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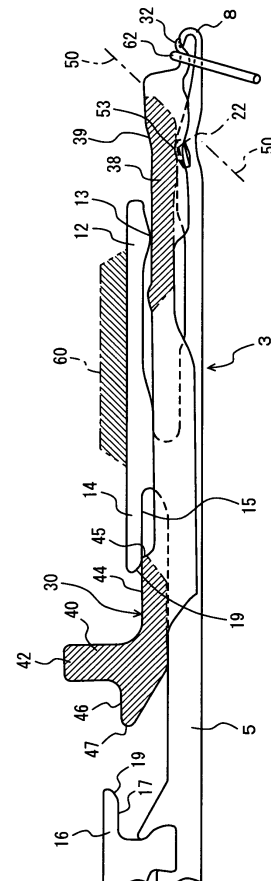
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(54) **COMPOUND NEEDLE**

(57) A needle member 3 has a branch portion 10 at its central position in the longitudinal direction. Further, the needle member 3 has a first fork 12, a second fork 14, and a third fork 16. The first fork 12 protrudes toward a hook 8 from the branch portion 10, and the second fork 14 protrudes backward from the branch portion 10. The third fork 16 faces the second fork 14. Tongues 32 are provided at the front end of a slider 30. A first fork contact cam surface 39 is provided in a front solid portion 80 of the slider 30 such that vertical movement of the slider 30 is limited by the first fork 12. Further, second and third fork contact surfaces 44, 46 are provided on the front side and the back side of a back solid portion 40 such that vertical movement of the slider 30 is limited by the second and third forks 14, 16.

Fig. 11



Description

Technical Field

[0001] The present invention relates to a compound needle used in a knitting machine such as a flat knitting machine. In particular, the present invention relates to a guide of a slider for a needle member.

Background Art

[0002] Japanese Laid-Open Patent Publication No. 2002-294541, Japanese Laid-Open Patent Publication No. 2001-032154, and Japanese Laid-Open Patent Publication No. 62-206069 disclose compound needles. According to the disclosure of Japanese Laid-Open Patent Publication No. 2002-294541, a needle member has a fork which is branched from substantially the central position in the longitudinal direction. The fork extends toward a hook side at the front end of the needle member. A slider is guided by the lower surface of the fork and the upper surface of the needle member. A slider butt is provided in the back portion of the slider, and a pair of support portions are provided at the lower back end of the slider. The needle member is sandwiched between the support portions. The support portions are considered to be protrusions provided on the slider.

[0003] Japanese Laid-Open Patent Publication No. 2001-032154 discloses a compound needle of a similar type. Instead of providing a fork for the needle member to sandwich the slider, the upper surface of the slider is supported by a metal belt on a needle bed.

[0004] According to the disclosure of Japanese Laid-Open Patent Publication No. 62-206069, forks are provided for a needle member and a slider, respectively, and the forks engage each other to position the slider.

[0005] As in the case of Japanese Laid-Open Patent Publication No. 2002-294541, if the stitch loop is supported by the tongues at the front end of the slider, a force is generated to bounce the back end of the slider. In opposition to the force, the pair of support portions are used for preventing the back end of the slider to move upwardly. The inventor of the present application found that it is difficult to sufficiently support the force which bounces the back end of the slider by the pair of support portions provided at the lower back end of the slider. In the structure, the product life of the compound needle is short, and it is difficult to accurately limit the height of the slider butt.

Summary of the Invention

[0006] An object of the present invention is to prevent upward movement of a butt provided at the back of a slider.

[0007] Another object of the present invention is to increase the strength of a needle member, and simplify processing of the needle member.

[0008] Still another object of the present invention is to provide structure in which the slider can move back and forth easily relative to second and third forks.

[0009] According to the present invention, a compound needle comprises a needle member having a hook at its front end, and a slider slidable over the needle member, and having tongues at its front end. The needle member and the slider are movable independently for formation and transferring of knit stitches.

[0010] The needle member has a first fork, a second fork, and a third fork. The first fork protrudes from a branch portion toward the hook. The branch portion is branched upwardly from substantially the central position of a region where the slider slides. The front half of the slider is sandwiched between the first fork and the needle member such that the slider is guided by the lower surface of the first fork to limit vertical movement of the front half of the slider.

[0011] The second fork protrudes from the branch portion toward an upper back position of the needle member, and toward a butt of the slider such that the slider is guided by the lower surface of the second fork at a position where the slider has moved forward relative to the needle member.

[0012] The third fork is branched forward from a position of the needle member behind the butt of the slider, and faces the second fork such that the slider is guided by the lower surface of the third fork at a position where the slider has moved back relative to the needle member.

[0013] The second fork and the third fork limit vertical movement of the back half of the slider.

[0014] The butt is provided in the back half of the slider.

[0015] A slit vertically passes through the slider at a position ahead of the butt, and the branch portion of the needle member passes through the slit.

[0016] A first fork contact cam surface is provided on the upper surface of the front half of the slider at a position ahead of the through slit, and the first fork contact cam surface is guided by the lower surface of the first fork.

[0017] A second fork contact surface is provided on the upper surface of the back half of the slider at a position ahead of the butt of the slider, and the second fork contact surface is guided by the lower surface of the second fork.

[0018] A third fork contact surface is provided on the upper surface at the back end of the slider behind the butt of the slider, and the third fork contact surface is guided by the lower surface of the third fork.

[0019] In the specification, the front side and the back side are defined based on the longitudinal direction of the compound needle. The hook and the tongues are provided on the front side. The slider, the butt, and the third fork are provided on the back side. The upper side and the lower side are defined based on the state in which the compound needle is set on a needle bed. The slider is positioned above the needle member, and rides (slides) over the needle member. The first fork and the second fork are positioned above the slider. The slider is sandwiched between the first and second forks and

the needle member. The left-right direction and the side direction mean the direction perpendicular to both of the longitudinal direction and the vertical direction, and such directions are used, e.g., when referring to thin plates on the left and right sides of the slider of the through slit, or thin plates on the left and right sides of the skirt.

[0020] It is preferable that the back half of the slider is solid, and has substantially the same thickness from the third fork contact surface to the second fork contact surface.

[0021] Further, it is preferable that the slider is separated into two parts on the left side and the right side from a position below the second fork contact surface to the through slit, and the upper surface and the lower surface of the slider are cut at the through slit to form the through slit.

[0022] Preferably, an oblique tapered portion oriented from the upper back to the lower front is provided at the back end of the second fork;

an oblique tapered portion oriented from the upper front to the lower back is provided at the front end of the third fork;

an oblique tapered portion oriented from the upper back to the lower front is provided at the front end of the second fork contact surface; and

an oblique tapered portion oriented from the upper front to the lower back is provided at the back end of the third fork contact surface.

[0023] It is preferable that the upper surface of the needle member includes an expanded portion expanded upwardly at a position behind the hook of the needle member;

upper part of the front half of the slider forms a solid portion, and lower part of the front half of the slider forms a skirt separated into two parts; and

when the tongues close the hook, a support portion provided at the bottom of the solid portion above the skirt is supported by the expanded portion at a position on the hook side.

[0024] In particular, it is preferable that, in the front half of the slider, the bottom of the solid portion around the support portion forms a recess which is curved upwardly, and the recess is provided behind a borderline extending from the upper front to the lower back at the front end on the hook side of the solid portion.

Advantages of the Invention

[0025] Operation and advantages of the present invention will be described. When the needle member moves forward from the slider, and the hook moves forward, the front half of the slider is pressed downwardly by the lower surface of the first fork. As a result, a force which presses the slider butt at the back of the slider upwardly is generated. At this time, the third fork supports the third fork contact surface, on the upper surface at the back end of the slider. Thus, upward movement of the slider butt is prevented. Further, in a state in which the tongues close

the hook, by the force from the stitch loop, a force which bounces the slider butt upwardly is generated. This force is supported by the contact between the second fork contact surface and the second fork of the needle member.

5 Thus, bouncing of the slider butt can be prevented. Since unwanted upward movement of the slider butt is prevented, it is possible to accurately limit the height of the slider butt. Therefore, operation of the slider becomes easy. The height of the slider butt is limited by the second fork, 10 the third fork, and the second fork contact surface and the third fork contact surface. These members can be formed with sufficient strength. Therefore, improvement in the reliability and durability of the needle spring is achieved.

15 **[0026]** The back half of the slider is formed to have substantially the same thickness from the third fork contact surface to the second fork contact surface. In the structure, the strength of this portion is increased, and improvement in the durability of the slider is achieved.

20 **[0027]** The slider is separated into two parts on the left side and the right side from a position below the second fork contact surface to the through slit, and the upper surface and the lower surface of the slider are cut at the through slit. In this manner, the slider can be fabricated 25 easily by cutting. Further, by separating the slider at a position below the second fork contact surface into the two left and right parts, the border between the solid portion near the slider butt and the portion having the two left and right parts near the through slit becomes long. 30 Therefore, damage due to the stress concentration to the border can be prevented.

[0028] The tapered portions oriented obliquely from the upper back to the lower front are provided at the back end of the second fork and at the front end of the second 35 fork contact surface. In the structure, it is possible to smoothly guide the second fork contact surface under the second fork. Likewise, the tapered portions oriented obliquely from the front to the lower back are provided at the front end of the third fork and the back end of the third 40 fork contact surface. In the structure, it is possible to smoothly guide the third fork contact surface by the lower surface of the third fork.

[0029] At the position where the hook is closed, while the tongues are held by the stitch loop, a force is applied 45 from the stitch loop to the tongues to cause flexure in the lateral direction. Therefore, preferably, at the expanded portion of the upper surface of the needle member on the hook side, the bottom of the solid portion above the skirt is supported by the upper surface of the needle 50 member. It should be noted that the position of the upper surface of the needle member supporting the bottom of the solid portion is referred to as the support portion. Since the distance between the tongues and the support portion is small, it is possible to improve the rigidity of the 55 tongues, and prevent flexure deformation or the like of the tongues. Thus, at the time of knitting using a hard knitting yarn or knitting a yarn in dense stitches, knitting operation can be performed easily.

[0030] The borderline of the solid portion of the front half of the slider, on the hook side, extending from the upper front to the lower back will be considered. The borderline is a borderline between the tongues and the skirt separated into two parts, and the solid portion. When the tongues close the hook, and part of the expanded portion near the hook contacts the recess as the support portion to support the bottom of the solid portion of the slider, the recess can be provided at a position relatively close to the tongues. Therefore, improvement in the rigidity of the tongues is achieved.

Brief Description of the Drawings

[0031]

FIG. 1 is a side view showing main parts of a needle member of a compound needle according to an embodiment.

FIG. 2 is a plan view showing a needle body in FIG. 1.

FIG. 3 is a side view showing main parts of a needle member of a compound needle according to a modified embodiment.

FIG. 4 is a plan view showing a slider of the compound needle according to the embodiment.

FIG. 5 is a side view showing the slider in FIG. 4.

FIG. 6 is an enlarged side view showing main parts in FIG. 5.

FIG. 7 is an enlarged side view showing a second fork and a third fork of the needle member and a second fork contact surface and a third fork contact surface of a slider in the compound needle according to the modified embodiment.

FIG. 8 is a side view showing a state in which the needle member has moved forward in the compound needle according to the modified embodiment.

FIG. 9 is a side view showing a state in which a hook of the needle member is closed by tongues of the slider in the compound needle according to the modified embodiment.

FIG. 10 is a side view showing a state in which the slider has moved further forward from the state in FIG. 9 in the compound needle according to the modified embodiment.

FIG. 11 is an enlarged view showing the state of the compound needle in FIG. 9.

Embodiment

[0032] Hereinafter, embodiments in the most preferred form for carrying out the present invention will be described.

[0033] An embodiment and its modified embodiment will be described with reference to FIGS. 1 to 11. FIGS. 1 and 2 show a needle member according to a first embodiment. The needle member 2 includes a main body 4 and an extension 6. A hook 8 is provided at the front end of the needle member 2. A branch portion 10 is pro-

vided near the center of the main body 4. On the upper side of the main body 4, the branch portion 10 is branched into a first fork 12 on the front side, and a second fork 14 on the back side. The lower surface of the first fork 12 on the front side of the branch portion 10 forms a guide 13 for guiding the upper surface of a slider. The lower surface of the second fork 14 on the back side of the branch portion 10 forms a guide surface 15. The needle member 2 is curved upwardly from a position near the back end of the main body 4. A third fork 16 protrudes forward from a position obliquely behind, and above the back end of the main body 4. The lower surface of the third fork 16 forms a guide surface 17. At the back end of the second fork 14, a tapered portion 18 is provided. The tapered portion 18 is tapered obliquely from the upper back to the lower front. At the front end of the third fork 16, a tapered portion 19 is provided. The tapered portion 19 is tapered obliquely from the upper front to the lower back.

[0034] In the specification, the front side and the back side are defined based on the longitudinal direction of the needle member 2 or the slider 30. The hook 8 is provided on the front side, and the third fork 16 or the like are provided on the back side. The needle member 2 is accommodated in a needle bed (not shown), and slides back and forth along the needle bed. The lower side and the upper side are defined by the lower sides and upper sides in FIGS. 1, 3, and 5. Side surfaces of the needle member 2 mean two side surfaces along the longitudinal direction in FIG. 2. It should be noted that two side surfaces shown on the upper and lower sides in FIG. 4 are left and right side surfaces of the slider 30.

[0035] In the needle member 2, a cheek 20 is provided at a position slightly backward from the hook 8 where the height is increased upwardly. The cheek 20 includes a dimple portion 21. Upper part of the dimple portion 21 (upper surface of the needle member) is swelled upwardly to form an upwardly expanded surface 22. When the hook 8 is closed by tongues 32 of the slider 30, a portion of the expanded surface 22 near the hook 8 supports the bottom of a solid portion 38 of the slider 30. As shown in FIG. 2, the dimple portion 21 is provided by dimple formation process of the needle member 2 at the portion of the cheek 20. For example, the dimple portion 21 has a rectangular shape, and is oriented obliquely from the lower back to the upper front. The front side of the dimple portion 21 is on the side of the hook 8. When the hook 8 is fully opened (FIG. 8), the tongues 32, 32 are depressed into the left and right dimple portions 21, 21 such that the tongues 32, 32 do not protrude from the side surfaces of the needle member 2. A reference numeral 23 schematically denotes a needle butt for moving the needle member 2 back and forth.

[0036] The needle member 2 shown in FIGS. 1 and 2 is considerably long. Therefore, the needle member 2 cannot be processed easily, and it is laborious to fit the needle member 2 into the slider 30. A needle member 3 shown in FIG. 3 includes a main body 5 and a needle

jack 7 separately. A fitting recess 24 is provided in the main body 5, and a fitting protrusion 25 is provided in the needle jack 7. The fitting recess 24 and the fitting protrusion 25 are fitted to each other to combine the main body 5 and the needle jack 7 together. Alternatively, the fitting protrusion may be provided on the side of the needle body 5, and the fitting recess may be provided on the side of the needle jack 7. In the case of the needle member 3 in FIG. 3, since the third fork 16 is provided on the side of the needle jack 7, attachment/detachment of the slider 30 is easy, and it is possible to produce the slider 30 easily.

[0037] The difference between the needle member 2 and the needle member 3 is whether the main body and the needle jack are separated into two components or formed integrally into one piece. The needle member 2 and the needle member 3 are the same in other respects. Description about the needle member 2 is applicable to the needle member 3, and description about the needle member 3 is applicable to the needle member 2. In the embodiments, the same constituent elements are labeled with the same reference numeral.

[0038] FIGS. 4 and 5 show the slider 30. At the front end of the slider 30, a pair of left and right tongues 32, 32 are present. A slit 33 is formed between the tongues 32, 32. The tongues 32, 32 are spaced away from each other toward the left side and the right side from the slit 33 at the central position. The tongues 32, 32 are bent such that the front ends of the tongues 32, 32 contact each other. Tongues or a hook of another slider can be inserted into the slit 33. At a position slightly backward from the tongues 32, a nose 34 is present. The nose 34 is expanded upwardly for preventing backward movement of the stitch loop held by the tongues 32, beyond the nose 34. At the center of the slider 30, a through slit portion 36 is provided. At the through slit portion 36, the slider 30 is separated into the left part and the right part. A through slit 37 is formed between the left part of and the right part of the through slit portion 36. The through slit portion 36 is swelled to the left and right for generating friction with, e.g., the wall surface of the needle groove of the needle bed to prevent unwanted movement of the slider 30. A front solid portion 38 is provided on the front side of the through slit portion 36, and a back solid portion 40 is provided on the back side of the through slit portion 36. The slider 30 is solid in these solid portions 38, 40. The thickness is constant in the solid portion 38, and the thickness is constant in the solid portion 40.

[0039] A first fork contact cam surface 39 is formed on the upper surface of the solid portion 38. The first fork contact cam surface 39 contacts the guide 13 on the lower surface of the first fork 12 for limiting vertical movement of the solid portion 38. On the front side and the lower side of the solid portion 38, the slider 30 is separated into the left part and the right part to form the tongues 32, the nose 32, and a skirt 41. The skirt 41 slides on the main body 4 or 5 from a portion facing the lower side of the first fork 12 to the portion of the cheek 20. The expanded

surface 22 supports the bottom surface of the solid portion 38 to prevent the front half of the slider from being depressed.

[0040] At the center of the back solid portion 40, a slider butt 42 protrudes upwardly. A second fork contact surface 44 is present on the front side of the slider butt 42. A tapered portion 45 is formed at the front end of the second fork contact surface 44. The tapered portion 45 is oriented from the upper back to the lower front. A third fork contact surface 46 is present on the back side of the slider butt 42. A tapered portion 47 is formed at the back end of the third fork contact surface 46. The tapered portion 47 is oriented from the upper front to the lower back. A borderline 48 between the solid portion 40 and the through slit portion 36 is in parallel with the second fork contact surface 44. Since the length of the borderline 48 is large, the stress applied to the borderline 48 can be distributed broadly.

[0041] FIG. 6 is an enlarged view showing an area around the solid portion 38 in the front half of the slider 30. The borderline 50 is an oblique borderline on the front side of the solid portion 38. The tongues 32 and the nose 34 are provided on the front side of the solid portion 38. An upwardly curved recess 52 is formed on the back side of the borderline 50. The front half of the recess 52 forms a support portion 53. When the tongues 32 hold a stitch loop, and the hook 8 is closed, the support portion 53 contacts the expanded surface 22 to prevent flexure deformation of the tongues 32. In the structure, the expanded surface 22 is positioned on the upper front half of the dimple portion 21. Since the distance between the support portion 53 and the tongues 32 is small, it is possible to improve the rigidity of the tongues 32.

[0042] FIG. 7 shows the relationship between the second fork 14 and the second fork contact surface 44, and the relationship between the third fork 16 and the third fork contact surface 46. When the slider 30 has moved forward, the second fork contact surface 44 is supported by the second fork 14. When the slider 30 has moved back, the third fork contact surface 46 is supported by the third fork 16. When the second fork contact surface 44 contacts the second fork 14, or the third fork contact surface 46 contacts the third fork 16, the solid portion 40 is guided by the tapered portions 18, 45 or the tapered portions 19, 47. Further, the solid portion 40 is solid having the constant thickness in the wide range extending from the third fork contact surface 46 to the second fork contact surface 44. Therefore, the strength of the solid portion 40 is high. Further, the stress applied to the border between the solid portion 40 and the through slit portion 36 is distributed by making the borderline 48 longer.

[0043] FIGS. 8 to 10 show three states of the compound needle. A reference numeral 60 denotes a metal band on the needle bed side. The metal band 60 contacts the upper surface of the first fork 12 or the upper surface of the second fork 14 to prevent the compound needle from floating above the needle groove of the needle bed.

[0044] FIG. 8 shows a state in which the hook 8 has

moved forward to the front end position, and the slider 30 has moved back to the back end position with respect to the needle member. At this time, the guide 13 at the lower surface of the first fork 12 applies a force to push the first fork contact cam surface 39 downwardly, and the force is operated to move the slider butt 42 upwardly. In the meanwhile, the third fork contact surface 46 contacts the third fork 16 to prevent the slider butt 42 from moving upwardly. At this time, the tongues 32 are depressed into the left and right dimple portions 21 of the needle main body 2, and do not protrude to the sides of the needle main body 2. Therefore, the stitch on the hook 8 can be transferred to the tongues 32 easily.

[0045] As shown in FIG. 9, in a state in which the tongues 32 close the hook 8, by the force from a stitch loop held by the tongues 32 or the like, a force which bounces the slider butt 42 upwardly is generated. This force is supported by the second fork contact surface 44 and the second fork 14 to prevent the unwanted upward movement of the slider butt 42. This mechanism is also applicable to a case of FIG. 10 in which the tongues 32 have moved further forward. FIG. 10 shows a state in which the slider 30 has moved forward to the front end position with respect to the needle member 3.

[0046] FIG. 11 is an enlarged view showing the state of FIG. 9. A stitch loop 62 is held by the tongues 32. Since tension is applied to the knitted fabric, e.g., by racking operation of the needle bed or drawing the knitted fabric downwardly, a force in the left-right direction is applied to the tongues 32. Further, a force is applied from the stitch loop 62 to the tongues 32 downwardly. At the tongues 32, the slider 30 is separated into the left part and the right part. Therefore, the rigidity of the tongues 32 is low. For example, this is required for moving the stitch loop by inserting tongues or a hook of another compound needle into the gap between the tongues 32, 32. The support portion 53 is positioned slightly backward from the oblique borderline 50 at the front of the solid portion 38. The support portion 53 contacts the expanded surface 22 on the side of the needle member 3. Thus, the bottom surface of the solid portion 38 is supported. In this manner, the distance between the support portion 53 and the tongues 32 is reduced, and flexure deformation of the tongues 32 is prevented.

[0047] In the embodiments, the following advantages are obtained.

(1) It is possible to limit vertical movement of the slider by the first to third fork, the first fork contact cam surface, and the second and third fork contact surfaces. In particular, it is possible to limit the force to move the slider butt upwardly by the second fork and the third fork or the like, and accurately limit the height of the slider butt.

(2) Since the portion, ranging from the third fork to the slider butt and to the second fork, is formed to have the constant thickness, the strength of this portion is high.

(3) When a force is applied from the stitch loop to the tongues, the slider is supported at a position near the tongues. Therefore, flexure deformation of the tongues is small. Thus, at the time of knitting using a hard knitting yarn or knitting a yarn in dense stitches, knitting operation can be performed stably.

Brief Description of the Symbols

10 [0048]

2, 3	Needle Member
4, 5	Main Body
6	Extension
8	Hook
10	Branch Portion
12	First Fork
14	Second Fork
13	Guide
14	Second Fork
16	Third Fork
15, 17	Guide Surface
18, 19	Tapered Portion
20	Cheek
21	Dimple Portion
22	Expanded Surface
23	Needle Butt
24	Fitting Recess
25	Fitting Protrusion
30	Slider
32	Tongue
33	Slit
34	Nose
36	Through Slit Portion
37	Through Slit
38,40	Solid Portion
39	First Fork Contact Cam Surface
41	Skirt
42	Slider Butt
44	Second Fork Contact Surface
46	Third Fork Contact Surface
45,47	Tapered Portion
48,50	Borderline
52	Recess
53	Support Portion
60	Metal Band
62	Stitch Loop

50 Claims

1. A compound needle comprising: a needle member having a hook at a front end of the needle member; and a slider slidable over the needle member and having tongues at a front end of the slider, the needle member and the slider being movable independently for formation and transferring of knit stitches, **characterized in that**

the needle member comprises a first fork, a second fork and a third fork;

the first fork protrudes from a branch portion toward the hook, the branch portion is branched upwardly from a substantially central position of a region of the needle member where the slider slides, and a front half of the slider is sandwiched between the first fork and the needle member such that the slider is guided by the lower surface of the first fork to limit vertical movement of the front half of the slider;

the second fork protrudes from the branch portion toward an upper back position of the needle member, and toward a butt of the slider such that the slider is guided by the lower surface of the second fork at a position where the slider has moved forward relative to the needle member;

the third fork is branched forward from a position behind the butt of the slider of the needle member, and faces the second fork such that the slider is guided by the lower surface of the third fork at a position where the slider has moved back relative to the needle member; and

the second fork and the third fork limit vertical movement of the back half of the slider, **and that**

the slider comprises the butt, a slit, a first fork contact cam surface, a second fork contact surface and a third fork contact surface;

the butt is provided in the back half of the slider;

the slit vertically passes through the slider at a position ahead of the butt, and the branch portion of the needle member passes through the slit;

the first fork contact cam surface is provided on the upper surface of the front half of the slider at a position ahead of the slit to be guided by the lower surface of the first fork;

the second fork contact surface is provided on the upper surface of the back half of the slider at a position ahead of the butt of the slider to be guided by the lower surface of the second fork; and

the third fork contact surface is provided on the upper surface at the back end of the slider behind the butt of the slider to be guided by the lower surface of the third fork.

2. The compound needle of claim 1, **characterized in that** the back half of the slider is solid and has substantially the same thickness from the third fork contact surface to the second fork contact surface.

3. The compound needle of claim 1, **characterized in that** the slider is separated into two parts on the left side and the right side from a position below the second fork contact surface to the slit, and the upper surface and the lower surface of the slider are cut at the slit to form the slit.

4. The compound needle of claim 1, **characterized in that** an oblique tapered portion oriented from the

upper back to the lower front is provided at a back end of the second fork;

an oblique tapered portion oriented from the upper front to the lower back is provided at a front end of the third fork;

an oblique tapered portion oriented from the upper back to the lower front is provided at a front end of the second fork contact surface; and

an oblique tapered portion oriented from the upper front to the lower back is provided at a back end of the third fork contact surface.

5. The compound needle of claim 1, **characterized in that** the upper surface of the needle member includes an expanded portion expanded upwardly at a position behind the hook of the needle member; an upper part of the front half of the slider forms a solid portion, and a lower part of the front half of the slider forms a skirt separated into two parts; and when the tongues close the hook, a support portion provided at the bottom of the solid portion above the skirt is supported by a hook side position of the expanded portion.

6. The compound needle of claim 5, **characterized in that**, in the front half of the slider, the bottom of the solid portion around the support portion forms a recess which is curved upwardly, and the recess is provided behind a borderline extending from the upper front to the lower back at the front end on the hook side of the solid portion.

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Fig. 1

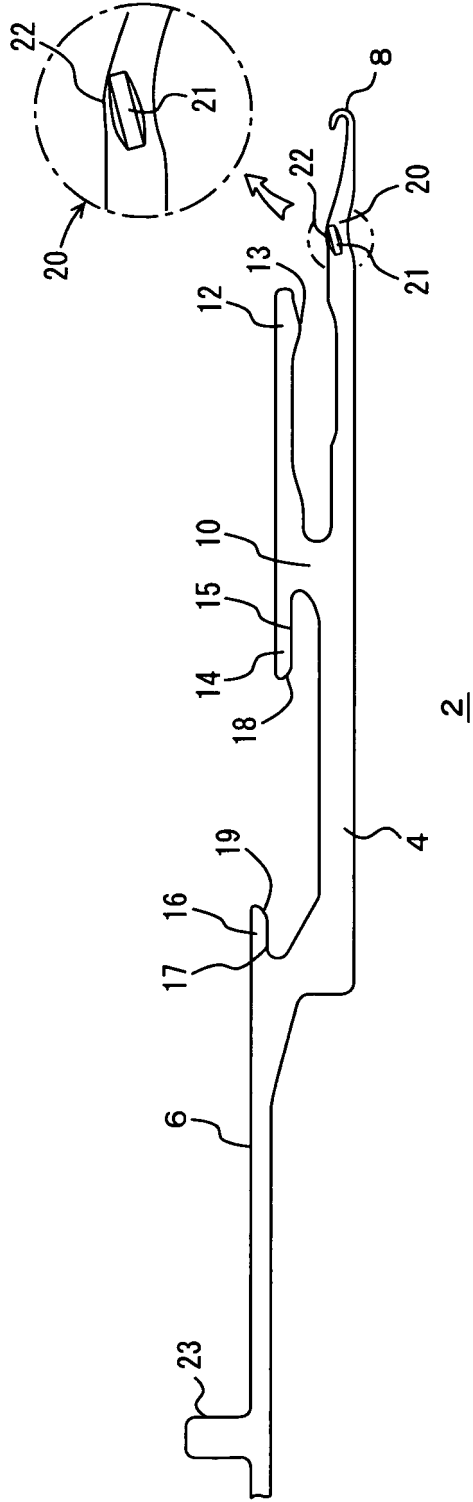
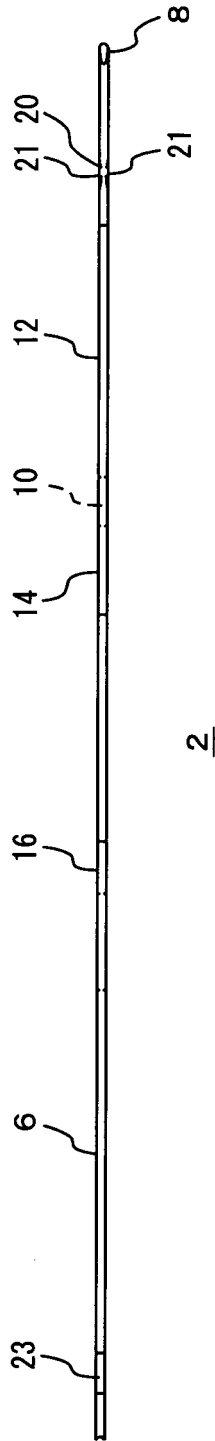


Fig. 2



2

Fig. 3

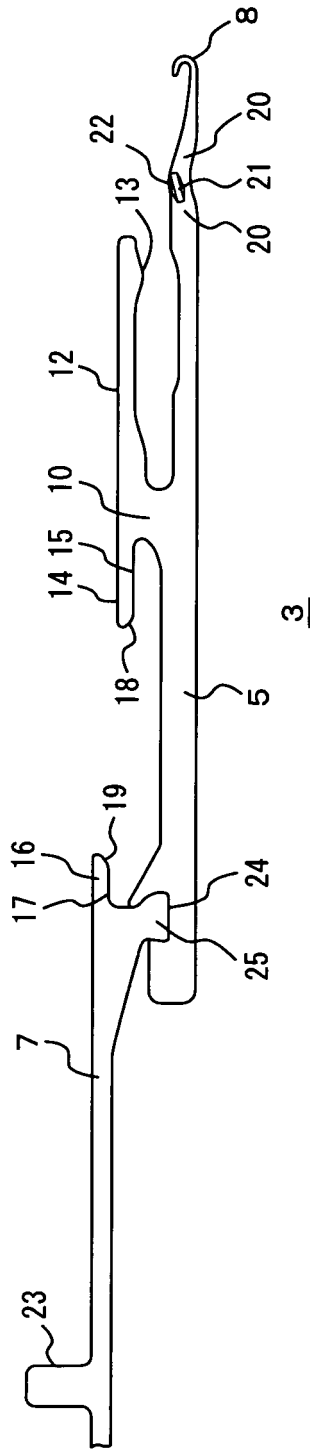


Fig. 4

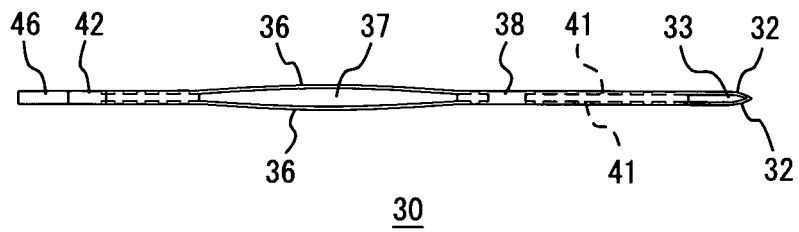


Fig. 5

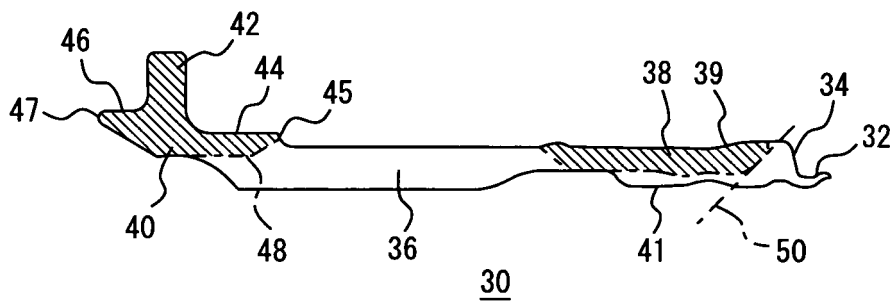


Fig. 6

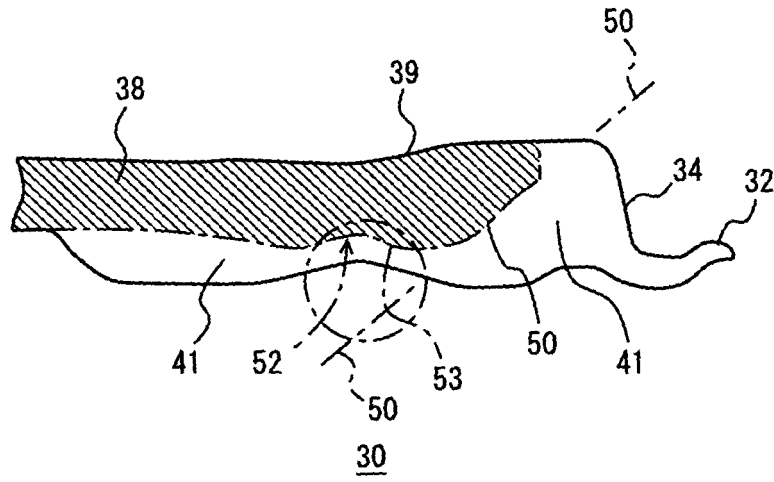


Fig. 7

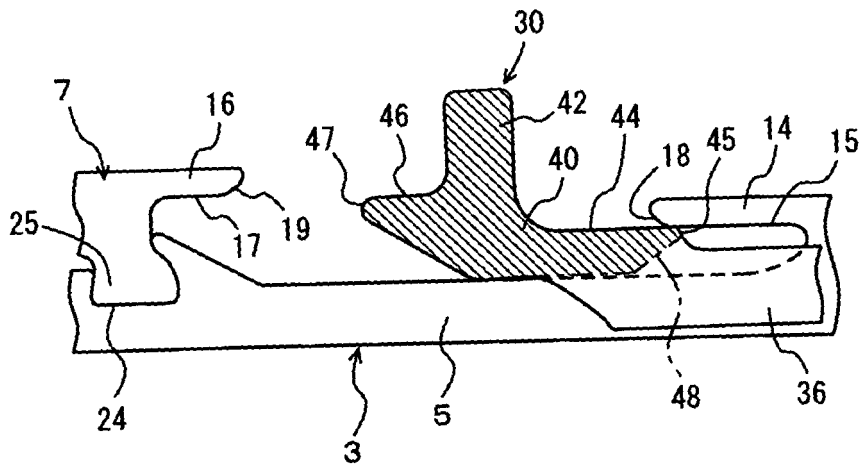


Fig. 8

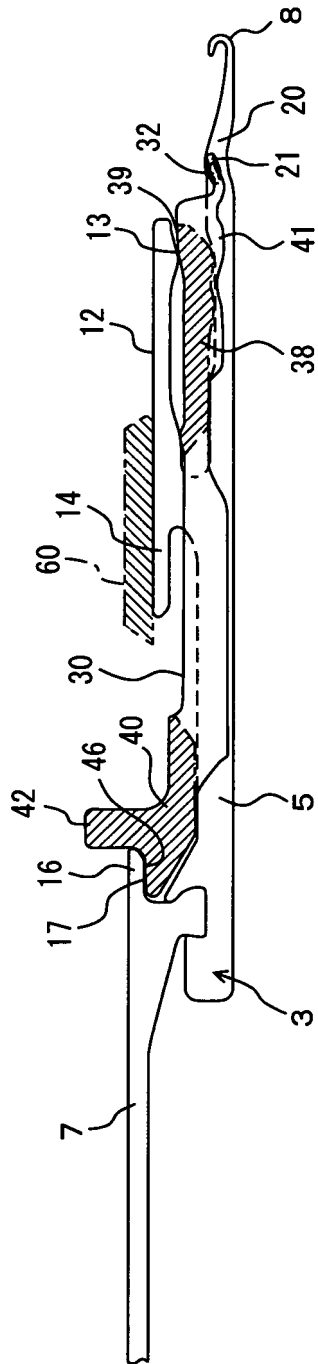


Fig. 9

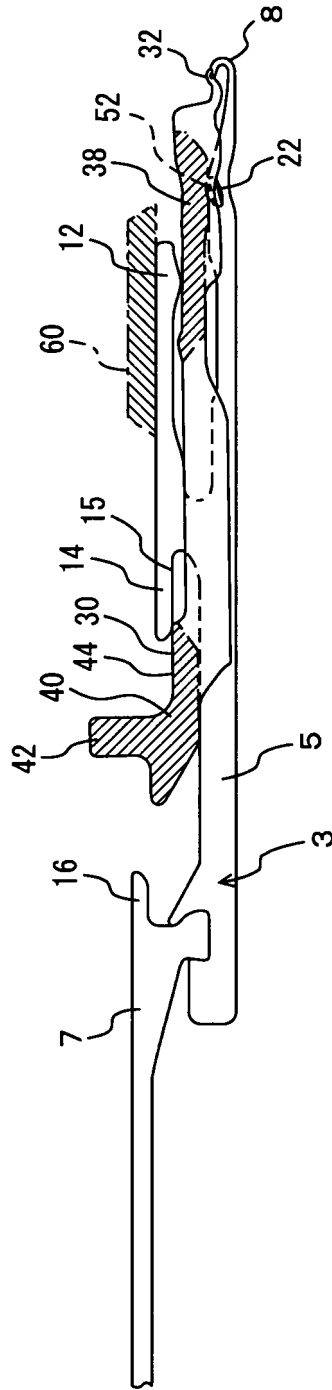


Fig. 10

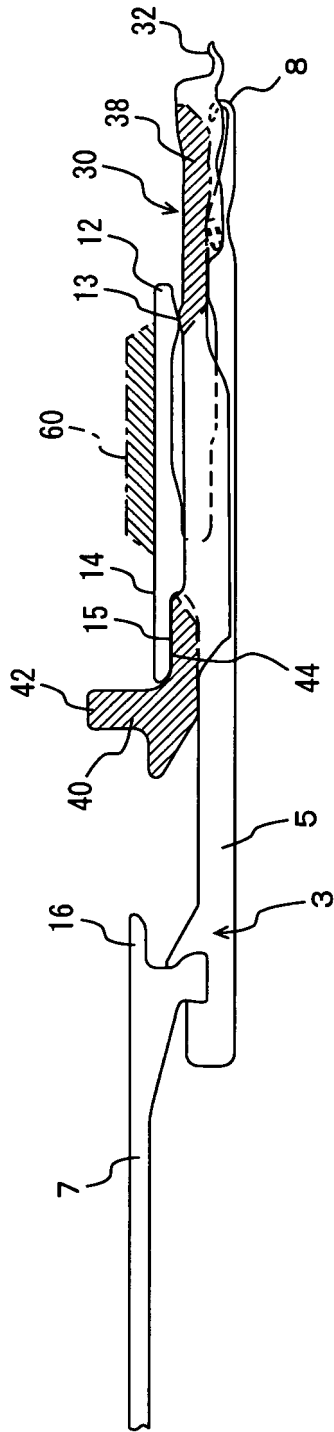
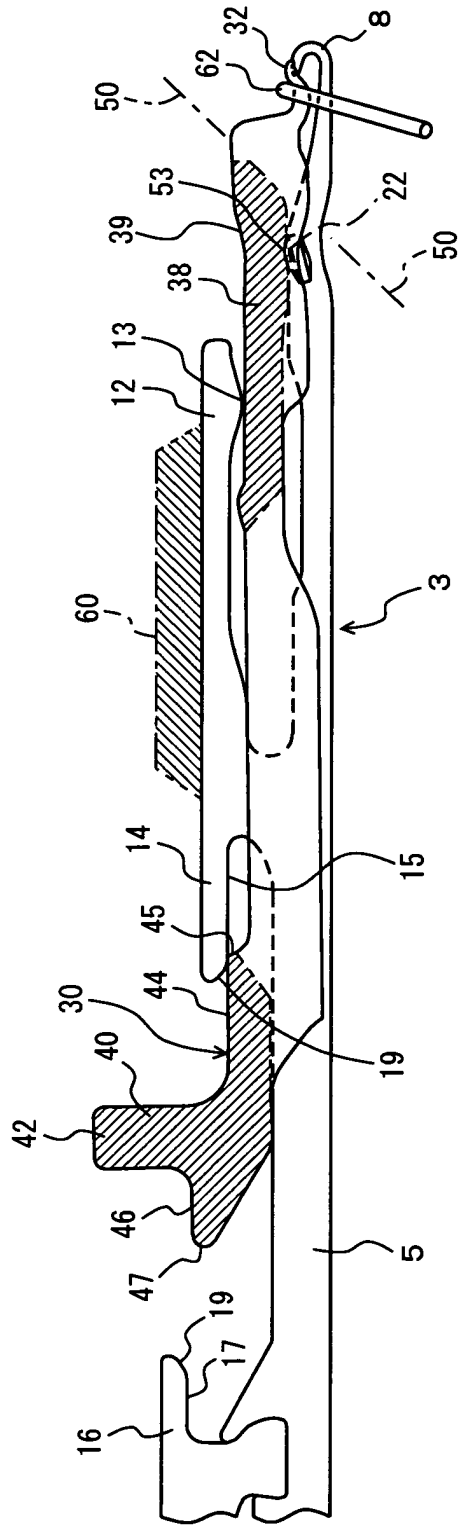


Fig. 11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2004/008123

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ D04B35/06		
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) Int.Cl ⁷ D04B35/06		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2004 Kokai Jitsuyo Shinan Koho 1971-2004 Jitsuyo Shinan Toroku Koho 1996-2004		
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 2002-294541 A (Shima Seiki Mfg., Ltd.), 09 October, 2002 (09.10.02), & EP 1233093 A1 & US 6510712 B & BR 200461 A & CN 1372028 A & EA 4389 A & FR 2821093 A & TW 553231 Y	1-6
A	JP 2001-32154 A (Shima Seiki Mfg., Ltd.), 06 February, 2001 (06.02.01), (Family: none)	1-6
A	JP 1-54459 B2 (Shibata Seishin Kabushiki Kaisha), 20 November, 1989 (20.11.89), (Family: none)	1-6
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> 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	"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	
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Date of the actual completion of the international search 16 August, 2004 (16.08.04)	Date of mailing of the international search report 31 August, 2004 (31.08.04)	
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer	
Facsimile No.	Telephone No.	

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/008123

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 01/031101 A1 (Shima Seiki Mfg., Ltd.), 03 May, 2001 (03.05.01), & EP 1229158 A1 & US 6568223 B & TW 477845 A	1-6