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

(11) **EP 2 474 654 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
11.07.2012 Bulletin 2012/28

(21) Application number: **10813494.1**

(22) Date of filing: **01.09.2010**

(51) Int Cl.:
D04B 15/82 *(2006.01)*

(86) International application number:
PCT/JP2010/005366

(87) International publication number:
WO 2011/027543 (10.03.2011 Gazette 2011/10)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **01.09.2009 JP 2009202112**

(71) Applicant: **Shima Seiki Manufacturing., Ltd.**
Wakayama-shi, Wakayama 641-8511 (JP)

(72) Inventors:
- **UEYAMA, Hiroyuki**
  Wakayama-shi
  Wakayama 641-8511 (JP)
- **TAJIMA, Daisuke**
  Wakayama-shi
  Wakayama 641-8511 (JP)

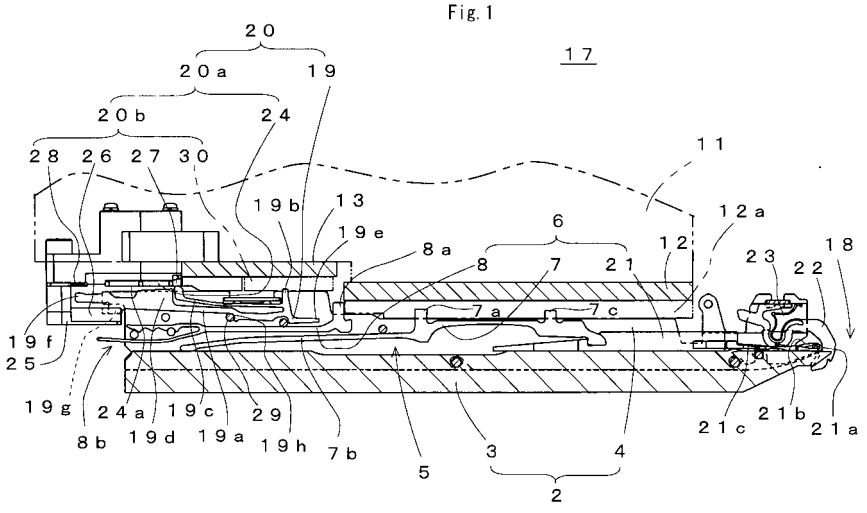
(74) Representative: **Wagner, Karl H.**
Wagner & Geyer
Gewürzmühlstrasse 5
80538 Munich (DE)

(54) NEEDLE SELECTION DEVICE OF FLAT KNITTING MACHINE, AND SELECTOR

(57) [Problem to be solved] To provide a needle selection device of a flatbed knitting machine which can select a needle stably even if a space between a carriage and a needle bed varies when the carriage travels, and a selector.

[Solution] A needle selection device 20 of a flatbed knitting machine 17 includes a needle selection mechanism 20a mounted on a carriage 11 and a selector 19 put in a needle groove 5 together with a knitting needle 6. A head end of an elastic leg piece 19c of the selector 19 bends to the carriage 11 side and the elastic leg piece 19c contacts against a cam surface of a spring support cam 27. When a pole contact 19d which is attracted to an attracting surface 24a of a needle selection actuator 24 provided on the carriage 11 side is released by cancellation of the attraction, an elastic force based on the elastic leg piece 19c is required to be larger than an attracting force. The selector 19 is supported depending on the carriage 11 only without depending on the needle bed 2 side, so that, even if a space between the carriage 11 and the needle bed 2 varies when the carriage 11 travels, it is possible that a stable elastic force is generated to perform a stable needle selection.

Fig. 1



EP 2 474 654 A1

Description

[Technical Field]

[0001] The present invention relates to a needle selection device of a flatbed knitting machine and a selector, wherein the needle selection device comprises the selector, being put in a needle groove of a needle bed together with a knitting needle, and a needle selection mechanism, being mounted on a carriage which travels in reciprocation with respect to the needle bed, and selecting a knitting needle which performs a knitting operation through the selector.

[Background Art]

[0002] Conventionally, in a flatbed knitting machine, a needle selection device which can select a knitting needle individually is provided so as to switch basic knitting operations such as knit, tuck, and miss for each knitting needle. The needle selection device comprises a selector, put in a needle groove of a needle bed together with the knitting needle, and a needle selection mechanism mounted on a carriage which travels along the needle bed. A cam mechanism, which drives the knitting needle put in the needle groove to perform knitting operations, is also mounted on the carriage. The needle selection mechanism reflects a result of needle selection to the knitting needle through the selector which is provided on a tail portion of the knitting needle in the needle groove. As for the needle selection mechanism of the needle selection device as described above, a type in which the selector is attracted by a permanent magnet and the selector is released by making an attraction force smaller with energization of electricity to an electromagnet has been known (for example, see Patent Literature 1).

[0003] Fig. 8 shows a structure which is basically the same as the needle selection device disclosed in Patent Literature 1 in a simplified manner. In a flatbed knitting machine 1, needle beds 2 are formed by sticking up needle plates 4 on a base plate 3 at a constant interval. The needle plates 4 are arranged in a direction perpendicular to a page space and needle grooves 5 are formed between adjacent needle plates 4. A knitting needle 6 is put in each needle groove 5. Each knitting needle 6 is in a state capable of a slide displacement to a right-left direction in Fig. 8 so that a hook, not illustrated, provided on a head end side thereof advances and retreats with respect to a needle bed gap provided at the right side in Fig. 8. It is to be noted that in the flatbed knitting machine 1, at least a pair of needle beds 2 are arranged so as to face to each other while sandwiching the needle bed gap therebetween in a normal case. Each needle bed 2 is inclined so as to be higher toward the needle bed gap and be lower in a direction away from the needle bed gap. However, in Fig. 8, only the needle bed 2 at one side is illustrated in a horizontal attitude. Further, in the following explanation, description may be made while the needle bed gap side of each knitting needle 6 is set to be a leading end side and the side thereof away from the needle bed gap is set to be a tail end side in some case. In addition, description may be made while a direction in which each knitting needle 6 floats from the needle groove 5 is set to be an upside and a direction in which each knitting needle 6 sinks in the needle groove 5 is set to be a downside in some case.

[0004] Although graphic representation is omitted in Fig. 8, the hook of each knitting needle 6 is provided at a leading end of a needle body, which is coupled to a right side of a needle jack 7. The needle jack 7 has a connecting portion formed on a leading end side for connecting to the needle, a butt 7a protruding from an intermediate portion of the needle jack 7 and receives a driving force for performing the knitting operations as the knitting needle 6, and an elastic leg piece 7b formed on a tail end side of the needle jack 7. The elastic leg piece 7b biases such that the butt 7a floats from the needle groove 5. An intermediate portion of the elastic leg piece 7b of the needle jack 7 is pressurized by a head end portion of a select jack 8. A butt 8a is stuck up from the head end portion of the select jack 8. The butt 8a of the select jack 8 is switched to move from a needle selection position of a B position as shown in Fig. 8 to an H position at a slightly right side of the B position or an A position at a further right side of the B position, or to remain to continue at the B position. A tail end side of the select jack 8 is bifurcated into two-forked shape to serve as a position holding portion 8b which keeps any one of the three needle selection positions.

[0005] A selector 9 presses the butt 8a of the select jack 8 with a head end portion 9a in a direction toward the needle bed gap so as to move the butt 8a from the B position to the H position or the A position. A pole contact 9b is provided on a tail end side of the selector 9. It is to be noted that although the pole contact 9b as shown in Fig. 8 is formed so as to be a several part different from other part of the selector 9 and is joined mechanically, the pole contact 9b can be also integrally combined in. Further, an elastic leg piece 9c is also provided on the selector 9 and a head end of the elastic leg piece 9c pressurizes a spring supporting point 8c on an upper surface of the position holding portion 8b of the select jack 8 from upside in the needle groove 5. The select jack 9 receives driving for pressing the select jack 8 to switch the needle selection position on a front butt 9d, which is biased so as to float from the needle groove 5 by the elastic leg piece 9c. A rear butt 9e is also stuck up from the tail end side of the select jack 9. Further, a head end projection 9f is stuck up from a vicinity of a joining portion between the head end portion 9a and the elastic leg piece 9c. Such selectors 9 are included in a needle selection device 10.

[0006] The needle selection device 10 also includes a needle selection mechanism 10a, which is mounted on a carriage

11 traveling in reciprocation along the surface of the needle bed 2 in a direction perpendicular to the page space. A cam mechanism 12a for driving knitting operations is also mounted on the carriage 11, which is equipped on a cam plate 12 and acts on the butts 7a, 8a of the needle jack 7 and the select jack 8. The needle selection mechanism 10a includes a cam mechanism 13a for selecting needles, which is mounted on a needle selection plate 13, and a needle selection actuator 14. An attracting surface 14a is installed on the needle selection actuator 14 included in the needle selection mechanism 10a. The attraction surface 14a is provided at a position, facing to the pole contact 9b of the selector 9 from a bottom surface side through a bracket 15, on a tail end portion of the needle groove 5.

[0007] If the pole contact 9b is attracted to the attracting surface 14a of the needle selection actuator 14, the needle selection device 10 becomes in a non-needle selection state. In the non-needle selection state, the front butt 9d sinks in the needle groove 5 and the selector 9 cannot receive driving for moving the select jack 8 with the head end portion 9a. A releasing position is set on the attracting surface 14a of the needle selection actuator 14. At the releasing position, if electricity is energized to the needle selection actuator 14, a generated electromagnetic force can weaken an attracting force of a permanent magnet. The pole contact 9b is biased in a direction of being separated from the attracting surface 14a by the elastic leg piece 9c. If electricity is energized to the needle selection actuator 14 at timing when the pole contact 9b reaches to the releasing position, the pole contact 9b is liberated from the attracting surface 14a since the attracting force is weakened. When the pole contact 9b is liberated as described above, the spring supporting point 8c on which the tail end of the elastic leg piece 9c pressurizes the upper surface of the position holding portion 8b of the select jack 8 receives an elastic force of the elastic leg piece 9c. If a contacting portion 13b against which a head end of the head end projection 9f contacts is provided on the cam mechanism 13a of the carriage 11 side, the elastic leg piece 9c which extends to the pole contact 9b from a middle of a height of the head end projection 9f rotates in a clockwise direction in Fig. 8 about the contacting portion 13b serving as a rotation supporting point. With the rotation, the pole contact 9b is separated from the attracting surface of the needle selection actuator 14, and a head portion of the front butt 9d floats from the needle groove 5 to the cam mechanism 13a side so that the needle selection device 10 becomes in a needle selection state.

[Citation List]

[Patent Literature]

[0008]

Patent Literature 1: Japanese Patent No. 3459514

[Disclosure of the Invention]

[Technical Problem]

[0009] In the flatbed knitting machine 1, a traveling speed of the carriage 11 is desired to be faster, and a space required for needle selection by the needle selection device 10 is desired to be reduced in order to raise production efficiency. The needle selection device 10 in a form as shown in Fig. 8 has been developed in response to such desires.

[0010] However, in the needle selection device 10 as shown in Fig. 8, the spring supporting point 8c when the pole contact 9b is released from the attracting surface 14a of the needle selection actuator 14 is provided on the upper surface of the position holding portion 8b of the select jack 8. The position holding portion 8b of the select jack 8, which receives pressure on the spring supporting 8c, is supported on the substrate 3 of the needle bed 2 as a bottom surface of the needle groove 5 through the elastic leg piece 7b of the needle jack 7. Other portions involved in the release of the pole contact 9b are supported on the carriage 11 side including the contacting portion 13b serving as the rotation supporting point of the head end of the head end protrusion 9f. The carriage 11 travels along the surface of the needle bed 2, so that, while the carriage 11 travels, it is inevitable that a space between the needle selection plate 13 and the needle bed 2 slightly varies, for example. This variation changes the elastic force by the elastic leg piece 9c through the spring supporting point to make switching over unstable between attracting and releasing of the pole contact 9b to the attracting surface 14a of the needle selection actuator 14. In particular, if the traveling speed of the carriage 11 is increased, the needle selection becomes further unstable.

[0011] An object of the present invention is to provide a needle selection device of a flatbed knitting machine and a selector so that a stable needle selection is possible, even if a space between a carriage and a needle bed varies when the carriage travels.

[Technical Solution]

[0012] The present invention is a needle selection device of a flatbed knitting machine, comprising:

a needle selection mechanism mounted on a carriage, which travels in reciprocation with respect to a needle bed of the flatbed knitting machine, together with a cam mechanism for driving knitting needles; and
selectors put in needle grooves so as to face to tail end sides of knitting needles for reflecting results of needle selection by the needle selection mechanism,

characterized in that:

the needle selection mechanism has a needle selection actuator which acts on the selectors from one side of the top surface side or the bottom surface side of the needle grooves and a resetting and bifurcating cam which acts on selectors from the other side of the top surface side or the bottom surface side of the needle grooves;
the needle selection actuator is provided with an attracting surface for selecting the knitting needles based on whether existence or nonexistence of cancellation to an electromagnetic attracting state;
the resetting and bifurcating cam presses the selectors to the one side in the needle groove to reset the selectors in the attracting state where the selectors are attracted to the attracting surface of the needle selection actuator, and then, guides the selectors so as to bifurcate into paths which are different in accordance with the needle selection results by the needle selection actuator;
the selector has a base body, a butt, a pole contact, an elastic leg piece, and a bifurcating projection;
the base body has a shape in general extending linearly in a direction of moving forward and backward to a needle bed gap, and is provided with a head end portion which is capable of pushing the knitting needle such that the knitting needle advances to the needle bed gap in accordance with the needle selection result and a tail end portion which contacts a surface on a tail end side with respect to the attracting surface on the one side so as to be separated from the surface in a releasing state in which attraction is cancelled;
the butt, in the vicinity of the head end portion of the base body, has a base portion, at a position spaced from the head end portion to the side of the tail end portion of the base body, and a head portion, which protrudes from the base portion towards the carriage side;
the pole contact is stuck up so as to protrude from the base body to the one side at a position closer to the tail end portion with respect to a position in the vicinity of an intermediate position between the head end portion and the tail end portion of the base body, is in an attracting state if the head portion of the pole contact is attracted to the attracting surface of the needle selection actuator, and is in a releasing state if the head portion is separated from the attracting surface;
the elastic leg piece extends from a midstream of the butt, which protrudes from the base portion to the head portion, to a position in the vicinity of the intermediate position of the base body so as to be substantially parallel with the base body, and contacts the surface on the one side at a position on the head end portion side with respect to the attracting surface of the needle selection actuator while a head end of the elastic leg piece bends to the one side; and
the bifurcating projection protrudes to the other side between the tail end portion of the base body and the pole contact, and receives an action of the resetting and bifurcating cam.

[0013] The needle selection device of the flatbed knitting machine according to the present invention, further comprising a supporting point member provided at a position facing to the base body from said other side in the vicinity of an intermediate position between said butt and said pole contact of said selector, separated from the other side of the base body in said attracting state of the pole contact, contacting the other side of the base body in said releasing state, and serving as a supporting point when the pole contact and said tail end portion of the base body rotates so as to be separated from the one side, wherein
said needle selection mechanism is provided with a spring support cam which presses said head portion of said elastic leg piece to the one side such that bending of the elastic leg piece is increased to make an elastic force of the elastic leg piece larger in the vicinity of a position at which the attracting state of the pole contact to the attracting surface is switched so as to serve as a spring supporting point.

[0014] In the needle selection device of the flatbed knitting machine according to the present invention,
said needle selection mechanism attracts said pole contact of said selector on said attracting surface of said needle selection actuator and is capable of canceling the attracting state of the pole contact only at a previously set releasing position, and
said resetting and bifurcating cam makes the selector reset to the attracting state of the pole contact by the needle selection actuator and guides said bifurcating projection to different paths in accordance with whether the attracting state is released or not at the releasing position so as to bifurcate the selector.

[0015] In the needle selection device of the flatbed knitting machine according to the present invention,
said needle selection actuator has a plurality of releasing positions at an interval in a direction along which said carriage travels in reciprocation , and
said resetting and bifurcating cam makes said selector bifurcate into different paths in accordance with the releasing position at which the attracting state of the pole contact is canceled, and
the needle selection device further comprising,
a needle selection cam which acts on the butt of the selector guided so as to bifurcate into the different paths by the resetting and bifurcating cam and guides the selector to different needle selecting position.

[0016] Moreover the present invention is a selector put in a needle groove so as to face to a tail end side of a knitting needle for reflecting to it a result of needle selection by a needle selection mechanism, which is mounted on a carriage traveling in reciprocation with respect to a needle bed of a flatbed knitting machine, and comprises a needle selection actuator which faces to one side of a top surface side or a bottom surface side of the needle groove, and a resetting and bifurcating cam which faces to the other side of the needle groove,
characterized in that
the selector has a base body, a butt, a pole contact, an elastic leg piece, and a bifurcating projection;
the base body has a shape in general extending linearly from a head end portion to a tail end portion;
the butt, in the vicinity of the head end portion of the base body, has a base potion, at a position spaced from the head end portion to the side of the tail end portion of the base body, and a head portion, which protrudes from the base portion towards the carriage side;
the pole contact is stuck up so as to protrude from the base body to the one side at a position closer to the tail end portion with respect to a position in the vicinity of an intermediate position between the head end portion and the tail end portion of the base body,;
the elastic leg piece extends from a midstream of the butt, which protrudes from the base portion to the head portion, to a position in the vicinity of the intermediate position of the base body so as to be substantially parallel with the base body, and has a head end which bends to the one side at a position nearer to the head end portion side than the pole contact; and
the bifurcating projection protrudes to the other side, which is opposite to the one side, between the tail end portion of the base body and the pole contact.

[Advantageous Effects]

[0017] According to the present invention, the needle selection device of the flatbed knitting machine comprises, a needle selection mechanism which is mounted on a carriage which travels in reciprocation with respect to a needle bed together with a cam mechanism for driving knitting needles, and selectors which are put in needle grooves provided on the needle bed, together with the knitting needles. The attracting state of the selector is switched over depending on whether it is cancelled or not that a pole contact is electromagnetically attracted to an attracting surface by a needle selection actuator of the needle selection mechanism. The needle selection actuator is provided on one side of a top surface side or a bottom surface side of the needle groove. The selector has an elastic leg piece of which head end bends to the one side and which contacts against the surface on the one side at a position on the head end portion side with respect to the attracting surface of the needle selection actuator. When the pole contact, attracted to the attracting surface of the needle selection actuator, is to be released by cancel of attraction, an elastic force, based on the elastic leg piece, is required to be larger than an attracting force. The head end of the elastic leg piece is supported by the carriage so that, even if a space between the carriage and the needle bed varies when the carriage travels, a stable elastic force is generated and needle selection is performed stably.

[0018] According to the present invention, when the pole contact of the selector is made into a releasing state by cancelling the attraction to the attracting surface, the base body of the selector contacts against the supporting point member at the other side of the needle groove. After contact, the selector is switched to be supported on the needle bed while the contacted part serves as a supporting point of rotation, so that this makes it possible to shift to the needle selection state reliably.

[0019] Further, according to the present invention, paths along which the selector moves can be switched by the resetting and bifurcating cam in accordance with the result of needle selection.

[0020] Further, according to the present invention, the selector can be guided to a plurality of different paths so as to be guided to different needle selection positions in accordance with the releasing positions at which attraction of the selector is cancelled.

[0021] In addition, according to the present invention, the head end of the elastic leg piece of the selector used in the needle selection device of the flatbed knitting machine is supported on the carriage side in the attracting state where the selector is attracted to the attracting surface of the needle selection actuator. The selector is supported on the carriage side so that a stable elastic force is generated even if a space between the carriage and the needle bed varies when

the carriage travels. With this, attraction and release of the pole contact to the attracting surface of the needle selection actuator mounted on the carriage are switched and needle selection is performed stably.

[Brief Description of Drawings]

[0022]

[Fig. 1] Fig. 1 is a right-side cross-sectional view showing a structure of a primary part of a needle selection device 20 of a flatbed knitting machine 17 according to one example of the present invention in a simplified manner.
[Fig. 2] Figs. 2 are partial right-side cross-sectional views showing an attracting state of the needle selection device 20 of Fig. 1 and a releasing state thereof immediately after the attraction has been cancelled.
[Fig. 3] Figs. 3 are right-side views showing structures of selectors 19 used in the needle selection device 20 of Fig. 1.
[Fig. 4] Fig. 4 is a plan view of as a carriage 11 showing structure of a cam mechanism 12a for driving knitting operation and a needle selection mechanism 20a, which is used in the flatbed knitting machine 17 of Fig. 1, and is a right-side view of as a knitting needle 6 showing a structure thereof.
[Fig. 5] Figs. 5 are a right-side view and a rear view showing a structure of a primary part of the needle selection mechanism 20a of Fig. 1.
[Fig. 6] Figs. 6 are a bottom view and a plan view showing, a needle selection actuator 24, and a resetting and bifurcating cam 26 of Figs. 5 respectively.
[Fig. 7] Fig. 7 is a right-side cross-sectional view showing a structure of a primary part of a needle selection device 40 according to another example of the present invention in a simplified manner.
[Fig. 8] Fig. 8 is a right-side cross-sectional view showing a structure of a conventional needle selection device in a simplified manner.

[Description of Embodiments]

[0023] Hereinafter, with Fig. 1 to Figs. 6 a structure according to an Example 1 of the present invention is shown. Fig. 1 shows a structure of a flatbed knitting machine 17 including a needle bed gap 18. In Fig. 1 to Figs. 6, structures of selectors 19 and a needle selection device 20 used in the flatbed knitting machine 17 are described. In the drawings, the same reference signs as those in Fig. 8 denote portions corresponding to those of a flatbed knitting machine 1 and a needle selection device 10 as shown in Fig. 8. Fig. 7 shows a structure according to an Example 2 of the present invention. In the Example 2, the same reference signs as those in the Example 1 denote portions corresponding to those in the Example 1. The portions denoted with the same reference signs would be not repeatedly described.

[0024] In the Example 1, pole contacts 19d of the selectors 19 are attracted to a top surface side of a needle groove 5. In the Example 2, a pole contact 49d of a selector 49 is attracted to a bottom surface side of the needle groove 5. That is to say, the present invention can be applied to cases where a pole contact is attracted to any of one side or the other side within the top surface side and the bottom surface side of the needle groove 5.

[Example 1]

[0025] Fig. 1 is a right-side cross-sectional view showing a structure of a primary part of a needle selection device 20 of a flatbed knitting machine 17 as an Example 1 of the present invention in a simplified manner when seen from the right side of the flatbed knitting machine 17. The flatbed knitting machine 17 includes a pair of needle beds 2 which are facing to each other in a front-rear direction while sandwiching a needle bed gap 18 therebetween. Each needle bed 2 is inclined such that a head end side toward the needle bed gap 18 is higher and a tail end side away from the needle bed gap 18 is lower, but in the drawing the needle bed 2 at the front side is only shown in a horizontal attitude.

[0026] Figs. 2 show, with (a) and (b), partial cross-sectional views in which the needle selection device 20 of Fig. 1 is in an attracting state and in a releasing state just after canceling of attracting state respectively, as seen from the right side of the flatbed knitting machine 17. Fig. 1 corresponds to Fig. 2(b). Further, in the following description, description is made while a direction toward the needle bed gap 18 is set to be a head end side and a direction away from the needle bed gap 2 is set to be a tail end side in some case. In addition, description is made while a direction toward the carriage 11 from each needle bed 2 is set to be up, and a direction toward each needle bed 2 from the carriage 11 is set to be down in some case.

[0027] The needle selection device 20 including the selector 19 also includes a needle selection mechanism 20a which is mounted on the carriage 11. The needle selection mechanism 20a also includes a cam device 20b for needle selection, which is mounted on the carriage 11. The selector 19 has a base body 19a, a butt 19b, an elastic leg piece 19c, and a pole contact 19d. The base body 19a has a shape in general extending linearly in a front-rear direction of advancing to and retreating from the needle bed gap 18, and the base body 19a has a head end portion 19e which is

capable of pressing a select jack 7 of a knitting needle 6 such that the select jack 7 advances to the needle bed gap 18 in accordance with a needle selection result, and a tail end portion 19f. The butt 19b is stuck up such that a head portion thereof protrudes to the side of the carriage 11 in the vicinity of the head end portion 19e of the base body 19a while a position spaced from the head end portion 19e to a base end side is set to a base portion. A head end of the head portion of the butt 19b protrudes to the carriage 11 side. A head portion of the pole contact 19d, which is stuck up toward the carriage 11 side, is attracted to an attracting surface 24a of a needle selection actuator 24 provided on the carriage 11 in the attracting state and is separated from the attracting surface 24a in the releasing state. The head portion of the armature 19d is in the attracting state attracted to and in the releasing state separated from the attracting surface 24a at a position closer to the tail end portion 19f with respect to an intermediate position of the base body 19a. The elastic leg piece 19c extends from a position in the vicinity of an intermediate position of a height from the base portion to the head portion of the butt 19b to a position in the vicinity of the intermediate position of the base body 19a, which is closer to the head end portion 19e with respect to the pole contact 19d. The elastic leg piece 19c extends so as to be approximately parallel with the base body 19a, and a head end of the elastic leg piece 19c bends to the carriage 11 side.

[0028] It is to be noted that a portion of the knitting needle 6 at the needle bed gap 18 side corresponds to a needle body 21. A hook 21a at a head end of the needle body 21 advances to and retreats from the needle bed gap 18 so as to form a knitted loop, perform stich transferring to/from the opposing needle bed 2, and so on. The knitting needle 6 is a type of latch needle and the hook 21a is opened and closed by a latch 21b. A clip 21c which is provided on a side surface of the needle body 21 is used in the stitch transferring. Accordingly, at the time of the stitch transferring, the knitting needle 6 is driven so as to move in the right direction in Fig. 1 until the clip 21c which retains a knitted loop to be transferred to the opposing needle bed 2 advances to the needle bed gap 18. When the stitch transferring is performed, an operation in which the hook 21a of the knitting needle 6 which advances to the needle bed gap 18 from the opposing needle bed 2 side receives the knitted loop which is retained by the blade 21c in the needle bed gap 18 is also required. Therefore, a butt 7c is also provided on the needle jack 7 in addition to a butt 7a. The butts 7a, 7c receive driving by a cam mechanism 12a for driving knitting operation, which is mounted on a cam plate 12 of the carriage 11.

[0029] In the flatbed knitting machine 17, movable sinkers 22 are provided on each needle bed 2 at the needle bed gap 18 side. The movable sinkers 22 are arranged alternately with the knitting needles 6 in a direction perpendicular to a paper plane. The movable sinkers 22 are disposed in a state capable of rocking displacement by using head end portions of needle plates 4 at the needle bed gap 18 side, and are biased by wire springs 23 so as to advance to the needle bed gap 18 side.

[0030] The needle selection mechanism 20a includes the needle selection actuator 24. The needle selection actuator 24 is mounted on a needle selection plate 13 of the carriage 11 and the attracting surface 24a is provided on a surface of the needle selection actuator 24, which faces to the side of the needle bed 2. In order to reset into the attracting state from a state where the attracting state is once cancelled and the pole contact 19d of the selector 19 is separated from the attracting surface 24a by making the head portion of the pole contact 19d closer to the attracting surface 24a side, a resetting and bifurcating cam 26 is also attached to the carriage 11 through a bracket 25. The resetting and bifurcating cam 26 presses the selector 19 from the bottom surface side of the needle groove 5 so as to make the selector 19 float, and after makes the selector 19 reset to the attracting state, then guides the selector 19 to a path which is different in accordance with a result of needle selection. A bifurcating projection 19g is also provided on the selector 19 so as to receive an action of the resetting and bifurcating cam 26, and is stuck up so as to protrude to the bottom surface side of the needle groove 5.

[0031] When the attracting state of the pole contact 19d to the attracting surface 24a is cancelled, the head end of the elastic leg piece 19c, which bends to the side of the carriage 11, contacts against a cam surface of a spring support cam 27, which is provided at the front side of the attracting surface 24a on the carriage 11, so as to serve as a spring support point which receives an elastic force. Further, in the attracting state, the tail end portion 19f of the base body 19a of the selector 19 contacts against a surface of a supporting point plate 28, which is provided on the carriage 11 on the tail end side with respect to the attracting surface 24a. A supporting point member 29 such as a wire which penetrates through the needle plate 4 in a direction perpendicular to the page space is provided on the base body 19a on the bottom surface side of the needle groove 5. In the releasing state like as shown in the drawing, the supporting point member 29 contacts against a rotation supporting portion 19h of the base body 19a. It is to be noted that a cam device 20b for needle selection, which is provided on the carriage 11, includes the resetting and bifurcating cam 26, the spring support cam 27, the supporting point plate 28, and a needle selection cam 30. A metal band 4a and a wire 4b which penetrate through the needle plate 4 in a direction perpendicular to the page space together with the supporting point member 29 are provided in the vicinity of the selector 19. The metal band 4a presses an upper surface of the elastic leg piece 19c at a position where a head end of the elastic leg piece 19c is not pressed by the cam surface of the spring support cam 27 so as to restrict the elastic leg piece 19c from floating to the surface side of the needle groove 5 more than necessary. The wire 4b restricts the select jack 8 from floating in the needle groove 5 more than necessary.

[0032] As shown in Fig. 2(a), when the pole contact 19d is in the attracting state to the attracting surface 24a, the rotation supporting portion 19h on a lower surface of the base body 19a is separated from the supporting point member

29. Further, the upper surface of the elastic leg piece 19c and a lower surface of the metal band 4a are separated from each other. A lower side of the base portion on which the butt 19b is stuck up from the base body 19a has a shape so as not to make contact with the wire 4b. Further, since a lower surface of the head end portion 19e is separated from an upper surface of the select jack 8, the selector 19 is supported without depending on the needle bed 2. The selector 19 is supported from the side of the carriage 11 stably with the head portion of the pole contact 19d which contacts against the attracting surface 24a, the tail end portion 19f which contacts against the surface of the supporting point plate 28, and the head end of the elastic leg piece 19c which contacts against the cam surface of the spring support cam 27. In this case, a position at which the tail end portion 19f contacts against the surface of the supporting point plate 28 serves as a supporting point. An attracting force to the attracting surface 24a acts on the pole contact 19d. An elastic force, from the cam surface of the spring support cam 27, acts on the head end of the elastic leg piece 19c. The attracting force and the elastic force become moments in opposite directions with the contacting position against the supporting point plate 28 as a supporting point. Even if the carriage 11 travels, the moment by the elastic force remains stable without being influenced by variation of the space between the needle selection plate 13 and the needle bed 2. If the moment by the attracting force is made smaller by application of electricity to the needle selection actuator 24 and is smaller than the moment by the elastic force, the base body 19a of the selector 19 rotates about the contacting position of the tail end portion 19f against the supporting point plate 28. It is to be noted that the head portion of the bifurcating projection 19g escapes from the resetting and bifurcating cam 26 at the bifurcating projection 19g side so as to correspond to the releasing position of the pole contact 19d at which the attracting force can be made smaller by the application of electricity, as will be described later. A rotation direction corresponds to a direction in which the pole contact 19d is separated from the attracting surface 24a, that is, a clockwise direction in the drawing, and the attracting state of the pole contact 19d to the attracting surface 24a is cancelled so that the pole contact 19d is released. In the attracting state, the moment by the elastic force of the elastic leg piece 19c in the direction, in which the attraction is cancelled, acts stably, so that an operation of cancelling the attracting state by the needle selection actuator 24 can be stably performed.

[0033] A distance between the tail end portion 19f of the base body 19a serving as a supporting point and the position at which the head end of the elastic leg piece 19c contacts against the cam surface of the spring support cam 27 is larger than a distance between the tail end portion 19f and the attracting position at which the pole contact 19d is attracted to the attracting surface 24a. Therefore, as the moment about the tail end portion 19f as a supporting point, a moment by the elastic force of the elastic leg piece 19c can be used in relatively large state. With the structure of the selector 9 as shown in Fig. 8, a distance between the contacting portion 13b of the butt 9f of which head end serves as a rotation supporting point and a position at which the pole contact 9b is attracted to the needle selection actuator 14 is larger than a distance between the contacting portion 13b and the spring supporting point 8c at the head end of the elastic leg piece 9c. Accordingly, a moment by the elastic force of the elastic leg piece 9c can be used only in relatively small state.

[0034] In the attracting state as shown in Fig. 2(a), if the base body 19a rotates about the supporting point of the tail end portion 19f which contacts against the supporting point plate 28 with the cancellation of the attracting state, the rotation supporting portion 19h at the intermediate portion of the base body 19a contacts against the supporting point member 29. As shown in Fig. 2(b) as a state immediately after the attracting state has been cancelled, if the rotation supporting portion 19h contacts against the supporting point member 29, the rotation supporting portion 19h serves as a new supporting point and the base body 19a rotates about the supporting point in the counterclockwise direction. With this, the head end of the tail end portion 19f is separated from the surface of the supporting point plate 28. The base portion of the butt 19b is located on the head end side with respect to the rotation supporting portion 19h so that the head portion of the butt19b protrudes from the needle groove 5 with the rotation in the counterclockwise direction. The head end of the elastic leg piece 19d continues to contact against the cam surface of the spring support cam 27 on the carriage 11, so that the selector 19 in the releasing state is supported from both sides of the carriage 11 and the needle bed 2. Reset from the releasing state to the attracting state is mechanically performed by the resetting and bifurcating cam 26 reliably, so that even if a space between the carriage 11 and the needle bed 2 varies when the carriage 11 travels, a needle selection operation does not become unstable.

[0035] Fig. 3 shows structures of the selectors 19 used in the needle selection device 20 of Fig. 1 when seen from the right side of the flatbed knitting machine 17. An pole contact 19i is provided on the selector 19 at a position closer to the tail end portion 19f with respect to the pole contact 19d so that the pole contacts 19d, 19i are located at different positions. The selectors 19 of which pole contacts 19d, 19i are located at different positions are alternately used. With this, even when the knitting needles 6 are closely disposed, needle selection can be performed for each knitting needle 6 reliably.

[0036] It is to be noted that the position of the pole contact 19i is closer to the tail end portion 19f which serves as a supporting point in the attracting state with respect to the position of the pole contact 19d. Therefore, an action of the elastic force received by the head end of the elastic leg piece 19c as the spring supporting point is larger than that at the position of the pole contact 19d, so that it is difficult to continue the attracting state with the same attracting force. Then, on the pole contact 19i, a length Li of a head end which makes contact with the attracting surface is made longer than a length Ld of the head end of the pole contact 19d such that the attracting force is adjusted to be increased.

[0037] Fig. 4 shows a structure of a cam mechanism and a needle selection mechanism on the carriage 11 used in the flatbed knitting machine 17 of Fig. 1 in comparison with a structure of the knitting needle 6 as shown on a right side. The attracting surface 24a of each needle selection actuator 24 is divided into an attracting surface 24d which attracts the pole contact 19d of the selector 19 and an attracting surface 24i which attracts the pole contact 19i as shown in Fig. 3. Actually units, each unit having an attracting surface which attracts a single pole contact, are arranged at two stages so as to form the needle selection actuator 24. It is sufficient that unites of the number corresponding to the number of the pole contacts are arranged even when equal to or more than three pole contact positions are set.

[0038] For two attracting surfaces 24d, 24i, the releasing positions 24b, 24c which are the same in the traveling direction of the carriage 11 as the right-left direction in Fig. 4 are set. If attracting forces are electromagnetically made smaller adjusting to the timing when the pole contacts 19d, 19i pass through the releasing positions 24b, 24c, the attractng states of the pole contacts 19d, 19i to the attracting surfaces 24d, 24i are cancelled so as to be released.

[0039] As for the needle selection actuator 24 on the left side in Fig. 4, a state where the cam surface of the resetting and bifurcating cam 26 is opposed to the lower side of the needle selection actuator 24 is shown. The resetting and bifurcating cam 26 acts on the bifurcating projection 19g of the selector 19. If the head portions of the bifurcating projections 19g are made to float from the bottom surface side of the needle groove 5, the pole contacts 19d, 19i which have been released by the cancellation of the attracting states are made to make contact with the attracting surfaces 24d, 24i again so as to reset in the attracting states. Further, the bifurcating projections 19g of the selectors 19 are guided to different paths in accordance with the releasing positions 24b, 24c at which attracting states are cancelled. Further, on the spring support cam 27 provided at the head end of each attracting surface 24a, a cam surface 27a which protrudes to the needle bed 2 side presses the head end of the elastic leg piece 19c of the selector 19 such that bending of the elastic leg piece 19c is increased to make the elastic force thereof larger. With this, the pole contacts 19d, 19i are made easy to be released.

[0040] The needle selection cams 30 are arranged on the needle selection plate 13 of the carriage 11 at the head end side of the needle selection actuators 24. Each needle selection cam 30 is bifurcated into different paths with an action on the bifurcating projection 19g by the resetting and bifurcating cam 26 so as to act on the head portion of the butt 19b of the selector 19, which protrudes from the needle groove 5. Each needle selection actuator 24 has two releasing positions 24b, 24c at which the attracting states of the pole contacts 19d, 19i can be cancelled so as to be spaced from each other in the traveling direction of the carriage 11. The resetting and bifurcating cam 26 and the needle selection cam 30 are combined with each other so that the butt 19b can be guided to two different paths 31, 32 in accordance with the two releasing positions 24b, 24c at which the attracting states of the pole contacts 19d, 19i are cancelled.

[0041] Since the carriage 11 travels in reciprocation, the cam mechanism and the needle selection mechanism are arranged so as to be bilaterally symmetric. For example, when the carriage 11 is supposed to travel to the right side in Fig. 4, the knitting needle 6 relatively moves to the left side in Fig. 4 with respect to the carriage 11. The pole contact 19 of the selector 19 which is provided at the tail end side of the knitting needle 6 is attracted to the attracting surface 24d so as to reach to the releasing position 24b. If the armature 19d is released at the release position 24b, the butt 19b enters the path 31 of the needle selection cam 30 so as to be guided subsequent to the bifurcation based on the guidance of the bifurcating projection 19g by the resetting and bifurcating cam 26. The path 31 swells out to the front side in a mountain shape so that the head end portion 19e of the selector 19 presses the select jack 8 to the needle bed gap 18 side. By pushing out till the top of path 31 of the mountain shape, the butt 8a of the select jack 8 is made to advance to the needle selecting position of the A position. If the pole contact 19d is not released at the releasing position 24b and is released at the releasing position 24c, the butt 19b enters the path 32 of the needle selection cam 30 so as to be guided subsequent to the bifurcation based on the guidance of the bifurcating projection 19g by the resetting and bifurcating cam 26. The selector 19 presses the select jack 8 to the needle bed gap 18 side with the head end portion 19e so as to make the butt 8a of the select jack 8 advance to the needle selecting position of the H position at a top of a mountain shape of the path 32. If the pole contact 19d is not released at any of the releasing positions 24b, 24c and remains attracted to the attracting surface 24d, the butt 8a of the select jack 8 keeps the needle selecting position of the B position.

[0042] The butt 8a of the select jack 8 is guided to a region in which a B presser 33 and an H pressers 34 are provided in a range where the cam mechanism 12a to perform driving knitting operation of the knitting needle 6 is provided on the cam plate 12 of the carriage 11. The B presser 33 is a fixed presser and acts on the butt 8a at the B position so as to press the butt 8a into the needle groove 5. With this, the butt 7a of the needle jack 7 also sinks into the needle groove 5 and does not receive an action of a knitting cam 35. Further, the hook 21a of the knitting needle 6 does not advance to the needle bed gap 18 and retains at the side of the needle bed 2. That is, the knitting needle 6 does not form a knitted loop, resulting in a miss operation. The H pressers 34 are arranged in a divided manner into three parts, for example, and are movable pressers which can retreat to positions as indicated by chain double-dashed lines in a sliding manner. The H pressers 34 which do not retreat also press the butt 8a of the select jack 8 in the needle groove 5 in the same manner as the B presser 33 so that the knitting needle 6 can perform a tuck operation and a stitch transferring operation.

When the butt 8a passes through the A position, since the pressers are not arranged, the butt 7a keeps a state of protruding from the needle groove 5 and receives driving by the knitting cam 35 so that the knitting needle 6 performs a knit operation.

[0043] At the head end side with respect to the knitting cam 35, is arranged a transferring cam 36, which acts on the butt 7c of the needle jack 7 and drives to make the knitting needle 6 perform an operation relating to the stitch transferring. On the right and left sides of the knitting cam 35, guide cams 37, which make the butt 8a of the select jack 8 return to the B position, are arranged.

[0044] It is to be noted that the two releasing positions 24b, 24c are provided on the attracting surface 24a and the corresponding paths 31, 32 are provided on the needle selection cam 30 so as to switch to the A position or the H position, however, if the number of releasing positions 24b, 24c is increased and the number of corresponding paths 31, 32 is increased, a number of operations can be switched by one needle selection device.

[0045] Figs. 5 show a structure of a primary part of the needle selection device 20 of Fig. 1 when seen from the right side and the front side. Figs. 6 show the needle selection actuator 24 of Figs. 5 when seen from the lower side and show the resetting and bifurcating cam 26 of Figs. 5 when seen from the upper side. As shown in Fig. 5(a), the spring support cam 27 and the supporting point plate 28 are attached to the needle selection actuator 24 so as to be closer to the attracting surface 24a. The resetting and bifurcating cam 26 is attached to the needle selection actuator 24 through the bracket 25 so as to be spaced from the attracting surface 24a.

[0046] As shown in Fig. 5(b), on the resetting and bifurcating cam 26, a convex portion 26a is provided at the center, and concave portions 26b, 26c are provided at the right and left sides respectively. Inclined plains 26d, 26e which are continuous to the height of the convex portion 26a are provided at the right and left sides of the concave portions 26b, 26c. For example, the inclined plane 26e presses the head portion of the bifurcating projection 19g of the selector 19 upward as indicated by a path 39 while contacting against the head portion so as to make the pole contacts 19d, 19i contact with the attracting surface 24a. With this, the pole contacts 19d, 19i can be made to return into the attracting states. The inclined plane 26d also has a function of the same kind. The concave portions 26b, 26c serve as escapes for the head portion of the bifurcating projection 19g such that sides of the bifurcating projection 19g can receive a bifurcating guide action of the resetting and bifurcating cam 26 when the pole contacts 19d, 19i are released from the attracting surface 24a. The concave portions 26b, 26c have a constant height which is lower than the convex portion 26a, and inclined planes 26f, 26g, which are further lowered, are provided on the ends of the concave portions 26b, 26c respectively.

[0047] Further, as shown in Fig. 5(b), the spring support cam 27 has inclined planes 27b, 27c on both sides of the cam surface 27a. An elastic force acting on the spring support cam 27 becomes weaker in a state where the head end of the elastic leg piece 19c of the selector contacts against the inclined planes 27b, 27c. The elastic force acts in a direction in which the pole contacts 19d, 19i are released from the attracting surfaces 24d, 24i. When the selector 19 starts to enter a region where the needle selection actuator 24 is arranged, the head end of the elastic leg piece 19c contacts against the inclined surfaces 27b, 27c of the spring support cam 27 and then shifts to the flat cam surface 27a. Accordingly, the elastic force of the elastic leg piece 19c, which acts on the attracting surfaces 24d, 24i to which the pole contacts 19d, 19i are attracted, can be set so as to be gradually increased along the inclined planes 27b, 27c from a state in which the elastic force hardly act with the move of the contacting position against the spring support cam 27, to a state in which the elastic force can be continued to act at a maximum level on the spring support cam 27.

[0048] As shown in Fig. 6(a), the attracting surfaces 24d, 24i are formed from the vicinity of both ends of the inclined planes 27b, 27c of the spring support cam 27, the pole contacts 19d, 19i can be attracted to the attracting surfaces 24d, 24i reliably in a state where the elastic force from the elastic leg piece 19c hardly act thereon. Further, the pole contacts 19d, 19i reach to the releasing positions 24b, 24c in a state where the pole contacts 19d, 19i are pressurized by the cam surface 27a and the elastic force from the elastic leg piece 19c acts thereon at the maximum level, so that the pole contacts 19d, 19i can be released reliably with the cancellation of the electromagnetic attraction.

[0049] As shown in Fig. 6(b), after the resetting and bifurcating cam 26 presses the head portion of the bifurcating projection 19g of the selector 19 along the path 39 so as to return the pole contacts 19d, 19i to the attracting state, if the attracting state is cancelled at either of the releasing positions 24b, 24c, the bifurcating projection 19g can be made to fall in the concave portions 26b, 26c so as to be bifurcated into paths 39A, 39H. The bifurcating projection 19g sinks to the bottom surface side of the needle groove 5 at the concave portions 26b, 26c, so that timing when the supporting point member 29 contacts against the rotation supporting portion 19h becomes earlier and the butt 19b can be made to protrude to the needle selection cam 30 side quickly. Since the path 39H passes through the inclined portion 26f, the head portion of the bifurcating projection 19g can be made to further sink, and timing, when the butt 19b is made to protrude, can be made earlier. If the attracting state is not cancelled at the releasing positions 24b, 24c, the bifurcating projection 19g passes through a path 39B on a line as an extension of the path 39. The paths 39A, 39H guide the butt 19b of the selector 19 to the paths 31, 32 of the needle selection cam 30 as shown in Fig. 4 in a state where the butt 19b is made to protrude from the needle groove 5 to the carriage 11 side.

[0050] It is to be noted that if a large-sized strong permanent magnet is used for making the attracting force on the

attracting surfaces 24d, 24i stronger, a large-sized strong electromagnet is also required for cancelling the attracting state at the releasing positions 24b, 24c. In order to reduce the needle selection actuator 24 in size, it is preferable to perform a bipolar driving, in which electricity is applied to an electromagnet in a direction of reinforcing magnetic flux of the permanent magnet in the non-needle selection and electricity is applied to the electromagnet in a direction of negating the magnetic flux of the permanent magnet in the needle selection.

[0051] Further, as the knitting needle 6 of Fig. 1, a latch needle which opens and closes the hook 21a with the latch 21b is used, however a compound needle which opens and closes the hook with a slider can be used.

[Example 2]

[0052] Fig. 7 shows a structure of a primary part of a needle selection device 40 as the Example 2 of the present invention. In the Example 2, the resetting and bifurcating cam 26 is arranged on a surface side of the needle groove 5, that is, on the carriage 11 side. A needle selection actuator 44 is arranged on the bottom surface side of the needle groove 5 through a bracket 45. The spring support cam 27 and the supporting point plate 28 are arranged on the head end side and the tail end side of an attracting surface 44a of the needle selection actuator 44 on the bottom surface side of the needle groove 5. A selector 49 has a base body 49a, a butt 49b, an elastic leg piece 49c, a pole contact 49d, a head end portion 49e, a tail end portion 49f, a bifurcating projection 49g, and a rotation supporting portion 49h. Functions of these portions are substantially the same as corresponding portions of the selector 19 basically. However, a direction, in which a head end of the elastic leg 49c and the pole contact 49d protrude, is a bottom surface side of the needle groove 5 and is different from that in the selector 19. Further, a direction in which the bifurcating projection 49g protrudes is the surface side of the needle groove 5 and is different from that in the selector 19. In addition, the rotation supporting portion 49h is provided on an upper surface side of the base body 49a and is separated from the supporting point member 29 in an attracting state of the selector 49. In the attracting state, the selector 49 is also separated from the metal band 4a and the wire 4b which penetrate through the needle plate 4 likely in the selector 19. Further, a lower surface of the head end portion 49e of the selector 49 is separated from an upper surface of the select jack 8. Accordingly, the selector 49 in the attracting state is stably supported depending on the carriage 11 only without depending on the needle bed even when the carriage 11 travels.

[0053] Fig. 7 shows the attracting state of the selector 49. A moment about a contacting part of the tail end portion 49f against the supporting point plate 28 based on the attracting force of the pole contact 49d to the attracting surface 44a is larger than a moment based on a spring reaction force that the head end of the elastic leg 49c receives from the surface of the spring support cam 27. In a state where a head portion of the bifurcating projection 49g is made to escape by the resetting and bifurcating cam 26, if the attracting force to the attracting surface 44a is made smaller and the moment about the tail end portion 49f based on the attracting force of the pole contact 49d is smaller than the moment based on the spring reaction force on the spring support cam 27, the attraction is cancelled and the pole contact 49d is separated from the attracting surface 44d. The base body 49a rotates in the counterclockwise direction about a portion on which the tail end portion 49f contacts against the supporting point plate 28. If the rotation supporting portion 49h contacts against the supporting point member 29, this contacting part serves as a supporting point for the rotation, and the direction thereof is inverted to the clockwise direction so that the tail end portion 49f is separated from the surface of the support plate 28. Although the butt 49b sinks with the rotation in the clockwise direction, it is sufficient that the butt 49b protrudes to the carriage 11 side to an extent that a head portion thereof can receive guidance by the needle selection cam 30. The butt 49b further protrudes in the attracting state, however, as shown in Fig. 4, a linear path for allowing the butt 49b to escape can be provided on the needle selection cam 30 at the lower side of the paths 31, 32.

[Reference Signs List]

[0054]

2	Needle bed
5	Needle groove
6	Knitting needle
11	Carriage
12a	Cam mechanism
19, 49	Selector

19a, 49a	Base body
19b, 49b	Butt
19c, 49c	Elastic leg piece
19d, 19i, 49d	Pole contact
19e, 49e	Head end portion
19f, 49f	Tail end portion
19g, 49g	Bifurcating projection
19h, 49h	Rotation supporting portion
20, 40	Needle selection device
20a	Needle selection mechanism
20b	Cam device
24, 44	Needle selection actuator
24a, 24d, 24i, 44a	Attracting surface
24b, 24c	Releasing position
26	Resetting and bifurcating cam
27	Spring support cam
28	Supporting point plate
29	Supporting point member
30	Needle selection cam
31, 32, 39, 39A, 39B, 39H	Path

Claims

1. A needle selection device (20, 40) of a flatbed knitting machine (17), comprising:

a needle selection mechanism (20a) mounted on a carriage (11), which travels in reciprocation with respect to a needle bed (2) of the flatbed knitting machine (17), together with a cam mechanism (12a) for driving knitting needles (6); and
selectors (19, 49) put in needle grooves (5) so as to face to tail end sides of knitting needles (6) for reflecting results of needle selection by the needle selection mechanism (20a),

characterized in that:

the needle selection mechanism (20a) has a needle selection actuator (24, 44) which acts on the selectors (19, 49) from one side of the top surface side or the bottom surface side of the needle grooves (5) and a resetting and bifurcating cam (26) which acts on selectors (19, 49) from the other side of the top surface side or the bottom surface side of the needle grooves (5);
the needle selection actuator (24, 44) is provided with an attracting surface (24a, 24d, 24i, 44a) for selecting

the knitting needles (6) based on whether existence or nonexistence of cancellation to an electromagnetic attracting state;
the resetting and bifurcating cam (26) presses the selectors (19, 49) to the one side in the needle groove (5) to reset the selectors (19, 49) in the attracting state where the selectors (19, 49) are attracted to the attracting surface (24a, 24d, 24i, 44a) of the needle selection actuator (24, 44), and then, guides the selectors (19, 49) so as to bifurcate into paths (31, 32) which are different in accordance with the needle selection results by the needle selection actuator (24, 44);
the selector (19, 49) has a base body (19a, 49a), a butt (19b, 49b), a pole contact (19d, 19i, 49d), an elastic leg piece (19c, 49c), and a bifurcating projection (19g, 49g);
the base body (19a, 49a) has a shape in general extending linearly in a direction of moving forward and backward to a needle bed gap (18), and is provided with a head end portion (19e, 49e) which is capable of pushing the knitting needle (6) such that the knitting needle (6) advances to the needle bed gap (18) in accordance with the needle selection result and a tail end portion (19f, 49f) which contacts a surface on a tail end side with respect to the attracting surface (24a, 24d, 24i, 44a) on the one side so as to be separated from the surface in a releasing state in which attraction is cancelled;
the butt (19b, 49b), in the vicinity of the head end portion (19e, 49e) of the base body (19a, 49a), has a base portion, at a position spaced from the head end portion (19e, 49e) to the side of the tail end portion (19f, 49f) of the base body (19a, 49a), and a head portion, which protrudes from the base portion towards the carriage (11) side;
the pole contact (19d, 19i, 49d) is stuck up so as to protrude from the base body (19a, 49a) to the one side at a position closer to the tail end portion (19f, 49f) with respect to a position in the vicinity of an intermediate position between the head end portion (19e, 49e) and the tail end portion (19f, 49f) of the base body (19a, 49a), is in an attracting state if the head portion of the pole contact (19d, 19i, 49d) is attracted to the attracting surface (24a, 24d, 24i, 44a) of the needle selection actuator (24, 44), and is in a releasing state if the head portion is separated from the attracting surface (24a, 24d, 24i, 44a);
the elastic leg piece (19c, 49c) extends from a midstream of the butt (19b, 49b), which protrudes from the base portion to the head portion, to a position in the vicinity of the intermediate position of the base body (19a, 49a) so as to be substantially parallel with the base body (19a, 49a), and contacts the surface on the one side at a position on the head end portion (19e) side with respect to the attracting surface (24a, 24d, 24i, 44a) of the needle selection actuator (24, 44) while a head end of the elastic leg piece (19c, 49c) bends to the one side; and
the bifurcating projection (19g, 49g) protrudes to the other side between the tail end portion (19f, 49f) of the base body (19a, 49a) and the pole contact (19d, 19i, 49d), and receives an action of the resetting and bifurcating cam (26).

2. The needle selection device (20, 40) of the flatbed knitting machine (17) according to claim 1, further comprising a supporting point member (29) provided at a position facing to the base body (19a, 49a) from said other side in the vicinity of an intermediate position between said butt (19b, 49b) and said pole contact (19d, 19i, 49d) of said selector (19, 49), separated from the other side of the base body (19a, 49a) in said attracting state of the pole contact (19d, 19i, 49d), contacting the other side of the base body (19a, 49a) in said releasing state, and serving as a supporting point when the pole contact (19d, 19i, 49d) and said tail end portion (19f, 49f) of the base body (19a, 49a) rotates so as to be separated from the one side, wherein
said needle selection mechanism (20a) is provided with a spring support cam (27) which presses said head portion of said elastic leg piece (19c, 49c) to the one side such that bending of the elastic leg piece (19c, 49c) is increased to make an elastic force of the elastic leg piece (19c, 49c) larger in the vicinity of a position at which the attracting state of the pole contact (19d, 19i, 49d) to the attracting surface (24a, 24d, 24i, 44a) is switched so as to serve as a spring supporting point.

3. The needle selection device (20, 40) of the flatbed knitting machine (17) according to claims 1 or 2, wherein
said needle selection mechanism (20a) attracts said pole contact (19d, 19i, 49d) of said selector (19, 49) on said attracting surface (24a, 24d, 24i, 44a) of said needle selection actuator (24, 44) and is capable of canceling the attracting state of the pole contact (19d, 19i, 49d) only at a previously set releasing position, and
said resetting and bifurcating cam (26) makes the selector (19, 49) reset to the attracting state of the pole contact (19d, 19i, 49d) by the needle selection actuator (24, 44) and guides said bifurcating projection (19g, 49g) to different paths (31, 32) in accordance with whether the attracting state is released or not at the releasing position so as to bifurcate the selector (19, 49).

4. The needle selection device (20) of the flatbed knitting machine (17) according to claim 3, wherein
said needle selection actuator (24) has a plurality of releasing positions (24b, 24c) at an interval in a direction along

which said carriage (11) travels in reciprocation , and
said resetting and bifurcating cam (26) makes said selector (19) bifurcate into different paths (31, 32) in accordance with the releasing position (24b, 24c) at which the attracting state of the pole contact (19d, 19i) is canceled, and the needle selection device (20) further comprising,
a needle selection cam (30) which acts on the butt (19b) of the selector (19) guided so as to bifurcate into the different paths (31, 32) by the resetting and bifurcating cam (26) and guides the selector (19) to different needle selecting position.

5. A selector (19, 49) put in a needle groove (5) so as to face to a tail end side of a knitting needle (6) for reflecting to it a result of needle selection by a needle selection mechanism (20a), which is mounted on a carriage (11) traveling in reciprocation with respect to a needle bed (2) of a flatbed knitting machine (17), and comprises a needle selection actuator (24, 44) which faces to one side of a top surface side or a bottom surface side of the needle groove (5), and a resetting and bifurcating cam (26) which faces to the other side of the needle groove (5),
characterized in that
the selector (19, 49) has a base body (19a, 49a), a butt (19b, 49b), a pole contact (19d, 19i, 49d), an elastic leg piece (19c, 49c), and a bifurcating projection (19g, 49g);
the base body (19a, 49a) has a shape in general extending linearly from a head end portion (19e, 49e) to a tail end portion (19f, 49f);
the butt (19b, 49b), in the vicinity of the head end portion (19e, 49e) of the base body (19a, 49a), has a base potion, at a position spaced from the head end portion (19e, 49e) to the side of the tail end portion (19f, 49f) of the base body (19a, 49a), and a head portion, which protrudes from the base portion towards the carriage (11) side;
the pole contact (19d, 19i, 49d) is stuck up so as to protrude from the base body (19a, 49a) to the one side at a position closer to the tail end portion (19f, 49f) with respect to a position in the vicinity of an intermediate position between the head end portion (19e, 49e) and the tail end portion (19f, 49f) of the base body (19a, 49a);
the elastic leg piece (19c, 49c) extends from a midstream of the butt (19b, 49b), which protrudes from the base portion to the head portion, to a position in the vicinity of the intermediate position of the base body (19a, 49a) so as to be substantially parallel with the base body (19a, 49a), and has a head end which bends to the one side at a position nearer to the head end portion (19e, 49f) side than the pole contact (19d, 19i, 49d); and
the bifurcating projection (19g, 49g) protrudes to the other side, which is opposite to the one side, between the tail end portion (19f, 49Ð of the base body (19a, 49a) and the pole contact (19d, 19i, 49d).

Fig. 1

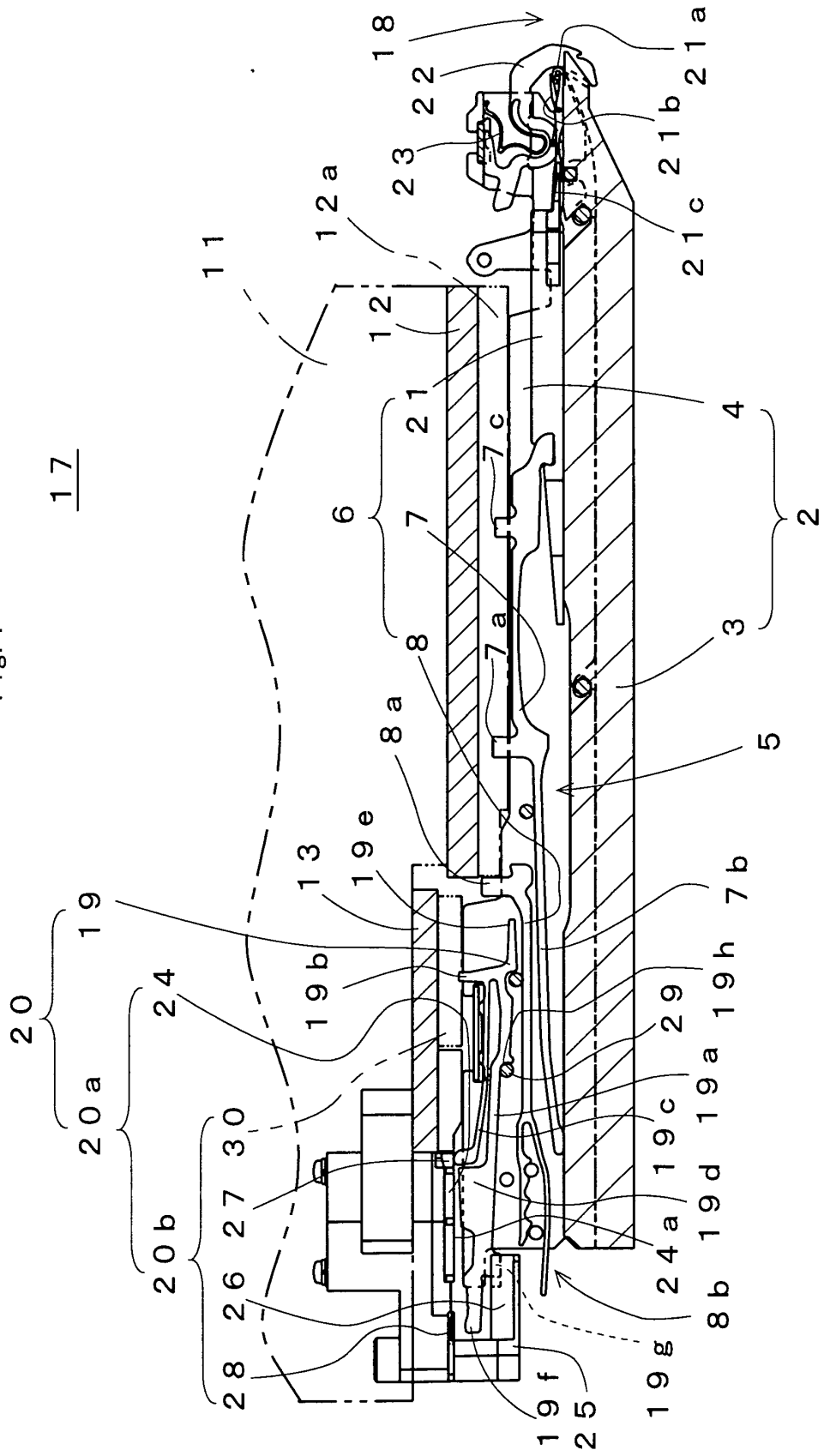

17
18
22
23
21a
21b
21c
12a
12
11
21
4
7c
6
7
2
3
7a
8
8a
5
13
19e
7b
19
19b
24
20
20a
29
19h
19a
19c
19d
20b
30
27
26
24a
8b
28
19g
19f
25

Fig. 2

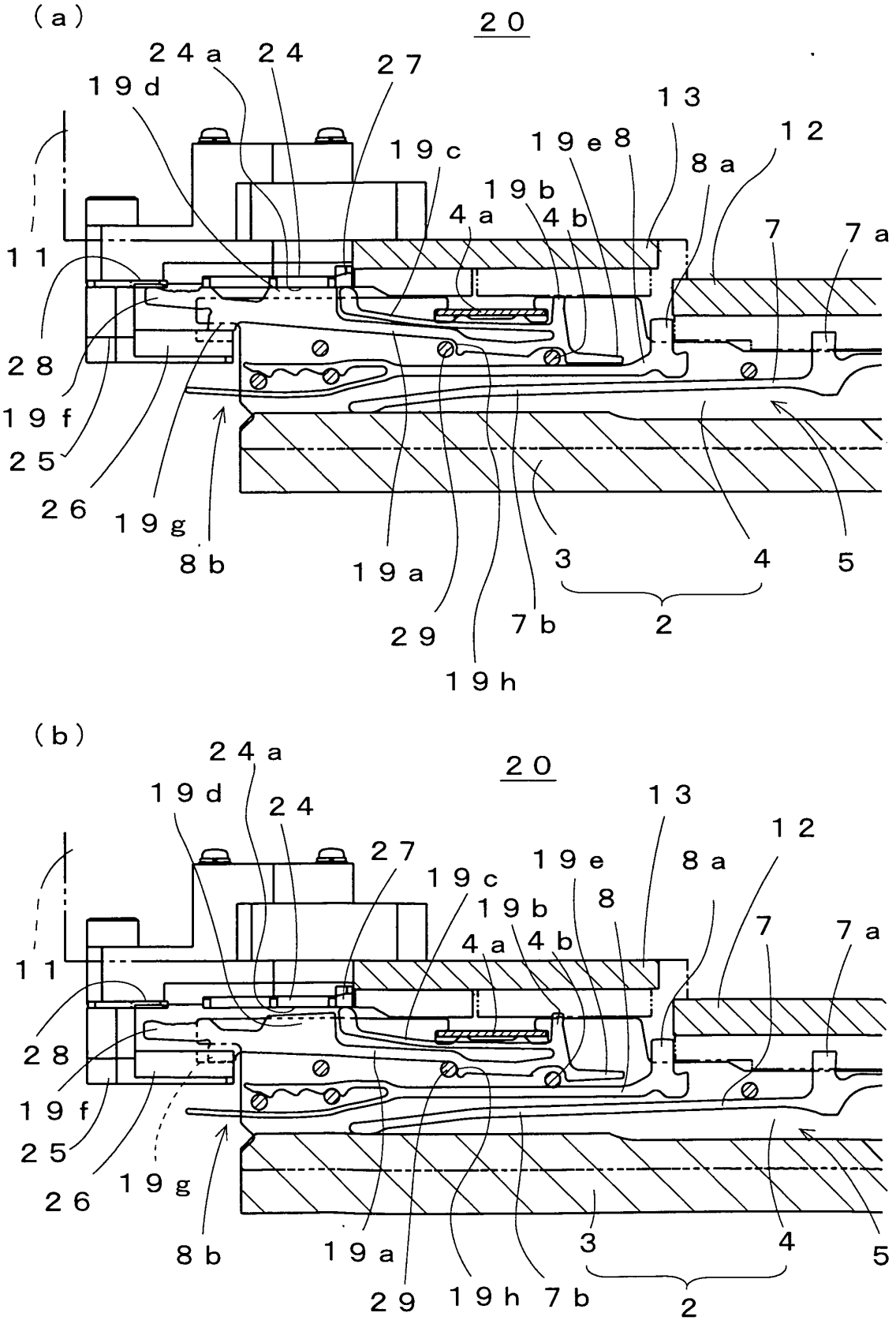

(a)
20
24a
24
27
19d
13
19c
19e
8
12
8a
19b
4a
4b
7
7a
11
28
19f
25
26
19g
8b
19a
3
4
5
29
7b
2
19h
(b)
20
24a
19d
24
13
12
27
19e
8a
19c
8
19b
7
7a
4a
4b
11
28
19f
25
26
19g
8b
19a
3
4
5
29
19h
7b
2

Fig. 3

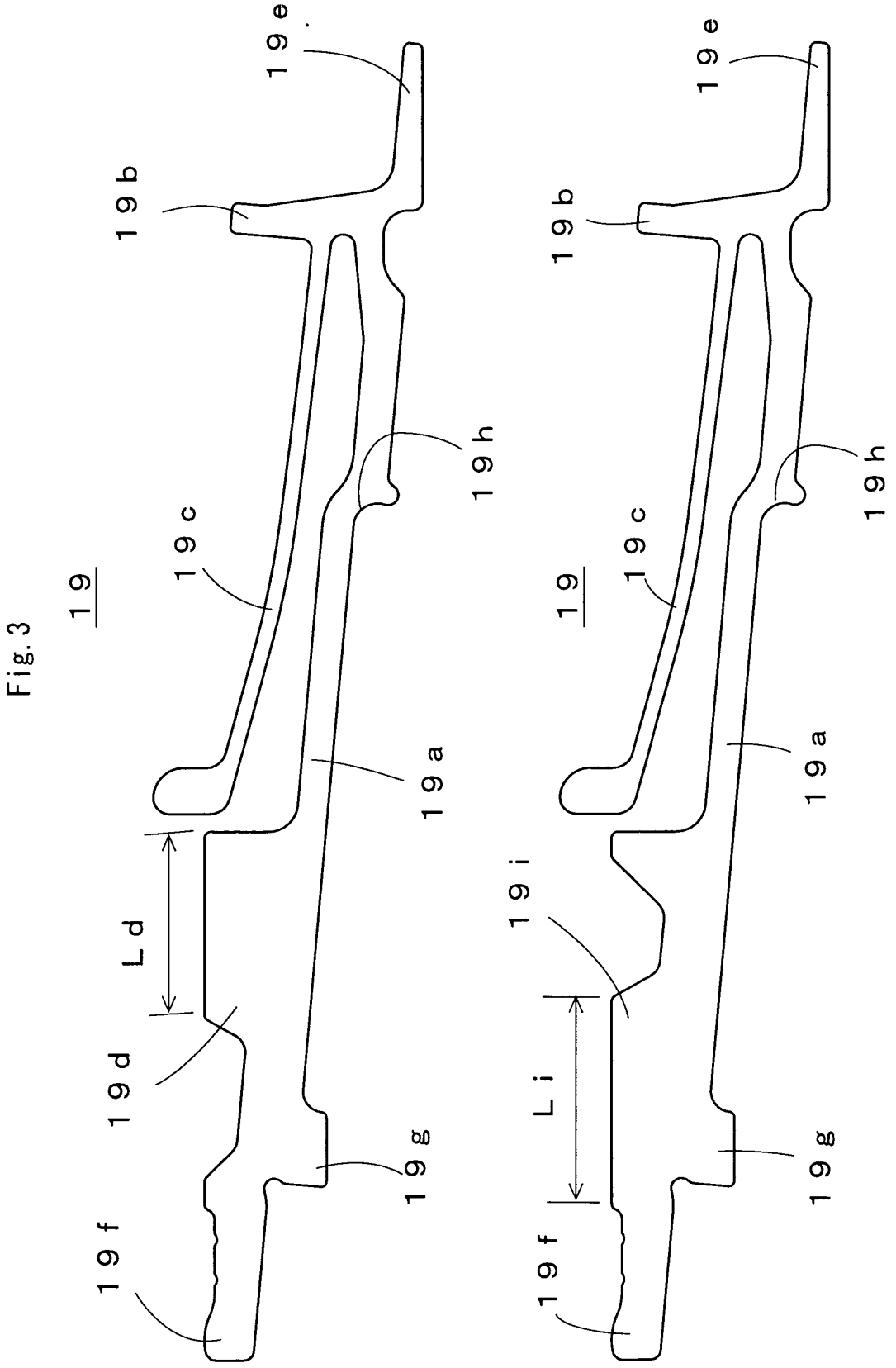

19
19e
19b
19c
19h
19a
Ld
19d
19g
19f
19
19e
19b
19c
19h
19a
19i
Li
19g
19f

Fig. 4

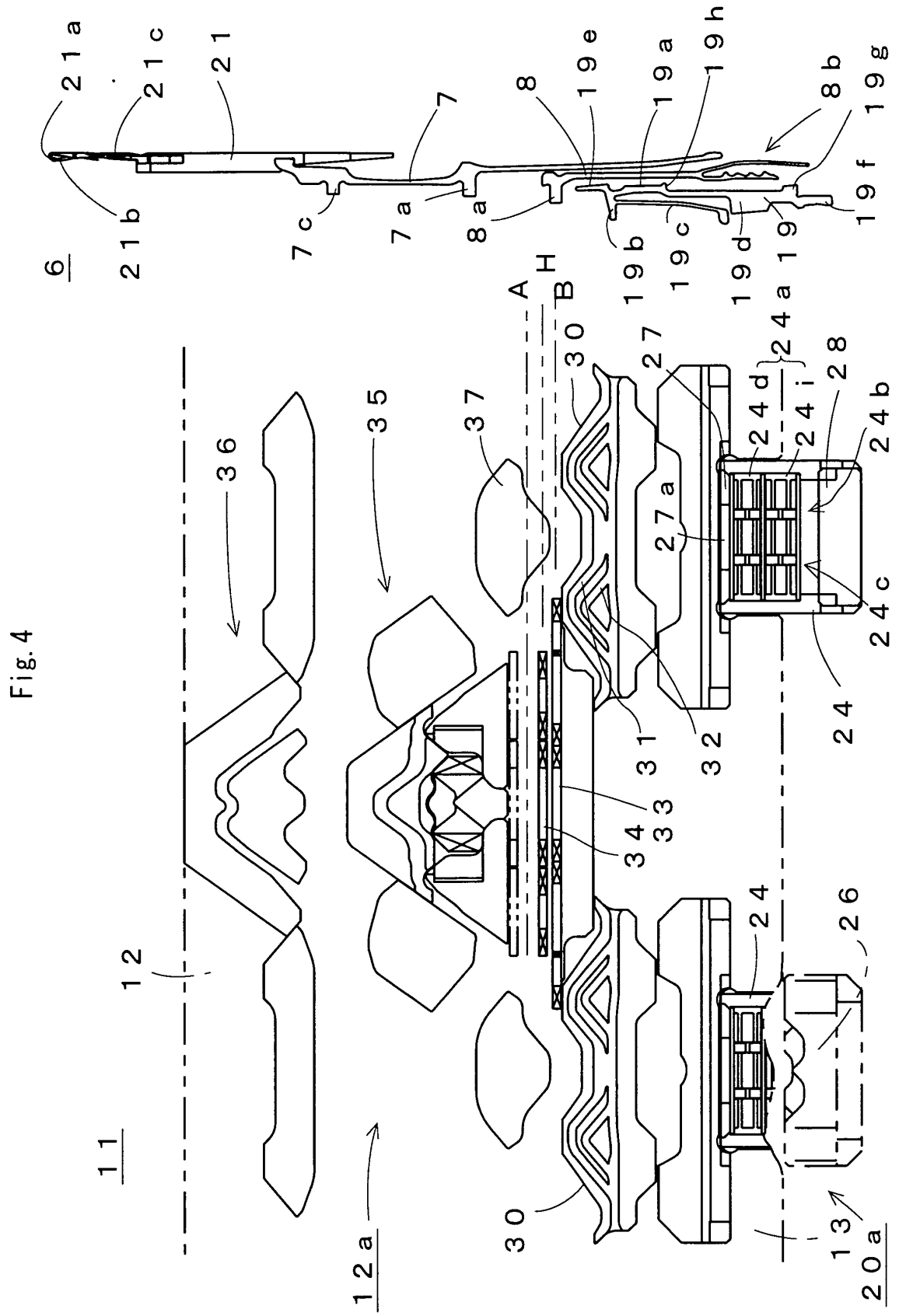

6
21a
21c
21
21b
7
7c
7a
8
8a
19e
19a
19h
8b
19f
19g
19b
19c
19d
19
24a
A
H
B
30
27
24d
24i
28
24b
35
37
36
27a
24c
24
31
32
33
34
12
11
12a
30
24
26
13
20a

Fig.5

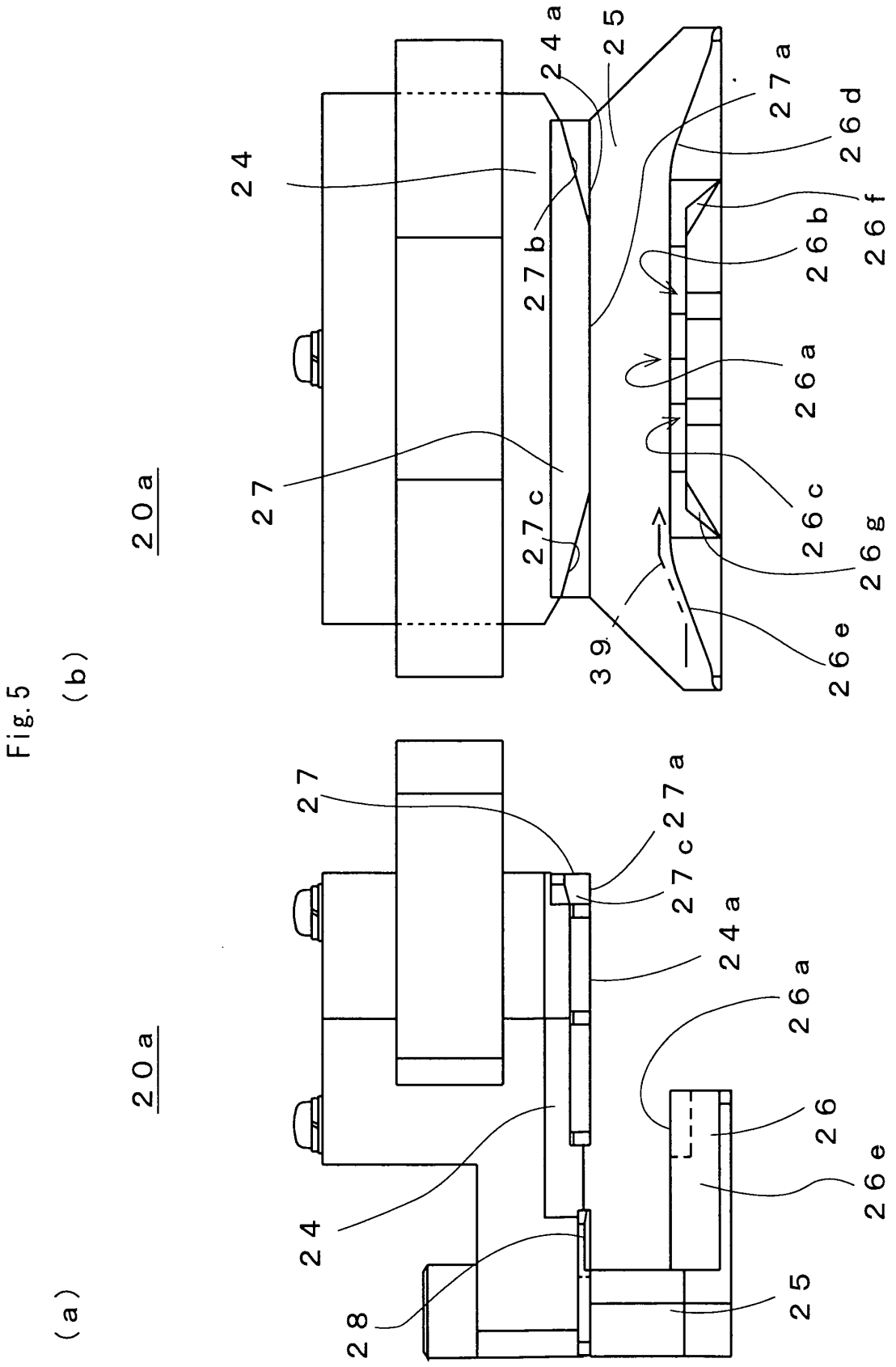

(b)
20a
24
27
24a
25
27a
26d
27b
26f
26b
26a
27c
26c
26g
39
26e
(a)
20a
27
27c
27a
24a
26a
24
26
26e
28
25

Fig. 6

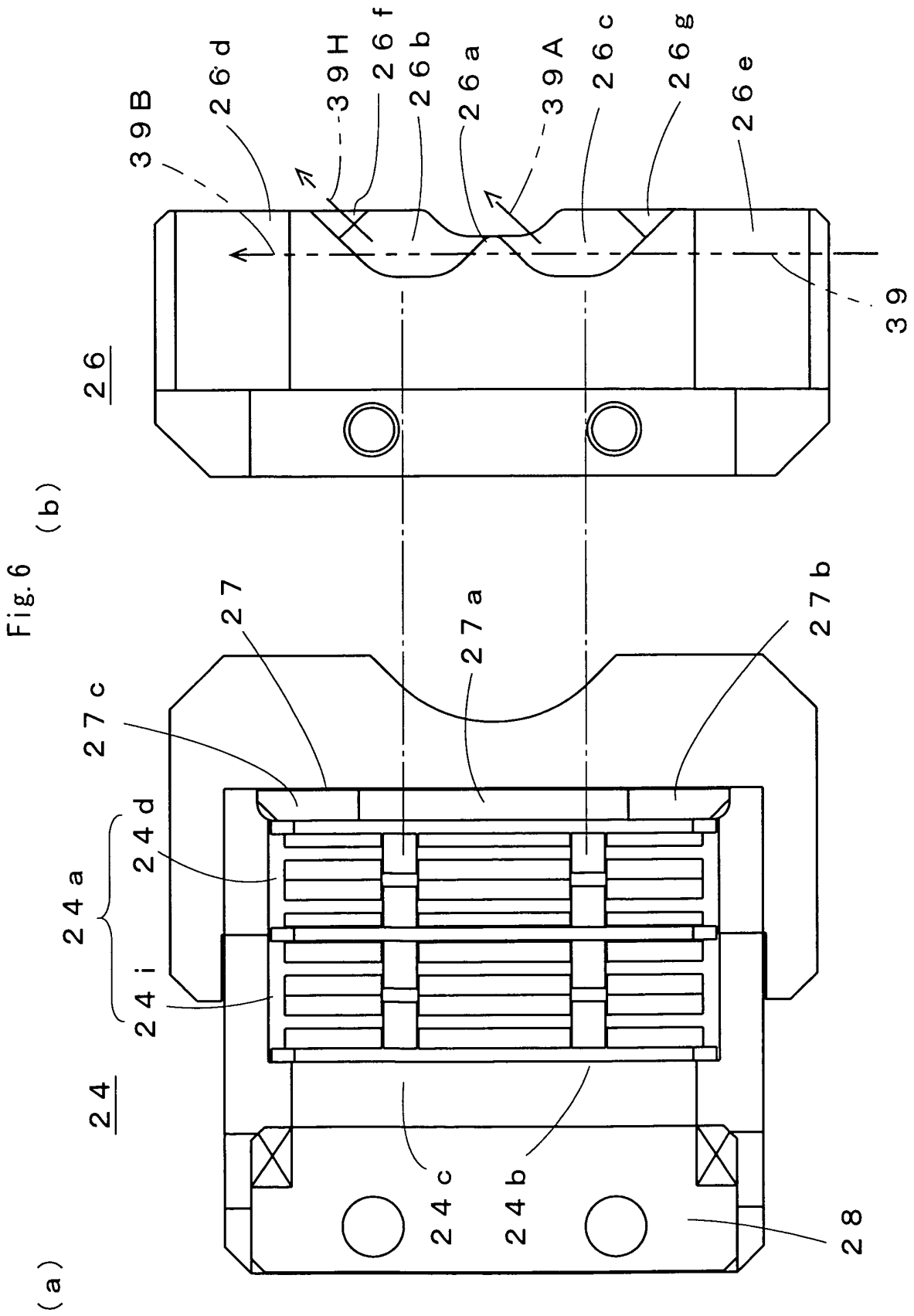

(b)
26
39B
26d
39H
26f
26b
26a
39A
26c
26g
26e
39
(a)
24
27
27a
27b
27c
24a
24d
24i
24c
24b
28

Fig. 7

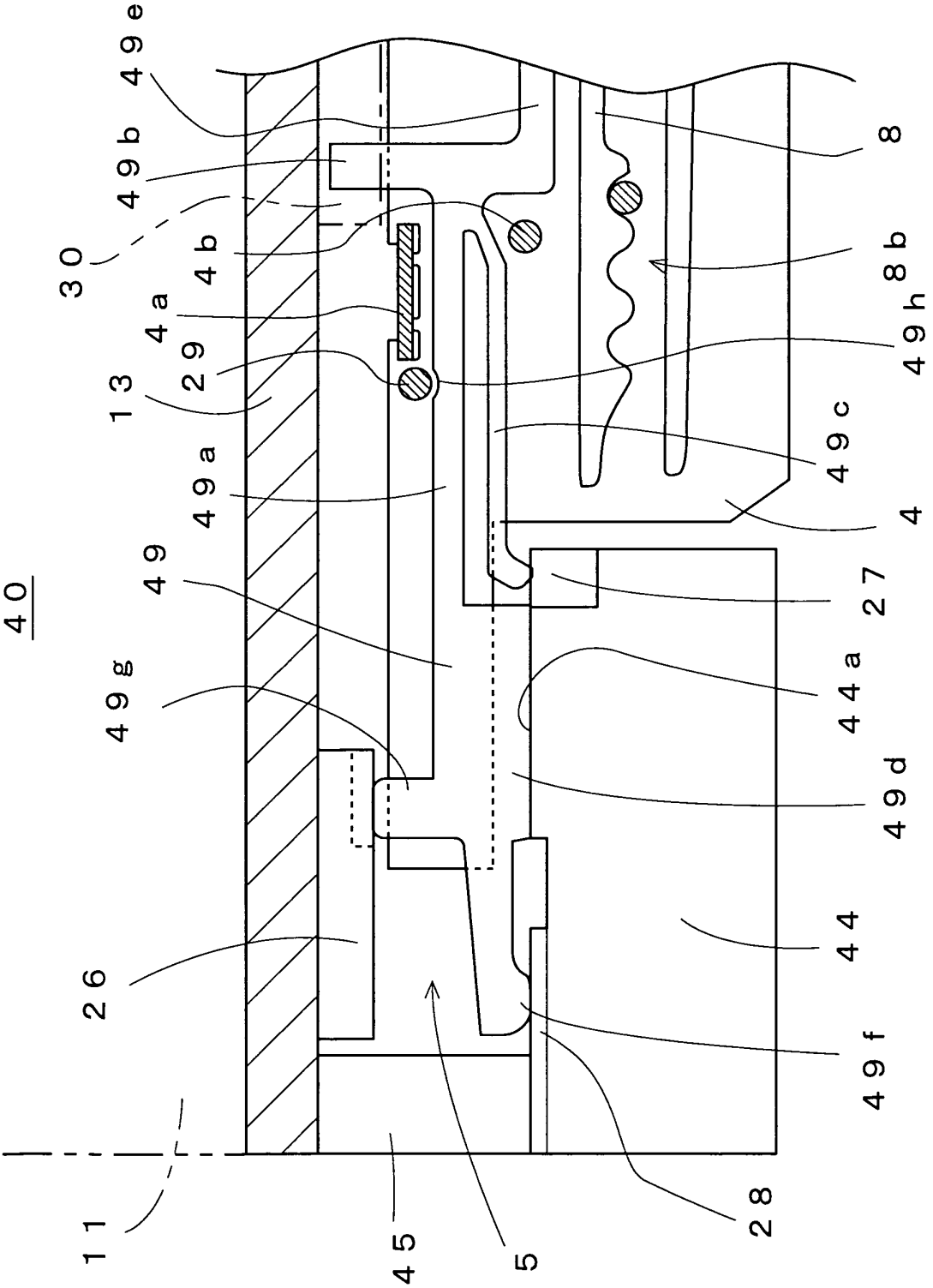
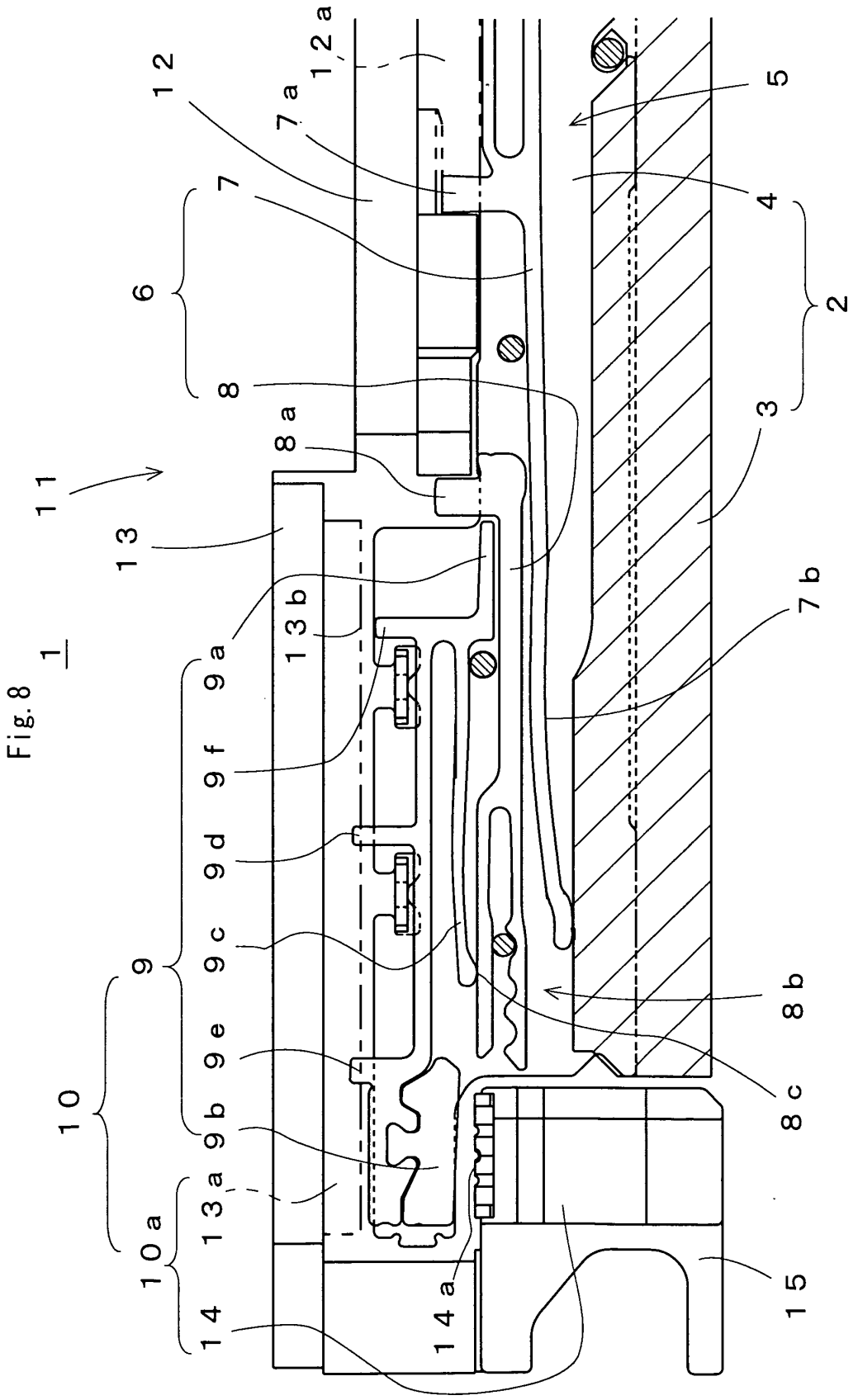

40
49e
49b
30
4b
4a
29
13
49a
49
49g
26
11
45
5
28
49d
44
49f
44a
27
4
49c
8
49h
8b

Fig.8


1
11
13
13b
9a
9f
9d
9c
9e
9b
9
10
10a
13a
14
14a
12
12a
7a
7
6
8
8a
5
4
2
3
7b
8b
8c
15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/005366

A. CLASSIFICATION OF SUBJECT MATTER
D04B15/82(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
D04B15/82

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3459514 B2 (Shima Seiki Mfg., Ltd.), 20 October 2003 (20.10.2003), entire text; all drawings & US 5802878 A & US 5819559 A & US 5694792 A & EP 748887 A1 & EP 1026299 A2 & DE 69612323 T & DE 69623829 T & ES 2178985 T & CN 1138645 A & CN 1313417 A	1-5
A	WO 2004/003275 A1 (Shima Seiki Mfg., Ltd.), 08 January 2004 (08.01.2004), entire text; all drawings & US 2006/0201208 A1 & JP 4016029 B2 & EP 1541734 A1 & CN 1662694 A	1-5

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 October, 2010 (01.10.10)	19 October, 2010 (19.10.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/005366

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 06-220752 A (Shima Seiki Mfg., Ltd.), 09 August 1994 (09.08.1994), entire text; all drawings (Family: none)	1-5
A	JP 47-016869 B1 (Echudo e Bontori S.A.), 18 May 1972 (18.05.1972), entire text; all drawings (Family: none)	1-5

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 3459514 B **[0008]**