lowering cam 11a acts on butt 18 of lever 17, lever 17 descends (FIG. 5 (b)). The descent of the lever causes link grooves 19a, 19b to act on pins 16a, 16b of the stitch cams, projecting the upper cam 13a and retracting the lower cam 13b (FIG. 5 (c)).

[0025] Notches are on the back of the lever 17, and a detent mechanism 21 respectively engages the notches for releasably holding the lever in the raised and lowered

positions.

[0026] As in the prior art, the stitch cam(s) of the present invention can also move up and down to vary the retraction of the needle, obtain the appropriate yarn amount and vary the stitch sizes.

[0027] For that purpose, the present invention provides a cam set piece 25a having a cavity with substantially the same length as the vertical length L of the cam 13a, as shown in FIG. 6. The cam 13a is mounted in such a way that it is moveably held by the cam set piece 25a, so that the cam 13a can move between positions in which it is respectively projecting from the cavity and retracted into the cavity. The cam set piece 25a is provided with a through-hole for shaft 15a of the cam 13a to penetrate, and the cam 13a is mounted in such a way that it is capable of projecting and retracting under the control of the lever 17, as described above.

[0028] As described below, the cam holder is provided with two stitch-amount-adjusters that are arranged one above the other. One is for the synchronous timing stitch cam and the other is for the delayed timing stitch cam. The two adjusters have substantially the same construction.

[0029] On the back of the cam set piece 25a, a pin 27a is embedded in such a way that it extends approximately halfway into the thickness of the cam set piece 25a. The protrusion of the pin 27a engages in a spiral groove 26c of the stitch-amount adjuster. When the stitch-amount adjuster 26a is rotated, the pin 27a moves up and down along the spiral groove 26c.

[0030] As the pin 27a moves up and down, the cam set piece 25a and the stitch cam 13a also move up and down.

[0031] The cylindrical periphery of the stitch adjuster 26a is provided with a notched surface 26e. The stitch-amount adjuster 26a is releasably rotatably fastened using a pin 29a that is urged by a spring 28a so that the pin 29a movably engages the notched surface 26e in a detent-like manner.

[0032] As noted above, a number of mechanisms are known that move the stitch cam(s) vertically. In the above embodiment, any of such known mechanisms can be used in place of the above mechanism as long as it does not conflict with the purpose of the present invention.

Second Embodiment

[0033] This is a device for switching between two stitch cams for synchronous timing. In the explanations and drawings for the first embodiment, read the two types of stitch cams 13, i.e., 13a and 13b, as two synchronous timing stitch cams.

Third Embodiment

[0034] This is a device for switching between two stitch cams for delayed timing. In the explanations and

drawings for the first embodiment, read the two types of stitch cams 13, i.e., 13a and 13b, as two delayed timing stitch cams.

Effects Of The Invention

[0035] According to the present invention, independent adjusters are used for each of the stitch cams, such stitch cams being a synchronous timing stitch cam and an delayed timing stitch cam, two synchronous timing stitch cams, or two delayed timing stitch cams. Therefore, an appropriate stitch amount can be set for each, and the adjusters can be manually operated. Because the selection of stitch cams can be controlled by a selecting cam carried by the cylinder, one selecting mechanism is sufficient for a knitting machine.

[0036] Because two races are provided for the synchronous timing and delayed timing stitch cams, two synchronous timing stitch cams or two delayed timing stitch cams, each race can be provided with an appropriate action line along which the needle moves. In other words, when designing a cam line, stitch angles and widths can be designed independently of the knitting timing. It is also possible to employ closed cams, which contribute to the making of high quality fabrics.

Claims

1. A double knit circular knitting machine having a device for switching between at least two stitch cams (13a, 13b), each of which is for one of synchronous timing and delayed timing, comprising:

a rotary cylinder (10) that slidably houses cylinder needles (23), and a rotary dial (25) that is above the cylinder (10) and slidably houses dial needles (24), wherein at least the cylinder needles (23) or the dial needles (24) comprise a set of needles that each include at least a first butt and a second butt;
control cams (13) that control movement of the cylinder needles (23), and control cams (28) that control movement of the dial needles (24), wherein at least the cylinder needle control cams (13) or the dial needle control cams (28) comprise:

a first stitch cam (13a) that is opposed to said set of needles and is for providing synchronous or delayed timing while controllably engaging the first butts of said set of needles, and

a second stitch cam (13b) that is opposed to said set of needles and is for providing synchronous or delayed timing while controllably engaging the second butts of said set of needles; and

a selecting mechanism for selectively moving the first and second stitch cams (13a, 13b) between first and second configurations,

wherein in the first configuration:

the first stitch cam (13a) is positioned for controllably engaging the first butts of said set of needles, and
the second stitch cam (13b) is positioned so as not to controllably engage the second butts of said set of needles, and

wherein in the second configuration:

the first stitch cam (13a) is positioned so as not to controllably engage the first butts of said set of needles, and
the second stitch cam (13b) is positioned for controllably engaging the second butts of said set of needles.

2. A double knit circular knitting machine having a device for switching between at least two types of stitch cams (13a, 13b), one for synchronous timing and the other for delayed timing, comprising:

a rotary cylinder (10) that slidably houses cylinder needles (23), and a rotary dial (25) that is above the cylinder (10) and slidably houses dial needles (24), wherein at least the cylinder needles (23) or the dial needles (24) comprise a set of needles that each include at least a first butt and a second butt;
control cams (13) that control movement of the cylinder needles (23), and control cams (28) that control movement of the dial needles (24), wherein at least the cylinder needle control cams (13) or the dial needle control cams (28) comprise:

a first stitch cam (13a) that is opposed to said set of needles and is for providing synchronous timing while controllably engaging the first butts of said set of needles, and
a second stitch cam (13b) that is opposed to said set of needles and is for providing delayed timing while controllably engaging the second butts of said set of needles; and

a selecting mechanism for selectively moving the first and second stitch cams (13a, 13b) between first and second configurations,

wherein in the first configuration:

the first stitch cam (13a) is positioned for controllably engaging the first butts of said set of

needles, and

the second stitch cam (13b) is positioned so as not to controllably engage the second butts of said set of needles, and

wherein in the second configuration:

the first stitch cam (13a) is positioned so as not to controllably engage the first butts of said set of needles, and
the second stitch cam (13b) is positioned for controllably engaging the second butts of said set of needles.

3. A double knit circular knitting machine having a device for switching between at least two stitch cams (13a, 13b) for synchronous timing, comprising:

a rotary cylinder (10) that slidably houses cylinder needles (23), and a rotary dial (25) that is above the cylinder (10) and slidably houses dial needles (24), wherein at least the cylinder needles (23) or the dial needles (24) comprise a set of needles that each include at least a first butt and a second butt;
control cams (13) that control movement of the cylinder needles (23), and control cams (28) that control movement of the dial needles (24), wherein at least the cylinder needle control cams (13) or the dial needle control cams (28) comprise:

a first stitch cam (13a) that is opposed to said set of needles and is for providing synchronous timing while controllably engaging the first butts of said set of needles, and
a second stitch cam (13b) that is opposed to said set of needles and is for providing synchronous timing while controllably engaging the second butts of said set of needles; and

a selecting mechanism for selectively moving the first and second stitch cams (13a, 13b) between first and second configurations,

wherein in the first configuration:

the first stitch cam (13a) is positioned for controllably engaging the first butts of said set of needles, and
the second stitch cam (13b) is positioned so as not to controllably engage the second butts of said set of needles, and

wherein in the second configuration:

the first stitch cam (13a) is positioned so as not

to controllingly engage the first butts of said set of needles, and
the second stitch cam (13b) is positioned for controllingly engaging the second butts of said set of needles.

4. A double knit circular knitting machine having a device for switching between at least two stitch cams (13a, 13b) for delayed timing, comprising:

a rotary cylinder (10) that slidably houses cylinder needles (23), and a rotary dial (25) that is above the cylinder (10) and slidably houses dial needles (24), wherein at least the cylinder needles (23) or the dial needles (24) comprise a set of needles that each include at least a first butt and a second butt;
control cams (13) that control movement of the cylinder needles (23), and control cams (28) that control movement of the dial needles (24), wherein at least the cylinder needle control cams (13) or the dial needle control cams (28) comprise:

a first stitch cam (13a) that is opposed to said set of needles and is for providing delayed timing while controllingly engaging the first butts of said set of needles, and
a second stitch cam (13b) that is opposed to said set of needles and is for providing delayed timing while controllingly engaging the second butts of said set of needles; and

a selecting mechanism for selectively changing between first and second configurations,

wherein in the first configuration:

the first stitch cam (13a) is positioned for controllingly engaging the first butts of said set of needles, and
the second stitch cam (13b) is positioned so as not to controllingly engage the second butts of said set of needles, and

wherein in the second configuration:

the first stitch cam (13a) is positioned so as not to controllingly engage the first butts of said set of needles, and
the second stitch cam (13b) is positioned for controllingly engaging the second butts of said set of needles.

5. A circular knitting machine according to any of claims 1 to 4, wherein the selecting mechanism includes:

one or more selecting cams (11a, 11b) provided on at least the cylinder or the dial, and
a lever (17) having:

a butt (18) that contacts at least one of the one or more selecting cams in a manner that causes movement of the lever (17), and
linkages (19a, 19b) that respectively engage and move the first and second stitch cams (13a, 13b) in response to movement of the lever (17).

6. A circular knitting machine according to claim 5, wherein the one or more selecting cams (11a, 11b) are capable of projecting outward with respect to the rotary cylinder (10), and the one or more selecting cams (11a, 11b) comprises:

a raising cam (11b) that contacts the butt (18) of the lever (17) and thereby raises the lever (17), and
a lowering cam (11a) that contacts the butt (18) of the lever (17) and thereby lowers the lever (17).

7. A circular knitting machine according to claim 6, wherein the raising cam (11b) is projected outward with respect to the rotary cylinder (10) by a driving force of an electromagnetic actuator (12).

8. A circular knitting machine according to claim 6, wherein the lowering cam (11a) is projected outward with respect to the rotary cylinder (10) by a driving force of an electromagnetic actuator (12).

9. A circular knitting machine according to any of claims 5 to 8, wherein the linkages are grooves (19a, 19b) provided on the lever and extending in opposite directions from one another, and parts (16a, 16b) of the first and second stitch cams (13a, 13b) respectively fit into and cooperate with the grooves (19a, 19b) so that movement of the lever causes the changing between the first and second configurations.

10. A circular knitting machine according to claim 9, wherein the grooves (19a, 19b) are shaped so that:

the first stitch cam (13a) moves outwardly into controlling engagement with the first butts of said set of needles while the second stitch cam (13b) moves inwardly so as not to controllingly engage the second butts of said set of needles, and
the first stitch cam (13a) moves inwardly so as not to controllingly engage the first butts of said set of needles while the second stitch cam

(13b) moves outwardly into controlling engagement with the second butts of said set of needles.

11. A circular knitting machine according to any of claims 1 to 10, wherein the first stitch cam (13a) is shaped differently than the second stitch cam (13b).

10

15

20

25

30

35

40

45

50

55

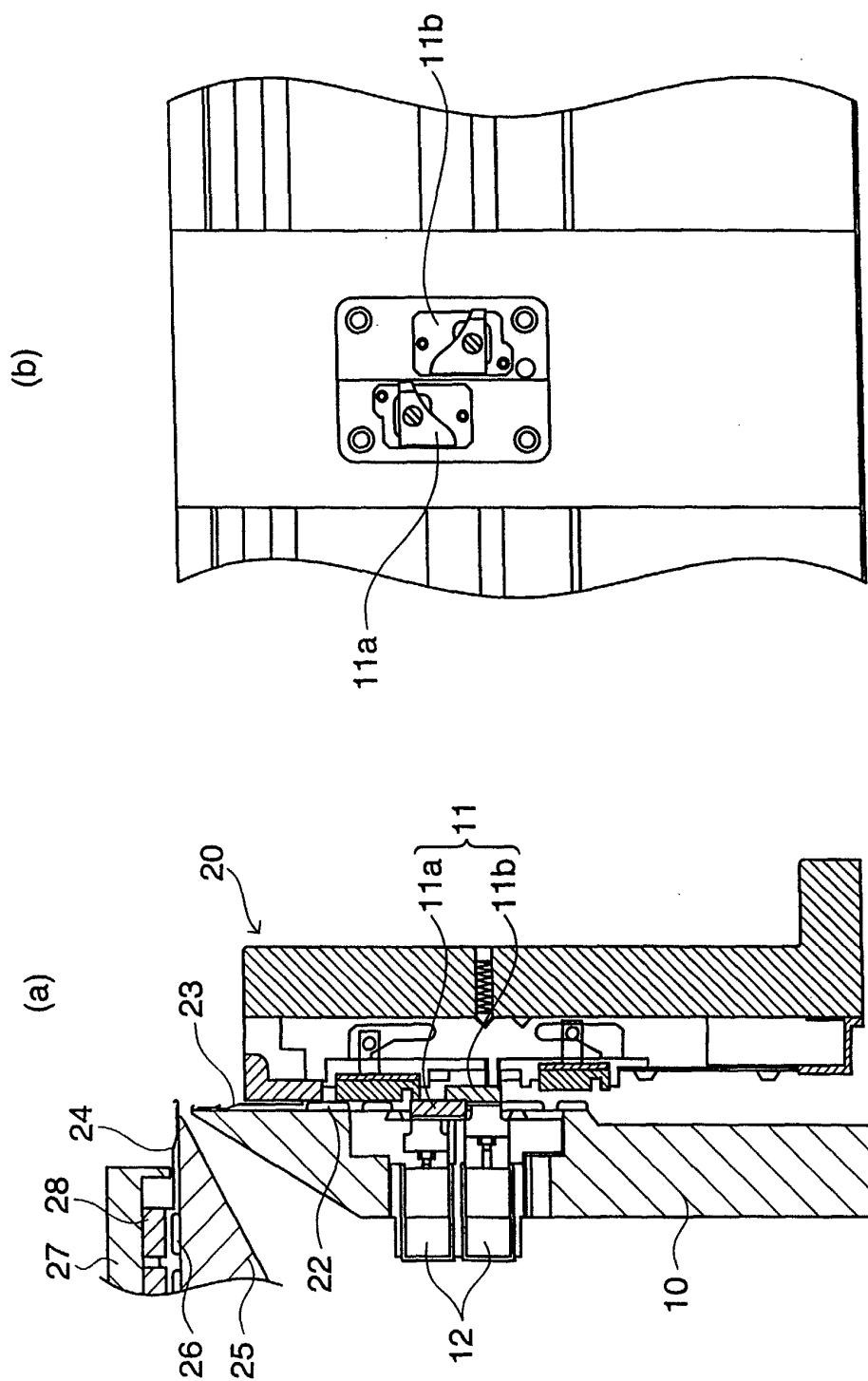


FIG. 1

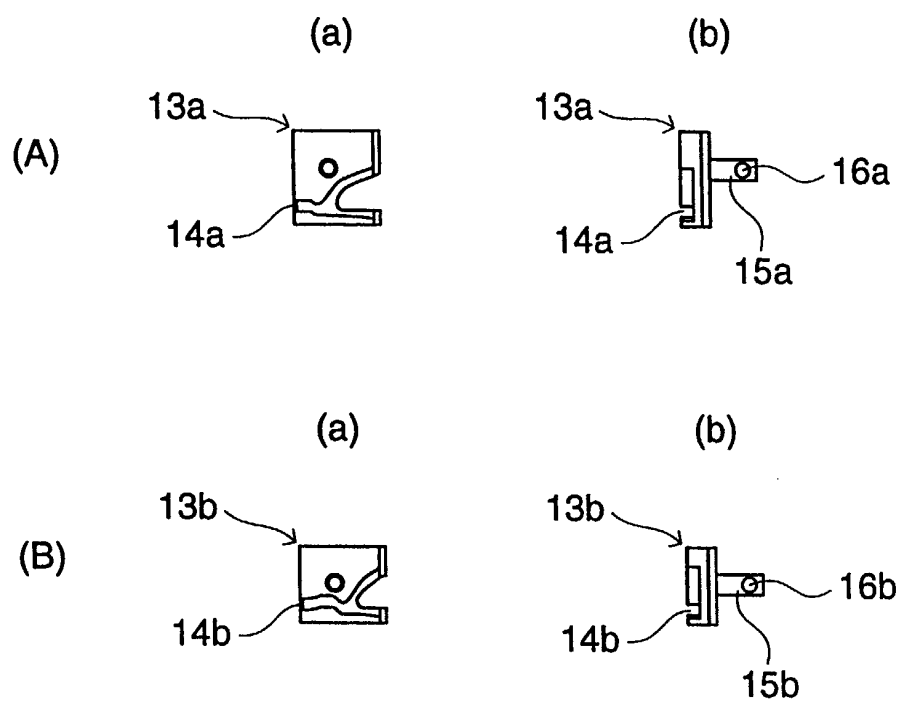


FIG. 2

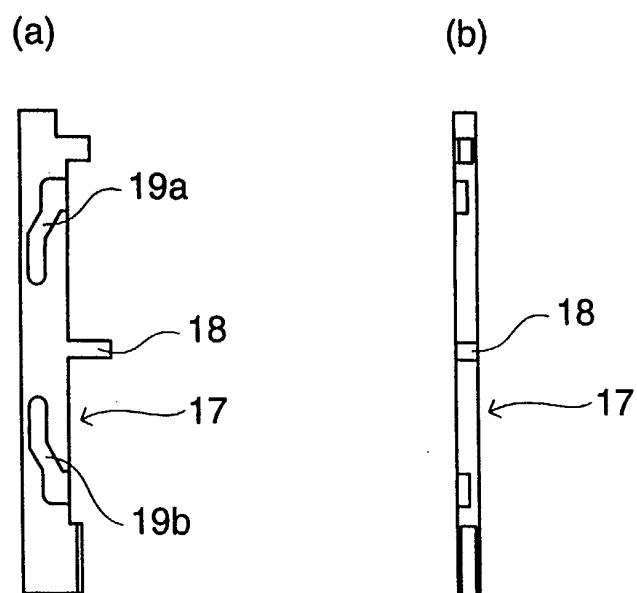


FIG. 3

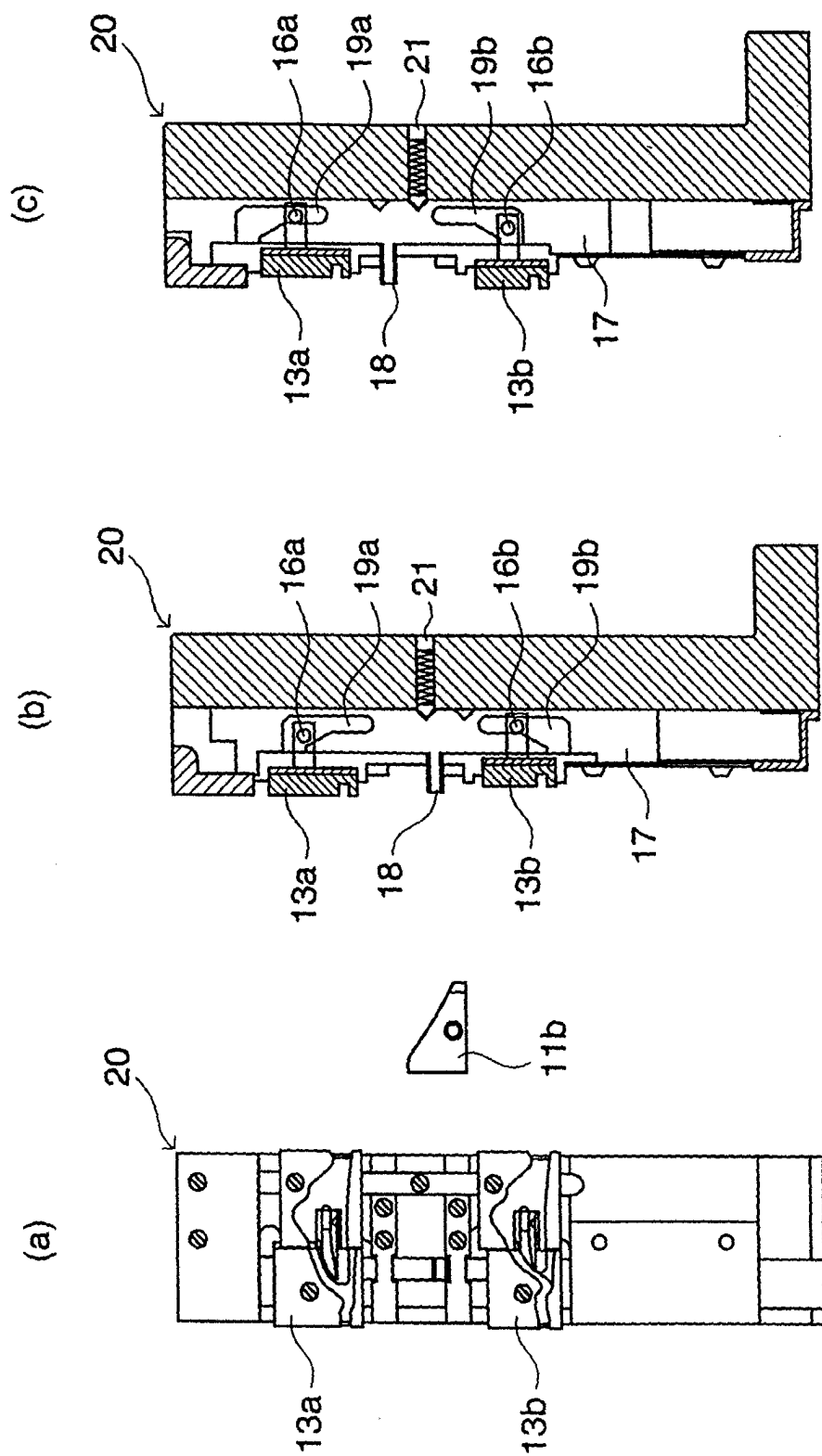


FIG. 4

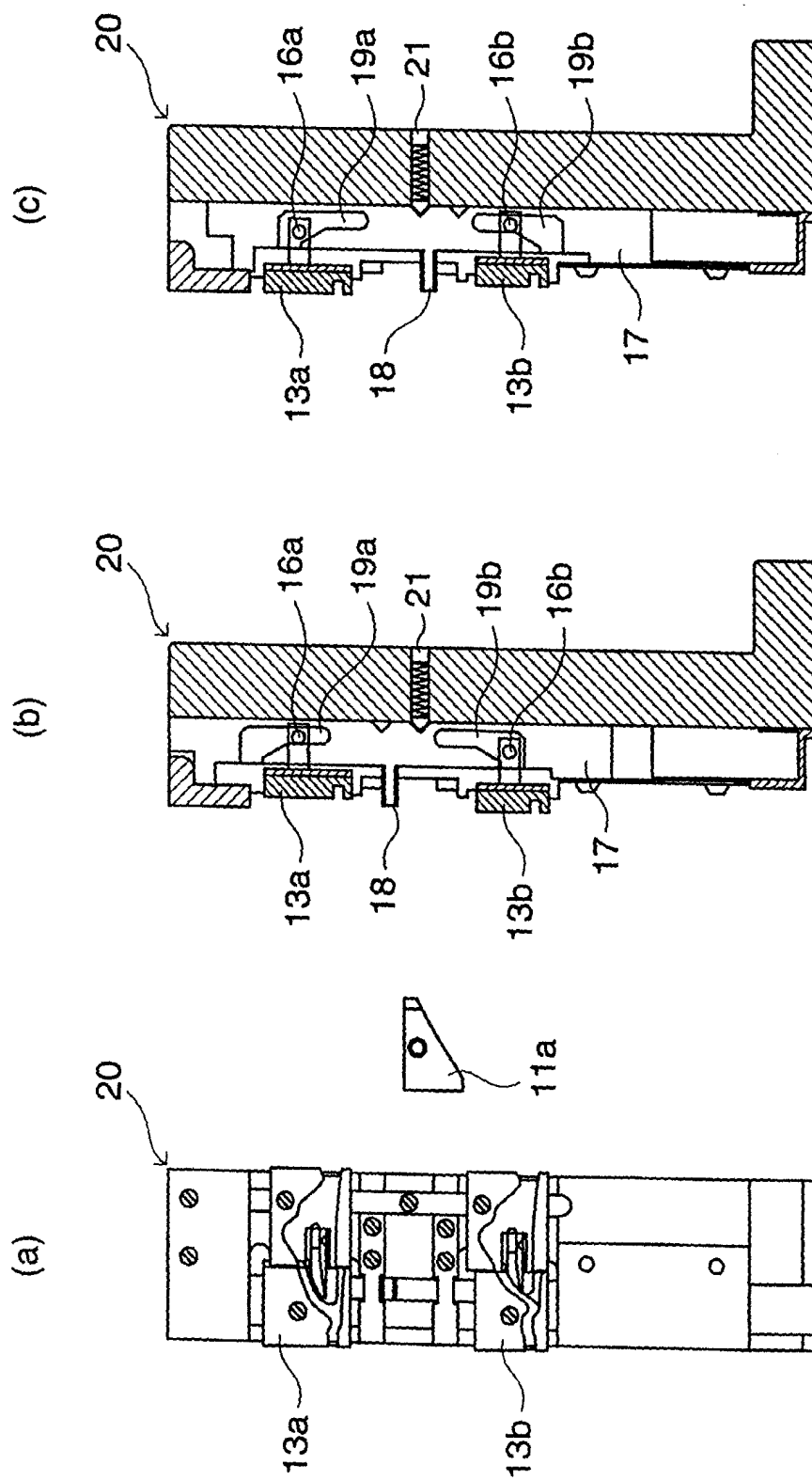


FIG. 5

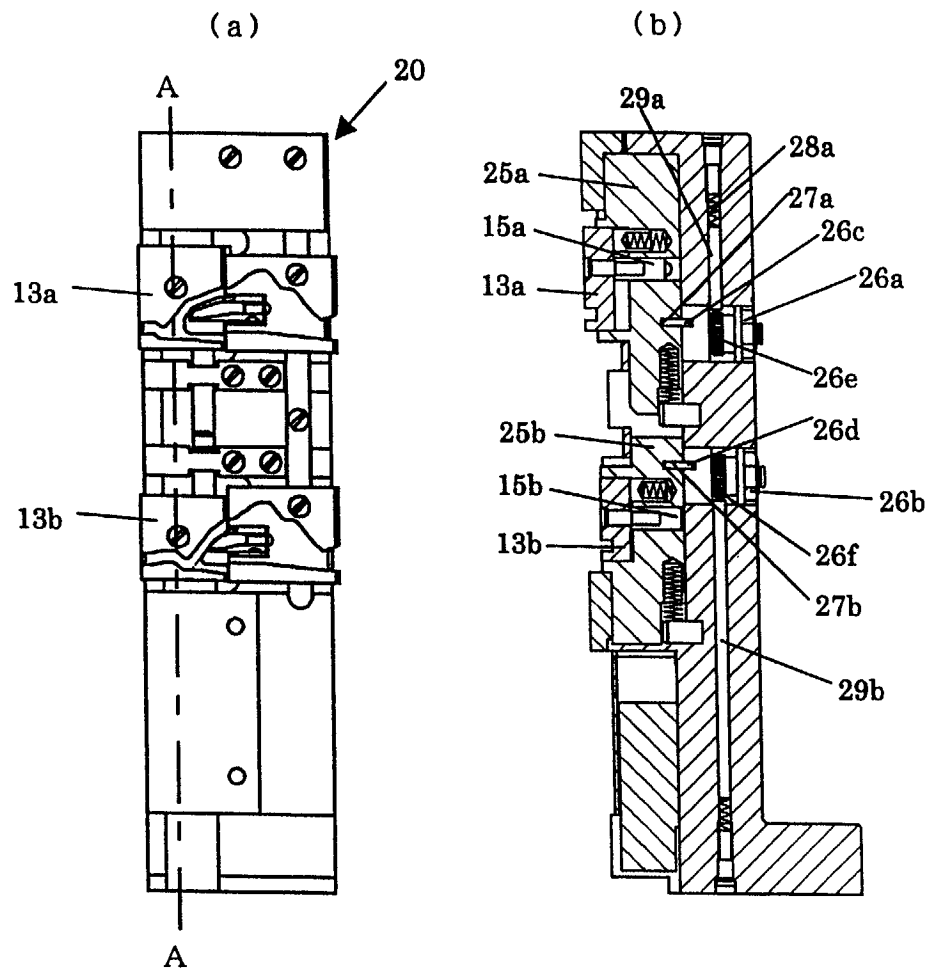


FIG. 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 25 2069

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	GB 1 079 169 A (WILDT MELLOR BROMLEY LTD) 16 August 1967 (1967-08-16) -----	1-4	D04B9/06 D04B15/32
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			D04B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 August 2004	Examiner Sterle, D
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P4/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 25 2069

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-08-2004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1079169 A	16-08-1967	DE 6606726 U	05-11-1970
		FR 1486720 A	30-06-1967
		US 3422638 A	21-01-1969

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82