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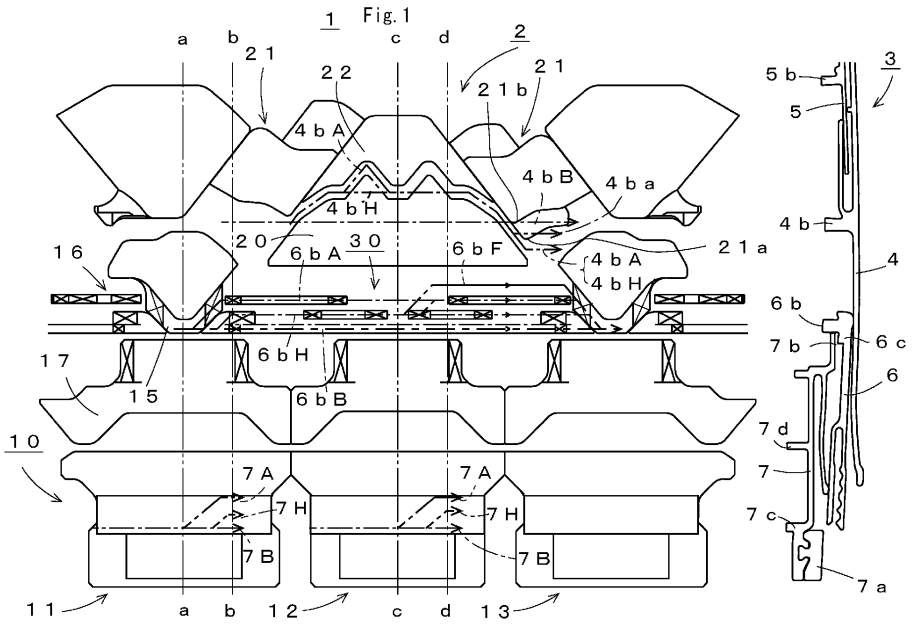
(54) FLATBED KNITTING MACHINE

(57) An object is to provide a flatbed knitting machine capable of performing a large number of types of selectable knitting operation and performing knitting operation in a mixed manner with improved knitting efficiency.

An entry-side needle selection mechanism 11 allows selection of a knitting needle 3 subjected to the action from the first by a cam system 2 so that a selection butt 6b of a select jack 6 is guided to one of an A-position 6bA, an H-position 6bH and a B-position 6bB, by acting on and guiding a selector 7 of the knitting needle 3 to one of paths 7A, 7H, 7B. An intermediate needle selection mechanism 12 allows selection to guide the select jack 6 of the knitting needle 3 acted on by the cam system 2 to an F-position 6bF newly arranged closer to a needle bed gap than a A-position. The selection of the F-position allows the second stitch or the split knit as additional knitting operation.

Fig. 1



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Description

[Technical Field]

[0001] The present invention relates to a flatbed knitting machine including a needle selection mechanism mounted on a carriage configured to reciprocate along a longitudinal direction of needle beds, for selecting knitting needles to perform knitting operation.

[Background Art]

[0002] Conventionally, the carriage which reciprocates along the longitudinal direction of the needle beds is equipped with the cam system which drives knitting needles to perform knitting operation, and a needle selection mechanism for selecting the knitting needles to be driven. At least one pair of front and rear needle beds are disposed so as to face each other across a needle bed gap. The knitting needles are housed in a plurality of needle grooves arranged in parallel at a constant pitch along the longitudinal direction of the needle beds so as to slide in the needle grooves, and are driven in the direction of advancing to and retracting from the needle bed gap. The selection of the knitting needle is reflected in protruding states of butts from the needle groove, each butt disposed in the knitting needle. The basic knitting operations of the knitting needle includes three types: knit, tuck and miss, and the needle selection mechanism is configured to basically select a target knitting needle according to the selection out of the three types in the entry side of the cam system (refer to, for example, Patent Citations 1, 2, 3).

[0003] Each of the knitting needle has a hook for forming a knitted loop on the tip thereof in the needle bed gap side, and a selector and a select jack for receiving the selection made in the needle selection mechanism on the tail part side apart from the needle bed gap. The selector is driven to guide the select jack to one of three positions, for example, a B-position, an H-position, and an A-position, in response to receive two times selection. Patent Citation 1 discloses the selection for the selector according to whether or not a selection butt disposed in the selector is pressed. Patent Citations 2, 3 disclose the selection for the selector according to whether or not the selector is released from the state of being attracted magnetically. Patent Citations 1, 2 disclose that the selector after the selection guides the select jack to the B-position according to the non-selection in the first time, to the H-position according to the selection in the first time and the non-selection in the second time, or to the A-position according to the selection both in the first time and the second time. Patent Citation 3 discloses the guiding to the A-position according to the selection in the first stage, to the H-position according to the non-selection in the first stage and the selection in the second stage, to the B-position according to the non-selection both in the first stage and the second stage. The guided select jack receives at the butt thereof press from a presser disposed in each path. The pressers corresponding to the knit, the tuck and the miss are basically disposed in the paths corresponding to the A-position, the H-position and the B-position, respectively. The cam system may be provided additionally with a new drive path for guiding a knitting needle, and some or all of the pressers may be made movable or may act on the butt to an intermediate position, so that it is possible for the knitting needle to be driven differently from the basic knitting operation.

[Citation List]

[Patent Literature]

[0004]

Patent Citation 1: WO2007074944A1
Patent Citation 2: JPH09-241952A
Patent Citation 3: JP2013-64207A

[Summary of Invention]

[Technical Problem]

[0005] In the conventional needle selection mechanisms only three positions are allowed to select for knitting needles, and the number of types of knitting operation in a mixed manner is restricted. For example, if the stitch cam disposed in the cam system so as to draw and retract a knitting needle from the needle bed gap is formed with difference in height on its drawing cam face so as to be lower in posterior half, and the butt disposed on the knitting needle is made to protrude with a different protruding amount according to the height, it is possible to perform a second stitch operation to change drawing amount of the knitting needle drawing a yarn fed to the hook thereof in the needle bed gap so as to form a knitted loop in different sizes, that is the stitch density is changed. In addition, partial change of the cam system or the pressers enables the split knit operation of forming a split stitch by transferring an old loop to the hook of a knitting needle of the facing needle bed instead of knocking-over, during the formation of a knitted loop. However, it is impossible to mix either type of these operations with the three types of basic operation, due to a lack of selectable positions.

[0006] If four or more positions could be allowed to select in the needle selection mechanism, another type of operation might be additionally mixed with the three types of basic operation. However, such a needle selection mechanism increases in size in the left-and-right direction in which the carriage moves and in the back-and-forth direction in which the knitting needles advance and retract. As the needle selection mechanism increases in size, the carriage to be mounted increases in size, and the moving stroke becomes longer in the longitudinal direction of the needle bed. As the moving stroke of the carriage becomes longer, the moving takes longer time

when moving at the same speed, resulting in reduction in the knitting efficiency. Even if a greater number of types of operation are made selectable by switching of the cam system or the pressers without the increase of the number of times of selection in the needle selection mechanism, the moving of the carriage needs to be interrupted before and after the switching, and the kick back of direction change after moving in an idle manner in the reverse direction. The kick back of the carriage also reduces the knitting efficiency.

[0007] The object of the present invention is to provide a flatbed knitting machine which provides a larger number of types of selectable knitting operation and is improved in knitting efficiency at the time of knitting operation in a mixed manner.

[Technical Solution]

[0008] The present invention is a flatbed knitting machine provided with:

at least a pair of front and rear needle beds disposed so as to face each other across a needle bed gap;
a plurality of knitting needles respectively housed in a plurality of needle grooves arranged in parallel at a constant pitch along a longitudinal direction of the needle beds;
a carriage configured to reciprocate along the longitudinal direction of the needle beds;
a cam system mounted on the carriage and configured to make the knitting needles perform knitting operation by driving the knitting needles in a direction of advancing to and retracting from the needle bed gap; and
a needle selection mechanism mounted on the carriage and configured to select the knitting needle for the knitting operation,
wherein each of the knitting needles including:

a select jack having a selection butt configured to receive action from the cam system, and being guided to various positions including a B-position corresponding to a base-state position, an H-position corresponding to an intermediate position and being arranged closer to the needle bed gap in a direction of advancing to the needle bed gap than the B-position, and an A-position corresponding to an advancing position, thereby various types of knitting operation being allowed in a selectable manner to be performed by the cam system with the knitting needles, according to difference in press received by the selection butt from the cam system in each of the positions; and
a selector driven to pass through one of a base path in a case of the knitting needle not selected, an intermediate path in a case of the knitting needle selected and an advancing path, corresponding to a selection state of the knitting needle by the needle selection mechanism, the selector configured to guide the select jack to the H-position or the A-position by engagement with the select jack at a time of the selector passing through the intermediate path or the advancing path respectively, and

the needle selection mechanism including a selector drive cam configured to move the selector along the previously set path so as to guide the select jack by the engagement with the selector,
characterized in that
the flatbed knitting machine further comprising:

an entry-side needle selection mechanism configured to select the knitting needle for a first half of the knitting operation with the knitting needle advancing to the needle bed gap, in an entry side of the cam system;
an intermediate needle selection mechanism configured to select the knitting needle for a second half of the knitting operation with the knitting needle retracting from the needle bed gap, in an intermediate position of the cam system; and
a pressing cam configured to press the select jack or the selector in a direction to sink into the needle groove,
wherein the engagement of the select jack with the selector being switched by the press applied by the pressing cam, in between a first stage of the select jack in the B-position engages with the selector and a second stage of the select jack in the H-position or the A-position engages with the selector, and
the intermediate needle selection mechanism is provided with a front position arranged closer to the needle bed gap in the direction of advancing to the needle bed gap than the A-position as a position for the select jack to be guided in the engagement in the second stage.

[0009] In the present invention

said pressing cam is disposed in said entry-side needle selection mechanism so as to press said selection butt of said select jack,
the select jack has an overhang part on a root part of the selection butt in a rear end side corresponding to a direction of retracting from said needle bed gap, and the overhang part is formed to overhang in the rear end side, and
a tip part of said selector in the direction of advancing to the needle bed gap is configured to be engaged with a rear end of the selection butt of the select jack sunk into the needle groove by the pressure applied by the pressing cam in said first stage, and to be engaged with a rear end of the overhang part in said

second stage.

[0010] In the present invention

said pressing cam is disposed in said intermediate needle selection mechanism so as to press a tail part disposed in said selector in a direction of retracting from said needle bed gap,
said select jack has, on a rear end, a protrusion protruding in a shallow direction in said needle groove,
said selector has, on a rear end in the direction of retracting from the needle bed gap, a protrusion protruding in a deep direction in the needle groove, and a tip part of the selector in the direction of advancing to the needle bed gap is configured to be engaged with a rear end of said selection butt of the select jack in said first stage, and the protrusion sunk into the needle groove by the press applied by the pressing cam is configured to be engaged with the protrusion of the select jack in said second stage.

[0011] In the present invention

each of said entry-side needle selection mechanism and said intermediate needle selection mechanism includes an attraction actuator capable of releasing said selector from being attracted by magnetic force, at a plurality of positions in response to said selecting, and
said selector drive cam is configured to drive and guide the selector selectively to various paths according to the positions of releasing from attraction by the attraction actuator.

[0012] In the present invention
said second half of said knitting operation includes a second stitch operation to change drawing amount by a stitch cam disposed in said cam system to make said knitting needle retract from said needle bed gap.

[Advantageous Effects of Invention]

[0013] According to the present invention, the needle selection is done by use of a selector and a select jack, thereby enabling to utilize a basic combination having been used with actual performance. In an intermediate needle selection mechanism disposed in the intermediate position of a cam system, the engagement point of the selector with the select jack of the knitting needle selected by an entry-side needle selection mechanism so as to be driven by the cam system is switched from the first-stage engagement in the entry-side needle selection mechanism to the second-stage engagement, so that another type of knitting operation becomes selectable additionally. The entry-side needle selection mechanism and the intermediate needle selection mechanism achieves to increase the number of types of selectable knitting operation in one run of a carriage, and are improved in knitting efficiency such as in the knitting operation in a mixed manner of basic knitting operation with another type of knitting operation.

[0014] Further according to the present invention, two-stage switching is possible in the engagement between the selector and the select jack with the press by the pressing cam to the select jack. The tip part of the selector is engaged with the rear end of the selection butt of the select jack in the first stage, and engaged with the rear end of the overhang part in the second stage, and thus the engaging part of the selector is used commonly.

[0015] Further according to the present invention, two-stage switching is possible in the engagement between the selector and the select jack with the press by the pressing cam to the selector. The combination of engaging points between the selector and the select jack are switchable in the first stage or in the second stage.

[0016] Further according to the present invention, the entry-side needle selection mechanism and the intermediate needle selection mechanism achieve to avoid size from increase in the left-and-right direction.

[0017] Further according to the present invention, the intermediate needle selection mechanism achieves to perform the second stitch operation in a mixed manner in the operation of drawing a knitting needle by a stitch cam.

[Brief Description of Drawings]

[0018]

[Fig.1] Fig. 1 is a simplified cam layout showing a schematic configuration of a flatbed knitting machine 1 provided with a cam system 2 and a needle selection mechanism 10, and a partial side view of a knitting needle 3 to be controlled, as an example 1 according to the present invention.
[Fig.2] Fig. 2 is a partial cam layout of the cam system 2 including the configurations of an entry-side needle selection mechanism 11 and an intermediate needle selection mechanism 12 shown in Fig. 1.
[Fig.3] Fig. 3 is partial side views showing engagement points which are switched by a pressing cam 15 shown in Fig. 1 and at which a select jack 6 is moved by a selector 7.
[Fig.4] Fig. 4 is partial side views showing positional relations between the selector 7 and the select jack 6 in the entry-side needle selection mechanism 11.
[Fig.5] Fig. 5 is partial side views showing positional relations between the selector 7 and the select jack 6 in the intermediate needle selection mechanism 12.
[Fig.6] Fig. 6 is partial side views showing engagement points which are switched in an example 2 according to the present invention and at which a select jack 46 is moved by a selector 47.
[Fig.7] Fig. 7 is partial side views showing positional relations between the selector 47 and the select jack

46, including switching in two stages of the engagement points.

[Description of Embodiments]

[0019] Fig. 1 to Fig. 5 relate to the configuration of the needle selection mechanism 10 of the flatbed knitting machine 1 as an example 1 according to the present invention. In Fig. 1 and Fig. 2, the areas with diagonals crossing each other correspond to inclined surfaces. Fig. 6 and Fig. 7 schematically show the guiding operation by the selector 47 to the select jack 46 in the example 2 according to the present invention. The corresponding parts in the respective drawings are denoted by the same reference sign, and duplicate descriptions thereof may be omitted. For convenience of explanation, a part not shown in a target drawing for description may be described with a reference sign used in another drawing.

[Example 1]

[0020] Fig. 1 shows the schematic configuration of the flatbed knitting machine 1 provided with the cam system 2 and the needle selection mechanism 10, as an example 1 according to the present invention. Hereinafter, some parts not shown may also be referred for simplicity. The cam system 2 is mounted on the carriage which reciprocates along the longitudinal direction of the needle beds of the flatbed knitting machine. At least a pair of needle beds is provided so as to face each other across a needle bed gap. Each of the needle beds has needle grooves which extend in the back-and-forth direction of advancing to and retracting from the needle bed gap. The needle grooves are arranged in parallel in the left-and-right direction corresponding to the longitudinal direction of the needle beds. The knitting needle 3 is housed in each of the needle grooves so as to be slidable in the back-and-forth direction, and includes a needle jack 4, a slider 5, the select jack 6, and the selector 7. The knitting needle 3 is a compound needle, and is connected by the needle jack 4 to the needle body including a hook on the tip thereof of the front-end side, which is omitted to show. Further in the front-end side omitted to show, the slider 5 has blades, which open and close the hook, and are needle jack 4, the slider 5 and the select jack 6 have a butt 4b, a butt 5b, and a selection butt 6b to be controlled by mechanical actions, respectively. The selector 7 has an armature 7a to be controlled by magnetic actions, and a tip part 7b to be engaged with the select jack 6. The selector 7 further has a drive butt 7c and a push-down butt 7d which will be described later.

[0021] The needle selection mechanism 10 and the cam system 2 have bidirectionality allowing the carriage to reciprocate in the left-and-right direction symmetrically in the same manner. The following description is based on the case where the carriage moves to the left in the drawing against the needle bed. The needle selection mechanism 10 has the entry-side needle selection mechanism 11, the intermediate needle selection mechanism 12, and an exit-side needle selection mechanism 13, to the cam system 2. In the case where the carriage moves to the right, the exit-side needle selection mechanism 13 turns to the entry-side one, and the entry-side needle selection mechanism 11 turns to the exit-side one. The entry-side needle selection mechanism 11 makes the selector 7 of the knitting needle 3 select one out of paths 7A, 7H, 7B. When the path 7A or 7H is selected, the moving stroke to the needle bed gap side occurs in the selector 7. The select jack 6 receives the moving stroke from the selector 7 at the engagement point, and moves to a position in the needle bed gap side. The knitting needle 3 acted on by the cam system 2 from the entry side is guided so that the selection butt 6b of the select jack 6 is moved to an A-position 6bA or an H-position 6bH by the selector 7 for which the path 7A or the path 7H is selected, correspondingly. The entry-side needle selection mechanism 11 is however provided with the pressing cam 15. The pressing cam 15 presses the selection butt 6b to sink the select jack 6 by approximately half height into the needle groove, and thus the tip part 7b of the selector 7 is engaged to the rear end of the selection butt 6b of the select jack 6 having been sunk by approximately half height. The intermediate needle selection mechanism 12 makes the selector 7 of the knitting needle 3 select one out of the paths 7A, 7H, 7B, as with the entry-side needle selection mechanism 11. In the intermediate needle selection mechanism 12 provided without the pressing cam 15, and provided without a succeeding A-presser 31b nor a succeeding H-presser 32b, or alternatively with the succeeding A-presser 31b in non-acting state and the succeeding H-presser 32b in non-acting state, the select jack 6 is raised, and the engagement point of the select jack 6 with the tip part 7b of the selector 7 is switched to the rear end of an overhang part 6c. The switching of the engagement points allows to guide the select jack 6 of the knitting needle 3 on which the cam system 2 acts, to a position closer to the needle bed gap than the position guided in the entry-side needle selection mechanism 11, in particular to guide the select jack 6 to an F-position 6bF which is newly arranged as a front position closer to the needle bed gap than the A-position. The exit-side needle selection mechanism 13 does not perform the needle selection operation of receiving the action of the cam system 2. The vertical lines with reference signs a, b, c, d in the entry-side needle selection mechanism 11 and the intermediate needle selection mechanism 12 indicate the phases corresponding to the positional relations described in Fig. 4 and Fig. 5, respectively. The needle selection mechanism 10 further has a returning part 16 which returns the select jack 6 to the B-position, and a returning cam 17 which returns the selector 7 to the path 7B.

[0022] The cam system 2 includes a needle raising cam 20, a stitch cam 21, and a bridge cam 22. Between the needle raising cam 20 and the bridge cam 22, a path 4bA corresponding to the knit operation for the butt 4b

of the needle jack 4 is disposed. The cam system 2 further has a slider cam, which is omitted to show, acting on the butt 5b of the slider 5, at a position closer to the needle bed gap than the bridge cam 22, Paths 4bH, 4bB extending across lower positions than the top of the needle raising cam 20 correspond to the knitting operation for the tuck and the miss, respectively. The stitch cam 21 has, in the posterior half of the drawing cam face, a stitch deciding cam face 21b where the cam height is high and a drawing amount is small, and a stitch deciding cam face 21a where the cam height is low and a drawing amount is large, and enables the second stitch knitting operation by changing the butt 4b with the protrude amount. The intermediate needle selection mechanism 12 allows the selection as to whether to keep the select jack 6 in the A-position or move the select jack 6 from the A-position to the F-position, by path switching for the butt 4b between the path 4ba for relatively tight loop knitting and the path 4bA for loose loop knitting. Such path switching for knitting is performed by a presser group 30 acting on the selection butt 6b of the select jack 6. The entry-side needle selection mechanism 11 allows the selection as to whether to keep the select jack 6 in the B-position or move the select jack 6 to the H-position or the A-position. The intermediate needle selection mechanism 12 also allows the selection out of the B-, H- and A-positions for the select jack 6 located in the B-position. When the H-position is selected in the entry-side needle selection mechanism 11, the intermediate needle selection mechanism 12 allows the selection out of the H-, A- and F-positions. When the A-position is selected in the entry-side needle selection mechanism 11, the intermediate needle selection mechanism 12 allows the selection out of the A- and F-positions. In the B-position, a fixed B-presser 33 is disposed, which presses the selection butt 6b to deeply sink the select jack 6 into the needle groove, as described later. Position change under the press applied by the B-presser 33 is not preferable, but may be performed when the protruding amount is reduced.

[0023] Fig. 2 shows a partial configuration of the cam system 2 including the configurations of the entry-side needle selection mechanism 11 and the intermediate needle selection mechanism 12 shown in Fig. 1. The entry-side needle selection mechanism 11 and the intermediate needle selection mechanism 12 of Fig. 1 include attraction actuators 11a, 12a and selector drive cams 11b, 12b, respectively. As with Patent Citation 2, the attraction actuators 11a, 12a allow switching between the state of attracting the armature 7a of the selector 7 by magnetic force and the state of releasing the armature 7a from the attraction upon selection, at release positions α, β arranged in front of and behind phases a, c. As with Patent Citation 3, the selector drive cam 11b of the entry-side needle selection mechanism 11 moves the drive butt 7c of the selector 7 in the state of being released from the attraction by the attraction actuator 11a along the preset path 7A, 7H, or 7B, so as to move the select jack 6 to one of three positions through an engagement point. The path 7B corresponds to a base-state position, and the paths 7H, 7A correspond to selection positions. The selector drive cam 12b of the intermediate needle selection mechanism 12 also moves the drive butt 7c in the state of being released from the attraction by the attraction actuator 12a along the path 7A, 7H, or 7B, so as to move the select jack 6 to one of not only the positions in the entry-side needle selection mechanism 11 but also an additional position made available by switching the engagement point. Accordingly, the F-position described above is able to be arranged for the select jack 6. The returning cam 17 has a cam face 17a which acts on the push-down butt 7d of the selector 7 to return to the path 7B in the exit sides of the selector drive cams 11b, 12b.

[0024] The presser group 30 acts on the selection butt 6b of the select jack 6, and controls whether to sink the butt 4b of the needle jack 4 and the butt 5b of the slider 5 so as not to protrude from the needle groove, by pressing the selection butt 6b. In the F-position, any presser is not provided. In the A-position and the H-position, a preceding A-presser 31a and a preceding H-presser 32a, and the succeeding A-presser 31b and the succeeding H-presser 32b are disposed via spaces therebetween, respectively. These pressers are switchable between acting state and non-acting state, individually. The B-position corresponds to the base state, and the B-presser 33 fixed to the acting state to press the selection butt 6b is provided in the B-position.

[0025] Fig. 3 shows the engagement points which are arranged in the entry-side needle selection mechanism 11 shown in Fig. 1 so as to be switched in two stages according to whether or not press is applied by the pressing cam 15, and at which the select jack 6 is moved by the selector 7. The pressing cam 15 presses the selection butt 6b of the select jack 6 so as to sink the select jack 6 by approximately half height into the needle groove, as shown in Fig. 3(a). When the path 7A or 7H is selected for the selector 7 in the entry-side needle selection mechanism 11, the tip part 7b of the selector 7 pushes forward the rear end of the selection butt 6b in the first stage so as to move the select jack 6 to the A-position or the H-position. As shown in Fig. 3(b), the select jack 6 in the A- or H-position free from press at the selection butt 6b is pushed up in the second stage by the selector 7, in the intermediate needle selection mechanism 12. The select jack 6 is raised in the needle groove, and thus the engagement point for pushing up by the tip part 7b of the selector is able to be switched from the rear end of the selection butt 6b to the rear end of the overhang part 6c. With regard to such switching, the rear end of the overhang part 6c is positioned behind the tip part 7b in the engagement in the first stage, while when the selector 7 is returned to the path 7B of the base state in the entry side of the selector drive cam 12b of the intermediate needle selection mechanism 12, the tip part 7b may be positioned behind the rear end of the overhang part 6c. It is noted that in the case where the B-position is selected

for the select jack 6 in the entry-side needle selection mechanism 11, the tip part 7b is kept in front of the overhang part 6c even when the selector 7 is returned to the path 7B of the base state, and the tip part 7b is kept in the state of engagement with the rear end of the selection butt 6b. With regard to such engagement state, as with the entry-side needle selection mechanism 11, the intermediate needle selection mechanism 12 also allows the selection out of the A-, H- and B-positions of in the engagement state of the first stage. With regard to the switching in two stages of the engagement points of the selector with the select jack, the engagement point to the tip part of the selector is switched from the rear end of the selection butt to the rear end of the overhang part. The present applicant discloses the present contents in the prior Japanese application of No. 2019-073176. The prior application further discloses another example of switching of the engagement points, and such an example is applicable to the present invention.

[0026] Fig. 4 shows the entry-side needle selection mechanism 11, and specifically Fig.4(a-A), Fig. 4(b-H), and Fig. 4(b-A) show the positional relations between the selection for the selector 7 and the select jack 6 in the phases a, b shown in Fig. 1, respectively. In the phase a, the select jack 6 is sunk by approximately. half height into the needle groove 8a of the needle bed 8 in response to the press applied by the pressing cam 15 to the selection butt 6b, so that the selector 7 is made to press the select jack 6 in the first stage at the engagement point shown in Fig. 3(a). The selector 7 shown in Fig. 4(a-A) is set to the base-state position, but is released from the attraction to the armature 7a by the attraction actuator 11a in response to the selection of setting the select jack 6 to the A-position, made at the release position α shown in Fig. 2. In the case where the selector 7 is released at the release position β in response to the selection of setting the select jack 6 to the H-position, or in the case where the selector 7 is not released at the release position α nor β in response to the non-selection of keeping the select jack 6 in the B-position, the armature 7a is in the state of being attracted by the attraction actuator 11a in the phase a. In the B-position, as with the pressing cam 15 in the phase a, the B-presser 33 presses the selection butt 6b after the phase b. Fig. 4(b-H) and Fig. 4(b-A) show the positional relations in the phase b after the H-position and the A-position are selected at the release positions β, α, respectively. In the H- and A-positions for the selection butt 6b, the preceding H-presser 32a and the preceding A-presser 31a are provided in the succeeding side of the phase b, respectively. Fig. 4(b-H) shows, for reference, the preceding H-presser 32a serving as a protruding/retracting type presser, specifically the non-acting state thereof with a dashed line and the acting state thereof with a solid line. Fig. 4(b-H) further shows the preceding A-presser 31a serving as a swing type presser, specifically the acting state thereof with a solid line and the non-acting state thereof with a dashed line. The pressers disposed in the A-position and the B-position and the pressing cam 15 described above including the preceding A-presser 31a and the preceding H-presser 32a in the acting states are set to have lower heights than the B-presser 33, so that the selection butt 6b of the select jack 6 protrudes by approximately half height from the needle groove.

[0027] Fig. 5 shows the intermediate needle selection mechanism12, and specifically Fig. 5(c-H to F), Fig. 5(d-A), and Fig. 5(d-F) partially show the positional relations between the selector 7 and the select jack 6 in the phases c, d shown in Fig. 1, respectively. In the phase c, the selection butt 6b is free from the press applied by the pressing cam 15 and is further free from press by any presser in the H- and A-positions. Thus, the select jack 6 is not sunk in the needle groove 8a of the needle bed 8, and the selector 7 is able to push up the select jack 6 at the engagement point in the second stage as shown in Fig. 3(b). The selector 7 shown in Fig. 5(c-H to F) is in the base state, and the select jack 6 is in the H-position. In the selector 7, the armature 7a is released from the attraction actuator 12a in response to the selection made at the release position α preceding the phase c. This selection allows the select jack 6 to guide from the H-position to the F-position. It is noted that the selection for the selector 7 at the release position α allows the select jack 6 to guide from the A-position to the F-position. Fig. 5(d-A) and Fig. 5(d-F) show the select jack 6 having been guided in the A- and F-positions in the phase d, respectively. The push-up in the second stage moves the select jack 6 to the A-position from the H-position, and to the F-position from the H-position or the A-position, respectively.

[0028] The presser group 30 allows the selection for the following knitting operation, by setting the preceding A-presser 31a to be in non-acting state, the succeeding A-presser 31b to be in acting state, the preceding H-presser 32a to be in acting state, and the succeeding H-presser 32b to be in non-acting state. The selection of the H-position or the A-position in the entry-side needle selection mechanism 11 corresponds to the selection of a type of knitting operation of the tuck or the knit in the first half portion. Such selection of the H-position allows the butt 4b of the needle jack 4 to be guided to the path 4bH for the tuck shown in Fig. 1. In the case where the H-position corresponding to the tuck is selected in the entry-side needle selection mechanism 11, the intermediate needle selection mechanism 12 allows the selection of the H-position or the A-position so as to form a knitted loop of the tuck in second stitch such as to be relatively loose or tight. In the case where the A-position corresponding to the knit is selected in the entry-side needle selection mechanism 11, the intermediate needle selection mechanism 12 allows the selection of the A-position or the F-position so as to form a knitted loop of the knit in second stitch such as to be relatively tight or loose. The present applicant discloses basic second stitch operation, for example, in the Japanese Patent publication JPH08-60499A. The present example achieves second

stitch knitting in the knit and the tuck, and thus enables the selection out of five types of knitting operation including a miss in the B-position.

[0029] In the present example 1, the compound needle in which the blades disposed on the tip side of the slider 5 open and close the hook serves as the knitting needle 3. Thus, the knitting needle 3 allows the knitting operation of the split knit as disclosed by the present applicant in the Japanese Patent Gazette JP5330249 to be mixed with the tuck in the second stitch and the knit. In the cam system 2, the slider cam acting on the butt 5b of the slider 5 is provided with a guide path for keeping the blades in the state of reaching to the needle bed gap during forming of a knitted loop. The slider cam is provided with a knit presser which presses the auxiliary butt provided in front of the butt 5b of the slider 5 in the F-position. When the knit presser is made to act in the F-position, the slider keeps the state of reaching to the needle bed gap while holding the old loop to be knocked over, during when the stitch cam 21 draws the needle jack 4. Such split knit operation is made possible by selecting the H-position or the A-position in the entry-side needle selection mechanism 11 and selecting the F-position in the intermediate needle selection mechanism 12.

[Example 2]

[0030] Fig. 6 shows the engagement points in the example 2 according to the present invention, which are switched in an entry-side needle selection mechanism 41 and an intermediate needle selection mechanism 42 respectively corresponding to the entry-side needle selection mechanism 11 and the intermediate needle selection mechanism 12 shown in Fig. 1, and at which the select jack 46 is moved by the selector 47. In the present example 2, the entry-side needle selection mechanism 41 is provided without the pressing cam 15, while the intermediate needle selection mechanism 42 is provided with a pressing cam 45. The select jack 46 and the selector 47 are the same as the select jack 6 and the selector 7 in the example 1, respectively, except for the difference in the switching of the engagement points by the pressing cam 45, and the cam system 2 is also used in the same way as in the example 1. The selector 47 has a protrusion 47e protruding in the direction of deepening in a needle groove, on the rear end in the direction of retracting from a needle bed gap. The selector 47 has a drive butt 47c and a push-down butt 47d which are the same as the drive butt 7c and the push-down butt 7d of the selector 7, and further has the protrusion 47e and a tail part 47f. In the present example 2, with regard to the engagement in the first stage, as shown in Fig. 6(a), the rear end of the selection butt 46b of the select jack 46 is engaged with a tip part 47b of the selector 47. With regard to the engagement in the second stage, as shown in Fig. 6(b), the protrusion 47e provided in the vicinity of an armature 47a provided on the rear end of the selector 47 is engaged with a protrusion 46c of the select jack 46. Such switching is performed in response to the press applied so that the tail part 47f of the selector 47 is slightly sunk into the needle groove as shown in Fig. 6(b). With regard to the switching of the engagement points, protrusion 46c is positioned behind the protrusion 47e in the engagement in the first stage, while when the selector 47 is returned to the path 7B of the base state in the exit side of a selector drive cam 41b of the entry-side needle selection mechanism 41, the protrusion 47e may be positioned behind the protrusion 46c.

[0031] Fig. 7 shows the positional relations between the selector 47 and the select jack 46, including the switching in two stages of the engagement points. The phases a, b, c and d correspond to those shown in Fig. 1. Fig. 7(a-A) shows the positional relation in the phase a where the selector 47 is in the base state and the A-position is selected for the select jack 46. Fig. 7(b-A) shows the positional relation in the phase b where the select jack 46 is moved to the A-position in the entry-side needle selection mechanism 41. This state corresponds to the state shown in Fig. 4(b-A). The select jack 46 may be moved to the H-position, as with the state shown in Fig. 4(b-H). Fig. 7(c-A to F) shows the state in the phase c where the F-position is selected after the state shown in Fig. 7(b-A). Fig. 7(d-F) shows the state in the phase d where the select jack 46 is moving from the A-position to the F-position.

[0032] In the examples 1, 2, the entry-side needle selection mechanisms 11, 41 and the intermediate needle selection mechanisms 12, 42 are provided respectively with the attraction actuators 11a, 12a and the attraction actuators 41a, 42a, which utilize magnetic force, alternatively, the needle selection mechanism as disclosed in Patent Citation 1 may be used. The use of the attraction actuators 11a, 12a or the attraction actuators 41a, 42a avoids size increase in the left-and-right direction, and further allows the arrangement of the intermediate needle selection mechanism 12 or 42 in the intermediate position of the existing cam system 2. The compound needle serves as the knitting needle 3, or alternatively the latch needle may be used. The present applicant discloses the split knit by use of the latch needle, for example, in the Japanese Patent Gazette JP5913427, and thus such operation may be added so as to be selectable in the intermediate needle selection mechanism 12. Furthermore, in the present invention, any combination other than the selector 7 and the select jack 6 and the selector 47 and the select jack 46 is also available for needle selection.

[Explanation of Reference]

[0033]

1	Flatbed knitting machine
2	Cam system
3	Knitting needle
4	Needle jack
4b, 5b	Butt

5	Slider
6, 46	Select jack
6b, 46b	Selection butt
6c	Overhang part
7, 47	Selector
7a, 47a	Armature
7b, 47b	Tip part
8	Needle bed
8a	Needle groove
10	Needle selection mechanism
11	Entry-side needle selection mechanism
11a, 12a	Attraction actuator
11b, 12b	Selector drive cam
15, 45	Pressing cam
21	Stitch cam
31a	Preceding A-presser
31b	Succeeding A-presser
32a	Preceding H-presser
32b	Succeeding H-presser
33	B-presser
46c, 47e	Protrusion
47f	Tail part

Claims

1. A flatbed knitting machine (1) provided with:

at least a pair of front and rear needle beds (8) disposed so as to face each other across a needle bed gap;
a plurality of knitting needles (3) respectively housed in a plurality of needle grooves (8a) arranged in parallel at a constant pitch along a longitudinal direction of the needle beds (8);
a carriage configured to reciprocate along the longitudinal direction of the needle beds (8);
a cam system (2) mounted on the carriage and configured to make the knitting needles (3) perform knitting operation by driving the knitting needles (3) in a direction of advancing to and retracting from the needle bed gap; and
a needle selection mechanism (10) mounted on the carriage and configured to select the knitting needle (3) for the knitting operation,
wherein each of the knitting needles (3) including:

a select jack (6, 46) having a selection butt (6b, 46b) configured to receive action from the cam system (2), and being guided to various positions including a B-position corresponding to a base-state position, an H-position corresponding to an intermediate position and being arranged closer to the needle bed gap in a direction of advancing to the needle bed gap than the B-position, and an A-position corresponding to an advancing position, thereby various types of knitting operation being allowed in a selectable manner to be performed by the cam system (2) with the knitting needles (3), according to difference in press received by the selection butt (6b, 46b) from the cam system (2) in each of the positions; and
a selector (7, 47) driven to pass through one of a base path (7B) in a case of the knitting needle (3) not selected, an intermediate path (7H) in a case of the knitting needle (3) selected and an advancing path (7A), corresponding to a selection state of the knitting needle (3) by the needle selection mechanism (10), the selector (7, 47) configured to guide the select jack (6, 46) to the H-position or the A-position by engagement with the select jack (6, 46) at a time of the selector (7, 47) passing through the intermediate path (7H) or the advancing path (7A) respectively, and

the needle selection mechanism (10) including a selector drive cam (11b, 12b; 41b, 42b) configured to move the selector (7, 47) along the previously set path (7B, 7H, 7A) so as to guide the select jack (6, 46) by the engagement with the selector (7, 47),
characterized in that
the flatbed knitting machine (1) further comprising:

an entry-side needle selection mechanism (11, 41) configured to select the knitting needle (3) for a first half of the knitting operation with the knitting needle (3) advancing to the needle bed gap, in an entry side of the cam system (2);
an intermediate needle selection mechanism (12, 42) configured to select the knitting needle (3) for a second half of the knitting operation with the knitting needle (3) retracting from the needle bed gap, in an intermediate position of the cam system (2); and
a pressing cam (15, 45) configured to press the select jack (6, 46) or the selector (7, 47) in a direction to sink into the needle groove (8a),
wherein the engagement of the select jack (6, 46) with the selector (7, 47) being switched by the press applied by the pressing cam (15, 45), in between a first stage of the select jack (6, 46) in the B-position engages with the selector (6, 46) and a second stage of the select jack (6, 46) in the H-position or the A-position engages with the selector (7, 47), and

the intermediate needle selection mechanism (12, 42) is provided with a front position arranged closer to the needle bed gap in the direction of advancing to the needle bed gap than the A-position as a position for the select jack (6, 46) to be guided in the engagement in the second stage.

2. The flatbed knitting machine (1) according to claim 1, wherein

said pressing cam (15) is disposed in said entry-side needle selection mechanism (11) so as to press said selection butt (6b) of said select jack (6),
the select jack (6) has an overhang part (6c) on a root part of the selection butt (6b) in a rear end side corresponding to a direction of retracting from said needle bed gap, and the overhang part is formed to overhang in the rear end side, and a tip part (7b) of said selector (7) in the direction of advancing to the needle bed gap is configured to be engaged with a rear end of the selection butt (6b) of the select jack (6) sunk into the needle groove (8a) by the pressure applied by the pressing cam (15) in said first stage, and to be engaged with a rear end of the overhang part (6c) in said second stage.

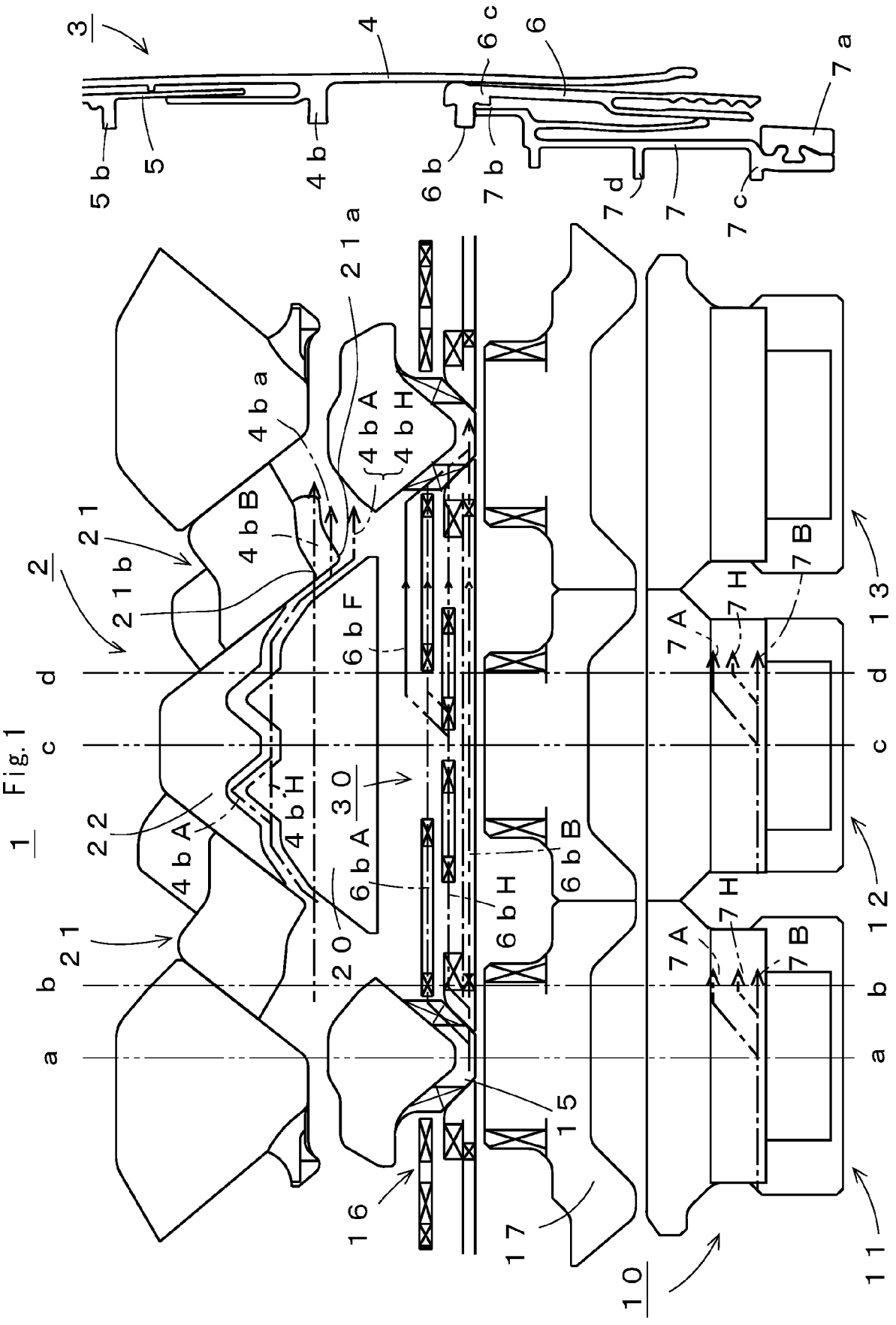
3. The flatbed knitting machine (1) according to claim 1, wherein

said pressing cam (45) is disposed in said intermediate needle selection mechanism (42) so as to press a tail part (47f) disposed in said selector (47) in a direction of retracting from said needle bed gap,
said select jack (46) has, on a rear end, a protrusion (46c) protruding in a shallow direction in said needle groove (8a),
said selector (47) has, on a rear end in the direction of retracting from the needle bed gap, a protrusion (47e) protruding in a deep direction in the needle groove (8a), and a tip part (47b) of the selector (47) in the direction of advancing to the needle bed gap is configured to be engaged with a rear end of said selection butt (46b) of the select jack (46) in said first stage, and the protrusion (47e) sunk into the needle groove (8a) by the press applied by the pressing cam (45) is configured to be engaged with the protrusion (46c) of the select jack (46) in said second stage.

4. The flatbed knitting machine (1) according to any one of claims 1 to 3, wherein

each of said entry-side needle selection mechanism (11, 41) and said intermediate needle selection mechanism (12, 42) includes an attraction actuator (11a, 12a; 41a, 42a) capable of releasing said selector (7, 47) from being attracted by magnetic force, at a plurality of positions in response to said selecting, and
said selector drive cam (11b, 12b; 41b, 42b) is configured to drive and guide the selector (7, 47) selectively to various paths (7B, 7H, 7A) according to the positions of releasing from attraction by the attraction actuator (11a, 12a; 41a, 42a).

5. The flatbed knitting machine (1) according to any one of claims 1 to 4, wherein
said second half of said knitting operation includes a second stitch operation to change drawing amount by a stitch cam (21) disposed in said cam system (2) to make said knitting needle (3) retract from said needle bed gap.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6c
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7a
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21a
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4bB
21
21b
2
6bF
7B
7H
7A
13
d
c
1
Fig.1
22
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4bH
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6bB
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21
12
b
a
15
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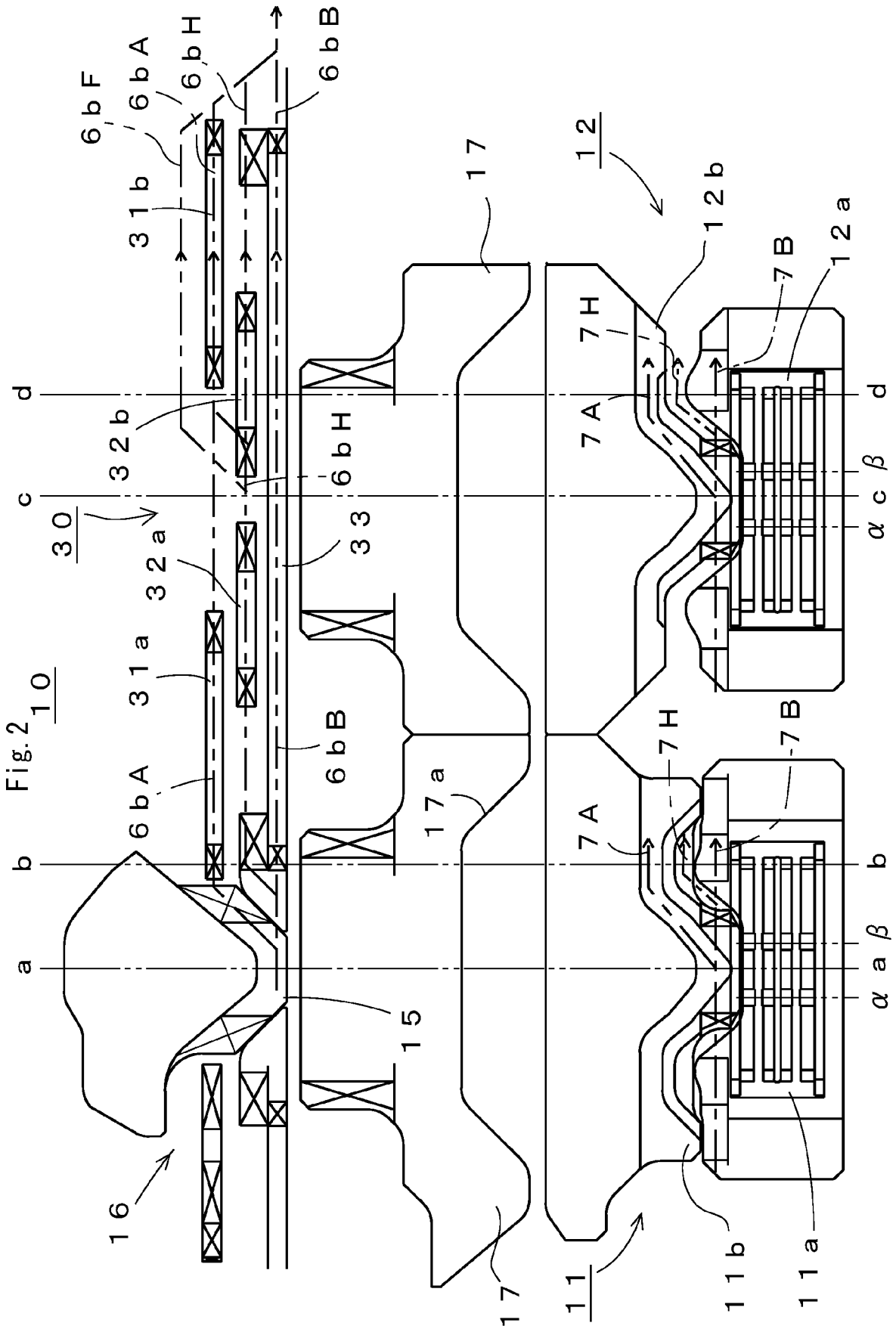
17
10
11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7H
7A
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α a β

Fig. 2 10

Fig.3

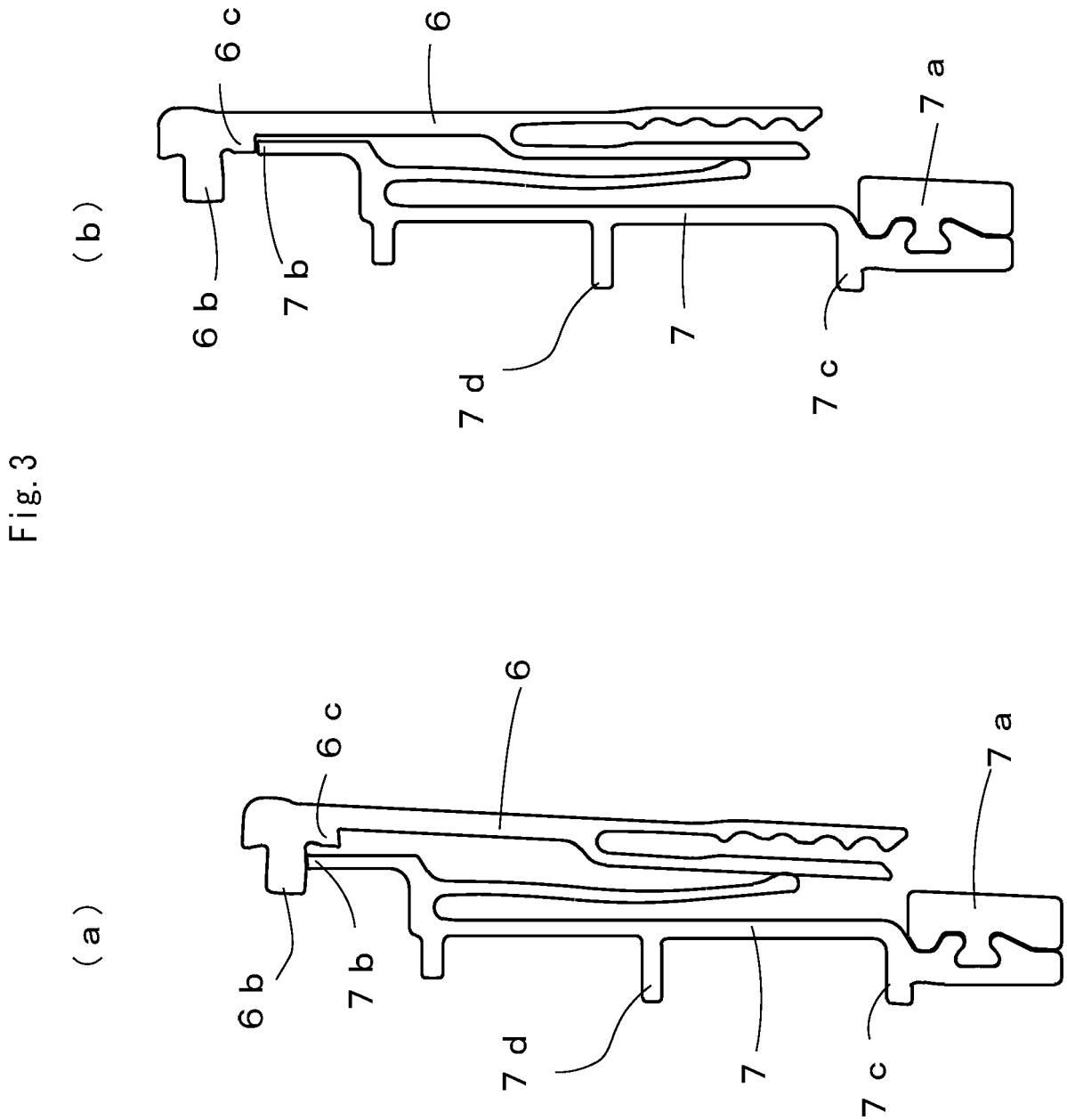
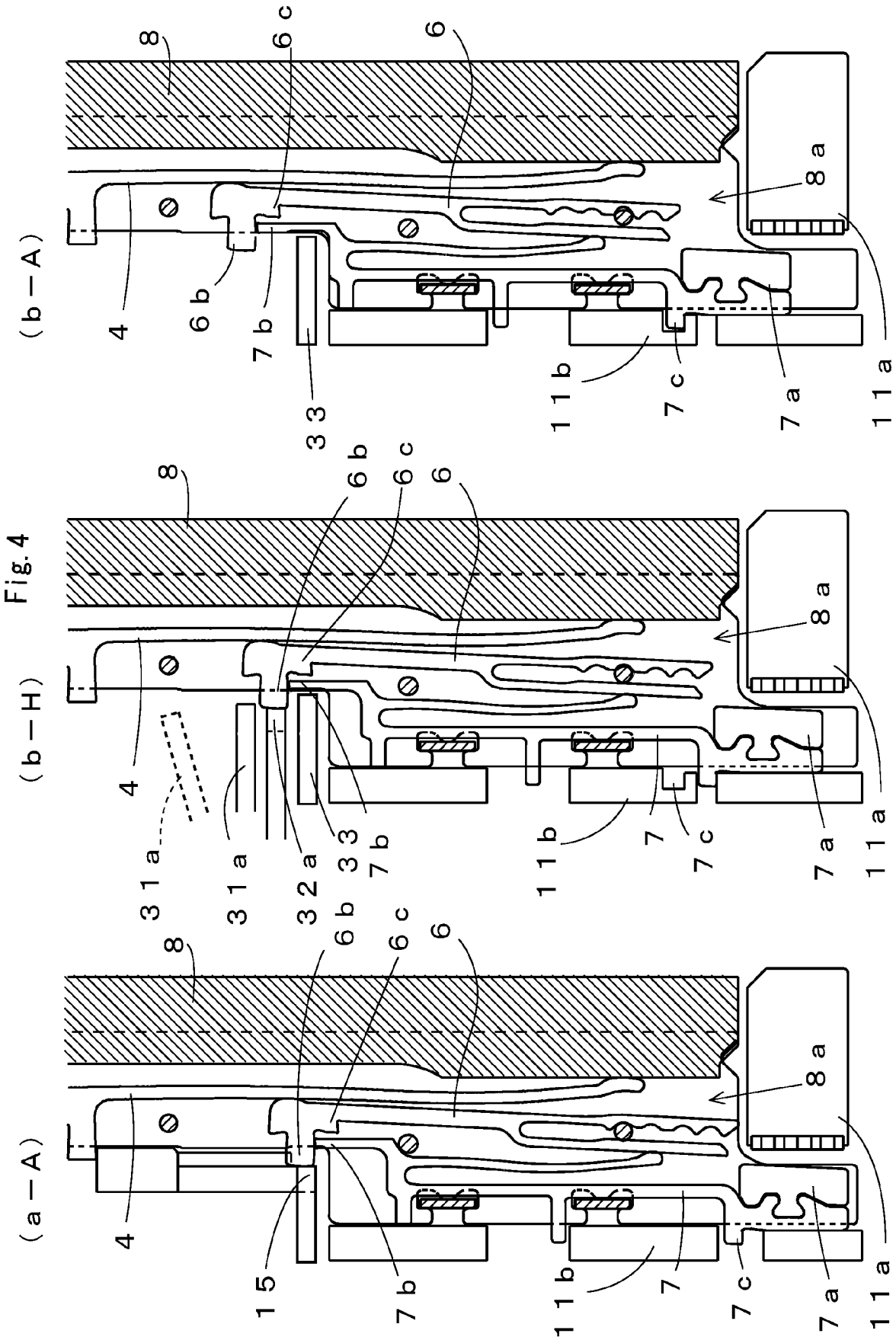


Fig. 4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7
7c
7a
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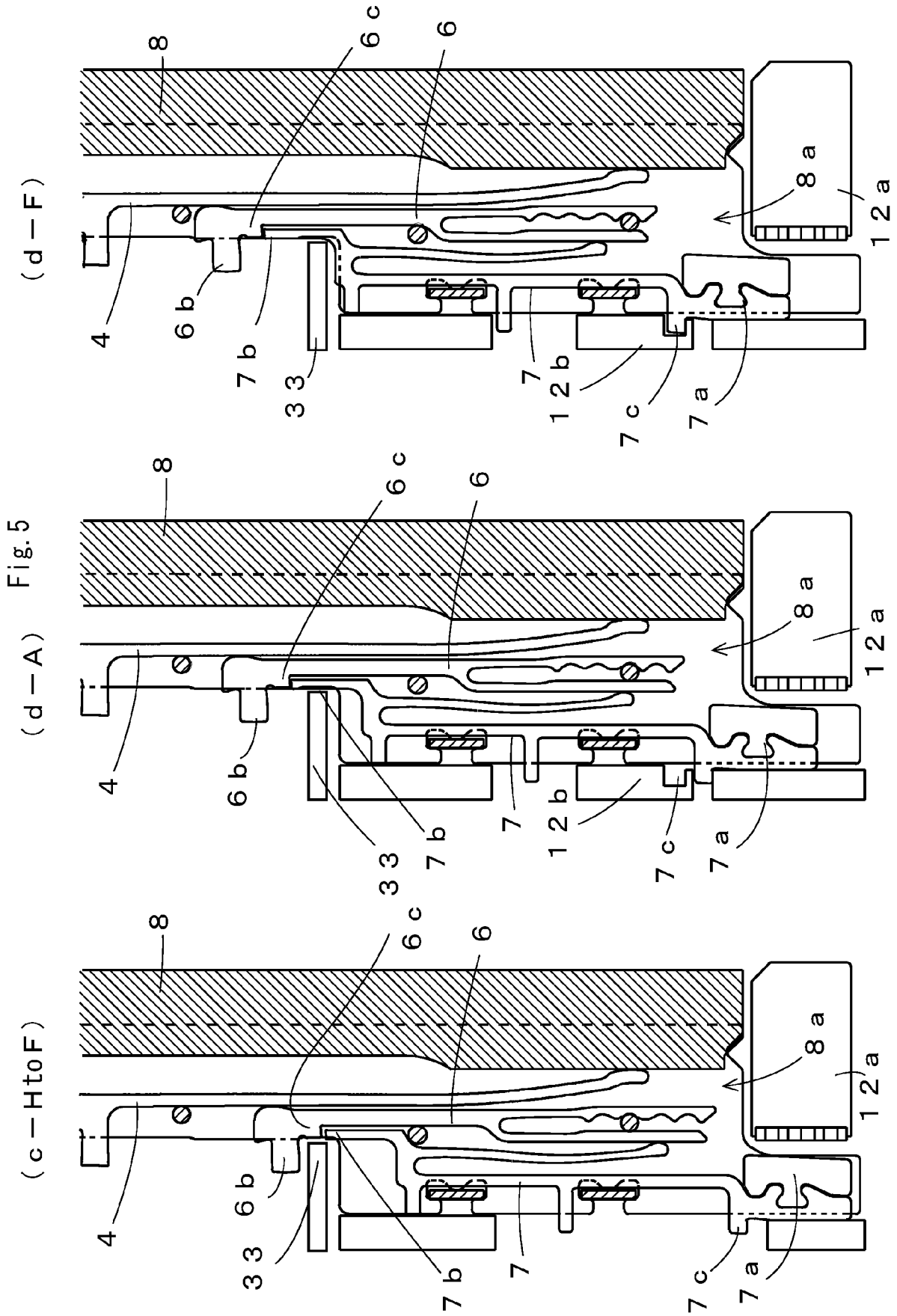
11a

Fig.5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7a
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8a
12a
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6b
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7b
7
12b
7c
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7c
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Fig.6

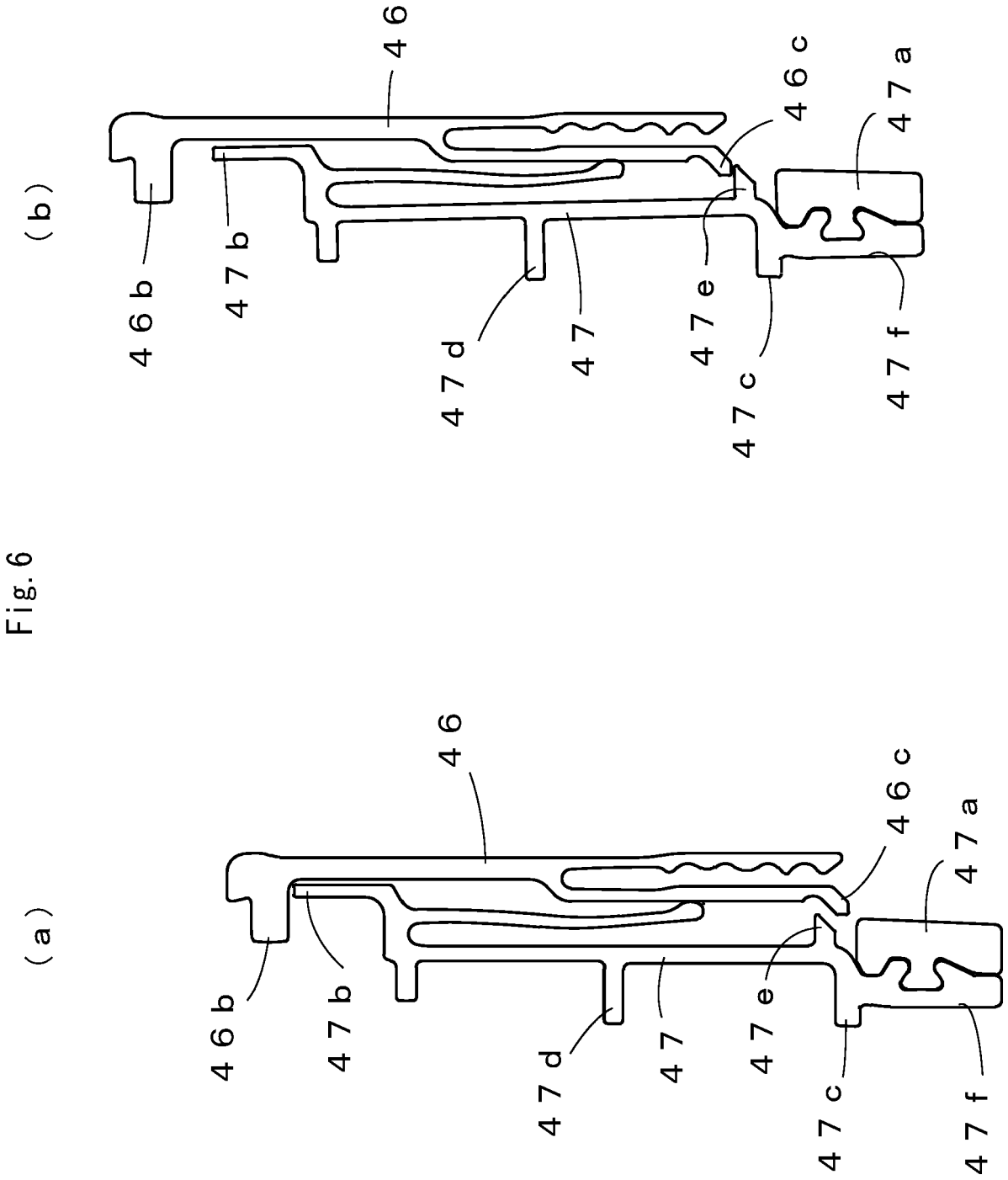
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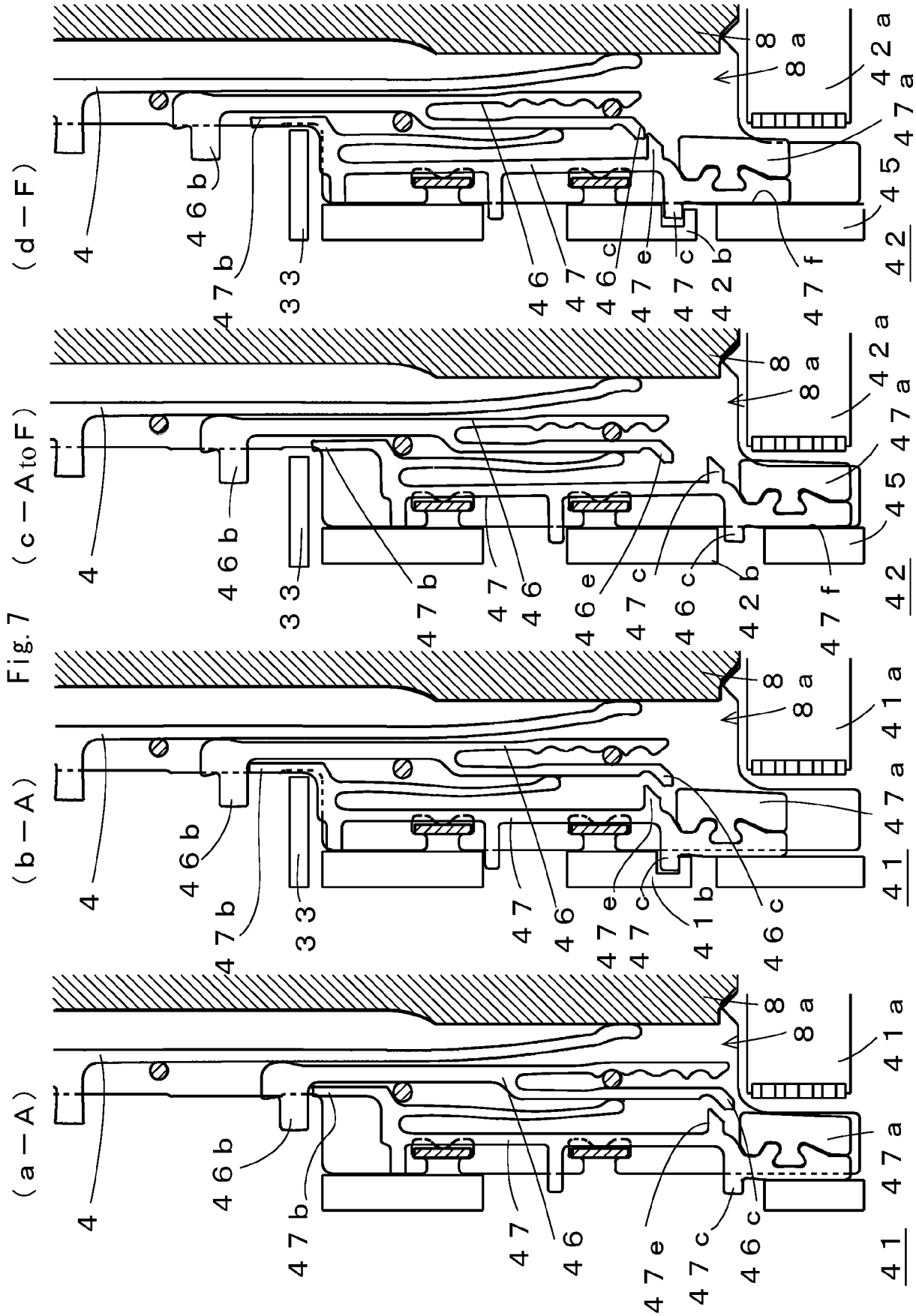
Fig. 7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EUROPEAN SEARCH REPORT

Application Number
EP 21 19 9924

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	GB 2 128 210 A (STOLL & CO H) 26 April 1984 (1984-04-26) * page 1, line 48 - page 5, line 74; claims 4, 6; figures 1-20 * -----	1,5	INV. D04B15/70 ADD. D04B15/32
A	GB 2 008 157 A (SHIMA IDEA CENTER CO LTD) 31 May 1979 (1979-05-31) * page 2, line 56 - page 5, line 108; claim 15; figures 1-6, 8-f, 12 * -----	1,3	
A,D	EP 2 942 428 A1 (SHIMA SEIKI MFG [JP]) 11 November 2015 (2015-11-11) * paragraphs [0007] - [0008], [0024]; claim 3; figures 4-6; example 2 * -----	1,2,4,5	

TECHNICAL FIELDS SEARCHED (IPC)
D04B

2 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 February 2022	Sterle, Dieter

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14-02-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2128210 A	26-04-1984	CH 659835 A5	27-02-1987
		DE 3237732 A1	12-04-1984
		ES 8405454 A1	01-06-1984
		GB 2128210 A	26-04-1984
		IT 1167365 B	13-05-1987
		JP S5988954 A	23-05-1984
		US 4490994 A	01-01-1985
GB 2008157 A	31-05-1979	CH 641851 A5	15-03-1984
		DE 2842054 A1	10-05-1979
		ES 474816 A1	16-03-1979
		GB 2008157 A	31-05-1979
		IT 1100935 B	28-09-1985
		JP S5468440 A	01-06-1979
		JP S5756576 B2	30-11-1982
		US 4214460 A	29-07-1980
EP 2942428 A1	11-11-2015	CN 105088499 A	25-11-2015
		EP 2942428 A1	11-11-2015
		JP 5913427 B2	27-04-2016
		JP 2015214767 A	03-12-2015
		KR 20150128567 A	18-11-2015

EPO FORM P0459

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2007074944 A1 **[0004]**
- JP H09241952 A **[0004]**
- JP 2013064207 A **[0004]**
- JP 2019073176 A **[0025]**
- JP H0860499 A **[0028]**
- JP 5330249 B **[0029]**
- JP 5913427 B **[0032]**