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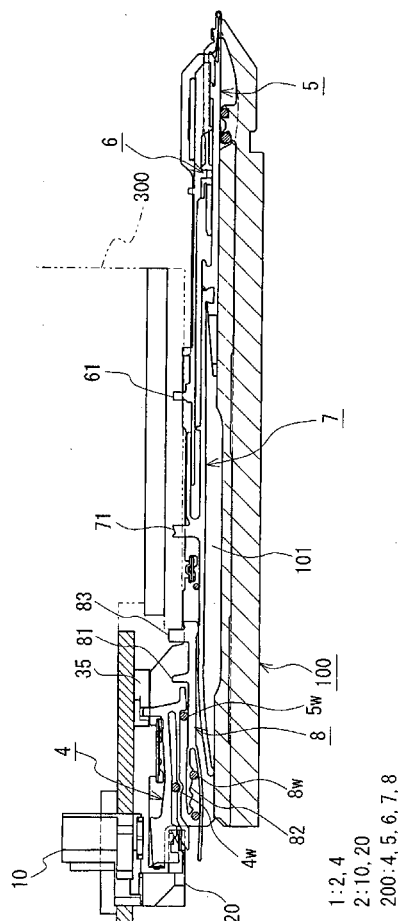
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(54) **Needle selecting system of flat knitting machine, selector, and flat knitting machine**

(57) To provide a needle selecting system of a flat knitting machine capable of stably selecting a needle compared to prior art.

A needle selecting system 1 including a selector 4 configuring one part of a knitting needle 200, and a needle selecting device 2 arranged in a carriage 300 that reciprocates in a longitudinal direction of a needle bed 100 is provided. The selector 4 includes an armature 43 and an elastic leg piece 44 extending towards a tail end side opposite to a needle bed gap side. The needle selecting device 2 includes a needle selecting actuator 10 and an interrupt cam 20. The interrupt cam 20 is arranged bulging out at a position facing the needle selecting actuator 10, and cuts in between the armature 43 and the elastic leg piece 44 of the selector 4 to spread the spacing between the armature 43 and the elastic leg piece 44 when the carriage 300 travels on the needle bed 100. As a result, the selector 4 is supported by the carriage 300 in which the interrupt cam 20 is arranged.

Fig. 4



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a needle selecting system of a flat knitting machine in which a needle selecting mistake is less likely to occur compared to a conventional configuration, a flat knitting machine using the needle selecting system, and a selector configuring a part of the needle selecting system.

Description of the Related Art

[0002] The flat knitting machine includes at least a front and a back needle bed, a knitting needle arranged in each of a great number of needle grooves lined in each of the needle beds, and a carriage that reciprocates along a longitudinal direction of the needle bed (direction orthogonal to an extending direction of the needle groove). A knitting cam is mounted on the carriage, and the knitting cam makes the knitting needle carry out a knitting operation (knit, tuck, miss, transfer of stitches between the front and back needle beds). The type of knitting operation performed by each knitting needle is determined by the selecting result of the knitting needle by the needle selecting system. The needle selecting system adopting an electromagnetic needle selecting method is known (refer to e.g., Patent Document 1).

[0003] Fig. 7 is an explanatory view for describing a needle selecting system of the electromagnetic needle selecting method of the prior art, and shows the vicinity of a selector in a cross-section of a needle bed. In Fig. 7, a carriage 300 reciprocates in a depth direction in the plane of drawing. Upon reciprocating the carriage 300, knitting needles 201 arranged in needle grooves 101 of a needle bed 100 are selected, and the knitting needles 201 are moved in the extending direction (left and right direction in the plane of drawing) of the needle grooves 101 based on the needle selecting result to perform knitting. The needle selecting system of Fig. 7 is configured by a selector 9 arranged in each of the knitting needles 201 and a needle selecting device 2T arranged in the carriage 300.

[0004] The knitting needle 201 includes a needle main body (not shown) with a hook, a needle jack 7 for advancing and withdrawing the needle main body in the extending direction of the needle groove 101, a select jack 8 for controlling whether or not to advance or withdraw the needle jack 7, and the selector 9 for changing the position of the select jack 8 in the extending direction of the needle groove 101. The operational state of the knitting cam 30 with respect to a knitting butt 71 arranged in the needle jack 7 and a driving butt (not shown) arranged in a slider changes according to the position of the select jack 8 and consequently the knitting operation of the knitting needle 201 changes.

[0005] The select jack 8 may take the following three positions (B, H, A) in the extending direction of the needle groove 101 (may take two positions depending on the flat knitting machine). For example, the position B corresponds to miss knitting. The position H is a position on a needle bed gap side (right side in the plane of drawing) of the position B, and corresponds to tuck knitting or transfer. The position A is a position on the needle bed gap side of the position H, and corresponds to knit knitting or transfer. Such positions are maintained by a position holding section 82 divided into two on a tail end side (side opposite to the needle bed gap side) of the select jack 8. The position holding section 82 is formed with three recesses, where the select jack 8 is positioned when a wire 8w extending in the longitudinal direction (depth direction in the plane of drawing) of the needle bed 100 is engaged with each recess.

[0006] The selector 9 for changing the position of the select jack 8 includes a base body 91, a distal end 92 arranged on the needle bed gap side of the base body 91, an armature 93 arranged on the tail end side of the base body 91, and an elastic leg piece 94 extending towards the tail end side from the base body 91. A raising butt 95 is arranged on an upper end side of the armature 93 (surface side of the needle bed 100 on the upper side in the plane of drawing), and a lowering butt 96 is arranged on an upper end side of the base body 91. The selector 9 moves towards the needle bed gap side when a needle selecting cam 39, to be described later, acts on the raising butt 95, thus pushing a butt 81 of the select jack 8 towards the needle bed gap side with the distal end 92, and moving the select jack 8 from the position B to the position H or the position A. Thereafter, the selector 9 is promptly returned to the position B to prepare for the next needle selection. The selector 9 is always at the position B, and the raising butt 95 of the selector 9 is in a state of projecting out from the needle groove 101.

[0007] The needle selecting device 2T includes the needle selecting cam 39 facing each of the butts 95, 96 of the selector 9, and a needle selecting actuator 10 facing a lower end face (to-be-adsorbed end face 93s) of the armature 93 of the selector 9. The needle selecting actuator 10 includes an adsorbing surface 10s where a permanent magnet is exposed, so that the armature 93 (to-be-absorbed end face 93s) of the selector 9 can be adsorbed to the adsorbing surface 10s. The adsorbing surface 10s is set with two separation regions in a width direction (depth direction in the plane of drawing) thereof, where in the separation regions, the magnetic force of the permanent magnet is weakened by the action of the electromagnetic force generated when current is flowed to the needle selecting actuator 10.

[0008] If knitting is carried out with the flat knitting machine having the above configuration, when the carriage travels on the needle bed 100 so that the needle selecting actuator 10 approaches the selector 9, the adsorbing surface 10s of the needle selecting actuator 10 adsorbs the armature 93 of the selector 9 (state before adsorption is

shown in Fig. 7) and sinks the raising butt 95 into the needle groove 101. This state is a so-called non-needle selecting state. The needle selecting cam 39 cannot act on the raising butt 95 unless the current is flowed to the needle selecting actuator 10, and the selector 9 is maintained at the position B without being moved to the needle bed gap side.

[0009] When the carriage travels with the armature 93 of the selector 9 adsorbed and the armature 93 approaches the separation regions of the adsorbing surface 10s, the armature 93 separates from the adsorbing surface 10s when current is flowed to the needle selecting actuator 10. The raising butt 95 then emerges from the needle groove 101 by an elastic force of the elastic leg piece 94 that abuts the upper end face of the position holding section 82 of the select jack 8, and a needle selecting state in which the needle selecting cam 39 can act on the raising butt 95 is realized. When the needle selecting cam 39 acts on the raising butt 95 of the selector 9, the selector 9 moves towards the needle bed gap side and the distal end 92 of the selector 9 pushes out the raising butt 81 of the select jack 8 towards the needle bed gap side thus changing the position of the select jack 8. The position of the selector 9 (select jack 8) is changed depending on in which of the two separation regions to separate the armature 93 from the adsorbing surface 10s.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0010]

[Patent Document 1] Japanese Patent No. 3459514

SUMMARY OF THE INVENTION

[0011] In recent years, further enhancement in the knitting efficiency of the flat knitting machine is desired, and review of the existing needle selecting system is being considered.

[0012] In a needle selecting device of Fig. 7, when the knitting speed is increased, the adsorption and separation of the armature 93 with respect to the adsorbing surface 10s become unstable thus causing needle selecting mistake due to slight fluctuation in the spacing of the carriage 300 and the needle bed 100 involved in the travelling of the carriage 300. This is because when the armature 93 of the selector 9 is adsorbed to the adsorbing surface 10s, the selector 9 is supported by both the needle bed 100 and the carriage 300. A spring supporting point 94b for generating the elastic force of the elastic leg piece 94 is positioned on the upper surface of the position holding section 82 of the select jack 8 on which the elastic leg piece 94 of the selector 9 abuts, where the elastic force of the elastic leg piece 94 that acts in the direction of emerging the armature 93 from the needle groove 101 fluctuates little at a time with the travelling of

the carriage 300 thus causing the adsorption and separation to become unstable.

[0013] In the illustrated configuration, a large moment tends to easily generate around the spring supporting point 94b since the position of the spring supporting point 94b and the position of the to-be-adsorbed end face 93s of the armature 93 are shifted against each other in the longitudinal direction of the needle groove 101. This is also a factor that the adsorption and separation of the armature 93 with respect to the adsorbing surface 10s do not stabilize.

[0014] In addition, when the flat knitting machine is fine gauged, the width of the armature 93 of the selector 9 becomes narrow, and the area of the to-be-adsorbed surface 93s becomes small. In this case as well, the adsorption and separation of the armature 93 with respect to the adsorbing surface 10s become unstable.

[0015] The present invention has been made in view of the above situations, and an object thereof is to provide a needle selecting system of a flat knitting machine capable of stably selecting a needle compared to the prior art, and a selector used in the needle selecting system. Another object of the present invention is to provide a flat knitting machine to which the needle selecting system of the flat knitting machine is applied.

[0016] A needle selecting system of a flat knitting machine according to the present invention includes a selector configuring one part of a knitting needle arranged in each of a plurality of needle grooves lined in a longitudinal direction of a needle bed of the flat knitting machine; and a needle selecting device, arranged in a carriage that reciprocates in the longitudinal direction of the needle bed, for changing a knitting operation to be carried out by the knitting needle by changing a position of the selector along an extending direction of the needle groove. The needle selecting device includes a needle selecting actuator for selecting the knitting needle by changing the position of the selector in a depth direction of the needle groove depending on whether to have one part of the selector remained adsorbed to an adsorbing surface for adsorbing one part of the selector by a magnetic force or separated from the adsorbing surface. The selector of the needle selecting system of the present invention includes a base body, a distal end arranged on a needle bed gap side of the needle bed in the base body, an armature arranged on a tail end side, which is opposite to the needle bed gap side, of the base body and arranged facing the adsorbing surface of the needle selecting actuator, and an elastic leg piece connected to the distal end and extended towards the tail end side. The needle selecting device of the needle selecting system of the present invention includes, in addition to the needle selecting actuator, an interrupt cam, arranged bulging out at a position facing the needle selecting actuator, for cutting in between the armature and the elastic leg piece of the selector to spread the spacing between the armature and the elastic leg piece, and making the armature adsorbed to the adsorbing surface of the needle selecting

actuator when the carriage travels on the needle bed. In the needle selecting system of the flat knitting machine of the present invention having the above configuration, while the interrupt cam passes through the selector, the elastic leg piece of the selector comes into abutment with the interrupt cam so that the selector is supported by the interrupt cam by the abutment.

[0017] According to one aspect of the needle selecting system of the flat knitting machine of the present invention, an abutting portion arranged on the elastic leg piece of the selector is preferably arranged in a forming range of the armature in the extending direction of the needle groove. The abutting portion is a portion that abuts the interrupt cam in the elastic leg piece of the selector and that becomes a spring supporting point for generating an elastic force for energizing the armature in a direction of approaching the elastic leg piece.

[0018] According to another aspect of the needle selecting system of the flat knitting machine of the present invention, the needle selecting actuator is preferably arranged in the carriage to face the armature of the selector from an upper surface side of the needle bed.

[0019] According to still another aspect of the needle selecting system of the flat knitting machine of the present invention, a raising butt is preferably formed on a side opposite to the to-be-adsorbed end face to be adsorbed to the needle selecting actuator in the armature of the selector; and guides for acting on the raising butt and advancing the selector towards the needle bed gap are preferably formed in the interrupt cam.

[0020] A selector of the present invention is a member configuring one part of a knitting needle arranged in each needle groove lined in a longitudinal direction of a needle bed of a flat knitting machine, and is a member for determining a knitting operation to be performed by the knitting needle by a position along an extending direction of the needle groove. The selector of the present invention includes a base body; a distal end arranged at one end side in a longitudinal direction of the base body; an armature arranged on the other end side in the longitudinal direction of the base body; and an elastic leg piece connected to the distal end and extended towards the other end side. The elastic leg piece of the selector includes an abutting portion, which abuts a member fixed to a carriage of the flat knitting machine when the member is interposed between the armature and the elastic leg piece, and which acts as a spring supporting point for generating an elastic force for energizing the armature in a direction of approaching the elastic leg piece.

[0021] A flat knitting machine of the present invention is a flat knitting machine including at least a front and a back needle bed, for performing knitting by a knitting needle arranged in each of a plurality of needle grooves lined in the needle beds; the flat knitting machine including the needle selecting system of the flat knitting machine of the present invention.

[0022] According to the needle selecting system of the flat knitting machine and the flat knitting machine of the

present invention, the adsorption and separation of the armature of the selector with respect to the adsorbing surface of the needle selecting actuator can be stabilized than the conventional configuration. This is because, the influence of the microscopic fluctuation between the carriage and the needle bed can be reduced as the selector is supported on the carriage side by the interrupt cam arranged in the carriage.

[0023] In the needle selecting system of the flat knitting machine and the flat knitting machine of the present invention, the adsorption and separation of the armature with respect to the adsorbing surface of the needle selecting actuator can be stabilized by arranging the spring supporting point (abutting portion) of the elastic leg piece within the forming range of the armature in the longitudinal direction of the selector. This is because the moment around the spring supporting point is less likely to act on the armature as the spring supporting point is immediately below the armature.

[0024] In the needle selecting system of the flat knitting machine and the flat knitting machine of the present invention, the needle selecting system can be miniaturized by having the needle selecting actuator face the armature from the upper surface side of the needle bed. This is because the carriage mounted with the needle selecting actuator is arranged on the upper surface side of the needle bed.

[0025] In the needle selecting system of the flat knitting machine and the flat knitting machine of the present invention, the interrupt cam may also play the role of the needle selecting cam for changing the position of the selector by arranging a guide for guiding the raising butt of the selector in the interrupt cam.

[0026] According to the selector of the present invention, the needle selecting system of the flat knitting machine of the present invention can be configured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

Fig. 1 is a schematic explanatory view showing a correspondence relationship of a knitting needle, a knitting cam, and a needle selecting device in a flat knitting machine described in an embodiment;

Fig. 2 is a schematic view of a selector arranged in the knitting needle of the flat knitting machine described in the embodiment;

Fig. 3A is a front view of a needle selecting device, Fig. 3B is a left side view of the needle selecting device, Fig. 3C is a bottom view of a needle selecting actuator, and Fig. 3D is a top view of an interrupt cam; Fig. 4 is a schematic view showing a position relationship of the knitting needle arranged in the needle bed and the needle selecting system;

Figs. 5A and 5B are partially enlarged views of the vicinity of the selector in Fig. 4, where Fig. 5A is a view showing a state in which an armature of the

selector is adsorbed to the adsorbing surface of the needle selecting actuator, and Fig. 5B is a view showing a state in which the armature is separated from the adsorbing surface;

Fig. 6 is a partially enlarged view of the vicinity of the selector in Fig. 4 showing a state in which the selector is advanced to the position A; and

Fig. 7 is an explanatory view describing the needle selecting system of the electromagnetic needle selecting method of the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] A flat knitting machine to which a needle selecting system of the flat knitting machine of the present invention is applied will be hereinafter described with reference to the drawings.

<Overall configuration>

[0029] The flat knitting machine of the present embodiment is a machine including a front and a back needle bed, a plurality of knitting needles lined in each of the needle beds, and a carriage that reciprocates on the needle beds, where a knitted fabric is knitted by operating each of the knitting needles with a knitting cam mounted on the carriage. The characteristic of the flat knitting machine described in the present embodiment lies in the needle selecting system for changing the knitting operation of the knitting needle. The needle selecting system includes a needle selecting device with a needle selecting actuator and an interrupt cam, and a selector configuring one part of the knitting needle, as will be described later, both of which have configurations different from the prior art. First, the knitting operation of the flat knitting machine of the present embodiment will be briefly described with reference to Fig. 1, and then the needle selecting system for changing the knitting operation to be carried out by the knitting needles will be described in detail with reference to Figs. 2 to 6.

[0030] A knitting needle 200 of the present embodiment shown in Fig. 1 is a compound needle including a needle main body 5, a slider 6, a needle jack 7, a select jack 8, and a selector 4. The needle main body 5 includes a hook for holding a knitting yarn. The slider 6 opens and closes the hook of the needle main body 5. The needle jack 7 advances and withdraws the needle main body 5 in the extending direction (up and down direction in plane of drawing) of a needle groove. The select jack 8 controls whether or not to advance or withdraw the needle jack 7 according to its own position in the extending direction of the needle groove. The selector 4 changes the position of the select jack 8 in the extending direction of the needle groove (selector 4 configuring the needle selecting system 1 will be described later). A singular or a plurality of butts are arranged on the members 6, 7, 8, 4. When a knitting cam 30 to be described next, or a needle selecting

device 2 to be described later acts on the butts, the members 6, 7, 8, 4 advance and withdraw in the extending direction of the needle groove. The knitting needle used in the flat knitting machine of the present embodiment may be a latch needle.

[0031] The knitting cam 30 including a plurality of cams 31 to 36 is attached to the carriage 300 of the flat knitting machine, which knitting cam 30 acts on each butt of the knitting needle 200 to perform the knitting operation. The knitting cam 30 may, of course, be mounted in plural number on the carriage 300. In Fig. 1, a slider guide cam that acts on a driving butt 61 of the slider 6 is omitted, and a direction of the knitting needle 200 is shown in a state different from the actual direction.

[0032] The knitting operation of the knitting needle 200 will be described based on the paths of the butts 71, 83, 45, 46 arranged in the knitting needle 200 (see the dashed lines). The path of each of the butt 71, 83, 45, 46 is divided into three, which are paths at position B, position H, and position A in order from the lower side in the plane of drawing.

[0033] Firstly, if the selector 4 is maintained at the position B by the needle selecting device 2, to be described later, when the carriage 300 travels, a pushing butt 83 of the select jack 8 is sunk into the needle groove by a fixing presser 33, and accompanied therewith, a knitting butt 71 of the needle jack 7 is also sunk into the needle groove. In this case, the knitting butt 71 is not subjected to the effect of the needle raising cam 31, and does not move towards the needle bed gap side (upward direction in the plane of drawing) in the extending direction of the needle groove. As a result, the knitting operation becomes miss knitting.

[0034] Secondly, if the selector 4 is moved to the position H by the needle selecting device 2 to be described later, the select jack 8 also reaches the position H. In this case, the knitting butt 71 moves towards the needle bed gap side upon receiving the effect of the needle raising cam 31. A movable presser 34 is arranged at a position overlapping the path of the pushing butt 83 at the position H. Thus, the pushing butt 83 is sunk into the needle groove by the movable presser 34, and accompanied therewith, the knitting butt 71 is also sunk into the needle groove, and the knitting butt 71 passes through a projection at an intermediate portion of the needle raising cam 31 on a lower side in the plane of drawing without receiving the effect of the projection. Thereafter, the knitting butt 71 is pulled down to the side opposite to the needle bed gap by a stitch cam 32 on the left side in the plane of drawing. As a result, the knitting operation becomes tuck knitting. The pushing butt 83 at the position H is lowered to the position B by a select jack lowering cam 36 on the left side in the plane of drawing, and the lowering butt 46 at the position H is pulled down to the position B by a selector lowering cam 35 on the right side in the plane of drawing.

[0035] Thirdly, if the selector 4 is moved to the position A by the needle selecting device 2 to be described later,

the pushing butt 83 also reaches the position A. In this case, the knitting butt 71 is pushed up towards the needle bed gap side upon receiving the effect of the needle raising cam 31, and thereafter, lowered to the side opposite to the needle bed gap upon receiving the effect of the stitch cam 32. As a result, the knitting operation becomes knit knitting. The pushing butt 83 and the lowering butt 46 at the position A are pulled down to the position B by the cams 36, 35, respectively.

<Needle selecting system>

[0036] As described above, the position of the selector 4 of the knitting needle 200 determines the knitting operation of the knitting needle 200. The selector 4 and the needle selecting device 2 for changing the position of the selector 4 configure the needle selecting system 1 of the present embodiment.

[0037] <<Selector>>

As shown in Figs. 2 and 4, the selector 4 is a plate-like member having a hairpin-like shape, and includes a base body 41, a distal end 42, an armature 43, an elastic leg piece 44, the raising butt 45, and the lowering butt 46.

[0038] The base body 41 is a rod-shaped portion that extends along a longitudinal direction of the needle groove 101 when the selector 4 is arranged in the needle groove 101.

[0039] The distal end 42 is a substantially L-shaped portion arranged on the needle bed gap side of the needle bed 100 when the selector 4 is arranged in the needle groove 101, and is the portion that pushes out the raising butt 81 of the select jack 8 from the tail end side to the needle bed gap side. The lowering butt 46 that projects out towards the upper side of the needle bed 100 is formed at the distal end 42. The lowering butt 46 always projects out from the needle groove 101 regardless of the position of the selector 4, and is the portion on which the selector lowering cam 35 acts, as already described with reference to Fig. 1.

[0040] The armature 43 is the plate-like portion arranged on the side (tail end side) opposite to the needle bed gap when the selector 4 is arranged in the needle groove 101. An upper end face of the armature 43 is a to-be-adsorbed end face 43s to be adsorbed to an adsorbing surface 10s of the needle selecting actuator 10 to be described later. The raising butt 45 is arranged to project out towards the bottom portion (lower side of needle bed 100) of the needle groove 101 from the lower end face of the armature 43. The raising butt 45 is the portion to be subjected to the effect of the interrupt cam 20 to be described later.

[0041] The elastic leg piece 44 is the rod-shaped portion having one end connecting to the distal end 42 and the other end being the free end, and is in parallel with the base body 41 with spacing in between. The other end of the elastic leg piece 44 is extended to the position facing the armature 43 in the longitudinal direction of the selector 4 (i.e., extending direction of needle groove 101).

An abutting portion 44b that abuts the interrupt cam 20, to be described later, is arranged on the side facing the armature 43 of the other end of the elastic leg piece 44. The abutting portion 44b becomes a spring supporting point for generating an elastic force for energizing the armature 43 towards the bottom portion of the needle groove 101. An engagement portion 44h bent to a semicircular arc shape is formed at an intermediate portion of the elastic leg piece 44. As shown in Fig. 4, the engagement portion 44h engages a wire 4w extending in the longitudinal direction of the needle bed 100 to position the selector 4 in the needle groove 101 when the selector 4 is arranged in the needle groove 101.

15 <<Needle selecting device>>

[0042] As shown in Figs. 3A and 3B, the needle selecting device 2 includes the needle selecting actuator 10 and the interrupt cam 20. The basic configuration of the needle selecting actuator 10 is the same as in the prior art other than that an engagement portion for attaching the interrupt cam 20 is arranged. Specifically, the needle selecting actuator 10 includes an adsorbing surface 10s for adsorbing the armature 43 of the selector 4, which surface having a plurality of permanent magnets 11 exposed (see particularly Fig. 3C). The adsorbing surface 10s includes separation regions 12a, 12b between the permanent magnets 11, 11 lined in the width direction (same as travelling direction of the carriage) of the needle selecting actuator 10. When current is flowed to an electromagnetic coil built in the needle selecting actuator 10, the magnetic force in the separation regions 12a, 12b tends to weaken.

[0043] As shown in Fig. 4, the needle selecting actuator 10 is arranged in the carriage 300 such that the adsorbing surface 10s faces the upper surface of the needle bed 100. Thus, if the carriage 300 travels in the depth direction in the plane of drawing to bring the needle selecting actuator 10 close to the selector 4, the adsorbing surface 10s faces the to-be-adsorbed end face 43s, which is the upper end face of the armature 43 of the selector 4 (Fig. 2). The needle selecting device 2 in Fig. 4 is on the far side in the plane of drawing of the knitting needle 200.

[0044] As shown in Figs. 3A, 3B, and 3D, the interrupt cam 20 configuring the needle selecting device 2 is a member that is attached to the needle selecting actuator 10 and that bulges out at the position facing the needle selecting actuator 10. The role of the interrupt cam 20 is to cut in between the armature 43 and the elastic leg piece 44 of the selector 4 to spread the spacing between the armature 43 and the elastic leg piece 44 so that the armature 43 can be adsorbed to the adsorbing surface 10s of the actuator 10 (see Figs. 5A and 5B and refer to the description thereof given hereinafter). The interrupt cam 20 also has a role of supporting the abutting portion 44b of the elastic leg piece 44 arranged in the selector 4 so that the selector 4 is not supported by the needle bed

100 (see Figs. 5A and 5B and refer to the description thereof given hereinafter). Furthermore, the interrupt cam 20 of the present embodiment also has a role of the needle selecting cam 39 of the conventional configuration shown in Fig. 7.

[0045] An inclined surface 21, an upper level surface 22, a middle level surface 23, and a lower level surface 24 are formed on the side facing the adsorbing surface 10s of the needle selecting actuator 10 in the interrupt cam 20. The inclined surface 21 of the interrupt cam 20 rises from the end in the width direction of the interrupt cam 20 towards the intermediate portion to connect to the upper level surface 22. The upper level surface 22 is a flat surface having an M-like shape. The middle level surface 23 is a substantially M-shaped flat surface that bends towards the tail end side (upper side in the plane of drawing in Fig. 3D) from the end in the width direction of the interrupt cam 20 towards the intermediate portion. The lower level surface 24 is a substantially hill-shaped flat surface. A wall portion 20b is formed at between the middle level surface 23 and the lower level surface 24 other than the step difference formed by the difference in height of the middle level surface 23 and the lower level surface 24. The wall portion 20b is formed only to right before the intermediate portion in the width direction of the interrupt cam 20, so that a route falling from the middle level surface 23 to the lower level surface 24 is formed. The height of the wall portion 20b is substantially equal to the height of the upper level surface 22 (see Figs. 3A and 3B).

[0046] As described above, a plurality of surfaces 21 to 24 having different height is formed on the upper surface of the interrupt cam 20. Three guide routes B, H, A (indicated by a chain double dashed line and an enclosed alphabet in Fig. 3D) for guiding the raising butt 45 of the selector 4 are formed by the step difference among the surfaces 21 to 24. Each of the guide routes B, H, A corresponds to the positions B, H, A of the selector 4, respectively. That is, the interrupt cam 20 of the present embodiment also serves as the needle selecting cam for pushing up the raising butt 45 of the selector 4 towards the needle bed gap.

[0047] How the knitting needle 200 is selected by the needle selecting system 1 having the configuration described above will now be specifically described.

[0048] First, when the carriage 300 travels and the needle selecting device 2 approaches the knitting needle 200 from the state of Fig. 4, the end in the width direction of the interrupt cam 20 of the needle selecting device 2 cuts in between the armature 43 and the elastic leg piece 44 of the selector 4 (Fig. 2). When the carriage 300 goes further, as shown in Fig. 5A, the inclined surface 21 of the interrupt cam 20 abuts the raising butt 45 at the lower end of the armature 43 and the lower end face 29 of the interrupt cam 20 (Fig. 3B) abuts the abutting portion 44b at the upper end face of the elastic leg piece 44, thus pushing open the space between the armature 43 and the elastic leg piece 44. The raising butt 45 then reaches

the upper level surface 22 of the interrupt cam 20, and the armature 43 is adsorbed to the adsorbing surface 10s of the needle selecting actuator 10. In this case, the elastic leg piece 44 of the selector 4 abuts the interrupt cam 20 at the position of the abutting portion 44b and the selector 4 is supported by the carriage 300, so that even if the spacing between the needle bed 100 and the carriage 300 is slightly fluctuated with the travelling of the carriage 300, the adsorption of the selector 4 by the adsorbing surface 10s is less likely to be influenced by such fluctuation. In this case, the selector 4 is preferably completely separated from the wires 4w, 5w, so that the selector 4 is not supported by the needle bed 100. The raising butt 45 and the upper level surface 22 are slightly separated.

[0049] Even in a state the selector 4 is not supported by the needle bed 100, the moment may act on the to-be-adsorbed end face 43s of the armature 43 by the vibration of the carriage 300 involved in the travelling of the carriage 300, and the armature 43 of the selector 4 may separate from the adsorbing surface 10s. In the present embodiment, on the other hand, the abutting portion 44b, which abuts the interrupt cam 20, of the elastic leg piece 44 becomes the spring supporting point for energizing the armature 43 towards the needle groove 101, and furthermore, the spring supporting point (abutting portion 44b) is at a position overlapping the forming range of the to-be-adsorbed end face 43s of the armature 43 in the extending direction of the needle groove 101 so that the moment having the spring supporting point 44b as the center is less likely to be generated. Thus, a force of a considerable extent needs to be acted to separate the armature 43 from the adsorbing surface 10s without using the electromagnetic force of the needle selecting actuator 10, where the armature 43 barely separates from the adsorbing surface 10s at the extent of the vibration of the carriage 300 involved in the travelling of the carriage 300.

[0050] As described above, if the armature 43 is remained adsorbed to the adsorbing surface 10s without being separated, the raising butt 45 moves on a guide route B shown in Fig. 3D in a state of being separated from the upper level surface 22 of the interrupt cam 20 and is not subjected to the action of the interrupt cam 20. As a result, the selector 4 maintains the position B without being moved in the extending direction of the needle groove 101. In this case, the knitting operation of the knitting needle 200 is the miss knitting.

[0051] If the armature 43 is separated in the first separation region 12a of the needle selecting actuator 10 shown in Fig. 3D, the raising butt 45 moves on a guide route A. Specifically, as shown in Fig. 5B, the raising butt 45 separated in the separation region 12a is energized towards the bottom of the needle groove 101 by the elastic force of the elastic leg piece 44 supported at the lower end face 29 of the interrupt cam 20 and is dropped to the position of the middle level surface 23 of the interrupt cam 20. When the carriage 300 further travels, as shown

in Fig. 3D, the raising butt 45 is pushed towards the needle bed gap along a guide g1 formed by the step difference of the upper level surface 22 and the middle level surface 23 and is dropped to the lower level surface 24. The raising butt 45 dropped to the lower level surface 24 is further pushed towards the needle bed gap along a guide g2 formed by the step difference of the middle level surface 23 and the lower level surface 24, and as a result, the selector 4 is at the position A as shown in Fig. 6. Since the wall portion 20b is formed between the lower level surface 24 and the middle level surface 23, the raising butt 45 does not go over the guide g2 onto a guide route H by the vibration of the carriage 300, and the like.

[0052] As shown in Fig. 3D, when the armature 43 passes through the first separation region 12a of the needle selecting actuator 10 and separated in the second separation region 12b, the raising butt 45 moves along the guide route H. Specifically, the raising butt 45 is dropped to the middle level surface 23 on the right side in the plane of drawing of the interrupt cam 20, and pushed towards the needle bed gap along a guide g3 formed by the step difference of the upper level surface 22 and the middle level surface 23. As a result, the selector 4 is at the position H. The raising butt 45 does not move too much towards the needle bed gap and go on the guide route A due to the wall portion 20b arranged in the interrupt cam 20.

[0053] Unlike the embodiment described above, the present invention may have a configuration in which the needle selecting actuator 10 approaches the selector 4 from the bottom surface side of the needle bed 100 and sinks the selector 4 in the needle groove 101 to be in the non-needle selecting state. In this case, the interrupt cam 20 is preferably arranged on the upper surface side of the needle bed 100 of the adsorbing surface 10s of the needle selecting actuator 10. The abutting portion 44b, to which the interrupt cam 20 is abutted, of the selector 4 may be positioned outside the forming range of the to-be-adsorbed end face 43s of the armature 43 in the extending direction of the needle groove 101. In addition, while the interrupt cam 20 of the present embodiment also serves as a needle selecting cam for changing the position of the selector 4 by including the guides g1 to g3, it may be an interrupt cam that does not have the role of the needle selecting cam. In this case, the needle selecting cam needs to be separately prepared.

Claims

1. A needle selecting system (1) of a flat knitting machine comprising:

a selector (4) configuring one part of a knitting needle (200) arranged in each of a plurality of needle grooves (101) lined in a longitudinal direction of a needle bed (100) of the flat knitting machine; and

a needle selecting device (2), arranged in a carriage (300) that reciprocates in the longitudinal direction of the needle bed (100), for changing a knitting operation to be carried out by the knitting needle (200) by changing a position of the selector (4) along an extending direction of the needle groove (101);

the needle selecting device (2) including a needle selecting actuator (10) for selecting the knitting needle (200) by changing the position of the selector (4) in a depth direction of the needle groove (101) depending on whether to have one part of the selector (4) remained adsorbed to an adsorbing surface (10s) for adsorbing one part of the selector (4) by a magnetic force or separated from the adsorbing surface (10s); **characterized in that**

the selector (4) includes,
a base body (41),

a distal end (42) arranged on a needle bed gap side of the needle bed (100) in the base body (41),

an armature (43) arranged on a tail end side, which is opposite to the needle bed gap side, of the base body (41) and arranged facing the adsorbing surface (10s) of the needle selecting actuator (10), and

an elastic leg piece (44) connected to the distal end (42) and extended towards the tail end side; and

the needle selecting device (2) includes,
an interrupt cam (20), arranged bulging out at a position facing the needle selecting actuator (10), for cutting in between the armature (43) and the elastic leg piece (44) of the selector (4) to spread the spacing between the armature (43) and the elastic leg piece (44), and making the armature (43) adsorbed to the adsorbing surface (10s) of the needle selecting actuator (10) when the carriage (300) travels on the needle bed (100); and

while the interrupt cam (20) passes through the selector (4), the elastic leg piece (44) of the selector (4) comes into abutment with the interrupt cam (20) so that the selector (4) is supported by the interrupt cam (20) by the abutment.

2. The needle selecting system of the flat knitting machine according to claim 1, **characterized in that** an abutting portion (44b), which is a portion that abuts the interrupt cam (20) in the elastic leg piece (44) of the selector (4) and which becomes a spring supporting point for generating an elastic force for energizing the armature (43) in a direction of approaching the elastic leg piece (44), is arranged within a forming range of the armature (43) in the extending direction of the needle groove (101).

3. The needle selecting system of the flat knitting machine according to claim 1 or 2, **characterized in that** the needle selecting actuator (10) is arranged in the carriage (300) to face the armature (43) of the selector (4) from an upper surface side of the needle bed (100). 5
4. The needle selecting system of the flat knitting machine according to any one of claims 1 to 3, **characterized in that** 10
 - a raising butt (45) is formed on a side opposite to a to-be-adsorbed end face (43s) to be adsorbed to the needle selecting actuator (10) in the armature (43) of the selector (4); and
 - guides (g1,g2,g3) for acting on the raising butt (45) and advancing the selector (4) towards the needle bed gap are formed in the interrupt cam (20). 15
5. A selector (4), which is a member configuring one part of a knitting needle (200) arranged in each of the needle grooves (101) lined in a longitudinal direction of a needle bed (100) of a flat knitting machine, the selector (4) determining a knitting operation to be performed by the knitting needle (200) by a position along an extending direction of the needle groove (101); the selector (4) **characterized by:** 20
 - a base body (41);
 - a distal end (42) arranged at one end side in a longitudinal direction of the base body (41); 30
 - an armature (43) arranged on the other end side in the longitudinal direction of the base body (41); and
 - an elastic leg piece (44) connected to the distal end (42) and extended towards the other end side; wherein 35
 - the elastic leg piece (44) includes an abutting portion (44b) which abuts a member, fixed to a carriage of the flat knitting machine, when the member is interposed between the armature (43) and the elastic leg piece (44), and which acts as a spring supporting point for generating an elastic force for energizing the armature (43) in a direction of approaching the elastic leg piece (44). 40 45
6. A flat knitting machine, including at least a front and a back needle bed (100), for performing knitting by a knitting needle (200) arranged in each of a plurality of needle grooves (101) lined in the needle beds (100); the flat knitting machine **characterized by:** 50
 - the needle selecting system (1) of the flat knitting machine according to any one of claims 1 to 4. 55

Fig. 1

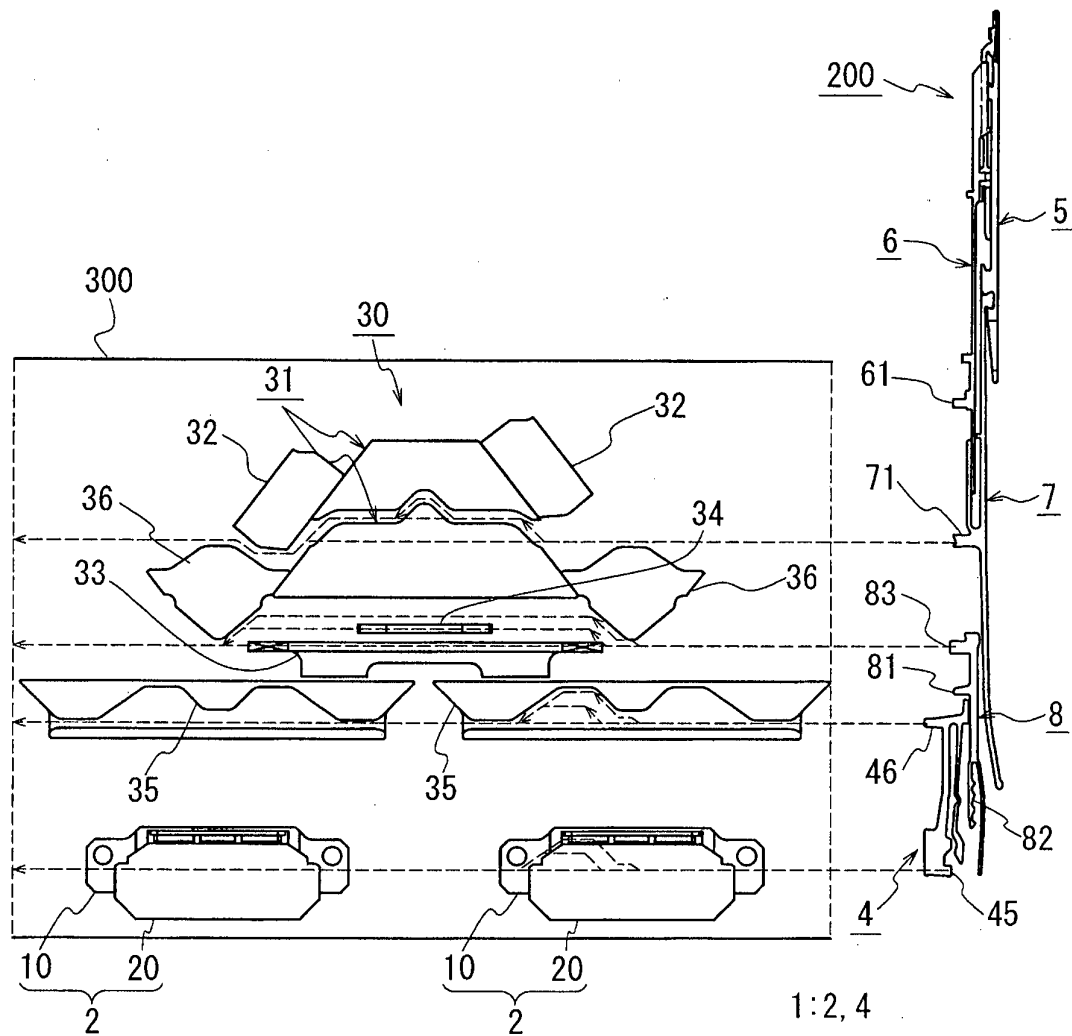


Fig. 2

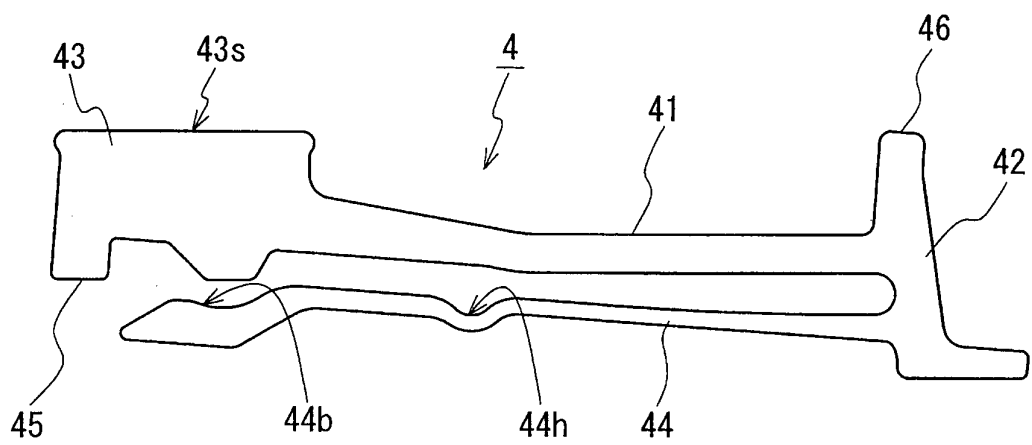


Fig. 3

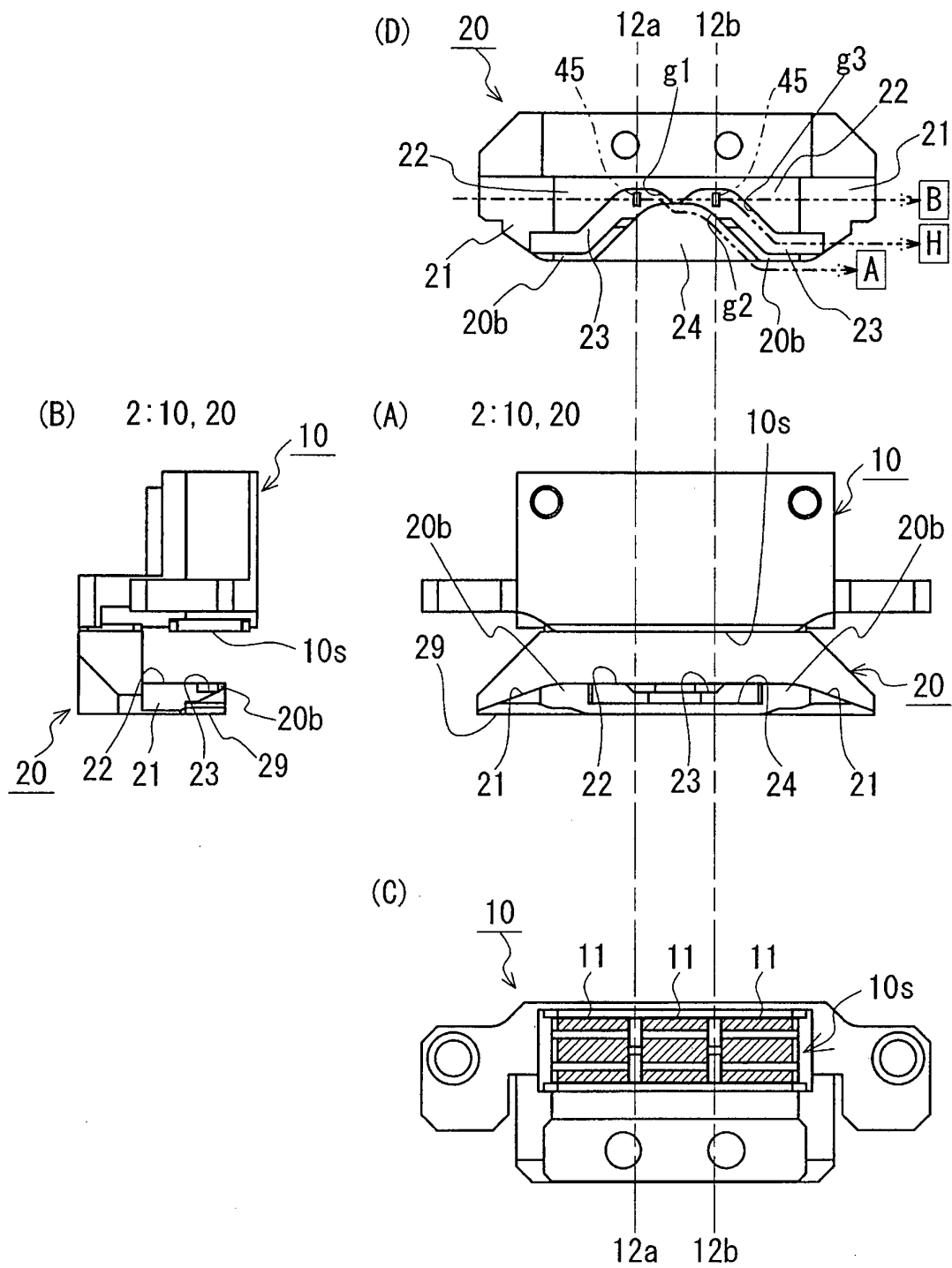


Fig. 4

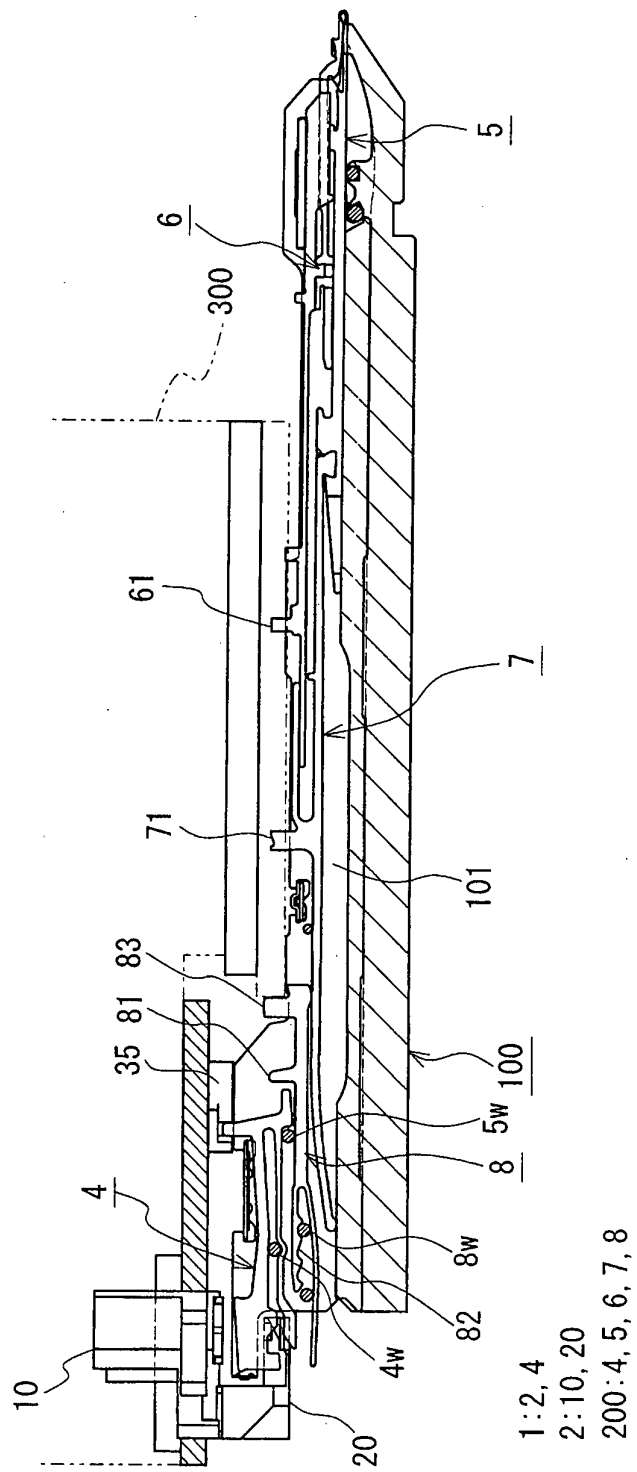


Fig. 5

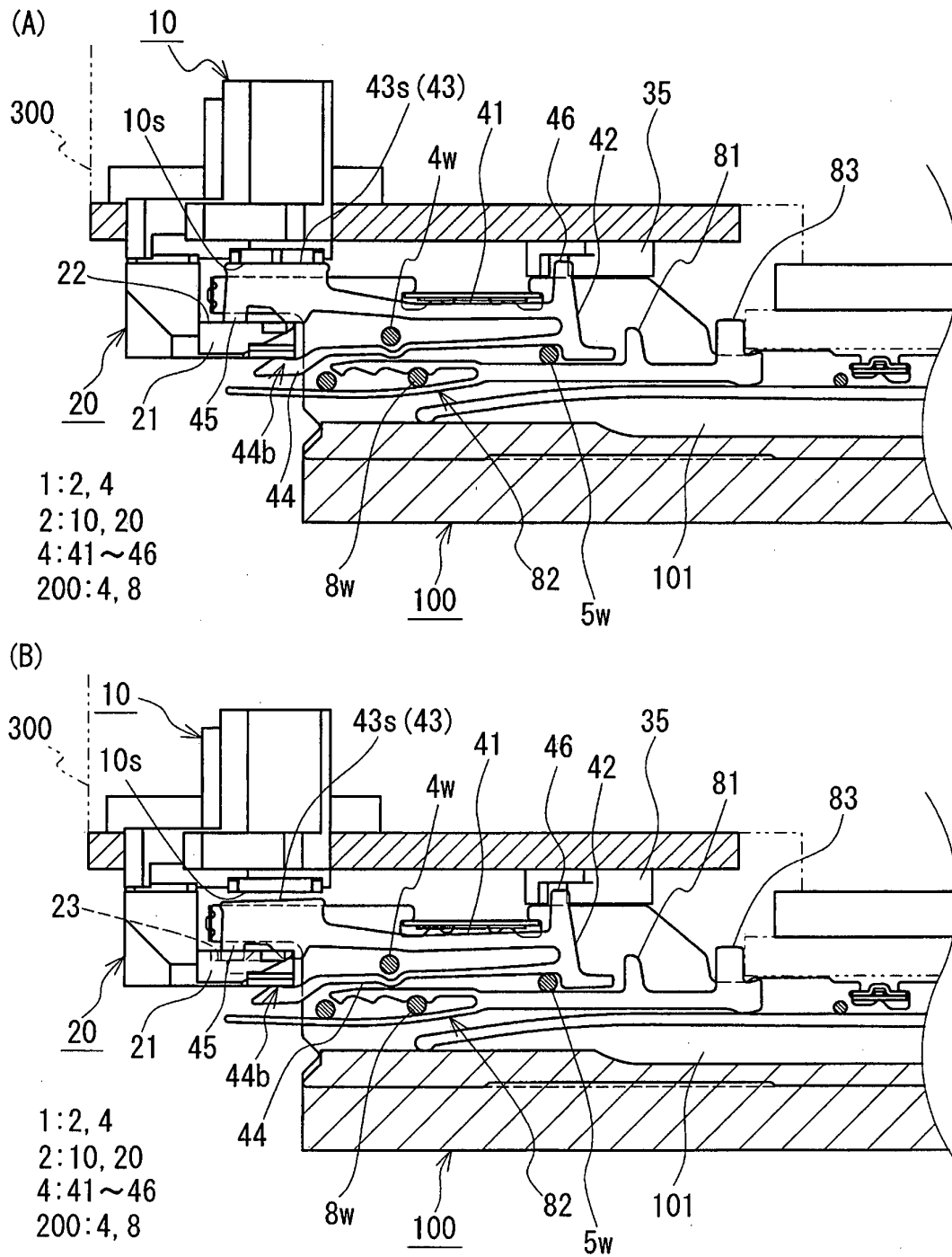


Fig. 6

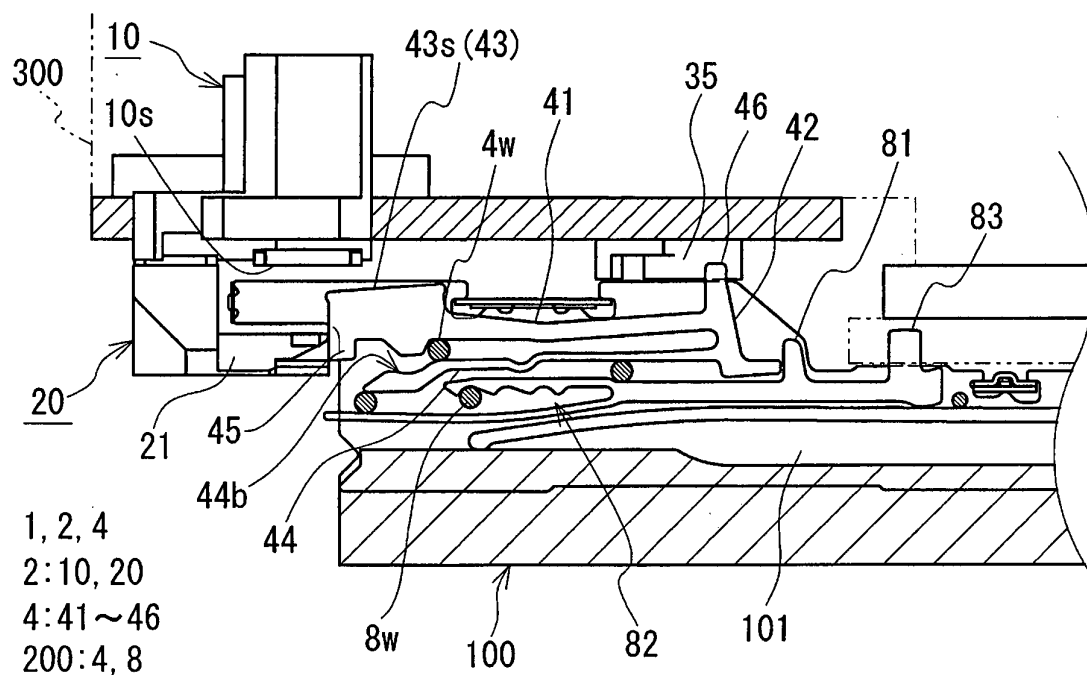
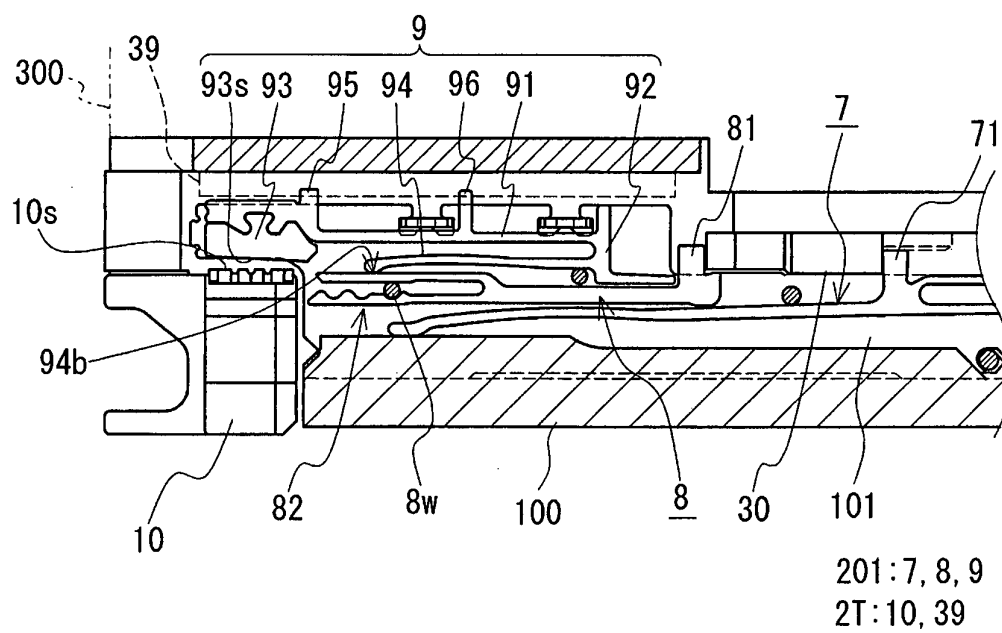


Fig. 7





EUROPEAN SEARCH REPORT

Application Number
EP 12 00 6475

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A	* paragraphs [0003] - [0008], [0010] - [0011]; figure 4 *	1-4,6	
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A	* paragraphs [0003] - [0009]; figure 4 *	1-4,6	
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			D04B
Place of search		Date of completion of the search	Examiner
Munich		26 November 2012	Wendl, Helen
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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