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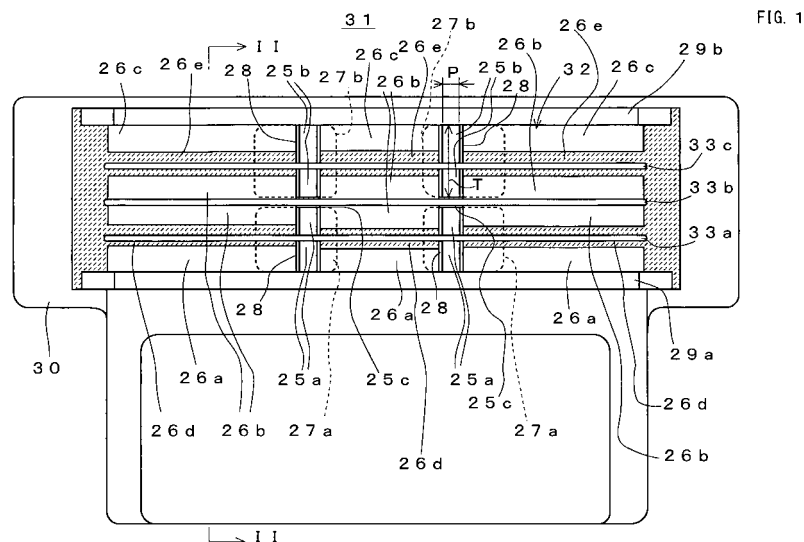
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(54) **NEEDLE SELECTING ACTUATOR, AND WEFT KNITTING MACHINE**

(57) A needle selecting actuator and a flatbed knitting machine are provided to prevent a needle selection mistake caused by a lubricant that flows down on an attraction site.

The needle selecting actuator (31) has grooves (33a, 33b, and 33c) formed in an attraction site (32). These grooves (33a, 33b, and 33c) are extended between the two ends of the attraction site (32) in the transverse direction of the drawing, in which an armature portion of a

selector of a knitting needle moves relative to the attraction site (32) when a carriage carrying the needle selecting actuator (31) in a manner to include it in a needle selecting mechanism reciprocates along the needle bed. By using the needle selecting actuator (31) having these grooves (33a, 33b, and 33c) in place of the needle selecting actuator having no groove on an attraction site in a flat knitting machine, the lubricant is able to be scraped out and a needle selection mistake caused by adhesion of the lubricant is able to be reduced.



Description

Technical Field

[0001] The present invention relates to a needle selecting actuator to be mounted to a carriage for conducting needle selection in a flatbed knitting machine, and to a flatbed knitting machine equipped with such a needle selecting actuator.

Background Art

[0002] Conventionally, in a flatbed knitting machine, to a large number of knitting needles disposed on a needle bed, needle selection and knitting drive are conducted by a needle selection mechanism and a cam mechanism mounted to a carriage that runs along the needle bed to knit a fabric. Using a needle selecting actuator that utilizes electromagnetic attraction as a needle selection mechanism enables high-speed operation, because of no movable portion (for example, Patent Citation 1 and Patent Citation 2).

[0003] Fig. 4 schematically shows a structure of a flatbed knitting machine 1 which is equipped with a needle selection mechanism same as that of Patent Citation 2. In the flatbed knitting machine 1, a plate-like form needle bed 2 that extends in the vertical direction with respect to this paper surface is equipped. On the needle bed 2, grooves that are vertical to a longitudinal direction, which is an extending direction, and extends in a transverse direction on this paper are formed in regular intervals. In the longitudinal direction of the needle bed 2, a carriage 3 runs back and forth. In a groove on the needle bed 2, a needle plate 4 is inserted. When all the needle plates 4 are inserted into the needle bed 2, the needle plates are tightened by plate fixing wire 5 and fixed. These needle beds 2 are opposed to one another with a needle bed gap 6 in between to make a pair. On the needle bed gap 6 side of the needle bed 2, sinker plates 7 are mounted and fixed by a sinker fixing wire 8. In the vicinity of the front end of the sinker plate 7 on the needle bed gap 6, a gap wire 9 is inserted.

[0004] In the flatbed knitting machine 1, the needle bed 2 is disposed in front and rear of the needle bed gap 6 as viewed from the front side when the knitting machine is generally used as a mechanical device. Each needle bed 2 is higher on the side facing to the needle bed gap 6 and is lower as it recedes from the needle bed gap 6. As viewed from the side of the needle bed gap 6, the needle beds 2 in front and rear of the needle bed gap 6 are tilted in an inverted V shape. However, on the drawing, for convenience of explanation, only one needle bed 2 is described to have a nearly horizontal position. Hereinafter, the forward and rearward direction will be described with the direction approaching the needle bed gap 6 designated as forward direction and the direction receding from the needle bed gap 6 designated as rearward direction. In addition, the upward and downward

direction will be described with the bottom side of the needle bed 2 designated as downward direction and the surface side as upward direction.

[0005] Between adjoining needle plates 4 on the needle bed 2, a needle groove is formed. In each needle groove, a knitting needle 10 is housed. The knitting needle 10 knits the fabric while sliding to be displaced in the horizontal direction of the drawing, that is, in the forward and rearward direction with the needle bed gap 6 used as a benchmark. The knitting needle 10 is configured by combining a needle 11, needle jack 12, select jack 13, and selector 14. The needle 11 carries out the knitting operation of the fabric by combining movement for advancing and retreating to the needle bed gap 6 side and movement for opening and closing of a front-end hook 11a by a latch 11b. At the position backward from the intermediate of the needle 11, a coupling portion 11c is provided.

[0006] With the coupling portion 11c of the needle 11, a head end portion 12a of the needle jack 12 engages. On the middle of the needle jack 12, a butt 12b is protruded, and the portion from the vicinity of the butt 12b to a rear end portion 12c functions as a spring that biases the butt 12b to come up in the needle groove. The portion between the butt 12b of the needle jack 12 and the rear end portion 12c is pressed by a head-end pressing portion 13a of the select jack 13.

[0007] The select jack 13 receives a pressing force at a pressure-receiving butt 13b from a presser of a cam mechanism mounted to the carriage 3. When this pressing force is applied from above, the select jack 13 presses the needle jack 12 by the head-end pressing portion 13a, and forces down it so that the butt 12b of the needle jack 12 does not protrude from the needle groove. At the rear position in a slight distance from the pressure receiving butt 13b of the select jack 13, a protrusion 13c is provided. At the rear of the select jack 13, a forked portion 13d is formed. The protrusion 13c is driven to advance by the selector 14. The side portion of the pressure-receiving butt 13b of the select jack 13 is driven to recede by the cam mechanism.

[0008] The selector 14 has a front butt 14a, middle butt 14b, and rear butt 14c. The front butt 14a serves as a rocking fulcrum when the selector 14 is subjected to an action of a needle selection mechanism. The middle butt 14b is driven upon rearward displacement. The rear butt 14c is driven upon forward replacement. When it is displaced in front, if the head-end portion 14d comes in contact with the protrusion 13c of the select jack 13, the selector 14 pushes the select jack 13 and displaces it to the needle bed gap 6 side. The rear side of the front butt 14a of the selector 14 is bifurcated, and the lower side is an elastic leg 14e and biases the upper side to come up. On the upper side of the part which is bifurcated at the rear of the selector 14, the middle butt 14b and the rear butt 14c are provided, and the rear end is a armature portion 14f.

[0009] To the needle plate 4, in the direction perpen-

dicular to this paper surface, a needle pressing plate 15, metal strips 16a, 16b, and wires 17a, 17b, and 17c are inserted. The needle pressing plate 15 restricts the needle 11 from above so that the needle 11 does not jump out from the needle groove. The metal strips 16a and 16b press the selector 14 so as that the selector 14 does not jump out from the needle groove. The wires 17a, 17b, and 17c function as stoppers, and the like.

[0010] The knitting needles 10, which are disposed in a large quantity on the needle bed 2, are selected by a needle selection mechanism mounted to the carriage 3 and driven to knit by the cam mechanism. On a bottom surface of a case 20 of the carriage 3, a cam plate 21, to which the cam mechanism is mounted, and a selector plate 22, to which the needle selection mechanism is mounted, are disposed and face the surface of the needle bed 2. It is however omitted to illustrate the cam mechanism and the needle selection mechanism. To a rear end of the selector plate 22, a needle selecting actuator 24 is mounted by a bracket 23.

[0011] In the surface of the needle selecting actuator 24, an attraction site 25 is formed. The attraction site 25 faces the armature portion 14f of the selector 14. In the attraction site 25, a plurality of magnetic poles 25a and 25b are disposed. The actual attraction site 25 is manufactured in such a manner that a clearance between magnetic materials, to the end portion of which magnetic poles 25a and 25b are formed, is filled with synthetic resin as a non-magnetic material 25c, and after the magnetic material is firmly fixed, the surface is flattened.

[0012] Fig. 5 shows structure of the attraction site 25 of the needle selecting actuator 24 (for example, see Patent Citation 3). In Patent Citation 3, two controlled attraction portions which have magnetic poles 25a and 25b and the non-magnetic material 25c are disposed so as that they are sandwiched by three non-controlled attraction portions which have magnetic poles 26a, 26b, and 26c and non-magnetic materials 26d and 26e. To the controlled attraction portions, magnetic flux generated from coils 27a and 27b as well as from a permanent magnet is supplied. It is possible to cancel magnetic flux from the permanent magnet by supplying current to the coils 27a and 27b, and the controlled attraction portion can be controlled to weaken the attraction force. To the non-controlled attraction portion, magnetic flux only from the permanent magnet is supplied. In the selector plate 22 of the carriage 3 shown in Fig. 4, a presser is mounted to press the tail portion of the selector 14 from above and bring the armature portion 14f in contact with the non-controlled attraction portion to attract. At the controlled attraction portion, whether the armature portion 14f of the selector 14 is continued to be attracted or attraction is cancelled is chosen for every knitting needle 10. Consequently, in the drawing, the length of the controlled attraction portion, shown in the transverse direction, is as short as about one pitch in the placement of the knitting needle 10 and the interval between the controlled attraction portion and the non-controlled attraction portion be-

comes narrow, so that, if any magnetic flux from the non-controlled attraction portion leaks, the leakage flux affects the attraction cancellation control at the controlled attraction portion.

[0013] In Patent Citation 3, in order to prevent the leakage flux from the non-controlled attraction portion from affecting control at the controlled attraction portion, locations of magnetic poles 26a, 26b, and 26c are shifted from locations of magnetic poles 25a and 25b. A copper plate 28 is provided between the controlled attraction portion and non-controlled attraction portion in order to suppress leakage flux and constitute an independent magnetic circuit in each attraction portion. In the attraction site 25, protectors 29a and 29b are disposed on both sides in the width direction, which is the longitudinal direction in the drawing. The whole needle selecting actuator 24 is housed in a case 30.

[0014] For measures against leakage flux at the attraction site 25 of the needle selecting actuator 24, there is a method of shifting the locations of magnetic poles 25a and 25b at the controlled attraction portion from those of magnetic poles at the non-controlled attraction portion, as shown in Fig. 5, and also a method of reducing leakage by distributing magnetic resistance without shifting the locations (for example, see Patent Citation 4).

Patent Citation 1: Japanese Examined patent application publication No. H01-38898

Patent Citation 2: Japanese Published patent application No. H09-241952

Patent Citation 3: Published Japanese translation of PCT international application No. 2004-507627

Patent Citation 4: Pamphlet of International Publication No. WO 01/075202

Disclosure of the Invention

Technical Problem

[0015] In the knitting needle 10 as shown in Fig. 4, a cam mechanism mounted to a carriage 3 works on the butt 12b of the needle jack 12 and knitting action takes place. In order to allow knitting action to take place smoothly, a lubricant is supplied to the vicinity of the butt 12b. Since the needle bed 2 is tilted so as to be higher on the needle bed gap 6 side and lower on the needle selecting actuator 24 side, the lubricant supplied to the vicinity of the butt 12b flows down in the needle groove to the armature portion 14f of the selector 14 and the attraction site 25 of the needle selecting actuator 24. When the lubricant pools in the armature portion 14f and the attraction site 25, depending on the environment in which the flat knitting machine 1 is placed, the clearance between the armature portion 14f and the attraction site 25 is bonded by the lubricant and a needle selecting mistake may occur because current supply cannot cancel attraction at the controlled attraction portion.

[0016] The structure disclosed in Patent Citation 1 has

a part corresponding to the needle selecting actuator 24 mounted on the carriage 3 side, and it is assumed that the problem of attraction due to the lubricant may not occur. However, the presser that forcibly brings a portion corresponding to the armature portion 14f in contact with the attraction site 25 must be mounted on the carriage 3 side, too. In a member that corresponds to the selector 14, the rocking fulcrum is provided between the portion pressed by the presser and the portion corresponding to the armature portion 14f, and therefore, the length of the member corresponding to the selector 14 in the longitudinal direction is increased and the needle selecting mechanism increases in size.

[0017] It is an object of the present invention to provide a needle selecting actuator and a flatbed knitting machine that can prevent a needle selection mistake caused by a lubricant that flows down on an attraction site.

Technical Solution

[0018] The present invention provides a needle selecting actuator mounted to a carriage that runs along a needle bed of a flatbed knitting machine, attracting an armature portion provided to a selector of each knitting needle in order to selectively drive knitting needles placed side by side on the needle bed, and having an attraction site to which a plurality of magnetic poles are disposed including a controlled magnetic pole which can electromagnetically control attraction condition, wherein at least one groove is formed in the attraction site so as to pass through between both ends thereof in a running direction of the carriage and so as to pass by at least one magnetic pole.

[0019] Additionally, in the needle selecting actuator of the present invention, said groove is formed so as to pass by said control magnetic pole grooves are formed so as to pass the control magnetic poles.

[0020] Moreover, in the needle selecting actuator of the present invention, said attraction site has a magnetic pole formed so as to allow said groove to pass by, and also has two magnetic poles that adjoin the magnetic pole in said running direction and that are disposed with an interval provided in a width direction perpendicular to the running direction, so as to allow the groove to pass in the intervals.

[0021] In the needle selecting actuator of the present invention, on said attraction site, at least two said controlled magnetic poles are disposed with an interval provided in said width direction, and

at least three non-controlled magnetic poles, which adjoin the two controlled magnetic poles in the running direction and conduct attraction only of said armature portion, are disposed with an interval provided in the width direction, but shifted in the width direction from the interval of the controlled magnetic poles.

[0022] Furthermore, the present invention provides a flatbed knitting machine, in which front and rear needle beds are facing each other with a needle bed gap in-

between, each of which is disposed tilting in such a manner that the needle beds ascend as they come close to the needle bed gap and descend as they recede from the needle bed gap, comprises:

a needle selecting actuator, mounted to a carriage that runs along a surface of each needle bed, and provided with an attraction site, which in order to selectively drive knitting needles placed side by side on the needle bed, attracting an armature portion on back side of a selector disposed on rear end of each knitting needle in the farthest distance from the needle bed gap, and to which a plurality of magnetic poles including controlled magnetic poles that can electromagnetically control the attraction condition are disposed, and

in the attraction site, at least one groove is formed so as to pass through between both ends thereof in a running direction of the carriage and so as to pass by at least one magnetic pole.

Advantageous Effects

[0023] According to the present invention, a needle selecting actuator is mounted to a carriage that runs along a needle bed of a flatbed knitting machine, and in an attraction site, at least one groove that pass through between both ends of the attraction site in the running direction of the carriage is formed in such a manner that it passes through at least one magnetic pole. It is assumed that providing at least one groove in the magnetic pole in this way may result in lowered attraction force, and conventionally, there existed no conception to provide at least one groove in the magnetic pole. The inventors of the present invention have found that any groove, even if the width is small enough to keep degradation of the attraction force within a permissible range, has a beneficial effect on prevention from a needle selection mistake. That is, since at least one groove in the running direction is formed, even if a lubricant or the like flows down on the attraction site of the needle selecting actuator, the lubricant or the like can be scraped out along the groove when the armature portion of the knitting needle selector is attracted and relatively slid so that the needle selection mistake can be prevented.

[0024] According to the present invention, since the groove passes through the surfaces of controlled magnetic poles, even if a lubricant flows down to a controlled pole, the lubricant is scraped out along the groove, adhesion of the lubricant becomes less likely to affect electromagnetic control in the attraction site, and a needle selection mistake can be prevented.

[0025] According to the present invention, the attraction site is provided at least with a magnetic pole on which at least one groove is formed, and with two magnetic poles, which adjoining it in the running direction, disposed with intervals in the width direction, and having at least one groove formed in the intervals. The groove is formed

in a clearance between two magnetic poles and can prevent weakening of attraction force of two magnetic poles.

[0026] According to the present invention, it is possible for the controlled magnetic pole to prevent influence of a magnetic flux that leaks from non-controlled magnetic poles that carry out attraction only.

[0027] Furthermore, according to the present invention, in a flatbed knitting machine having front and rear needle beds facing each other with a needle bed gap in-between, each of which is disposed tilting in such a manner that the needle beds ascend as they approach to the needle bed gap and descend as they recede from the needle bed gap, even when the needle selecting actuator is disposed on the lower side and a lubricant pools on the attraction site, at least one groove is provided in the attraction site, and thus a needle selection mistake can be prevented.

Brief Description of Drawings

[0028]

[Fig. 1] Fig. 1 shows a needle selecting actuator 31 as one embodiment of the present invention, viewing from an attraction site 32 side.

[Fig. 2] Fig. 2 is a cross-sectional view taken by a cutting surface line II-II of Fig. 1.

[Fig. 3] Fig. 3 shows a needle selecting actuator 41 as viewed from an attraction site 42 side as another embodiment of the present invention.

[Fig. 4] Fig. 4 is a partly broken-away cross-sectional side view showing a schematic structure of a conventional flatbed knitting machine 1. [Fig. 5] Fig. 5 shows a needle selecting actuator 24 of Fig. 4, viewing from an attraction site 25 side.

Explanation of Reference

[0029]

- | | |
|-----------|--|
| 1. | Flatbed knitting machine |
| 2. | Needle bed |
| 3. | Carriage |
| 14 | Selector |
| 14f | Armature portion |
| 25a, 25b; | 26a, 26b, 26c; 46a, 46b Magnetic poles |
| 31, 41 | Needle selecting actuator |
| 32, 42 | Attraction site |
| 33a, 33b, | 33c; 43a, 43b, 43c Groove |

Best Mode for Carrying Out the Invention

[0030] Fig. 1 shows schematic structure of an attraction site 32 for a three-row yoke type needle selecting actuator 31 as one embodiment of the present invention. In the needle selecting actuator 31, identical reference characters are designated to portions corresponding to a needle selecting actuator 24 shown in Fig. 4 and Fig.

5, and similar explanation is not repeated. In the needle selecting actuator 31, grooves 33a, 33b, and 33c are provided on the attraction site 32. Grooves 33a, 33b, and 33c are provided in such a manner that grooves extend between both ends of the attraction site 32 in the transverse direction of the drawing, in which an armature portion 14f of a selector 14 runs relative to the attraction site 32 when a carriage 3 advances and retires relative to a needle bed 2. By using the needle selecting actuator 31 having these grooves 33a, 33b, and 33c in place of the needle selecting actuator 24 in a flatbed knitting machine 1, a lubricant is able to be scraped out while the carriage 3 is running, and a needle selection mistake caused by adhesion of a lubricant is able to be reduced.

[0031] The center groove 33b passes a portion of a non-magnetic material 25c between magnetic poles 25a and 25b of a controlled attraction portion. In a non-controlled attraction portion, the groove is formed to penetrate the surface of a magnetic pole 25b. Grooves 33a and 33c on both sides of the center groove 33 pass a portion of non-magnetic material 26d between magnetic poles 26a and 26b, and a portion of a non-magnetic material 26e between magnetic poles 26b and 26c, respectively, but in the controlled attraction portion, the groove is formed so as to penetrate the surfaces of magnetic poles 25a and 25b, respectively.

[0032] Incidentally, a length P, which magnetic poles 25a and 25b of the controlled attraction portion have in the running direction, corresponds to arrangement interval of knitting needles 10 on the needle bed 2. For example, in 12 gauge (G) flatbed knitting machine, twelve knitting needles are disposed per 25.4 mm (1 inch), the length P becomes 2 mm. The width T, which magnetic poles 25a and 25b have in the width direction perpendicular to the running direction is, for example, 3.5 mm.

[0033] Fig. 2 shows cross-sectional structure as viewed from a cutting surface line II-II of Fig. 1. As described above, the center groove 33b is provided on the surface of the magnetic pole 26b, and therefore, it is desirable for the width to have a range that can permit weakening of attraction force of magnetic pole 26b. In particular, in the grooves 33a, 33b, and 33c formed on magnetic poles 25a, 25b, and 26c, the width of the grooves 33a, 33b, and 33c affect the attraction force while the depth does not affect the attraction force. However, when the depth is increased, the grooves do not contribute to the effect of measures against oil for scraping out a lubricant. It has been clarified that if a groove width W shown as the transverse direction in the drawing is in a range between about 0.5 mm and 1.2 mm, and a depth D shown as the longitudinal direction in the drawing is in a range between about 0.1 mm and 0.5 mm, weakening of attraction force is within the permissible range and the effect of measures against oil is able to be achieved.

[0034] Incidentally, the cross-sectional shapes of the grooves 33a, 33b, and 33c are circular arc. This kind of cross-sectional shape can be obtained by holding a wire rod of circular cross section to the surface, when liquid-

form synthetic resin is filled as non-magnetic materials 26d and 26e between magnetic materials, removing the wire rod after the synthetic resin solidifies, and grinding the overall attraction surface 32. The cross-sectional shapes of grooves 33a, 33b, and 33c may be rectangle or others which are different from circular arc, and grooves 33a, 33b, and 33c may be formed by cutting after grinding flat the attraction surface 32.

[0035] In a case 30 below the surface of the non-magnetic materials 26d and 26e, permanent magnet 34, coils 27a and 27b, and cores 35a and 35b for supplying magnetic flux to the controlled attraction portion and permanent magnets 36a and 36b and yokes 37a; 37b, and 37c, and the like for supplying magnetic flux to the non-controlled attraction portion are housed. The end face at the attraction site 32 of the yokes 37a, 37b, and 37c disposed in three rows form magnetic poles 26a, 26b, and 26c of the non-controlled attraction portion, respectively. Each component portion is firmly fixed by filling synthetic resin which serves as non-magnetic materials 26d and 26e.

[0036] Fig. 3 shows schematic structure of a two-row yoke type needle selecting actuator 41 as another embodiment of the present invention. In the needle selecting actuator 41, identical reference characters are designated to portions corresponding to the needle selecting actuator 24 shown in Fig. 4 and Fig. 5, and similar explanation is not repeated. The attraction site 42 of the needle selecting actuator 41 has three grooves 43a, 43b, and 43c, but the magnetic poles 46a and 46b of the non-controlled attraction portion are formed as end faces of a two-row yoke as is the case of the attraction site of Patent Citation 4. Three grooves 43a, 43b, and 43c are provided at the positions corresponding to grooves 33a, 33b, and 33c of Fig. 1, respectively. Grooves 43a and 43c on both sides are formed so as to pass through the surfaces of magnetic poles 25a, 46a and 25b and 46b, but the center groove 43b is formed so as to pass through the regions of non-magnetic materials 25c and 46c and so as not to pass through the magnetic poles.

[0037] In Fig. 1 and Fig. 3, a total of 3 grooves each, 33a, 33b, and 33c and 43a, 43b, and 43c are provided, but it is desirable to adjust the groove width and the number of grooves depending on the environment so that a needle selection mistake would be less likely to occur. In Fig. 1, grooves 33a and 33c pass magnetic poles 25a and 25b, respectively, and in Fig. 3, grooves 43a and 43c pass the magnetic poles 46a and 46b, respectively, but it is only necessary for at least one groove to pass the magnetic pole. In addition, as shown in Fig. 1 and Fig. 3, instead of grooves 33a, 33b, and 33c and 43a, 43b, and 43c, which are horizontal to the transverse direction but inclined grooves may be provided. In the event that a large amount of a lubricant flows, if a groove is inclined, flow-down of the lubricant is facilitated and the adhering amount of the lubricant to the attraction sites 32 and 42 can be reduced.

Claims

1. A needle selecting actuator mounted to a carriage that runs along a needle bed of a flatbed knitting machine, attracting an armature portion provided to a selector of each knitting needle in order to selectively drive knitting needles placed side by side on the needle bed, and having an attraction site to which a plurality of magnetic poles are disposed including a controlled magnetic pole which can electromagnetically control attraction condition, wherein at least one groove is formed in the attraction site so as to pass through between both ends thereof in a running direction of the carriage and so as to pass by at least one magnetic pole.
2. The needle selecting actuator according to claim 1, wherein said groove is formed so as to pass by said control magnetic pole.
3. The needle selecting actuator according to claim 1, wherein said attraction site has a magnetic pole formed so as to allow said groove to pass by, and also has two magnetic poles that adjoin the magnetic pole in said running direction and that are disposed with an interval provided in a width direction perpendicular to the running direction, so as to allow the groove to pass in the intervals.
4. The needle selecting actuator according to claim 3, wherein in said attraction site, at least two said controlled magnetic poles are disposed with an interval provided in said width direction, and at least three non-controlled magnetic poles, which adjoin the two controlled magnetic poles in the running direction and conduct attraction only of said armature portion, are disposed with an interval provided in the width direction, but shifted in the width direction from the interval of the controlled magnetic poles.
5. A flatbed knitting machine, in which front and rear needle beds are facing each other with a needle bed gap in-between, each of which is disposed tilting in such a manner that the needle beds ascend as they come close to the needle bed gap and descend as they recede from the needle bed gap, comprises:

a needle selecting actuator, mounted to a carriage that runs along a surface of each needle bed, and provided with an attraction site, which in order to selectively drive knitting needles placed side by side on the needle bed, attracting an armature portion on back side of a selector disposed on rear end of each knitting needle in the farthest distance from the needle bed gap, and to which a plurality of magnetic poles including controlled magnetic poles that can electro-

magnetically control the attraction condition are disposed, and
in the attraction site, at least one groove is formed so as to pass through between both ends thereof in a running direction of the carriage and so as to pass by at least one magnetic pole.

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FIG. 1

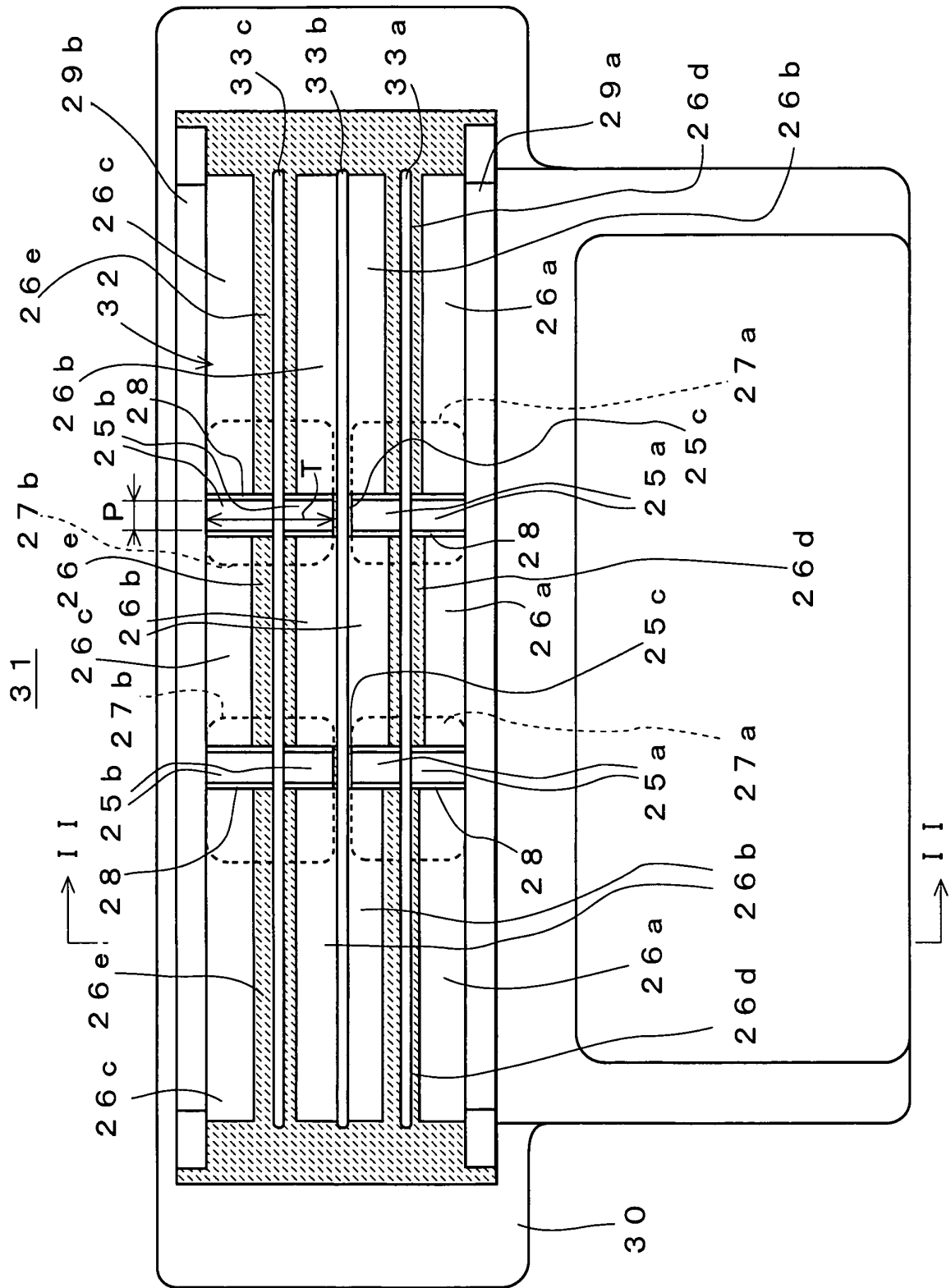


FIG. 2

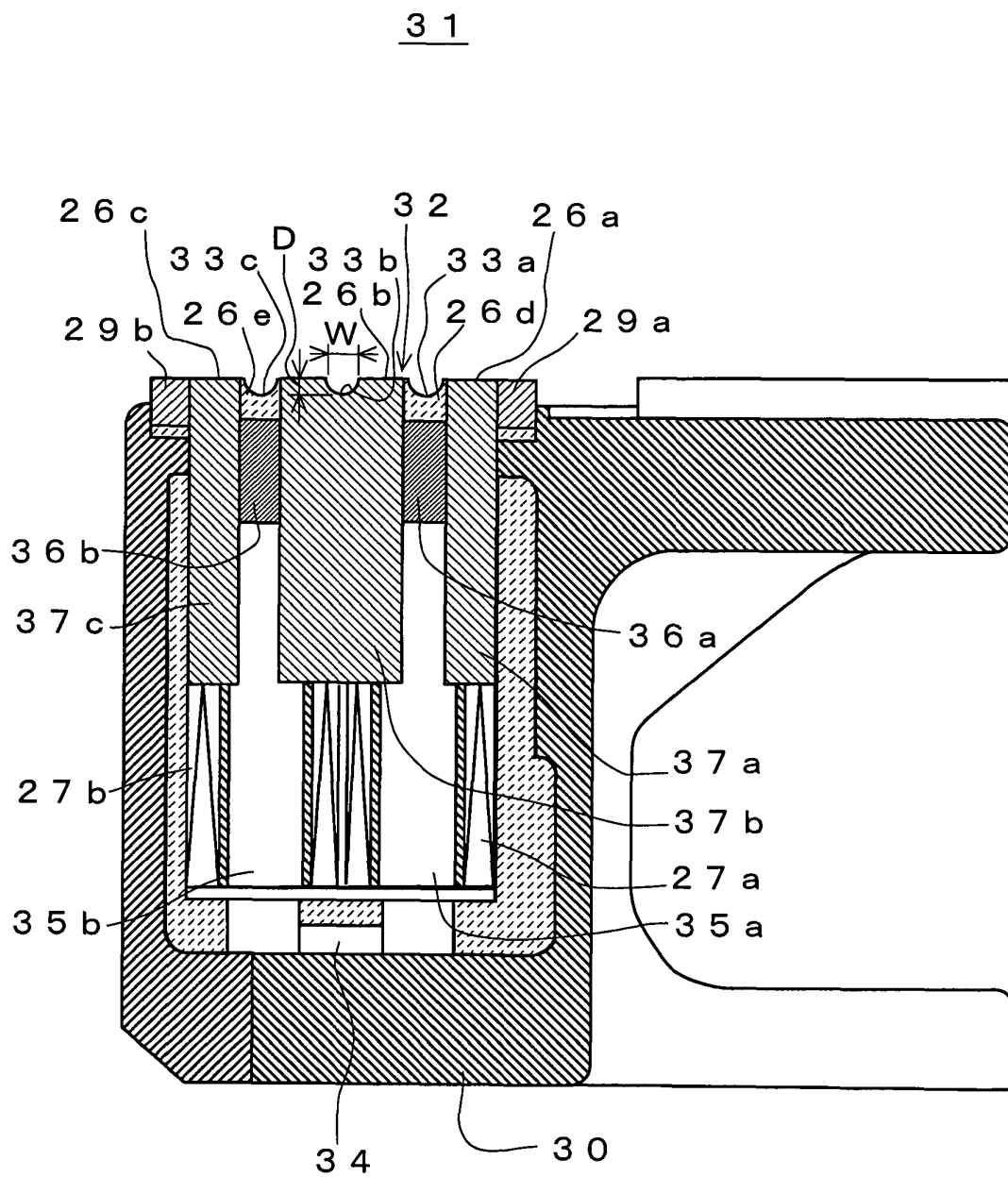


FIG. 3

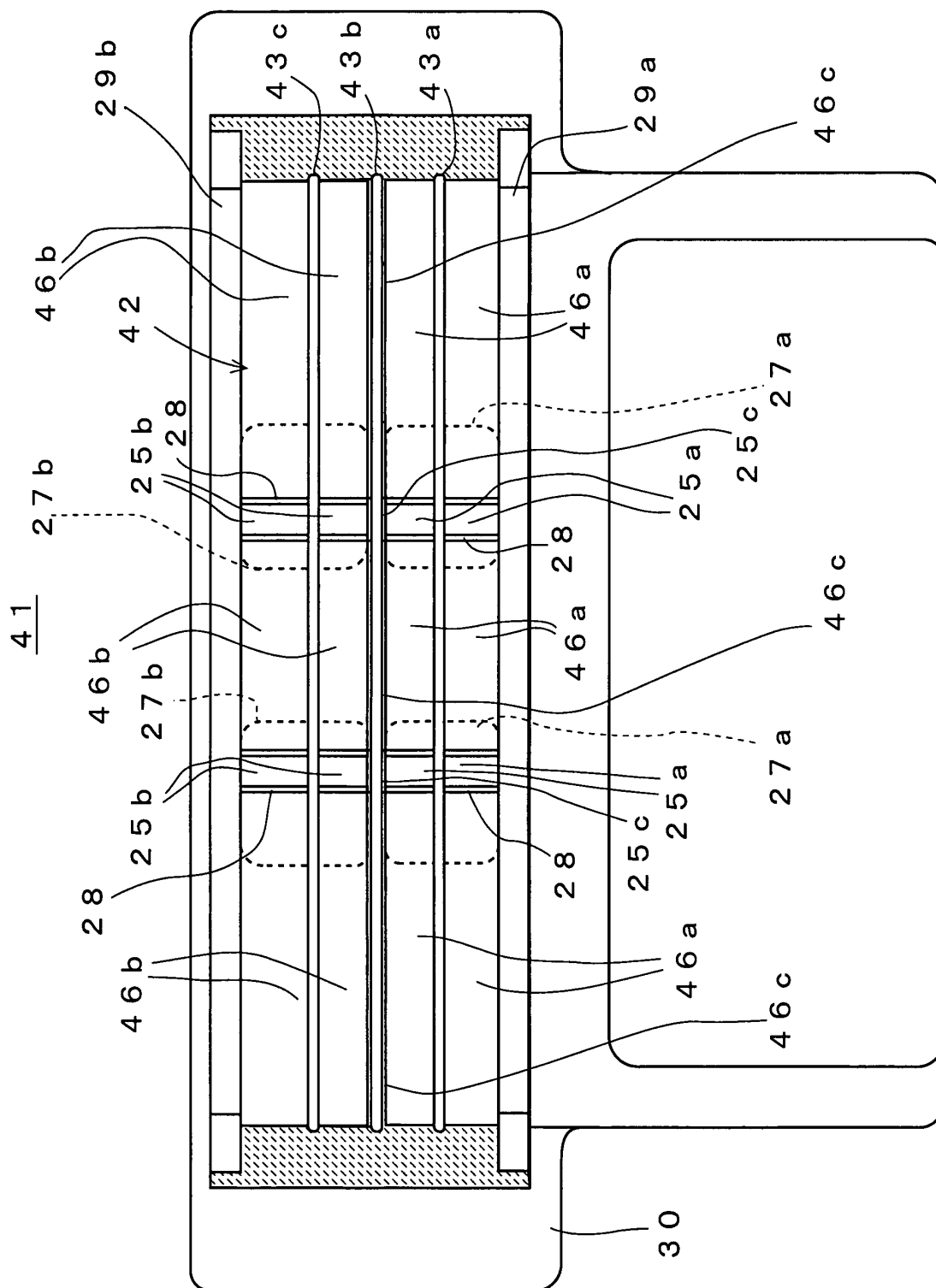


FIG. 4

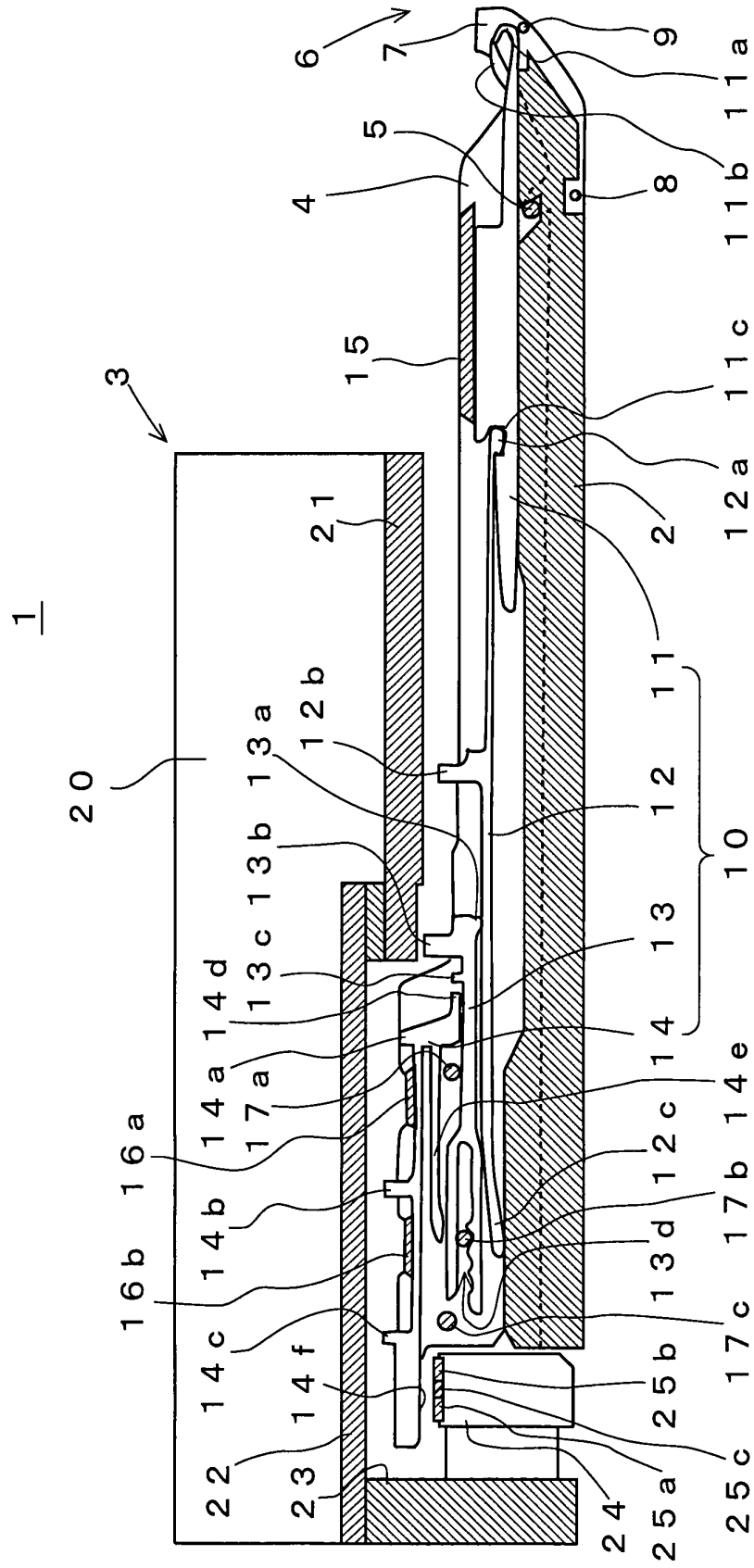
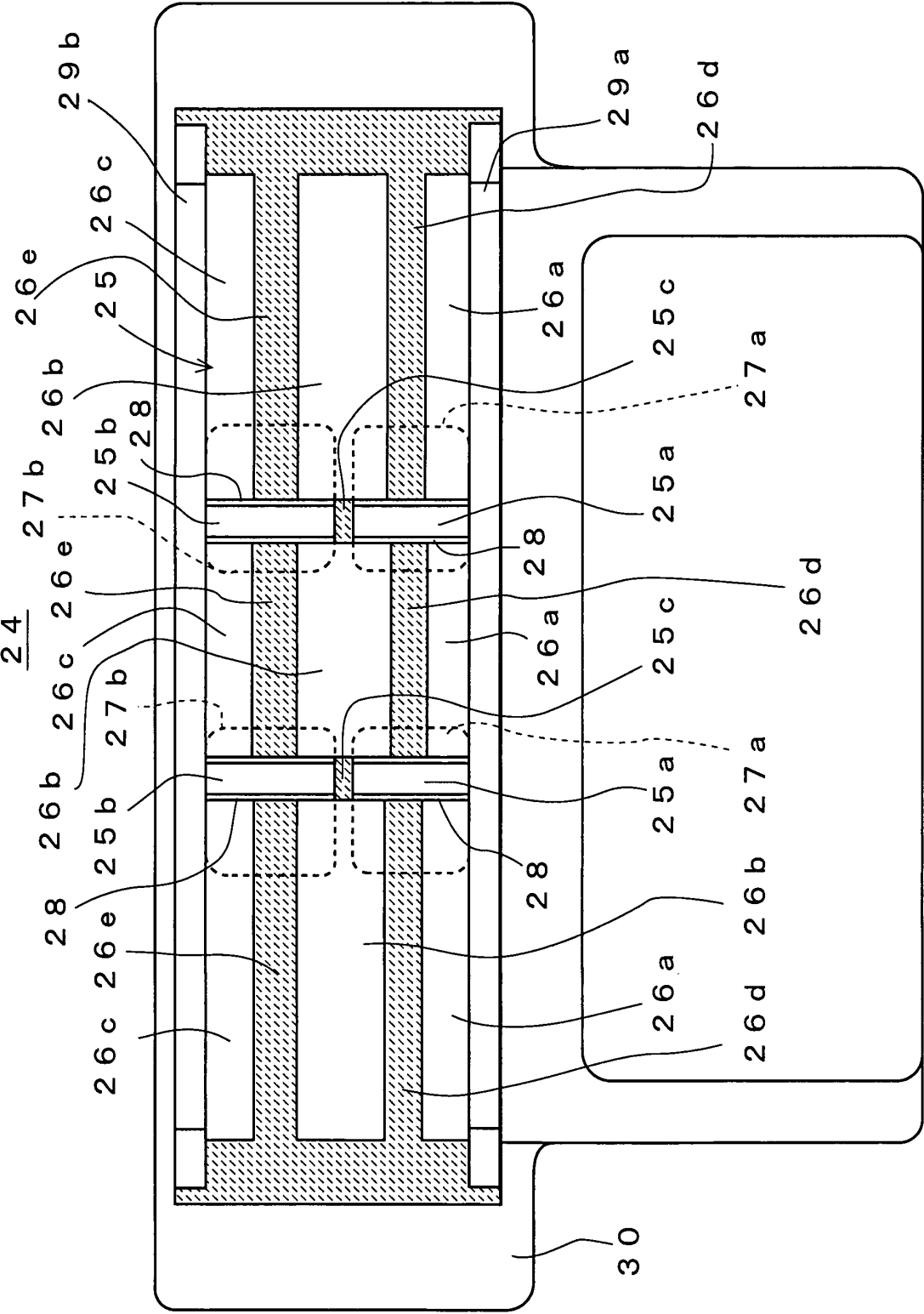


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/001297

A. CLASSIFICATION OF SUBJECT MATTER

D04B15/82(2006.01) i, D04B35/28(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)

D04B15/66-15/86, D04B35/28

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 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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 1-38898 B2 (H.Stoll GmbH & Co.), 17 August, 1989 (17.08.89), & US 4686839 A & DE 3541171 C & EP 224031 B & ES 2005053 B	1-5
A	JP 3459514 B2 (Shima Seiki Mfg., Ltd.), 20 October, 2003 (20.10.03), & US 5694792 A & TW 368532 A & EP 748887 B1 & CN 1182286 C	1-5
A	JP 2004-507627 A (Shima Seiki Mfg., Ltd.), 11 March, 2004 (11.03.04), & WO 2002/018690 A2 & AU 200180193 A & TW 531579 A & US 6651464 B2 & KR 2003064738 A & EP 1313903 B1 & CN 1268799 C	1-5

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

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Date of the actual completion of the international search
05 February, 2008 (05.02.08)Date of mailing of the international search report
12 February, 2008 (12.02.08)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.

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REFERENCES CITED IN THE DESCRIPTION

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