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

(11) EP 0 979 892 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.02.2000 Bulletin 2000/07

(51) Int. Cl.[7]: **D04B 7/22**

(21) Application number: **99107832.0**

(22) Date of filing: **20.04.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **05.08.1998 JP 22178298**

(71) Applicant:
TSUDAKOMA KOGYO KABUSHIKI KAISHA
Kanazawa-shi Ishikawa-Ken (JP)

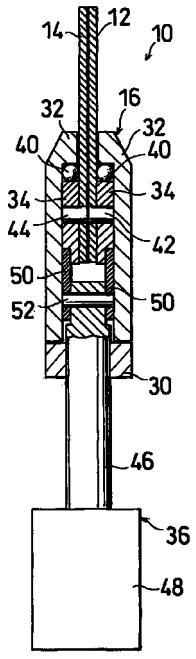
(72) Inventors:
- **Maenaka, Koyu**
  Matto-shi, Ishikawa-ken (JP)
- **Hirai, Jun**
  Ishikawa-gun, Ishikawa-ken (JP)

(74) Representative:
Turi, Michael, Dipl.-Phys. et al
Samson & Partner
Widenmayerstrasse 5
80538 München (DE)

(54) Set up device of flat knitting machine and set up method by using the same

(57) In a set up device for use in a flat knitting machine, first and second set up combs each having a plurality of upwardly extending comb teeth are used, wherein at least one of the first and second set up combs is provided with hooks extending either rightward or leftward formed at the tip ends of two or more comb teeth. The knitting yarn can be restrained in the dosed space formed by the set up combs or released therefrom by moving the first and second set up combs relatively in the lateral direction.

FIG. 1



EP 0 979 892 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a set up device for use in a flat knitting machine including front and rear needle beds and also relates to a set up method using the above set up device.

2. Description of the Prior Art

[0002] One of set up devices of this kind is disclosed in Japanese Patent Publication Disclosure (KOKOKU) No. 3-77298 wherein the set up device hooks knitting yarns of first and second courses to zigzag on a plurality of knitting needles provided on front and rear needle beds and catches the knitting yarns of both courses by the intersecting portions thereof and downwardly moves them by means of set up combs which are arranged so as to move up and down though a gap between the front and rear needle beds of a flat knitting machine. In the following description, the above gap is simply described as "the gap."

[0003] In the above conventional set up device, the set up comb includes a comb head in the shape of a slender plate which extends in the left-and-right direction (i.e. the moving direction of a yarn carrier), and a great number of set up needles which are arranged in parallel with the comb head.

[0004] Each of these set up needles includes a slender needle body which is arranged on the comb head so as to extend in the direction of the width (the up-and-down direction) of the comb head and a slender slider which is arranged on the needle body so as to move in the longitudinal direction of the needle body. The slider includes, at its upper end, a hook which projects forwardly, and the needle body includes, at its upper end, a projection for housing the hook (described as "housing projection" hereinafter). The upper end face of the housing projection is made in the form of a forwardly declining slope, while the lower end face of the same is made in the form of a forwardly rising slope.

[0005] The set up method using the set up device as described above is carried out as follows: firstly, hooking the knitting yarn of the course 1 to zigzag on a plurality of knitting needles on the front and rear needle beds, thereby executing the knitting of the yarn of the first course; secondly, hooking the knitting yarn of the second course to zigzag on a plurality of knitting needles on the front and rear needle beds, which are different from the plurality of previous knitting needles, such that the yarn of the second course intersects the knitting yarn of the first course in the gap, thereby knitting the yarn of the second course; then, upwardly moving each upper end of the set up needles so as to pass through the space formed between the rear needle bed and the intersecting portion of the knitting yarns with the hook held in the housing projection; and finally, moving the set up needles downwardly with the hook projecting out from the housing projection.

[0006] While the set up needles are moved upwardly, the knitting yarn comes into contact with the upper end face of the housing projection and is carried forward to exceed the front end of the housing projection. When the upward movement of the set up needles is completed, the intersecting portion of the knitting yarns comes under the hook. After this, the hook is made to project out from the housing projection. Therefore, when the set up needles are moved downwardly, the knitting yarns come to engage with the set up needles to be moved downwardly during the downward movement of the set up needles.

[0007] After the processes as described above, a pertinent knitting such as a tubular knitting of several courses is performed and, then, a predetermined knitting is commenced. After carrying out the knitting of a predetermined number of courses, the set up comb moves the slider downwardly, and the knitting yarn comes to the front side of the hook, whereby the knitting yarns are released from the hook.

[0008] In case of the above-mentioned set up device, however, the space between the rear needle bed and the intersecting portion made by the knitting yarns of the first and second courses is rather narrow, so that it is hard for the tip end of the set up needle to accurately pass through the space. For this, the knitting yarn cannot be certainly caught by the hook.

[0009] Consequently, even if the knitting yarn is caught by the hook, the knitting yarn is apt to get out of the hook with ease, and catching of the knitting yarn is not stabilized. Especially, since a fabric tends, in general, to make the knitted fabric width as narrower as possible, the knitting yarns engaging with the hooks, especially the hooks on or near the both sides of the knitted fabric, are apt to pull the hooks toward the center of the fabric in the direction of its width and to bend the hooks toward the center of the fabric width. If the hooks are bent, the knitting yarn more easily gets out of the hooks. Consequently in order to prevent the hook from being bent, it is required to increase the thickness of the slider including the hook and the needle body, that is, the set up needle itself. However, as the space described above is narrow, the thickness of the set up needle has to be naturally limited, and it is not allowed to freely set the strength of the set up needle to a desired value.

[0010] Unless the set up needle is formed with a desired strength, it is deformed toward the center of the fabric width, and the knitted fabric cannot be moved downwardly with uniformity over its entire width. In order to enlarge the space as described above, the needle draw-off structure (interlock structure) should be limited to 3×1.

[0011] In the prior art set up device as described

above, the knitting yarn is only passively got out of the hook by making use of the upwardly slanting lower end face of the housing projection. Consequently, it sometimes happens that the knitting yarn is kept engaged with the housing projection and fails to be released from the knitting needle.

[0012] Therefore, in the flat knitting machine, one of its most important characteristics is that catching and releasing of the knitting yarn by the set up means can be carried out with certainty.

SUMMARY OF THE INVENTION

[0013] A set up device according to the invention comprises the first and second set up combs, each of which includes a plurality of comb teeth extending upwardly, and a driving device capable of making the first and second set up combs move up and down in regard to the gap of the flat knitting machine and also making them relatively shift to the right-and-left direction. The first and second set up combs are arranged in parallel in the front-rear direction. Two or more comb teeth of at least one of the first and second set up combs have one hook each that extends either in the rightward or leftward direction, and the hooks of two or more comb teeth provided on identical set up combs are formed so as to extend in the same direction. In case both of the first and second set up combs include two or more comb teeth having one hook each, the hooks of the comb teeth on the first set up comb and the hooks of the comb teeth on the second set up comb may be arranged so as to mutually extend in opposite directions. The hook may be formed on all the comb teeth so as to cover the entire width of the knitted fabric.

[0014] Furthermore, according to the invention, there is provided a set up method using the above-mentioned set up device. The set up method includes the steps of: firstly, moving a yarn carrier either rightward or leftward and advancing a plurality of knitting needles on the front and rear needle beds, thereby hooking a knitting yarn of the first course to zigzag on the advanced knitting needles on the front and rear needle beds; secondly, moving a yarn carrier either rightward or leftward to advance a plurality of other knitting needles on the front and rear needle beds, which are different from the plurality of previously advanced knitting needles on the front and rear needle beds, thereby hooking a knitting yarn of the second course to zigzag on the other knitting needles on the front and rear needle beds such that the knitting yarn of the second course intersects the knitting yarn of the first course to form intersecting portions in the gap of the flat knitting machine; and thirdly, upwardly moving the first and second set up combs such that each of the comb teeth of the first and second set up combs comes to be put between two neighboring intersecting portions. At this time, the comb teeth having one hook each provided on one of the first and second set up combs and the comb teeth having one hook each provided on the other set up comb, come to exist as a pair thereof between the above neighboring intersecting portions.

[0015] Subsequently, according to the set up method of the invention, the first and second set up combs are relatively moved in the right-and-Left direction, thereby catching the knitting yarns of the first and second courses by the comb teeth of the first and second set up combs and further downwardly moving the first and second set up combs.

[0016] Each of the comb teeth of the first and second set up combs is made to pass through the space between two neighboring intersecting portions of the knitting yarns. For this, the space allowing each comb tooth to pass therethrough is made so wide that the comb tooth can certainly pass with ease through the space between two neighboring intersecting portions of the knitting yarns. As the space allowing the comb tooth to pass therethrough is made wider, each comb tooth can be enlarged in size, thereby enhancing the rigidity of the comb tooth and also to prevent deformation of the comb tooth caused by the knitted fabric as described above. Consequently, the knitted fabric can be uniformly moved downwardly over the entire width thereof.

[0017] By shifting the first and second set up comb either rightward or leftward, the intersecting portion formed by both of the knitting yarns is relatively brought under the lower side of the hook and, at the same time, the space under the hook is surrounded by the tooth having a hook (of the first or second set up comb) and the tooth of the other set up comb (the second or first). In this case, the above tooth of the other set up comb (the second or first) is defined as a tooth that is in the position next in the projecting direction of the hook relative to one tooth overlapped by the hook. In this manner, both of set up combs catch the knitting yarns by their intersecting portion or its vicinity. While the set up combs catch the knitting yarns, the closed space for catching the knitting yarns is formed under each hook, thus catching the knitting yarns in the closed space with certainty. The knitting yarns can be released from the closed space by relatively shifting the first and second set up combs in the direction opposite to the direction as described above.

[0018] Therefore, according to the invention, the knitting yarns of both courses can be caught by or released from the hooks by relatively shifting the first and second set up combs in the right-and-left direction, thereby realizing the exact and stable catching and releasing of the knitting yarns.

[0019] Among at least the other of the comb teeth of the first and second set up combs, each comb tooth corresponding to the comb tooth having the hook of the at least one of said first and second set up combs and the comb teeth positioned at the side where said hook extends relative to the comb teeth respectively include edge portions extending at least from the position corresponding to the lower end edge of the hook to the lower end of the comb tooth at the side of the comb tooth hav-

ing the hook. With this, when the first and second comb teeth are relatively shifted either rightward or leftward, a complete space is formed under the hooks, so that the knitting yarns can be caught more exactly Further, when the first and second set up combs are relatively shifted in opposite directions, the knitting yarns engaged with the hooks of one set up comb are forcibly pushed out by the comb teeth of the other set up comb to be forcibly pushed out of the hook. As a result, the knitting yarns can be released more exactly. The first and second set up combs are moved by the driving device such that the comb teeth pass through the gap. The upper face of each comb tooth has a mountain-like shape declining toward widthwise both ends.

[0020] The set up method of the invention may further include the steps of performing the knitting of a third and subsequent courses with the set up combs moved downwardly and relatively shifting the first and second set up combs in the direction opposite to the direction described above after carrying out the knitting of a predetermined number of courses, thereby releasing the knitting yarns of the first and second courses from the comb teeth. A first yarn carrier is moved either rightward or leftward, and a first group of knitting needles disposed on the front and rear needle beds are advanced or withdrawn, thereby hooking a knitting yarn of the first course to zigzag on the first group of knitting needles. Then the first yarn carrier or a second yarn carrier is moved either rightward or leftward, and a second group of knitting needles other than the first group of the knitting needles are advanced or withdrawn, thereby hooking a knitting yarn of the second course to zigzag on the second group of the knitting needles so as to intersect the knitting yarn of the first course to form intersecting portions in the gap of the flat knitting machine. In that state, the first and second set up combs are upwardly moved so that the comb teeth may come between the intersecting portions of the first and second knitting yarns. Next, the first and second set up combs are relatively moved in the lateral direction, and the knitting yarns of the first and second courses are caught by means of the first and second set up comb teeth. Lastly, the first and second set up combs are downwardly moved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a sectional view of a set up device according to an embodiment of the invention.

Fig. 2 is an exploded perspective view of the principal part of the set up device as shown in Fig. 1.

Fig. 3 shows an embodiment of a slider and a coupling piece in the set up device as shown in Fig. 1.

Fig. 4 is a perspective view for showing the relationship among a base, a rod and a slider in the set up device as shown in Fig 1.

Figs. 5(A) to 5(E) are illustrations showing the first embodiment of set up combs and explaining the first embodiment of a set up method.

Figs. 6(A), 6(B) and 6(C) are plan views of the gap of a flat knitting machine for explaining the first embodiment of the set up method using the set up device as shown in Fig. 1.

Figs. 7(A), 7(B) and 7(C) are illustrations for explaining the subsequent knitting processes according to the set up method as shown in Fig. 6(C).

Figs. 8(A), 8(B) and 8(C) are illustrations for explaining a process carried out in place of the process as shown in Fig. 7(C).

Figs. 9(A), 9(B) and 9(C) are plan views of the gap of a flat knitting machine for explaining the second embodiment of the set up method.

Figs. 10(A), 10(B) and 10(C) are illustrations for explaining the subsequent knitting processes according to the set up method as shown in Fig. 9.

Fig. 11(A), 11(B) and 11(C) are an illustration for explaining a process carried out in place of the process as shown in Fig. 10(C).

Fig. 12 is an illustration showing a main part of a horizontal driving mechanism according to the second embodiment.

Fig. 13 is an illustration showing a main part of a horizontal driving mechanism according to the third embodiment.

Fig. 14 is an illustration showing a main part of a horizontal driving mechanism according to the fourth embodiment.

Fig. 15 is an illustration showing a main part of a horizontal driving mechanism according to the fifth embodiment.

Fig. 16 is an illustration showing a main part of a horizontal driving mechanism according to the sixth embodiment.

Figs. 17(A) and 17(B) are illustrations showing set up combs according to the second embodiment.

Figs. 18(A) and 18(B) are illustrations showing set up combs according to the third embodiment.

Figs. 19(A) and 19(B) are illustrations showing set up combs according to the fourth embodiment.

Figs. 20(A) and 20(B) are illustrations showing set up combs according to the fifth embodiment.

Fig. 21 is an illustration showing set up combs according to the sixth embodiment.

Fig. 22 is an illustration showing set up combs according to the seventh embodiment.

Figs. 23(A) to 23(H) are illustrations for explaining an embodiment of the set up method using the set up comb as shown in Fig. 22.

Figs. 24(A), 24(B) and 24(C) are illustrations showing set up combs according to the eighth embodiment.

Fig. 25 is an illustration showing set up combs according to the ninth embodiment.

Figs. 26(A), 26(B) and 26(C) are illustrations showing set up combs according to the tenth embodiment.

Fig. 27 is an illustration showing set up combs according to the eleventh embodiment.

Figs. 28(A) and 28(B) are illustrations showing set up combs according to the twelfth embodiment.

Figs. 29(A) and 29(B) are illustrations showing set up combs according to the thirteenth and fourteenth embodiments.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Referring now to Fig. 1, there is shown a set up device 10 which is arranged under the gap between the opposing front and rear needle beds of the flat knitting machine (not shown). The set up device 10 includes the first and second set up combs 12 and 14 and a driving device 16 which drives the first and second set up combs 12 and 14 in the left-and-right direction (i.e. the direction along the width of the knitted fabric) as well as in the vertical or up-and-down direction.

[0023] In the following description, expressions 'the direction along the width of the knitted fabric' and 'the left-and-right direction' will be described as "the lateral direction," while the direction perpendicular thereto, that is, the direction that the front and rear needle beds oppose to each other will be described as "the front-rear-direction."

[0024] As illustrated in Fig. 5, the fist and second set up boards or the first and second set up combs 12 and 14 are respectively provided with a plurality of comb teeth 22 and 24, which are respectively extending upwardly from one edge of elongated plate-like base portions 18 and 20 of the set up combs.

[0025] The comb teeth 22 and 24 are arranged respectively on the base portions 18 and 20 at a predetermined interval in the longitudinal direction. The comb teeth 22 and 24 include respectively hooks 26 and 28 which extend in the same direction either rightward or leftward; for instance, the hooks 26 extend to the right, while the hooks 28 extend to the left or vice versa. Each upper face of the comb teeth 22 and 24 is formed so as to draw a mountain-like shape, of which the ridgeline including each upper face of the hooks 26 and 28 gently slopes down toward both side edges of the comb tooth. Each lower face of the hooks 26 and 28 is formed so as to make a slope slanting down toward the tip of the hook. The comb teeth 22 and 24 are the same in shape and size except the direction of the extension of the hooks.

[0026] The edges 22a and 24a at the sides of the hooks 26 and 28 of the comb teeth 22 and 24 extend from the base portions 18 and 20 up to the hooks 26 and 28, respectively, and contribute to catching of the knitting yarns. Contrary to this, the edges 22b and 24b opposite to the sides of the hooks 26 and 28, respectively, extend from the base portions 18 and 20 up to the level higher than that of the hooks 26 and 28 but have no direct contribution to catching of the knitting yarns.

[0027] The first and second set up combs 12 and 14 are coupled perpendicularly with the driving device 16 so as to be arranged in parallel in the front-rear direction such that the hooks 26 and 28 are projected in opposite directions to each other.

[0028] As shown in Figs. 1 though 4, the driving device 16 includes a base 30 extending in the lateral direction of the flat knitting machine, a pair of guides 32 coupled with the base 30 so as to oppose to each other, a pair of sliders 34 in the shape of an elongated plate disposed the guides 32 so as to be movable in the lateral direction, a horizontal driving mechanism 36 for driving both of sliders 34 in the lateral direction, and a vertical driving mechanism (not shown) for driving the base 30 and the horizontal driving mechanism 36 as well in the vertical direction.

[0029] The base 30 is supported at both the left and right ends thereof by the vertical driving mechanism. The pair of guides 32 are connected with each other by means of one or more connecting pins 38 so as to form, in cooperation with the base 30, a space extending in the lateral direction of the flat knitting machine. Each of sliders 34 is arranged in the space formed by each of the guides 32 so as to extend in the lateral direction of the flat knitting machine and to oppose to each other at a predetermined interval in the front-rear direction.

[0030] In order to reciprocate the slider 34 smoothly, a plurality of balls 40 are disposed between the upper portion of the slider 34 and the upper inside face of the guide 32 and also between the lower portion of the slider 34 and the upper face of the base 30.

[0031] Each lower end of the base portions 18 and 20 of the first and second set up combs 12 and 14 is received between sliders 34. The first and second set up combs 12 and 14 are connected with sliders 34 and 34 by means of a plurality of pins 42 and 44, respectively, so as not to move relatively to each other.

[0032] The horizontal driving mechanism 36 reciprocates a rod 46 by using an actuator 48 such as a plunger, thereby pivoting a pair of L-shaped coupling pieces 50 which are pivotally connected with the upper end portion of the rod 46, in response to the reciprocation of the rod 46. The upper end portion of the rod 46 is received by the base 30.

[0033] Each of the L-shaped coupling pieces 50 is supported by the base 30 though the boundary (or corner) portion of its two continuous arm portions forming the L-shape, so that it pivots in response to the reciprocation of the rod 46 in a plane extending in both horizontal and vertical directions.

[0034] Two coupling pieces 50 are disposed at an interval in the front-rear direction with the rod 46 interposed and are connected, through their one arm portion, with the upper portion of the rod 46 by means of a single common pin 52 so that they may be displaced in

opposite directions from each other in response to the movement of the rod 46. The other arm portion of each coupling piece 50 is engaged with a recess formed in the slider 34.

[0035] In the horizontal driving mechanism 36, when the rod 46 is moved upwardly, the coupling pieces 50 are pivoted in opposite directions, respectively, as indicated by arrow marks shown in Fig. 4. In response to this motion of the coupling pieces 50, the set up combs 12 and 14 are moved in opposite directions. Contrary to this, by moving the rod 46 downwardly, the coupling pieces 50 are pivoted oppositely to the case of moving the rod 46 upwardly; thus, the set up combs 12 and 14 are moved oppositely, too.

[0036] The vertical driving mechanism is a known mechanism using a suitable actuator, for instance a jack of the double acting type, as a driving source. Such vertical driving mechanism can drive the set up combs 12, 14 and the horizontal driving mechanism 36 as well to move up and down between two vertical levels, that is, a higher level where the comb teeth 22 and 24 project above the gap of the flat knitting machine and a lower level where the comb teeth 22 and 24 are under the gap of the same.

[0037] In the following, the invention will be further explained with reference to Figs. 5, 6 and 7. However, in the following description, as shown in Fig. 5(A), the interval between adjacent comb teeth 22 and that between adjacent comb teeth 24 are made equal to the pitch P of the knitting needles.

[0038] As shown in Figs. 5(A) and 6(A), before starting the set up operation, each position of set up combs 12 and 14 in the lateral direction as well as in the vertical direction is adjusted by means of the driving device 16 such that respective upper portions of comb teeth 22 and 24 having hooks 26 and 28 are aligned so as to overlap each other in the front-rear direction and are put under the gap of the flat knitting machine. Further, the front and rear needle beds F and R are adjusted to achieve the alignment of 1×1.

[0039] Then, as shown in Fig. 6(A), when a yarn carrier for a knitting yarn Y1 is moved either rightward or leftward, for instance, moved rightward, a plurality of knitting needles F1 and R1 on the front and rear needle beds F and R are advanced or withdrawn in the front-rear direction. With this, the knitting yarn Y1 of the first course is hooked to zigzag on a plurality of knitting needles F1 and R1 on the front and rear needle beds so as to cover the entire set up width, thereby completing the knitting of the first course. In this instance as shown in the figure, the knitting of the first course is carried out with the interlock-knitting of 2×2.

[0040] In the next, as shown in Fig. 6(B), when another yarn carrier for a knitting yarn Y2 is moved either rightward or leftward , for instance, moved rightward, a plurality of knitting needles F2 and R2 other than knitting needles F1 and R1 are advanced or withdrawn in the front-rear direction. With this, the knitting yarn Y2 of the second course is hooked to zigzag on a plurality of knitting needles F2 and R2 such that the knitting yarn Y2 of the second course intersects the knitting yarn Y1 of the first course in the area of the gap, thereby completing the knitting of the second course. In this instance, as shown in the figure, the knitting of the second course is performed also in the interlock-knitting of 2×2.

[0041] In this case, the knitting yarn Y2 of the second course may be either identical to or different from the knitting yarn Y1 of the first course. Also, the travelling direction of the yarn carrier for knitting the yarn of the second course may be either identical or opposite to that of the yarn carrier for knitting the yarn of the first course.

[0042] In the next, as shown in Fig. 5(B) and 6(C), the set up combs 12 and 14 are moved upwardly so as to put each of the comb teeth 22 and 24 between two neighboring intersecting portions 54 formed by knitting yarns Y1 and Y2. At this time, the comb teeth 22 and 24 are aligned so as to overlap each other in the front-rear direction. With this, respective upper portions and hooks 26 and 28 of the comb teeth 22 and 24 come to project above the knitting yarns Y1 and Y2 through the space between two neighboring intersecting portions 54 formed by the knitting yarns Y1 and Y2.

[0043] In the set up device 10, the above-mentioned space (between two neighboring intersecting portions) though which the comb teeth 22 and 24 project is made comparatively large, so knitting yarns Y1 and Y2 would hardly prevent the set up combs 12 and 14 from moving upwardly; thus, the comb teeth 22 and 24 are able to pass through the space with certainty. Should the knitting yarns come into contact with the upper faces of the comb teeth 22 and 24 while they are being moved upwardly, since they have a mountain-like shape with gentle falling slopes spreading to both sides, the knitting yarn would be guided along one of the slopes, either rightward or leftward, to the gap between adjacent comb teeth 22 and 24; thus, the knitting yarns are certainly received between adjacent comb teeth.

[0044] Subsequently, the set up combs 12 and 14 are shifted by a distance of 0.5P in opposite directions, more specifically, shifted from the first position where the hooks 26 and 28 respectively overlap with the comb teeth 24 and 22 in the front-rear direction to the second position (the position releasing the knitting yarns) where the hooks 26 and 28 overlap each other as shown in Figs. 5(C) and 7(A).

[0045] The moving direction of the set up combs 12 and 14 at this time is opposite. With this, the set up combs 12 and 14 form a plurality of closed spaces, each of which can receive the knitting yarns at the intersecting portion 54 or its vicinity. More specifically, each of plural closed spaces is formed by the lower edge of the hook 26 of the comb tooth 22, the edge 22a of the comb tooth 22, the lower edge of the hook 28 of the comb tooth 24, and the edge 24a of the comb tooth 24.

Accordingly the intersecting portion 54 of the knitting yarns Y1 and Y2 or its vicinity can be surely caught in the closed space.

[0046] The set up combs 12 and 14 are then moved downwardly as shown in Figs. 5(D) and 7(B). With this, both of the knitting yarns Y1 and Y2 are also moved downwardly by the set up combs 12 and 14 at their intersecting portion 54 or its vicinity. At this time, the knitting yarns Y1 and Y2 are so firmly engaged with the hooks 26 and 28 that there is no fear that the knitting yarns Y1 and Y2 might get out of the comb teeth 22 and 24.

[0047] After several courses are knitted, for instance, after the tubular knitting of four courses is executed, there is commenced another knitting using a predetermined knitting yarn other than the knitting yarns Y1 and Y2, as shown in Fig. 7(C). The above tubular knitting of four courses is carried out by the following two steps, that is, first moving the yarn carrier for the knitting yarn Y1 to the left and then moving it back to the right, thereby achieving one tubular knitting of two courses; and then, moving the yarn carrier for the knitting yarn Y2 to the left and then moving it back to the right, thereby achieving the other tubular knitting of two courses. In this case, the knitting yarn for use in the tubular knitting may be either identical to or different from the knitting yarns Y1 and Y2. Also, the tubular knitting may be replaced by other knitting patterns such as the rib stitch.

[0048] After moving the set up combs 12 and 14 downwardly as shown in Fig. 7(B), if the knitting is changed directly to the tubular knitting as shown in Fig. 7(C), the knitted loop of the interlock-knitting of 2×2 as previously knitted is apt to get out of the knitting needles with ease.

[0049] In order to prevent this, it is preferable, after downwardly moving the set up combs 12 and 14, to execute the interlock-knitting of 1×1 using a pertinent knitting yarn as shown in Fig. 8(A), further to carry out the interlock-knitting of 1x1 using another pertinent knitting yarn as shown in Fig. 8(B), and finally to perform the tubular knitting using a pertinent knitting yarn as shown in Fig. 8(C), which does not show the comb teeth 22 and 24.

[0050] In this case, the knitting yarn for use in the above interlock-knitting of 1×1 may be identical to the knitting yarns Y1 and Y2, or the knitting yarn used in the tubular knitting, or a knitting yarn other than the above. There would be no need for the process of Fig. 8 to be carried out if the knitting yarns hardly get out of the hooks when shifting to the tubular knitting.

[0051] The interlock-knitting of 1×1 using both of the above pertinent knitting yarns may be carried out with a single course or plural courses with respect to each knitting yarn. In case of performing the plural-course knitting using each of the above pertinent knitting yarns, it is possible to alternately repeat the single-course knitting using one knitting yarn and the same using the other knitting yarn, or to alternately repeat the plural-course knitting using one knitting yarn and the same using the other knitting yarn.

[0052] Upon completion of the tubular knitting of a predetermined number of courses, as shown in Fig. 5(E), the set up combs 12 and 14 are relatively shifted by a distance of 0.5P in the direction opposite to the side of the hooks 26 and 28; namely, from the second position where the knitting yarns Y1 and Y2 are pinched by the side edges 22a and 24a of the comb teeth 22 and 24 to the first position where the upper portions of the comb teeth 22 and 24 including the hooks 26 and 28 overlap each other in the front-rear direction.

[0053] With this shifting motion of the set up combs 12 and 14, the knitting yarns Y1 and Y2 are released from the comb teeth 22 and 24. In this case, even though the knitting yarns Y1 and Y2 fail to get out of the hooks 26 and 28, they are pushed out by the edges 22b and 24b of the comb teeth 22 and 24, which have no contribution to catching the knitting yarns, so that the knitting yarns Y1 and Y2 can surely get out of the hooks 26 and 28.

[0054] After the steps as described above, a predetermined knitting is started again. The timing of unfastening the knitting yarns from the set up combs 12 and 14 may be arbitrarily determined. Accordingly the knitting yarns may be unhooked out of the set up combs 12 and 14 after completing the knitting of one knitted fabric.

[0055] In the embodiment as shown in Figs 6, 7 and 8, the front and rear needle beds F and R are arranged so as to have a needle bed alignment of 1×1, and the knitting yarns of the first and courses are hooked on knitting needle groups F1, R1 and F2, R2 opposing to each other. However, the front and rear needle beds F and R may be arranged so as to have the other needle bed alignment, and the knitting yarns of the first and second courses may be hooked on the knitting needles not opposing to each other.

[0056] In the embodiment as shown in Figs. 9, 10 and 11, the front and rear needle beds F and R are adjusted so as to have an all needle structure, and the knitting needle groups F1, F2 and R1, R2 not opposing to each other are respectively used for the knitting of the first and second courses.

[0057] As shown in Fig. 9(A), before starting the set up operation, each location of the set up combs 12 and 14 in both lateral and vertical directions are adjusted by means of the driving device 16 such that comb teeth 22 and 24 including books 26 and 28 overlap each other and are put under the gap of the flat knitting machine. The front and rear needle beds F and R are adjusted to have an all needle structure rib.

[0058] Then, as shown in Fig. 9(A), when a yarn carrier for a knitting yarn Y1 is moved either rightward or leftward, a plurality of knitting needles F1 and R1 on the front and rear needle beds F and R are advanced or withdrawn. After this, as shown in Fie. 9(B), when the yarn carrier identical to or different from the above yarn carrier is moved either rightward or leftward.. a plurality of knitting needles F2 and R2 other than the knitting

needles F1 and R1 are advanced or withdrawn.

[0059] With this. the knitting yarn Y1 of the first course is hooked to zigzag on a plurality of knitting needles F1 and R1 on the front and rear needle beds, and the knitting yarn Y2 of the second course is also hooked to zigzag on a plurality of knitting needles F2 and R2. At this time the knitting yarn Y1 and the knitting yarn Y2 come to intersect each other in the gap area.

[0060] In the next. as shown in Fig. 9(B), the set up combs 12 and 14 are moved upwardly so as to position the comb teeth 22 and 24 in the space between two neighboring intersecting portions 54 formed by the knitting yarns Y1 and Y2. At this time, the comb teeth 22 and 24 stand so as to overlap each other in the front-rear direction. With this, the upper portions of the comb teeth 22 and 24 as well as the hooks 26 and 28 come to project above the knitting yarns Y1 and Y2 through the space between the two neighboring intersecting portions 54 of the knitting yarns Y1 and Y2.

[0061] Then, as shown in Fig. 9(C), the set up combs 12 and 14 are shifted to the second position for catching the weft by a distance of 0.5P toward the hooks 26 and 28. At this time, the set up combs 12 and 14 are mutually shifted in opposite directions.

[0062] With this, the set up combs 12 and 14 come to form a plurality of closed spaces for receiving the intersecting portion 54 of the knitting yarns, so that the knitting yarns Y1 and Y2 are surely caught and confined in the closed spaces in the intersecting portion 54 or its vicinity.

[0063] Subsequently, the set up combs 12 and 14 are downwardly moved as shown in Figs. 10(A). With this, both of the knitting yarns Y1 and Y2 are also moved down by the set up combs 12 and 14 in the intersecting portion 54 of the knitting yarns or its vicinity. After this, a yarn carrier for another knitting yarn Y3 other than the knitting yarns Y1 and Y2 is moved rightward, thereby feeding the yarn Y3 to all the knitting needles on the rear needle bed R, and further, a yarn carrier for still another knitting yarn Y4 other than the above yarns is moved similarly rightward, thereby feeding the yarn Y4 to all the knitting needles on the front needle bed F.

[0064] Then, as shown in Figs. 10(B)and 10(C), there are properly executed some knitting of several courses; for instance, the tubular knitting of four courses. After this, there is commenced a predetermined knitting using a predetermined knitting yarn. The tubular knitting of four courses is carried out with the following two steps: firstly, moving the yarn carrier for the knitting yarn Y3 to the left and then moving it back to the right, thereby achieving one tubular knitting of two courses; and secondly moving the yarn carrier for the knitting yarn Y4 to the left and then moving it back to the right, thereby achieving another tubular knitting of two courses. In Fig. 10(C), the comb teeth 22 and 24 are not shown.

[0065] In the embodiment as shown in Figs. 9 and 10, if the tubular knitting is directly started as shown in Figs. 10(B) and 10(C) after the set up combs 12 and 14 are downwardly moved as shown in Fig. 10(A) similarly to the foregoing embodiment, the knitted loop of the 2×2 interlock-knitting as previously knitted is apt to get out of the knitting needles with ease.

[0066] In order to prevent this, similarly to the embodiment shown in Figs. 6 through 8, it is preferable, after moving the set up combs 12 and 14 downwardly, to execute the 1×1 interlock-knitting using a pertinent knitting yarn Y as shown in Fig. 11(A), further to carry out the 1x1 interlock-knitting using another pertinent knitting yarn as shown in Fig. 11(B), and finally, to perform the tubular knitting using a pertinent knitting yarn as shown in Fig. 11(C). In Fig. 11(C), the comb teeth 22 and 24 are not illustrated.

[0067] At the time when the tubular knitting has been carried out by a predetermined number of courses, the set up combs 12 and 14 are shifted from the second position to the first position for releasing the knitting yarns, by a distance of 0.5P in opposite directions to the side of the hooks 26 and 28, thereby releasing the knitting yarns Y1 and Y2 from the comb teeth 22 and 24.

[0068] At this stage, even if the intersecting portion 54 is still engaged with the hooks 26 and 28, the knitting yarns Y1 and Y2 are pushed out by the edges 22b and 24b of the comb teeth 22 and 24, so that the knitting yarns Y1 and Y2 can certainly get out of the hooks 26 and 28. After this, the predetermined knitting is commenced again.

[0069] Referring to Fig. 12, there is shown a horizontal driving mechanism 60 which moves the set up comb 12 and 14 in the lateral direction. A pair of L-shaped coupling pieces 62 are pivotally connected at their bent portions (corners of L-shape) with the base 30. Also, one of their arm portions is pivotally connected with the top portion of a rod 64, while the other is pivotally connected with the slider 34 in the longitudinal middle portion thereof. One arm portion of the pair of coupling pieces 62 is pivotally connected with one of a pair of the sliders 34, while the other arm portion of the same is pivotally connected with the other of the pair of sliders 34

[0070] In the horizontal driving mechanism 60, when the rod 64 is moved up and down by an actuator 48, both of coupling pieces 62 are synchronously pivoted about their bent portions in opposite directions, thereby the other arm portions of both coupling pieces 62 are shifted in opposite directions. With this, the pair of sliders 34 synchronously reciprocate in opposite directions i.e. in the lateral direction, respectively.

[0071] Instead of connecting the coupling piece 62 with the slider 34 in the middle portion in the longitudinal direction thereof as is done in the horizontal driving mechanism 60, it is possible to pivotally connect an L-shaped coupling piece 68 with one end of the slider 34 of another horizontal driving mechanism 66 as shown in Fig. 13. In this case, the bent portion of the coupling piece 68 is pivotally connected with the base 30 or other pertinent member.

[0072] Referring to Fig. 14, there is shown still another horizontal driving mechanism 70. In this mechanism, each of slides 34 is provided with a slanting slot 72, and an engaging member (not shown) moving along each of the slots 72 is connected with the upper end portion of the rod 64. The slanting directions of the slots 72 provided on both sliders 34 are made opposite to each other.

[0073] In the horizontal driving mechanism 70, when the rod 64 is moved up and down by the actuator 48, the engaging member is moved up and down within the slot 72, thereby making the slider 34 move in the lateral direction.

[0074] Referring to Fig. 15, there is indicated still another horizontal driving mechanism 74. In this mechanism, one of the sliders 34 is provided, at its one end face, with a slanting face 76 which is directed downwardly so as to make contact with the semicircular or semispherical upper end of the rod 64. The counterpart of the sliders 34 (not shown) which is provided on the opposite side so as to make a pair with the above slider, may be constructed such that it has, at its right end face in the figure, a similar but reversely slanting face 76. Consequently another horizontal driving mechanism may be separately prepared for this reversely slanting face.

[0075] In the horizontal driving mechanism 74, when the rod 64 is moved upwardly by the actuator 48, the rod 64 pushes the slanting face 76 through its upper end face. With this, the slider 34 is shifted either rightward or leftward. In this mechanism 74, the movement of the slider 34 opposite to that which is caused by the actuated rod 64, is attained by applying the other force such as a spring force to the slider.

[0076] Referring to Fig. 16, there is illustrated still another horizontal driving mechanism 78. In this mechanism, a link piece 82 is pivoted with the reciprocation of a rod 80, thereby the slider 34 being reciprocated in the lateral direction in response to the pivoting motion of the link piece 82. The link piece 82 is pivotally connected with the rod 80 and also with the slider 34 through both of its end portions, and is also pivotally connected with the base 30 or other member in the middle portion in the longitudinal direction thereof.

[0077] In case of the embodiment as shown in Fig. 15, every slider 34 may be provided with the similar horizontal driving mechanism 74. Also, in the embodiment as shown in Fig. 16, every slider 34 is provided with the similar horizontal driving mechanism 76.

[0078] Referring to Fig. 17, there is shown the first and second set up combs 92 and 94 which are different from the set up combs 12 and 14 as previously described in that the hooks 96 and 98 of the set up combs 92 and 94 have a slanting lower face rising toward the tip of the hook while the hooks 26 and 28 of the set up combs 12 and 14 have a slanting lower face falling toward the tip of the hook. Despite of this difference, the set up combs 92 and 94 may be installed on the flat knitting machine in the same way as the set up combs 12 and 14. Also, the set up operation using the set up combs 92 and 94 is carried out in the same way as the operation using the first and second set up combs 12 and 14.

[0079] At the beginning of the set up operation, the set up combs 92 and 94 are arranged, as shown in Fig. 17(A), such that the comb teeth 22 and 24 including hooks 96 and 98 are aligned so as to overlap each other in the front-rear direction, and are put under the gap of the flat knitting machine. In this state, the knitting yarns of the first and second courses are hooked to zigzag respectively on the predetermined knitting needles on the front and rear needle beds.

[0080] Then, as shown in Fig. 17(B), the set up combs 92 and 94 are moved upwardly so as to make their comb teeth pass through the space between two neighboring intersecting portions formed by the knitting yarns of the first and second courses. In this state, the set up combs 92 and 94 are mutually shifted in opposite directions by a distance of about 0.5P, from the first position making the comb teeth 22 and 24 overlap each other in the front-rear direction, to the second position making the hooks 96 and 98 overlap each other in the front-rear direction. With this, the comb teeth 22 and 24 catch the knitting yarns by their intersecting portion or its vicinity and confine them in the closed space formed by the comb teeth 22 and 24. In this state, the set up combs 92 and 94 are moved downwardly, thus enabling the knitting yarns also to be moved downwardly along therewith.

[0081] Subsequently, the set up combs 92 and 94 are reversely shifted with the proper timing by a distance of 0.5P from the second position to the first position, thereby releasing the knitting yarns. When releasing the knitting yarns, the comb teeth 22 and 24 push the knitting yarns with their edges 22b and 24b, respectively, so that even if the intersecting portion of knitting yarns is still engaged with the hooks 96 and 98, the knitting yarns are pushed out by the comb teeth 22 and 24, thus enabling the knitting yarns to certainly get out of the hooks 96 and 98.

[0082] Referring to Fig. 18, there is indicated another first and second set up combs 102 and 104, which are different from the set up combs 92 and 94 with respect to the shape of the edge portions 22b and 24b of the comb teeth 22 and 24. More specifically the edge portions 22b and 24b are modified so as to bring their upper parts more close to the hooks 96 and 98.

[0083] However, the set up combs 102 and 104 are disposed in the flat knitting machine in the same way as the set up combs 12, 14 and the set up combs 92, 94. Also, the set up operation using the set up combs 102 and 104 are carried out in the same way as the set up operation using the set up combs 12, 14 and the set up combs 92, 94.

[0084] Therefore, when the set up combs 102 and 104 are shifted from the first position releasing the knitting yarns to the second position restricting the same, they

surely catch and confine the knitting yarns in the closed space formed by the comb teeth 22 and 24.

[0085] Contrary to this, when the set up combs 102 and 104 are returned from the second position to the first position, the knitting yarns are released from the comb teeth 22 and 24. When releasing the knitting yarns, the comb teeth 22 and 24 push the knitting yarns with the edges 22b and 24b thereof, respectively. Thus, even if the intersecting portion of the knitting yarns is still engaged with the hooks 96 and 98, the knitting yarns are pushed out by the comb teeth 22 and 24, thus enabling the knitting yarns to certainly get out of the hooks 96 and 98.

[0086] Referring to Fig. 19, there are shown still another first and second set up combs 112 and 114, which are different from the set up combs 12 and 14 with respect to the shape of the edge portions 22a, 22b and 24a, 24b of the comb teeth 22 and 24. More specifically, the edge portions 22a, 22b and 24a, 24b are modified such that their lower half parts have slopes spreading in the lateral direction. Therefore, the lower half of the space formed by the edges 22a, 22b and 24a, 24b as lined side by side comes to indicate a shape like a letter of V or U.

[0087] The set up combs 112 and 114 are disposed in the flat knitting machine in the same way as the set up combs 12, 14. Also, the set up operation using the set up combs 112 and 114 are carried out in the same manner as the set up operation using the set up combs 12 and 14.

[0088] Therefore, when the set up combs 112 and 114 are shifted from the first position to the second position, they surely catch and confine the knitting yarns in the closed space formed by the comb teeth 22 and 24.

[0089] Contrary to this, when the set up combs 112 and 114 are returned from the second position to the second position, the knitting yarns are released from the comb teeth 22 and 24. When the knitting yarns are released, the comb teeth 22 and 24 push the knitting yarns with the edges 22b and 24b thereof, respectively. Thus, even if the intersecting portion of the knitting yarns is still engaged with the hooks 26 and 28, the knitting yarns are pushed by the comb teeth 22 and 24, thus enabling the knitting yarns to certainly get out of the hooks 26 and 28.

[0090] Referring to Fig. 20, there are illustrated still another first and second set up combs 122 and 124, which are different from the set up combs 12 and 14 in that each comb tooth 24 of the second set up comb 124 has a flat head portion. However, the set up combs 122 and 124 are disposed in the flat knitting machine in the same way as the set up combs 12 and 14. Also, the set up operation using the set up combs 122 and 124 may be carried out in the same way as the set up operation using the set up combs 12 and 14.

[0091] Therefore, when the set up combs 122 and 124 are shifted from the first position to the second position, they surely catch and confine the set up yarns in the closed space formed by the comb teeth 22 and 24. When the set up combs 122 and 124 are shifted back to the first position from the second position, the set up yarns are released from the comb teeth 22 and 24.

[0092] Releasing the knitting yarns, the comb teeth 22 and 24 push the knitting yarns with the edges 22b and 24b thereof, respectively. Thus, even if the intersecting portion of the knitting yarns is still engaged with the hooks 26 and 28, the knitting yarns are pushed by the comb teeth 22 and 24, so that the knitting yarns can certainly get out of the hooks 26 and 28.

[0093] In all the foregoing embodiments, there are used two set up combs. However, the number of set up combs is not to be limited to two but may be thee or more. Also, it is not always needed for all the comb teeth of the set up comb to be provided with a hook. Instead of providing teeth of all the set up combs, only one set up comb may be provided with no hook. For instance, in the embodiment as shown in Fig. 5, the hooks 28 of the comb teeth 24 can be omitted, but their edges 24a can be vertically extended, instead.

[0094] Referring to Fig. 21, there is indicated another embodiment in which the third set up comb 126 is used in addition to the first and second set up combs 122 and 124. The third set up comb 126 is formed to have the same configuration as the first set up comb 122 and is disposed such that the hooks thereof extend in the same direction as those of the first set up comb 122 and is disposed on the opposite side to the first set up comb 122 with respect to the second set up comb 124. The first and third set up comb 122 and 126 perform similar movement together in the lateral direction.

[0095] In the set up method using the three set up combs 122, 124 and 126, when the set up combs are shifted from the first position to the second position, the three comb teeth 22, 24 and 22 certainly catch the knitting yarns by their intersecting portions or its vicinity and confine them in the closed space formed by these comb teeth. According to this embodiment, complete closed spaces are formed by the comb teeth 22, 24 and 22 of the first, second and third set up combs 122, 124 and 126, respectively, so that the knitting yarn can be caught between the parallel edges of the above three comb teeth.

[0096] Also, when the set up combs are returned from the second position to the first position, the knitting yarns are pushed by the edges 24b of the comb teeth 24 so that they can get out of the hooks 26 and 28 of two comb teeth 22, and in parallel, the knitting yarns are pushed by the two edges 22b of the two comb teeth 22, so that they can get out of the hooks 26 and 28 of the comb teeth 24 with certainty.

[0097] Referring to Figs. 22 and 23, there is shown still another embodiment in which the first, second and third set up combs 132, 134 and 136 are used. Each of the first and third set up combs 132 and 136 is provided with an inverted L-shaped comb tooth 138 while each of the second set up combs 134 is provided with an I-shaped

comb tooth 140.

[0098] The first, second and third set up combs 132, 134 and 136 are disposed in parallel in this order in the front-rear direction. The first and third set up combs 132 and 136 are disposed such that the upper parts respectively of the comb teeth 138 are directed in the same direction with respect to the lateral direction.

[0099] The upper part of the comb teeth 138 are bent in the same direction with respect to their corresponding lower parts to function as a hook 141 for engaging with the knitting yarns. The tip faces of the comb teeth 138 and the upper faces of the comb teeth 140 are arc-shaped to smoothly guide the knitting yarns to the gap between comb teeth. Similarly, the outside surface of the corner or the bent portion of each of the comb teeth 138 is formed so as to have an inclined surface, which also smoothly guides the knitting yarns to the gap between comb teeth. The comb teeth 138, 140 and 138 have the same height.

[0100] The set up method using set up combs 132, 134 and 136 is carried out as follows.

[0101] At first, as shown in Fig. 23(A), the knitting yarns Y1 and Y2, respectively, of the first and second courses are hooked to zigzag on a plurality of predetermined knitting needles on the front and rear needle beds.

[0102] In the next, as shown in Fig. 23(B), the set up combs 132, 134 and 136 are moved upwardly so as to make the comb teeth 138, 140 and 138 pass through the space formed between two neighboring intersecting portions 54 made by the knitting yarns Y1 and Y2. At this stage, the tip portions of the hooks 141 of the comb teeth 138 and the upper portions of the comb teeth 140 are aligned in the front-rear direction.

[0103] Then, as shown in Fig. 23(C), the set up combs 132, 134 and 136 begin to move either rightward or leftward. At this time, the set up combs 132, 136 and the set up comb 134 are moved in opposite directions. In the example shown in the figure, the set up combs 132 and 136 are moved to the left while the set up comb 134 is moved to the right.

[0104] As shown in Fig. 23(D), the set up combs 132, 134 and 136 are moved to the second position where the comb teeth 138, 140 and 138 are aligned to the adjacent comb teeth in the lateral direction. With this, the knitting yarns are caught by one comb tooth 140 and two comb teeth 138 to be confined in the closed space defined by these comb teeth.

[0105] Subsequently as shown in Fig. 23(E), the set up combs 132, 134 and 136 are moved together downwardly, thereby puffing down the knitting yarns Y1 and Y2. At this time, the knitting yarns Y1 and Y2 are engaged with each upper portion of two comb teeth 138 i.e. each hook 141, so that there is no fear that the knitting yarns Y1 and Y2 get out of the comb teeth 138, 140 and 138.

[0106] Next, the knitting is carried out by a predetermined number of courses in the state as mentioned above.

[0107] After the above knitting of the predetermined number of courses, the set up combs 132, 134 and 136 begin to move, as shown in Fig. 23(F), in the respective directions opposite to those which are described above. More specifically, as shown in Fig. 23(H), the set up combs 132, 134 and 136 are returned to the first position, namely returned to the condition where the tip portions of the hooks 141 of the comb teeth 138 and the upper end portions of the comb teeth 138 are respectively aligned to overlap each other in the front-rear direction, passing through the intermediate process as shown in Fig. 23(G). With this, the knitting yarns Y1 and Y2 are released from the set up combs 132, 134 and 136.

[0108] When releasing the knitting yarns, as shown in Fig. 23(H), the comb teeth 140 push the knitting yarns Y1 and Y2 with one edge 140b thereof. Therefore, the knitting yarns can certainly get out of the hooks 141 of two comb teeth 138 to be exactly released from the set up combs 132, 134 and 136.

[0109] In the embodiment as shown in Figs. 22 and 23, it is not always necessary to use the third set up comb 136.

[0110] Referring to Fig. 24, there is indicated still another embodiment using the first and second set up combs 142 and 144, of which the respective comb teeth 146 and 148 are formed in the shape of a short plate. Each of the comb teeth 146 has a hook 150 extending either rightward or leftward from its upper portion. The upper faces of the comb teeth 146 and 148 are formed in the shape of a mountain of which the slopes guide the knitting yarns to the gap between the comb teeth. The width of the comb tooth 146 having the hook 150 is made a little narrower than that of the comb tooth 148.

[0111] The set up method using the set up combs 142 and 144 is carried out also in the same way as the method using the other set up combs, that is, as follows.

[0112] Firstly, as shown in Fig. 24(A), the set up combs 142 and 144 are moved upwardly so as to make their comb teeth 146 and 148 pass through the space formed between two neighboring intersecting portions of the knitting yarns Y1 and Y2. At this stage, the comb teeth 146 and 148 are aligned to overlap each other in the front-rear direction, respectively.

[0113] Then, the set up combs 142 and 144 are oppositely shifted by a predetermined distance in the lateral direction, from the first position as shown in Fig. 24(A) to the second position for catching the knitting yarns Y1 and Y2 between the edges 146a and 148a of the comb teeth 146 and 148 as shown in Fig. 24(B). With this, the knitting yarns Y1 and Y2 can be exactly caught in the closed space formed by the comb teeth 146 and 148.

[0114] After this, the set up combs 142 and 144 are downwardly moved, thereby pulling down the knitting yarns Y1 and Y2. At this stage, the knitting is carried out by a predetermined number of courses.

[0115] Next, as shown in Fig. 24(C), the set up combs

142 and 144 are reversely shifted from the second position to the first position. With this, the knitting yarns Y1 and Y2 are pushed by the edge 148b of the comb teeth 148, so that even if the knitting yarns Y1 and Y2 are engaged with the hook 150, the knitting yarns can get out of the hooks 150 with certainty to be certainly released from the comb teeth 146 and 148.

[0116] As shown in Fig. 25, the width of the comb tooth 146 including the hook 150 may
be made wider than that of the comb tooth 148. In this case, the set up combs 142 and 144 are be shifted so as to take two positions, that is, the first position for hiding the hook 150 behind the comb tooth 148, and the second position for catching the knitting yarns between the edges 146a and 148a.

[0117] In this embodiment, the knitting yarns are also surely caught and confined in the closed space made by the comb teeth 146 and 148 when the set up combs 142 and 144 are shifted to the second position. On the other hand, when the set up combs 142 and 144 are shifted to the first position, the knitting yarns are pushed by the edges 148b of the comb teeth 148 and get out of the hooks 150 to be certainly released from the comb teeth.

[0118] Referring to Fig. 26, there is shown still another first and second set up combs 152 and 154. In this case, the comb teeth 156 of the set up comb 152 are alternately provided with hooks 160, and similarly, the comb teeth 158 of the set up comb 154 are alternately provided with hooks 160. The upper faces of the comb teeth 156 and 158 are formed in the shape of a slope falling down toward the tip of the hook 160. The set up method using the set up combs 152 and 154 is carried out in the same way as has been already described so far, that is, as follows.

[0119] At first, as shown in Fig. 26(A), the set up comb 152 and 154 take such a position as the comb teeth 156 and 158 having the hooks 160 overlap each other in part at the side of their edges 156b and 158b in the front-rear direction, while the other comb teeth 156 and 158 having no hook 160 also overlap each other in part at the side of their edges 156b and 158b in the front-rear direction. In this state, the comb teeth 156 and 158 as overlapped in part as above are made to pass the space between two neighboring intersecting portions made by the knitting yarns Y1 and Y2 of the first and second courses.

[0120] Then, the set up combs 152 and 154 are oppositely shifted by a predetermined distance in the lateral direction, from the first position as shown in Fig. 26(A) to the second position as shown in Fig. 26(B). With this, the knitting yarns Y1 and Y2 are exactly caught and confined in the closed space formed by the comb teeth 156 and 158; more specifically, the closed space as defined by the hook 160, the edge of the comb tooth 156a, and the edge of the comb tooth 158a.

[0121] After this, the set up combs 152 and 154 are downwardly moved. whereby the knitting yarns Y1 and Y2 are also moved downwardly. In this state, the knitting of a predetermined number of courses is carried out.

[0122] Subsequently, the set up combs 152 and 154 are returned to the first position as shown in Fig. 26(A) after passing through the intermediate process as shown in Fig. 26(C). With this, as shown in Fig. 26(C), the knitting yarns Y1 and Y2 are pushed by the edges 156b and 158b and get out of the hooks 160 to be certainly released from the comb teeth 156 and 158.

[0123] Referring to Fig. 27, there are illustrated another first and second set up combs 162 and 164, both being divided in the lateral direction, into a plurality of comb portions 162A, 162B and 164A 164B, respectively.

[0124] The comb teeth 166A and 168B of the comb portions 162A and 164B are provided, at their upper portion, with the hooks 170 and 172, respectively while no hook is included in the comb teeth 166B and 164A of the comb portions 162B and 164A. The comb portions 162A and 162B are disposed in parallel to the comb portions 164A and 164B in the front-rear direction, respectively.

[0125] The set up method using the set up combs 162 and 164 is carried out in the same way as described in the above, that is, as follows.

[0126] Firstly as shown in Fig. 27, the set up combs 162 and 164 are moved upwardly so as to make the comb teeth 166A, 168A and 166B, 166B pass though each space formed between two neighboring intersecting portions of the knitting yarns Y1 and Y2. At this stage, the comb teeth 166A, 168A and the comb teeth 166B, 166B are aligned in the front-rear direction, respectively.

[0127] Then, the set up combs 162 and 164 are shifted from the first position as shown in Fig. 27 to the second position for catching the knitting yarns Y1 and Y2 by the edges 166a and 168a. With this, the knitting yarns Y1 and Y2 are surely caught and confined in the closed space formed by the comb teeth; more specifically, the closed space formed by the edges 166a of the comb teeth 166A and the edges 168a of the comb teeth 168A.

[0128] After this, the set up combs 162 and 164 are downwardly moved, thereby moving the knitting yarns Y1 and Y2 also downwardly In this state, the knitting is carried out by a predetermined number of courses.

[0129] Subsequently, the set up combs 162 and 164 are shifted in opposite directions and returned from the second position catching the knitting yarns to the first position for releasing the same. At this time, the knitting yarns are pushed by the side edges 166b and 168b, so that they can be unhooked from the hooks 170 and 172, thereby being released with certainty

[0130] Referring to Fig. 28, there is shown another set up combs 182 and 184 having the comb teeth 186 and 188, which function as a hook, too. Each of the comb teeth 186 and 188 extends upwardly from the base portions 18 and 20 in the shape of a plate such that its upper part is more inclined either rightward or leftward,

as shown in the figure, relative to its lower part.

[0131] The set up method using the set up combs 182 and 184 is carried out in the same way as discussed in the above, that is, as follows.

[0132] Firstly as shown in Fig. 28, the set up combs 182 and 184 are moved upwardly so as to pass through the space between two neighboring intersecting portions formed by the knitting yarns Y1 and Y2. At this time, the comb teeth 186 and 188 intersect each other at their mid portions so as to form a shape like a letter X.

[0133] Subsequently, the set up combs 182 and 184 are shifted from the first position as shown in Fig. 28(A) to the second position as shown in Fig. 28(B). With this, the knitting yarns Y1 and Y2 are surely caught and confined in the closed space formed by the comb teeth.

[0134] After this, the set up combs 182 and 184 are downwardly moved, whereby the knitting yarns Y1 and Y2 are also pulled downwardly. In this state, the knitting is carried out by a predetermined number of courses.

[0135] Subsequently, the set up combs 182 and 184 are shifted in opposite directions to those described above and are returned from the second position catching the knitting yarns to the first position for releasing them. At this time, the knitting yarns are pushed by the side edges 186b and 188b, so that they can get out of the comb teeth 186 and 188 serving as the hooks to be certainly released. At this time, the edges 186b and 188b have not completely pushed out the knitting yarns to the tip end of the hook. However, since the lower edges of the hooks, i.e., the edges 186b and 188b of the set up combs obliquely extend toward their tip ends, the knitting yarns may naturally get out therefrom.

[0136] In the embodiment as described in the above, one of the first and second set up combs may be formed such that all the comb teeth thereof are shaped like a letter I having no hook. In this case, each of the I-shaped comb teeth comes to form the lower edge of the comb tooth serving as the hook; more specifically, the edge that extends at least up to the lower edge of the hook tip.

[0137] The first and second set up combs 192 and 194 as shown in Fig. 29(A) are provided with a plurality of comb teeth 196, 198, 200 and 202, 204, 206, of which the shapes are made different from each other. However, the comb teeth 196 and 202, ditto 198 and 204, and ditto 200 and 206, are formed in the same shape, respectively

[0138] Also, the first and second set up combs 212 and 214 as shown in Fig. 29(B) are provided with a plurality of comb teeth 216, 218 and 220, 222, of which the shapes are made different from each other. However, the comb teeth 216 and 220, and ditto 218 and 222, are formed in the same shape, respectively.

[0139] The set up method as has been described so far can be carried out with whichever set up comb as shown in Figs. 29(A) or 29(B).

[0140] In the embodiments as have been discussed thus far, the upper face of at least one of comb teeth serves as a guide face for guiding the knitting yarn in the gap between the comb teeth arranged side by side in the lateral direction of the set up comb. However, the upper face of the comb tooth may have such a shape as does not serve as the guide face. The comb tooth may be modified to have a variety of shapes.

[0141] Also, in the above-mentioned embodiments, each of the comb teeth is formed in such a shape as can push the knitting yarns by its edge, thereby forcibly releasing the knitting yarns therefrom when the set up combs are shifted from the second position to the first position. It is not always needed, however, for the comb tooth to have such a form as to forcibly release the knitting yarns. The comb teeth may be formed in any shape if the lower edge of its hook or its part serving as the hook includes a slope rising toward its tip portion.

[0142] Furthermore, in any of the embodiments as have been described in the above, the position where the set up combs begin to move for catching the knitting yarns may be a position other than the first position for releasing the knitted fabric.

[0143] The present invention is not limited to the embodiments as have been discussed in the above. Accordingly, the invention may be changed and modified in various ways without departing from the spirit and scope of the invention as set forth herein.

Claims

1. A set up device for use in a flat knitting machine provided with front and rear needle beds (F, R), comprising first and second set up combs (12, 14, 92, 94, 102, 104, 112, 114, 122, 124, 126, 132, 134, 136, 142, 144, 152, 154, 162, 164, 182, 184, 192, 194, 212, 214), each of which includes a plurality of comb teeth (22, 24, 138, 140, 146, 148, 156, 158, 166A, 166B, 168A, 168B, 186, 188, 196, 198, 200, 202, 204, 206, 216, 218, 220, 222) extending upwardly, and a driving device (16) for vertically moving said first and second set up combs relative to a gap of the flat knitting machine and for relatively shifting them to the lateral direction, wherein said first and second set up combs are disposed in parallel in the front-rear direction, each of two or more comb teeth of at least one of said first and second set up combs has hook(26, 28, 96, 98, 141, 150, 160, 170, 172) extending either leftward or rightward, and said hooks on the identical set up comb are formed so as to extend in the same direction.

2. A set up device as claimed in claim 1, wherein, among at least the other of the comb teeth of said first and second set up combs, each comb tooth corresponding to the comb tooth having the hook of said at least one of said first and second set up combs and the comb teeth positioned at the side where said hook extends relative to the comb teeth respectively include edge por-

tions(22a,22b,24a,24b,138a,138b,140a,140b,146a,146b,148a,148b,156a,156b,158a,158b,166a,166b,168a,168b,186a,186b,188a,188b) extending at least from the position corresponding to the lower end edge of said hook to the lower end of the comb tooth at the side of the comb tooth having the hook.

3. A set up device as claimed in claim 1 or 2, wherein said first and second set up combs are moved by said driving device(16) so as to pass through said gap.

4. A set up device as claimed in claim 1, 2 or 3, wherein the upper face of each comb tooth has a mountain-like shape declining toward both widthwise ends.

5. A set up method by a flat knitting machine using the set up device as claimed in any one of claims 1 to 4, comprising the steps of:

moving a first yarn carrier either rightward or leftward and advancing or withdrawing a first group of knitting needles(F1,R1) disposed on the front and rear needle beds(F,R), thereby hooking a knitting yarn(Y1) of the first course to zigzag on said first group of knitting needles;
moving said first yarn carrier or a second yarn carrier either rightward or leftward and advancing or withdrawing a second group of knitting needles(F2,R2) other than said first group of knitting needles(F1,R1), thereby hooking a knitting yarn(Y2) of the second course to zigzag on said second group of the knitting needles(F2,R2) so as to intersect said knitting yarn(Y1) of said first course to form intersecting portions in the gap of the flat knitting machine;
upwardly moving said first and second set up combs(12,14,102,104,122,124,126,132,134,142,144,152,154,162,164,192,194, 212,214) so that said comb teeth may come between the intersecting portions(54) of said first and second knitting yarns(Y1,Y2);
relatively moving said first and second set up combs in the lateral direction and catching said knitting yarns(Y1,Y2) of the first and second courses by means of said first and second set up combs teeth; and
downwardly moving said first and second set up combs.

6. A set up method as claimed in claim 5, further comprising the steps of: performing knitting of third and subsequent courses with said first and second set up combs moved downward, and after knitting a predetermined number of courses, relatively moving said first and second set up combs in opposite directions, thereby releasing said intersecting portions of the knitting yarns of the first and second courses from said comb teeth.

7. A set up method as claimed in claim 5 or 6, wherein knitting of a plurality of courses from said third courses includes a tubular knit.

8. A set up method as claimed in claim 5 or 6, wherein knitting of said plurality of courses from said third courses an interlock-knitting of one or more courses and a plurality of courses of tubular knits carried out thereafter.

FIG. 1

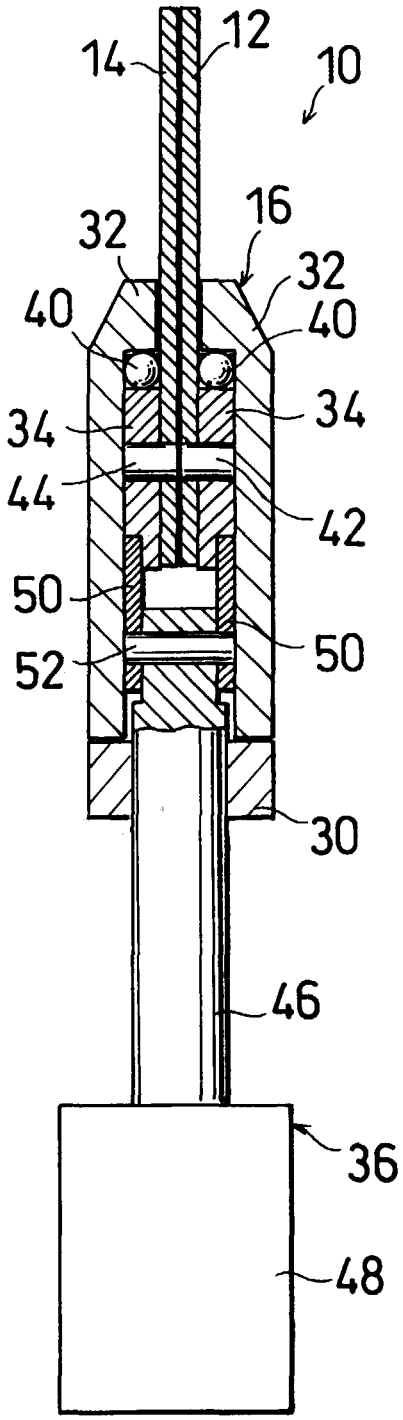


FIG. 2

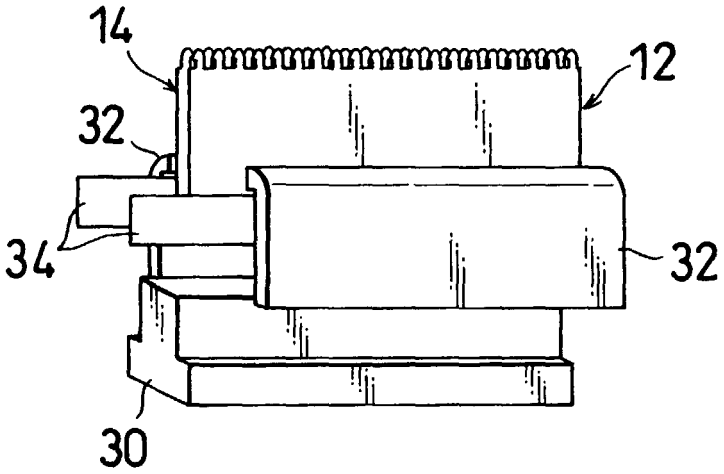


FIG. 3

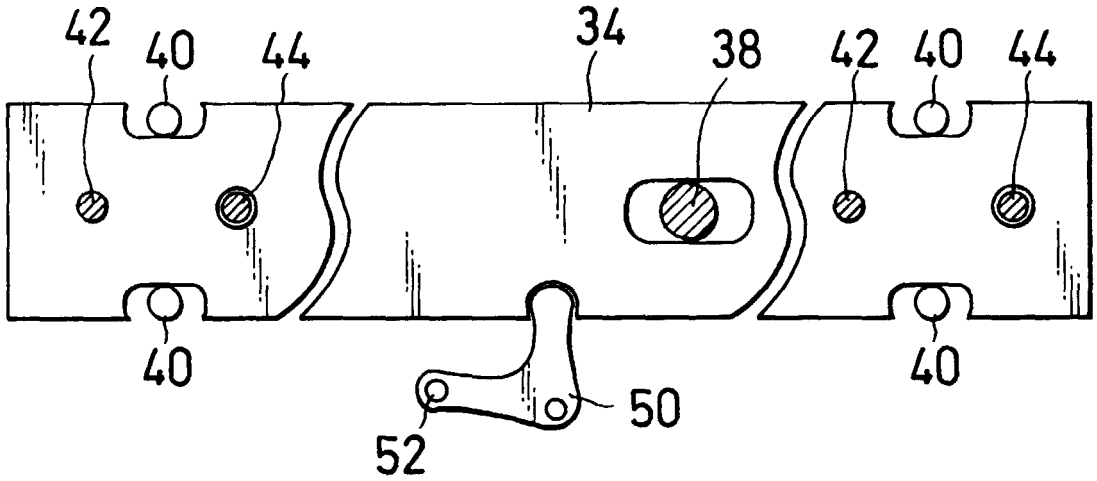


FIG. 4

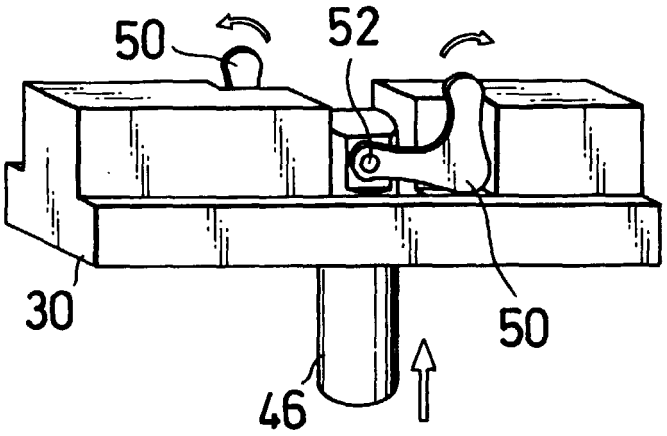


FIG. 5 (A)

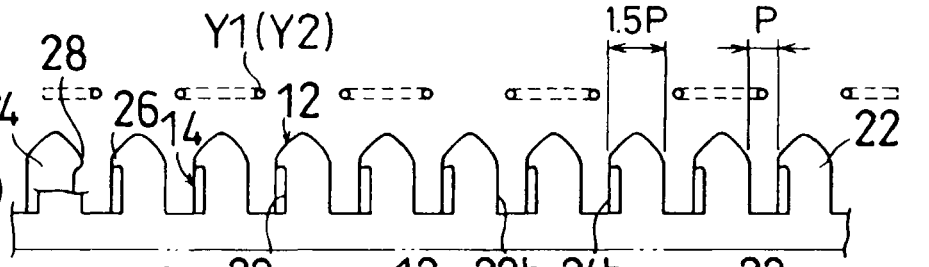


FIG. 5 (B)

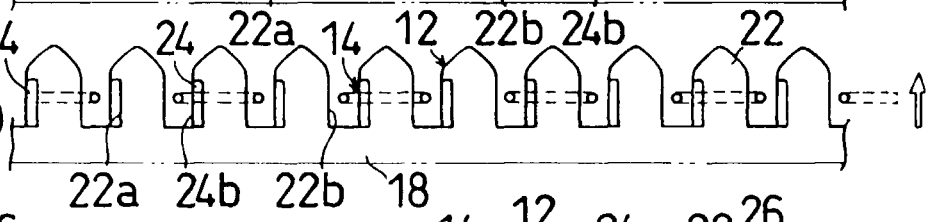


FIG.5 (C)

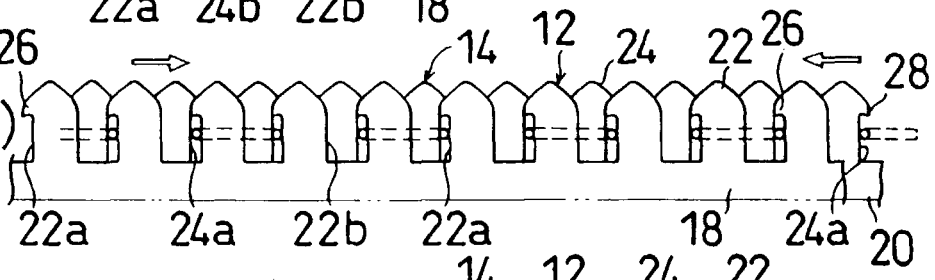


FIG.5 (D)

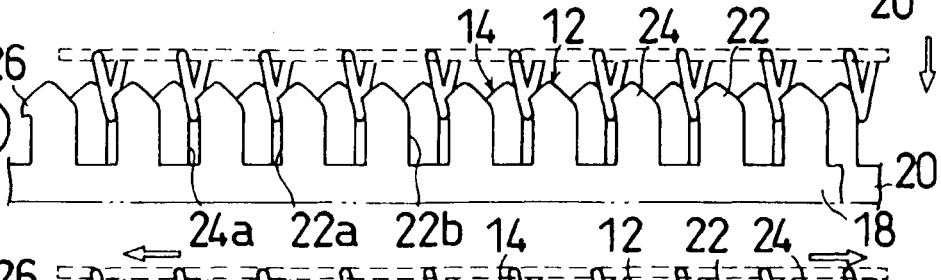


FIG.5 (E)

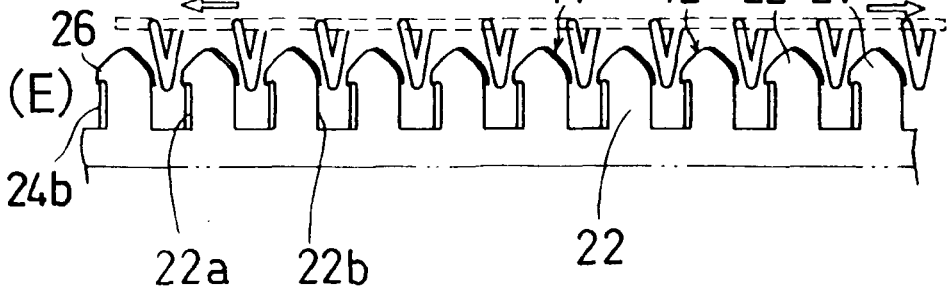


FIG.6(A)

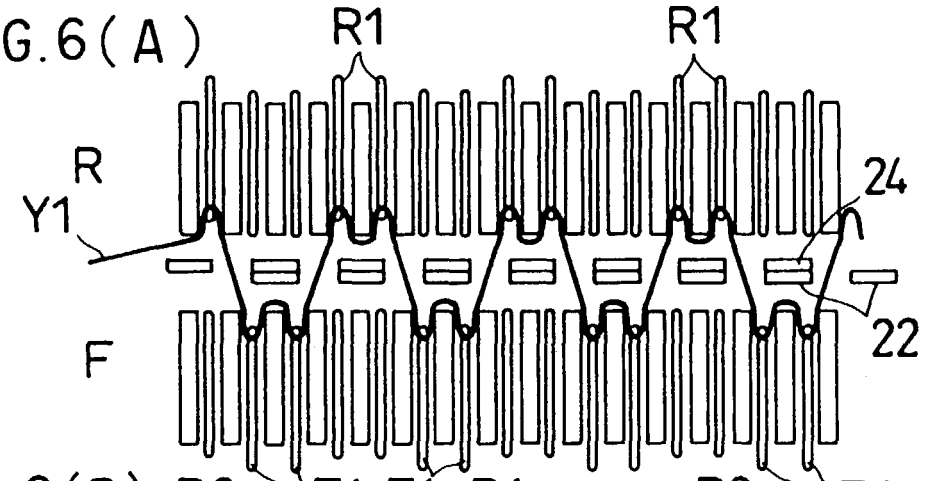


FIG.6(B)

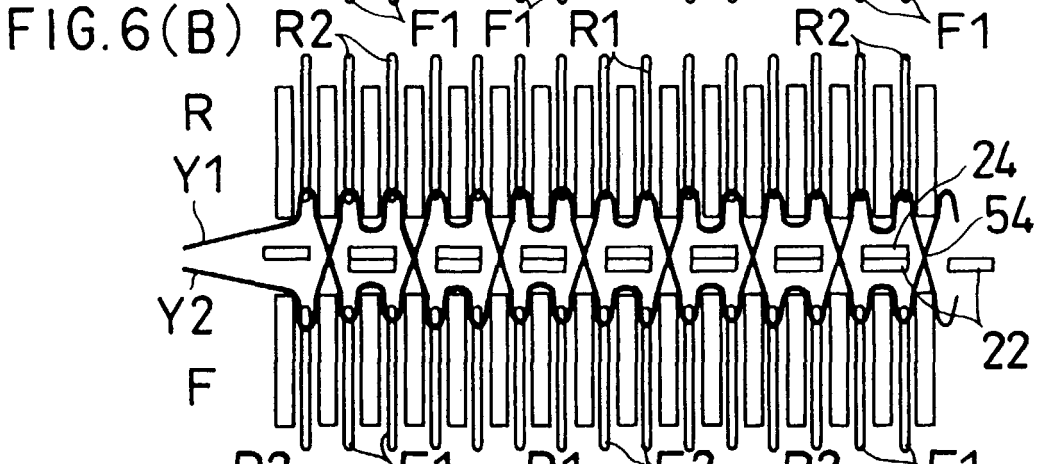


FIG.6(C)

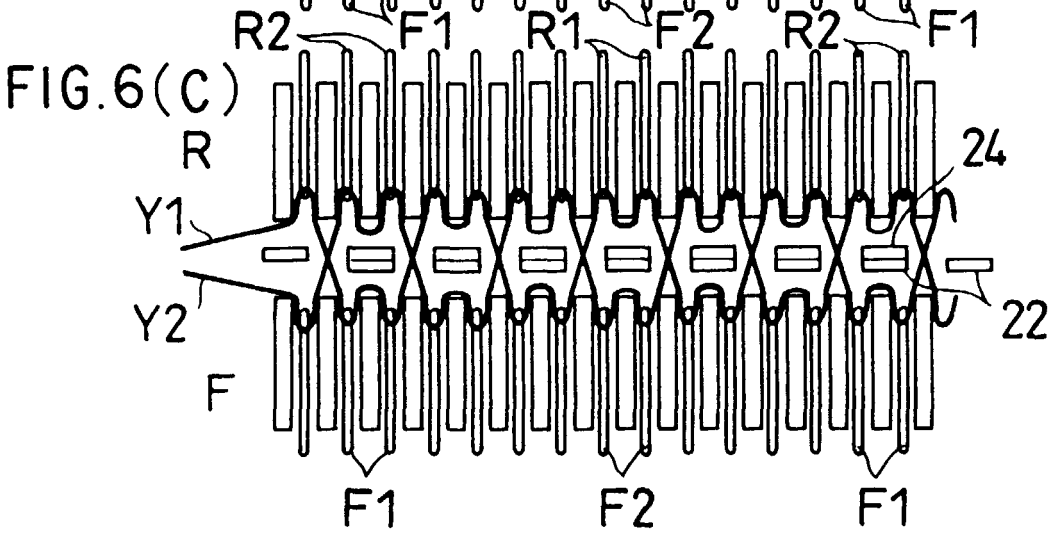


FIG.7(A)

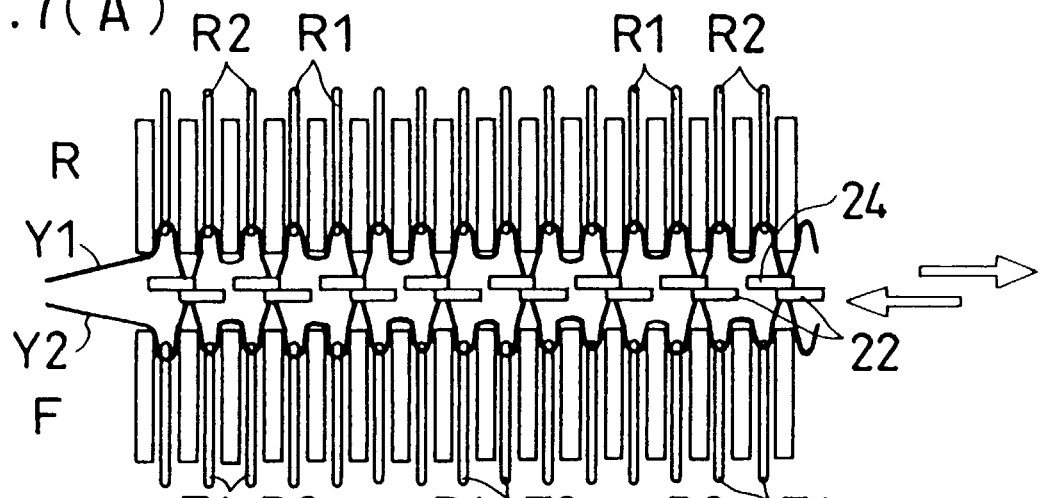


FIG.7(B)

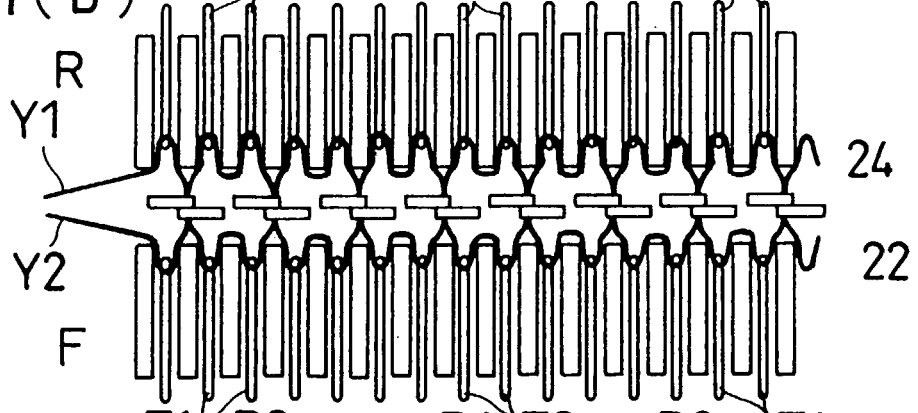


FIG.7(C)

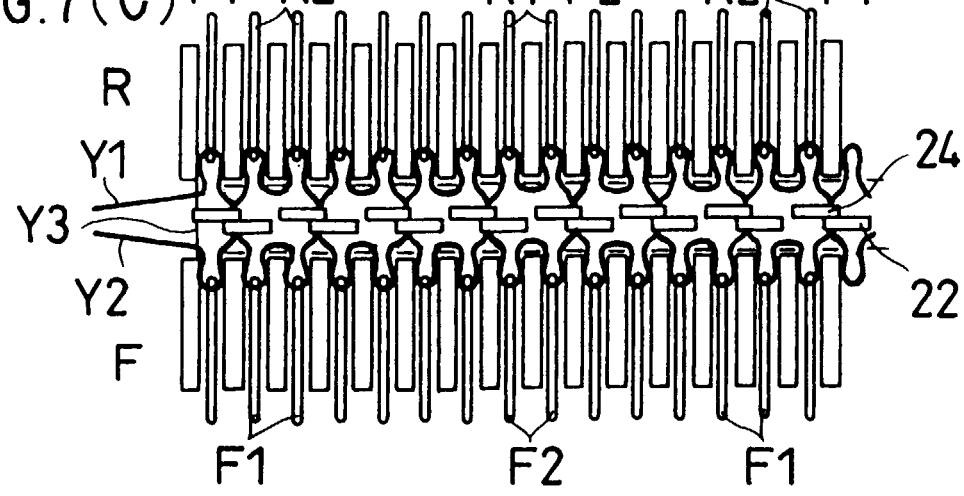


FIG. 8(A)

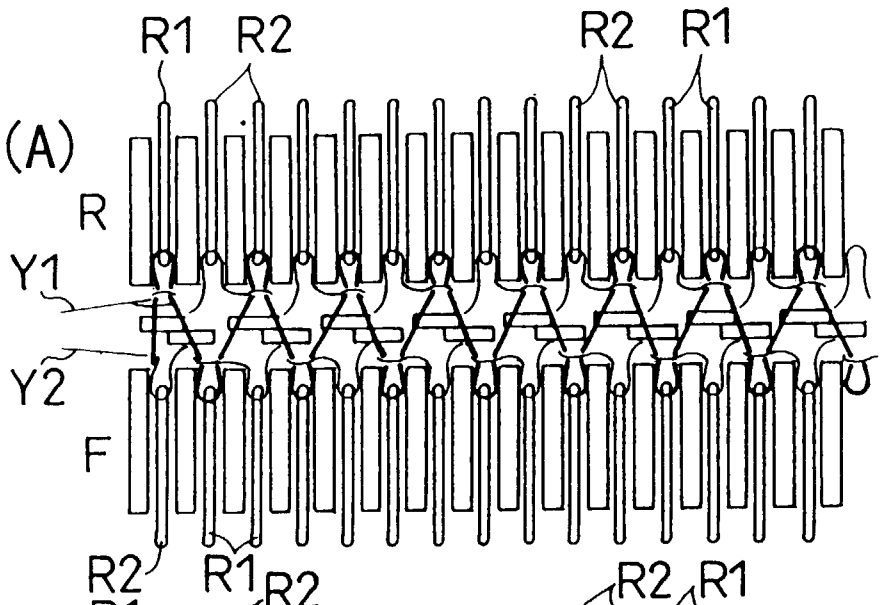


FIG. 8(B)

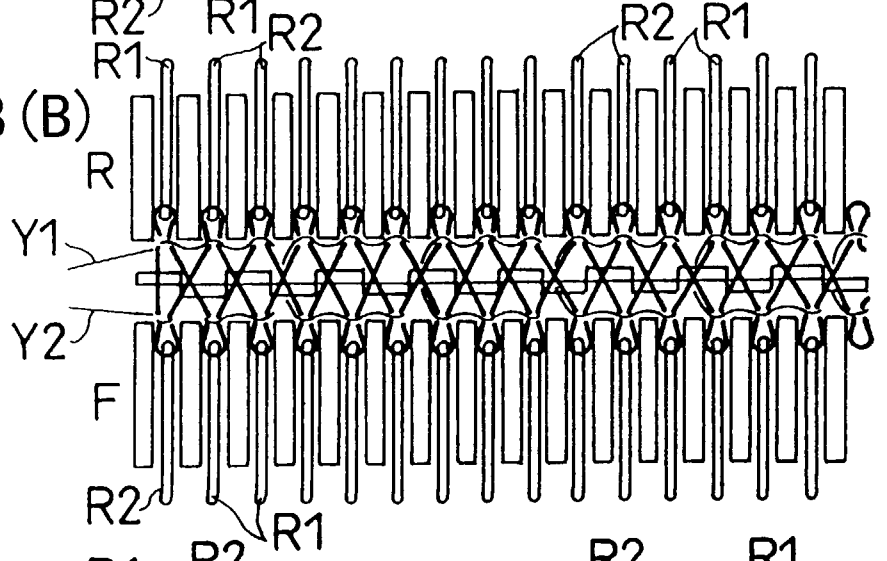


FIG. 8(C)

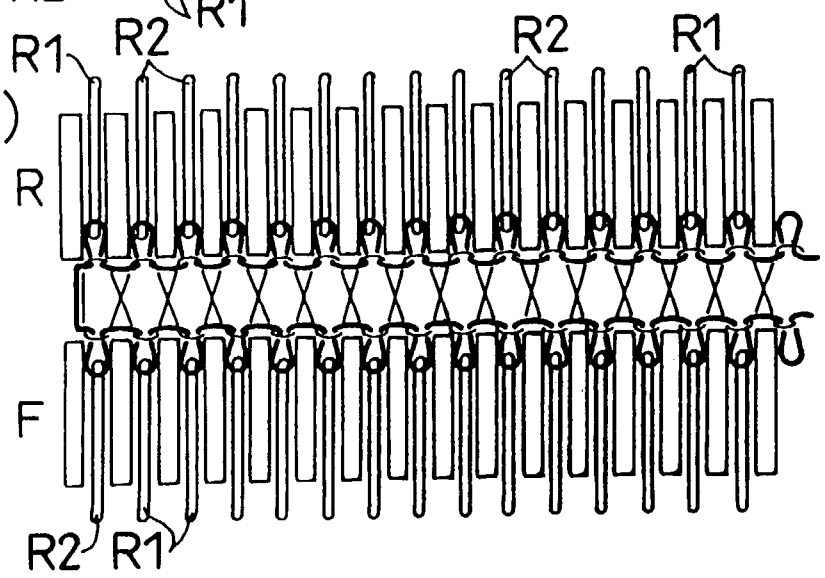


FIG. 9(A)

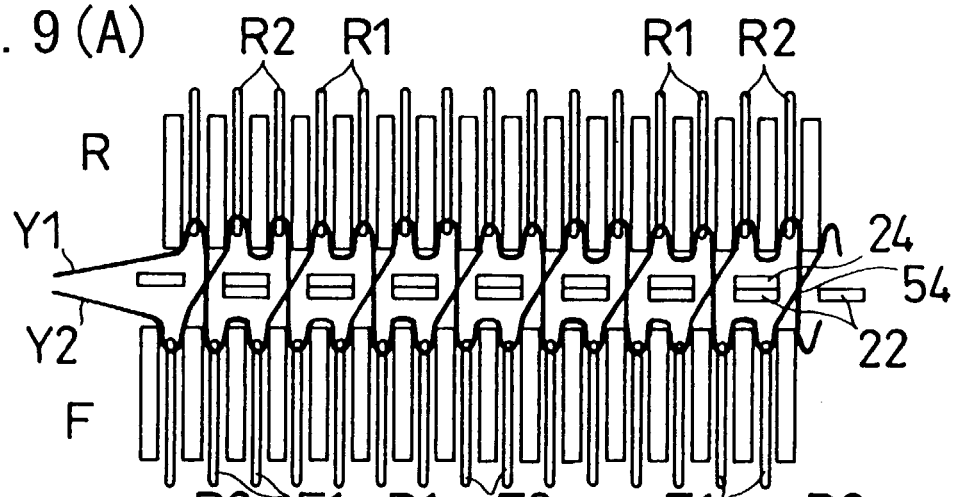


FIG. 9(B)

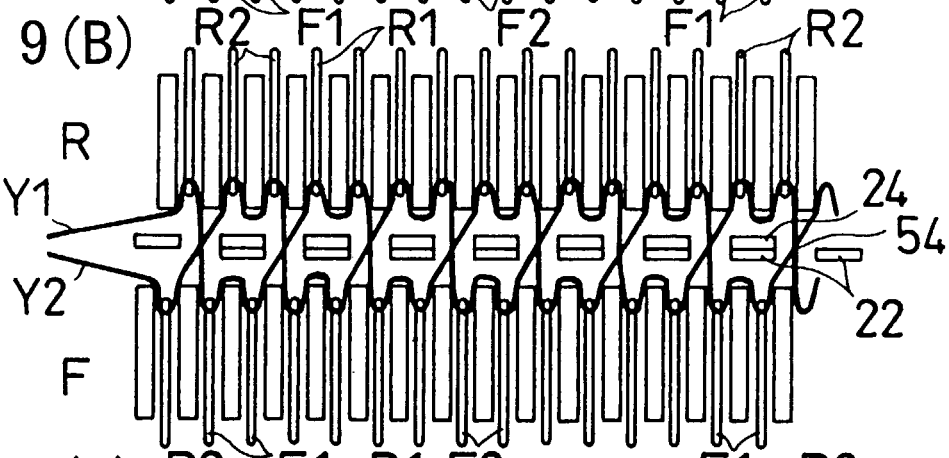


FIG. 9(C)

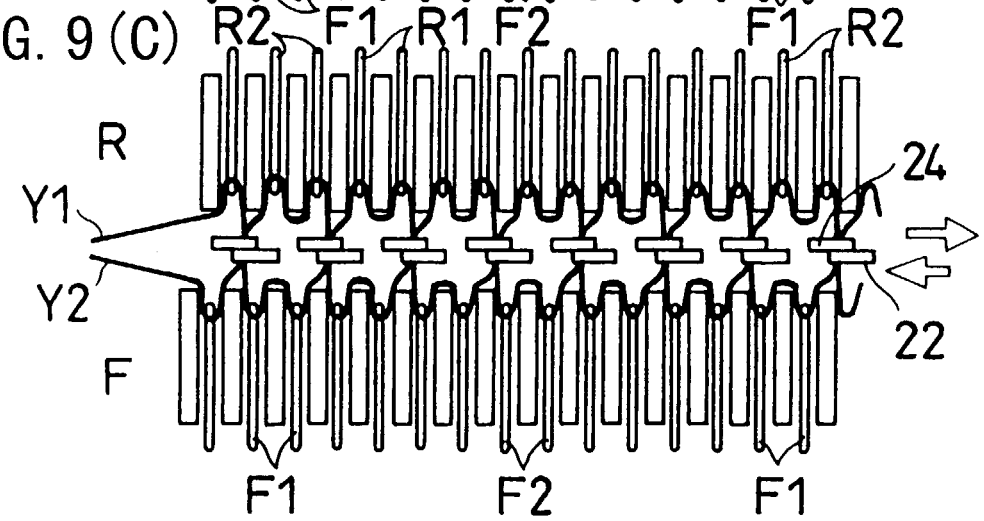


FIG. 10(A)

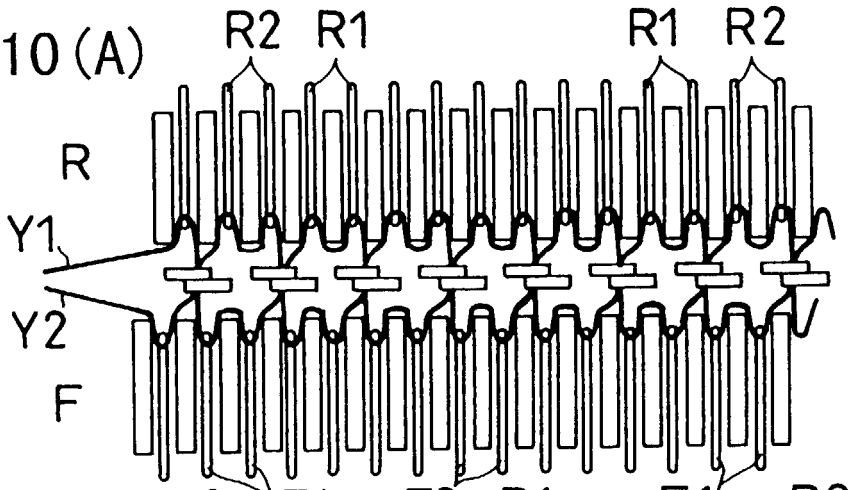


FIG. 10(B)

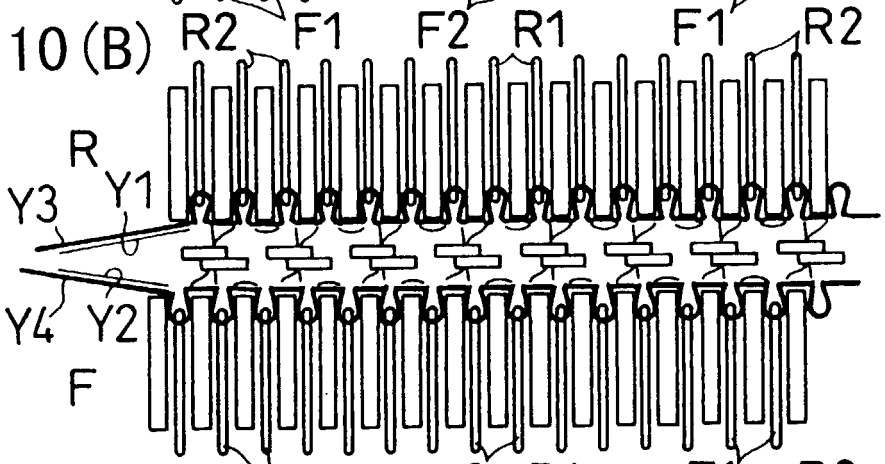


FIG. 10(C)

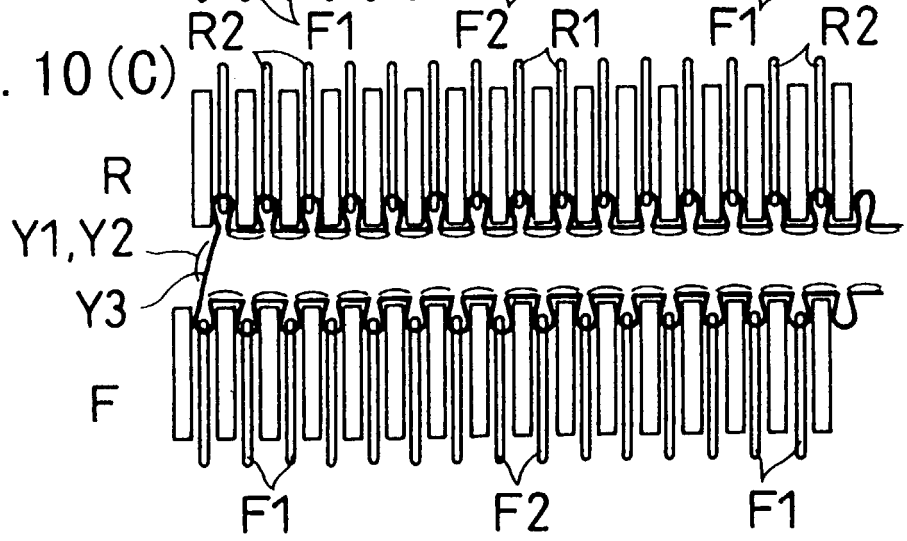


FIG. 11 (A)

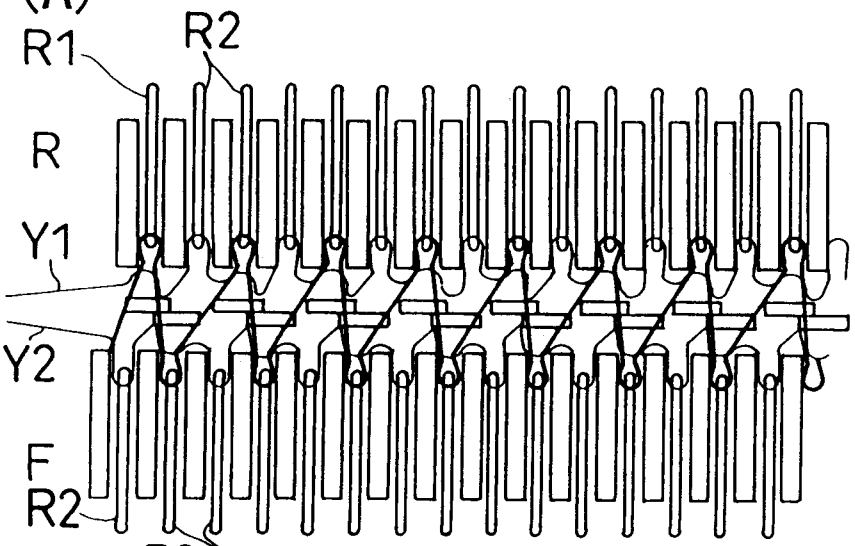


FIG. 11 (B)

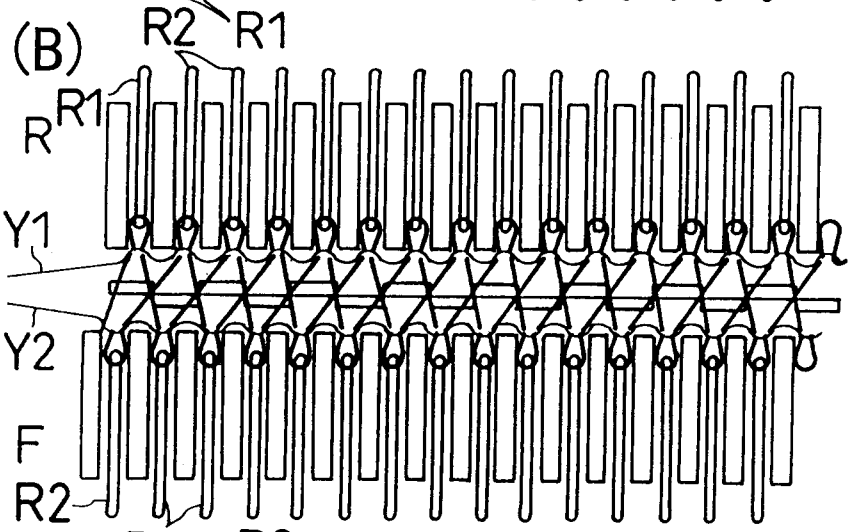


FIG. 11 (C)

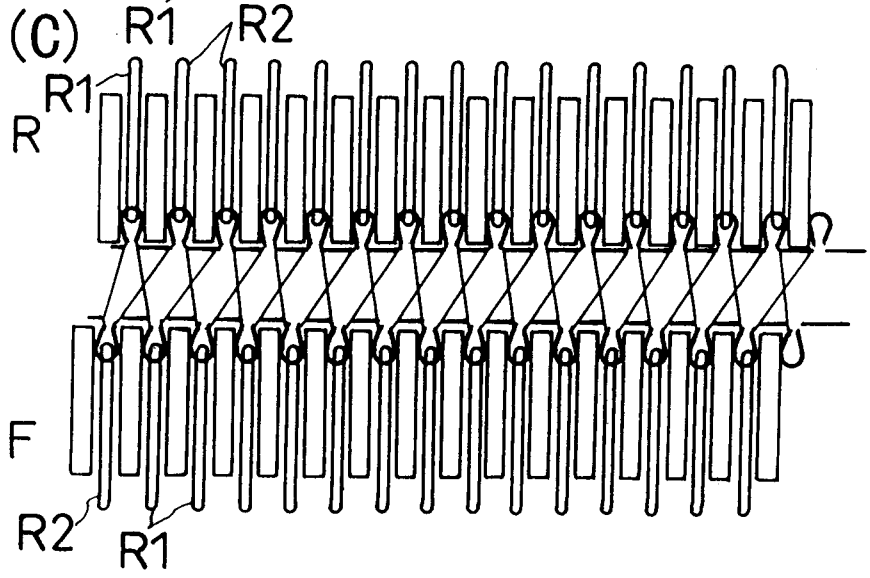


FIG. 12

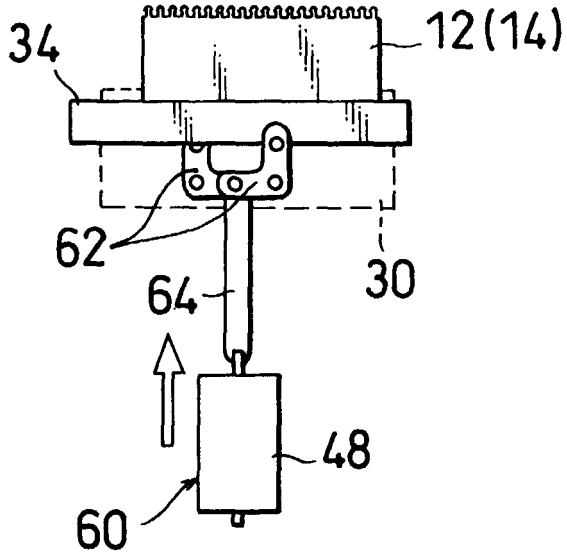


FIG. 13

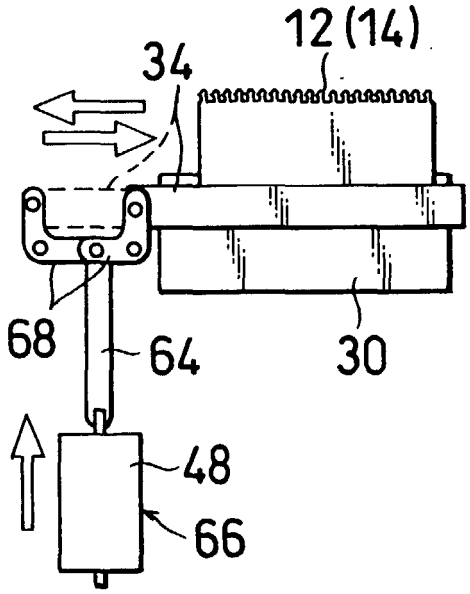


FIG. 14

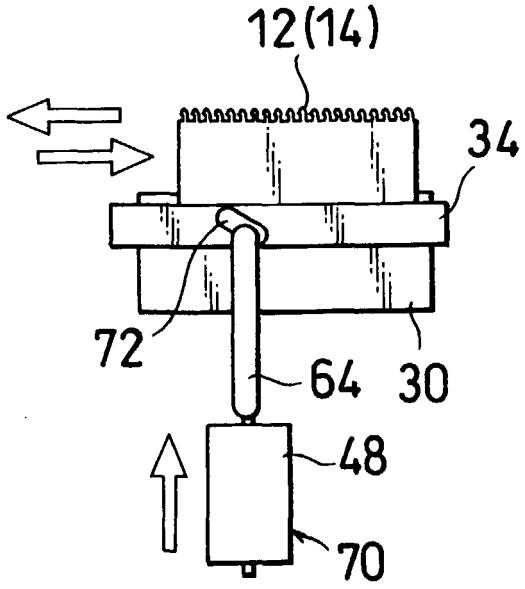


FIG. 15

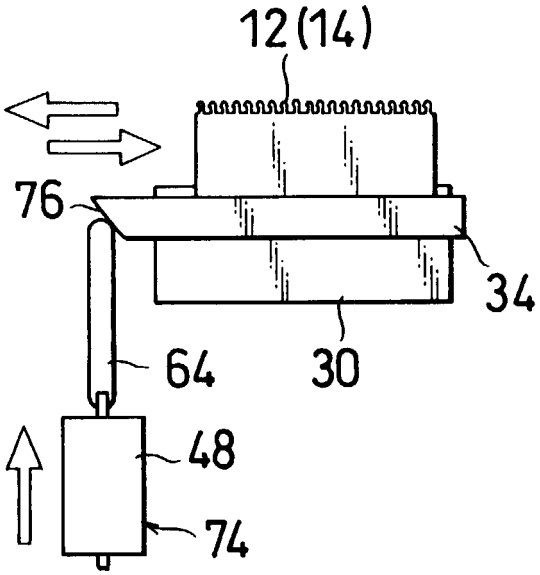


FIG. 16

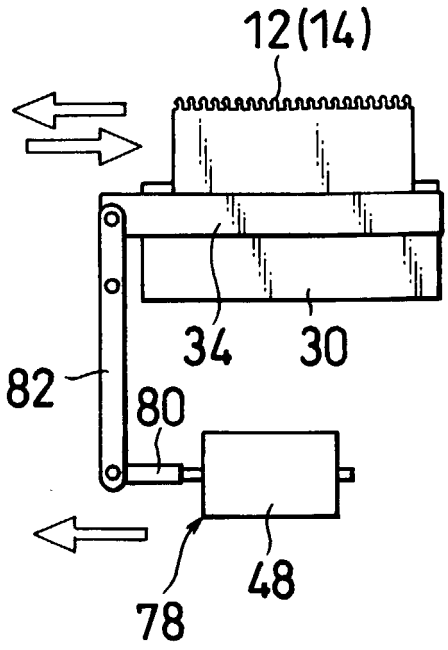


FIG. 17 (A)

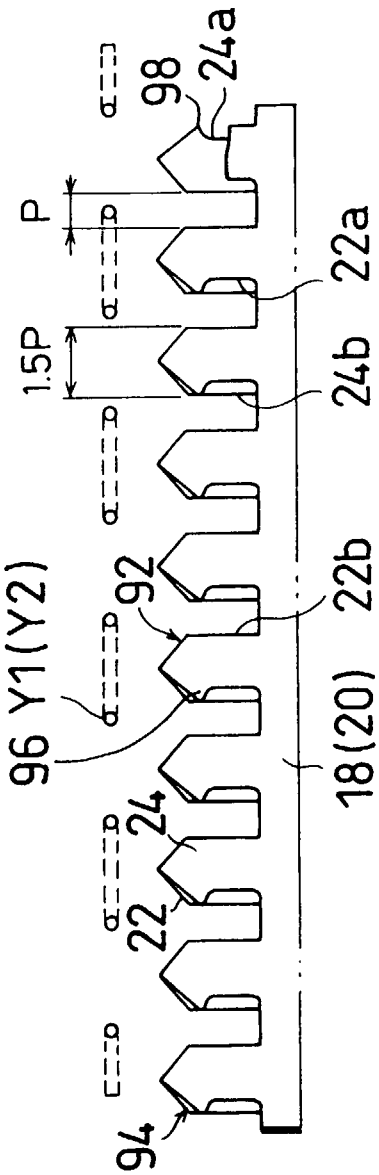


FIG. 17 (B)

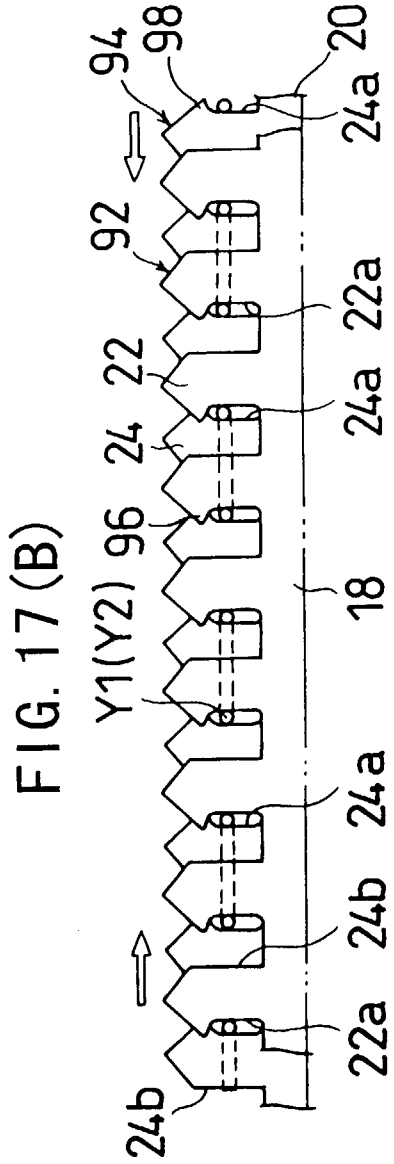


FIG. 18(A)

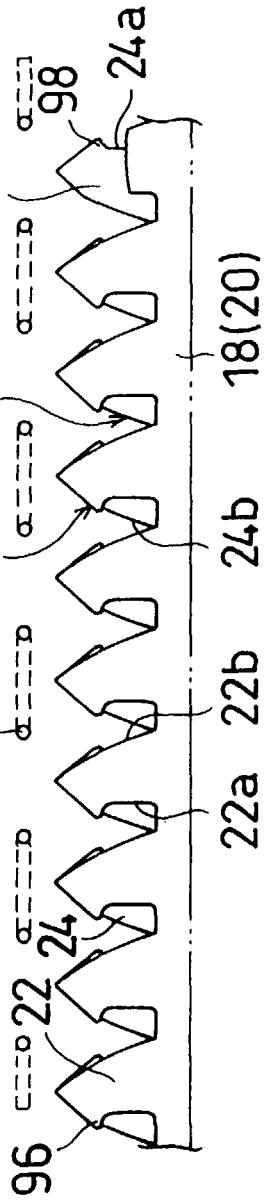


FIG. 18(B)

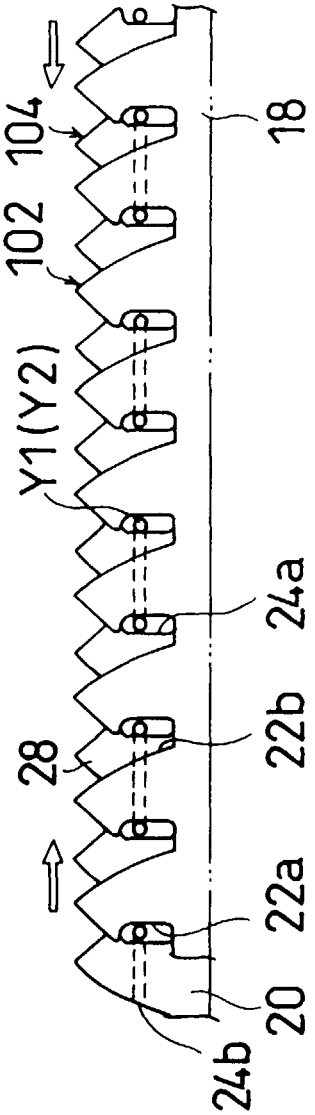


FIG. 19 (A)

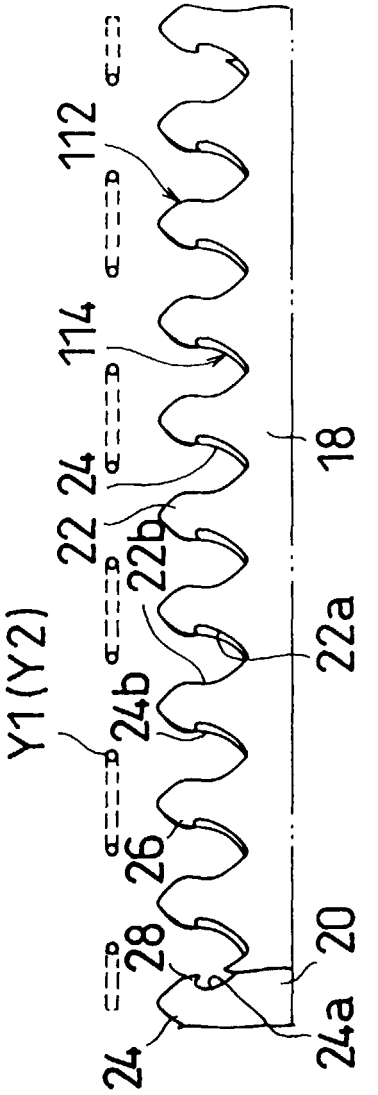


FIG. 19 (B)

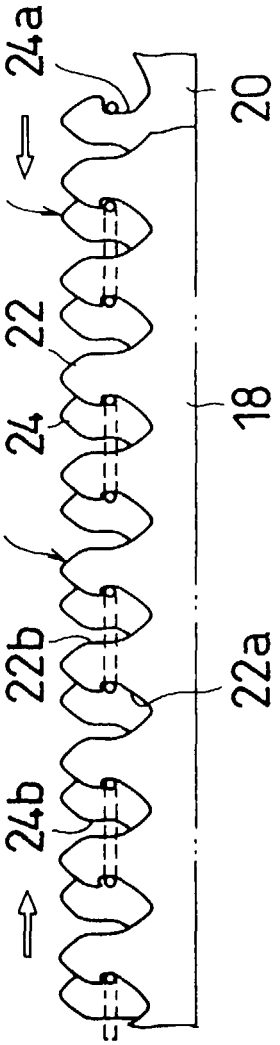


FIG. 20 (A)

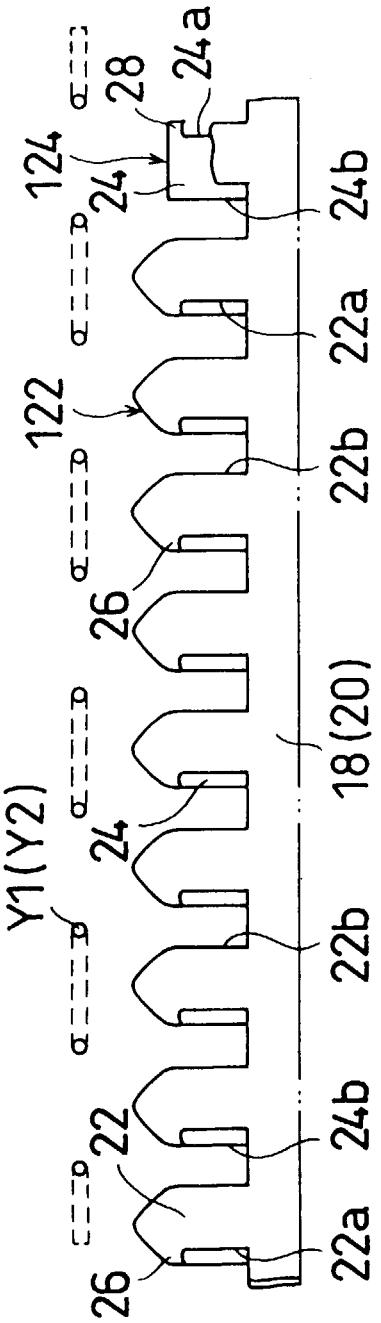


FIG. 20 (B)

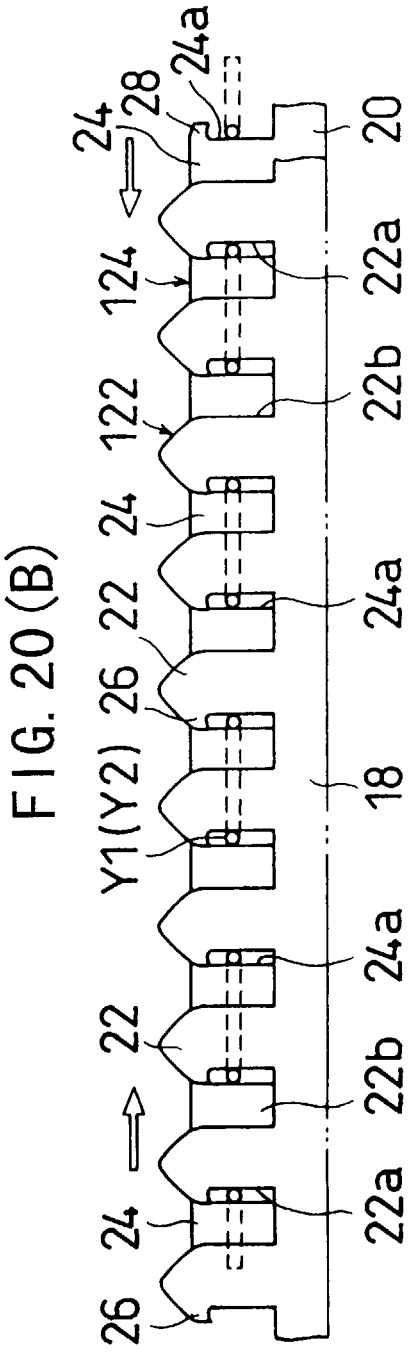


FIG. 21

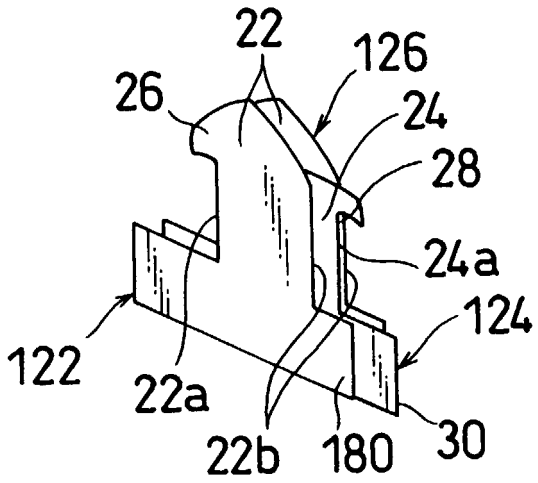

22
126
26
24
28
24a
124
122
22a
22b
180
30

FIG. 22

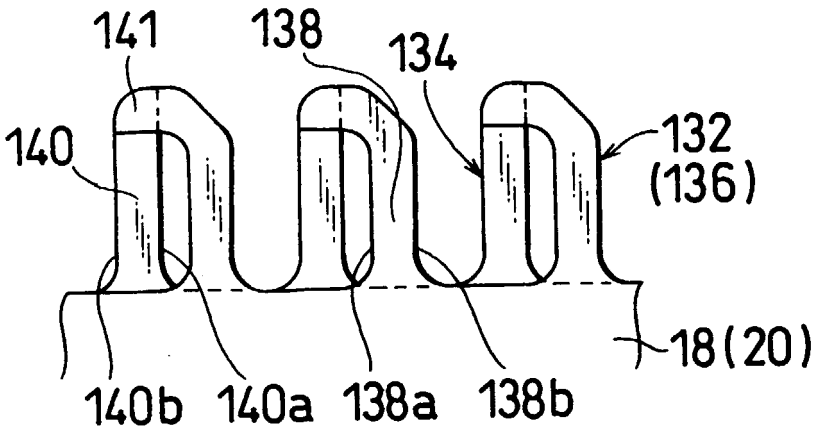

141
138
134
140
132
(136)
18(20)
140b
140a
138a
138b

FIG. 23 (A)

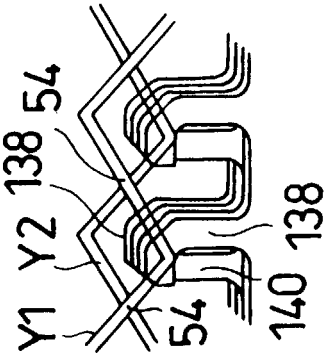


FIG. 23 (B)

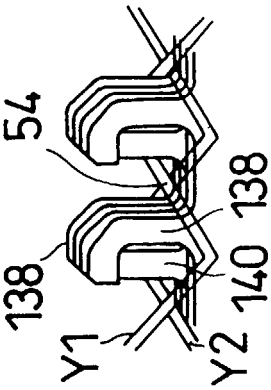


FIG. 23 (C)

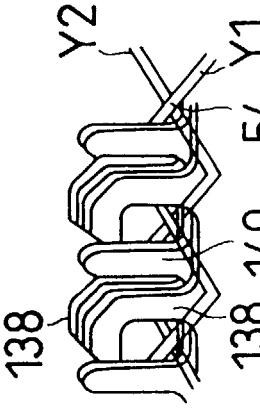


FIG. 23 (D)

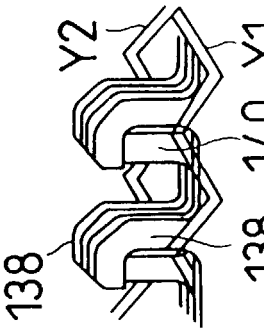


FIG. 23 (E)

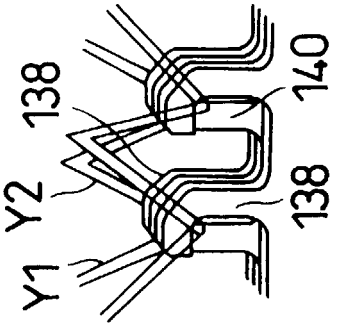


FIG. 23 (F)

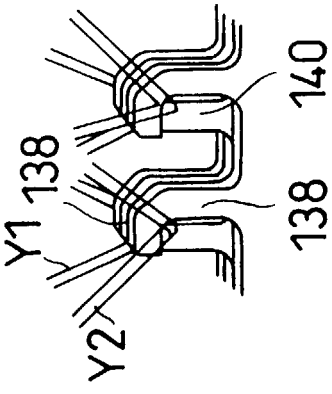


FIG. 23 (G)

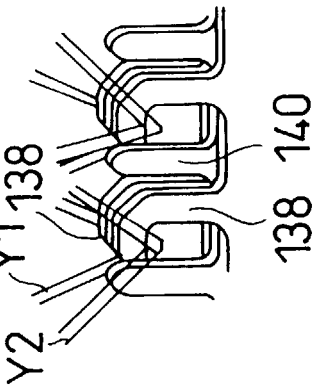


FIG. 23 (H)

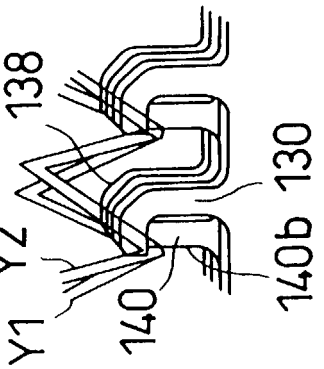


FIG. 24 (A)

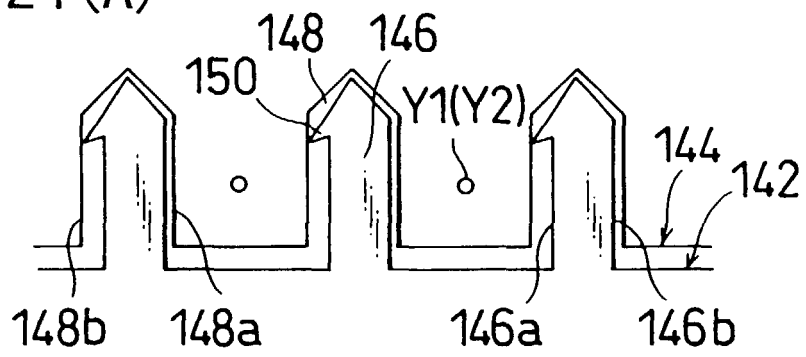


FIG. 24 (B)

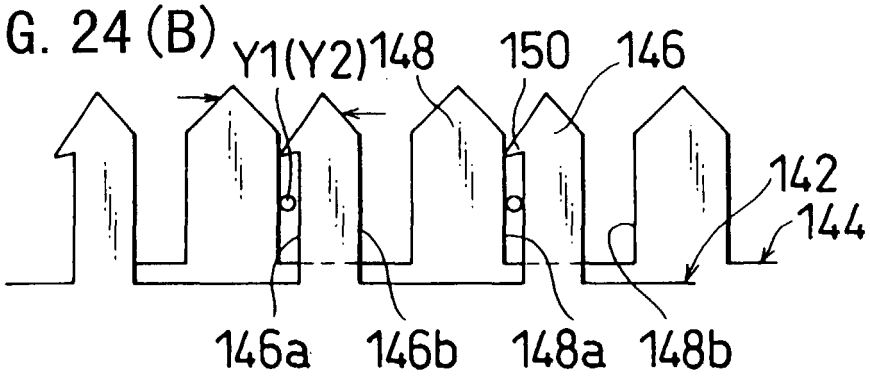


FIG. 24 (C)

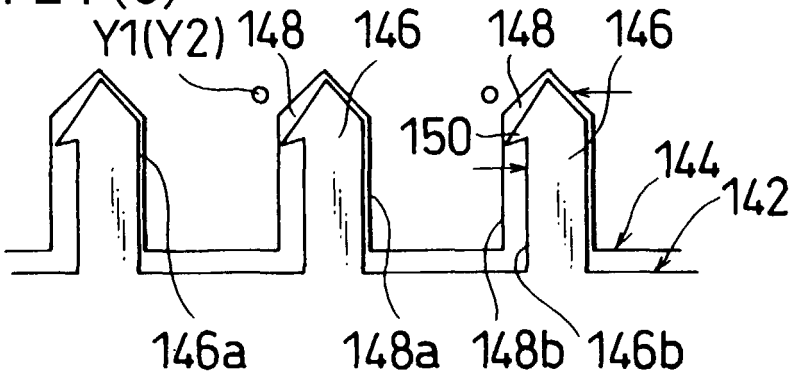


FIG. 25

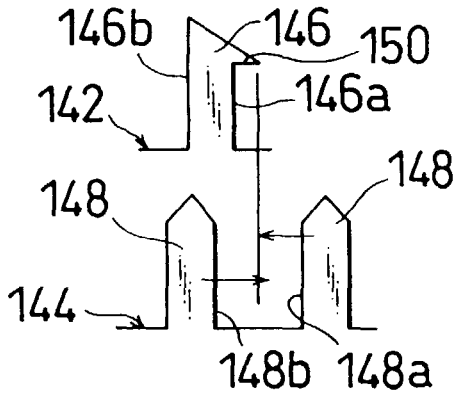


FIG. 26 (A)

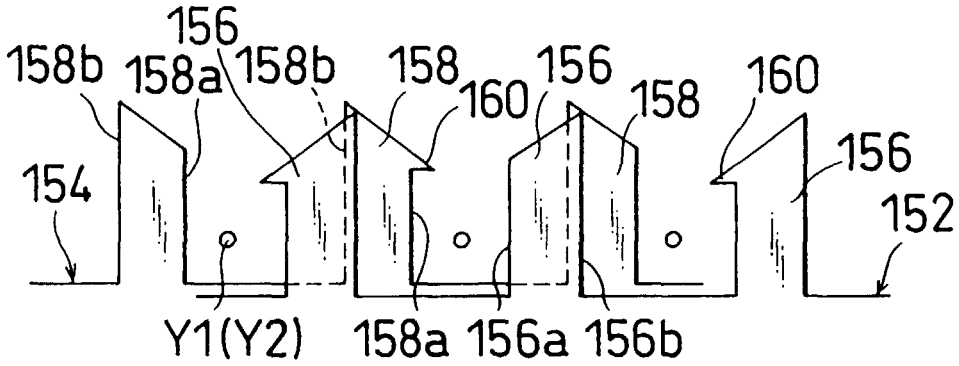


FIG. 26 (B)

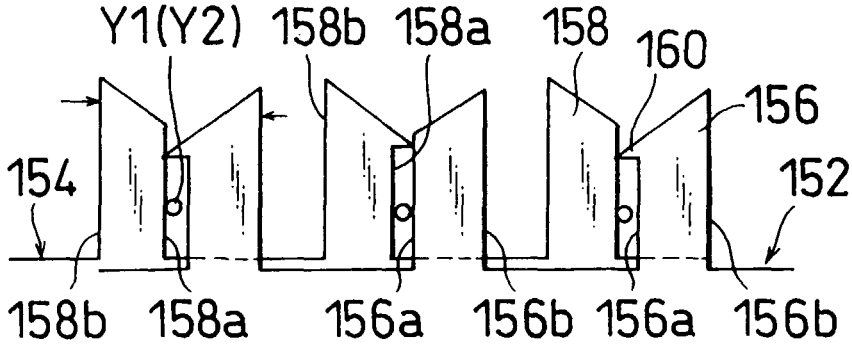


FIG. 26 (C)

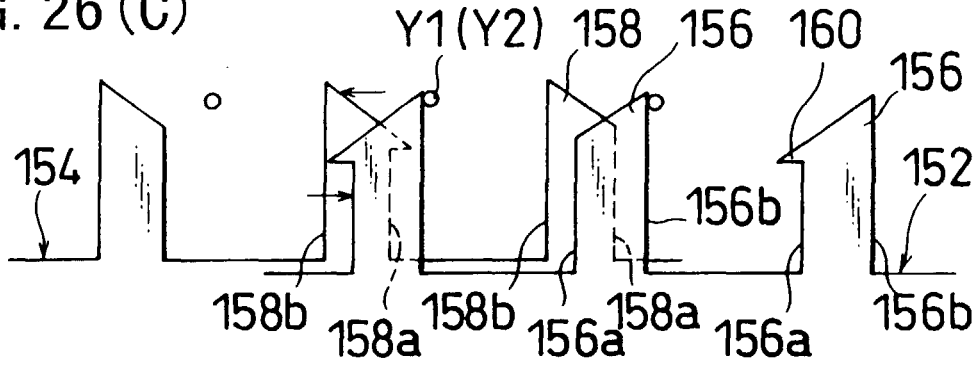
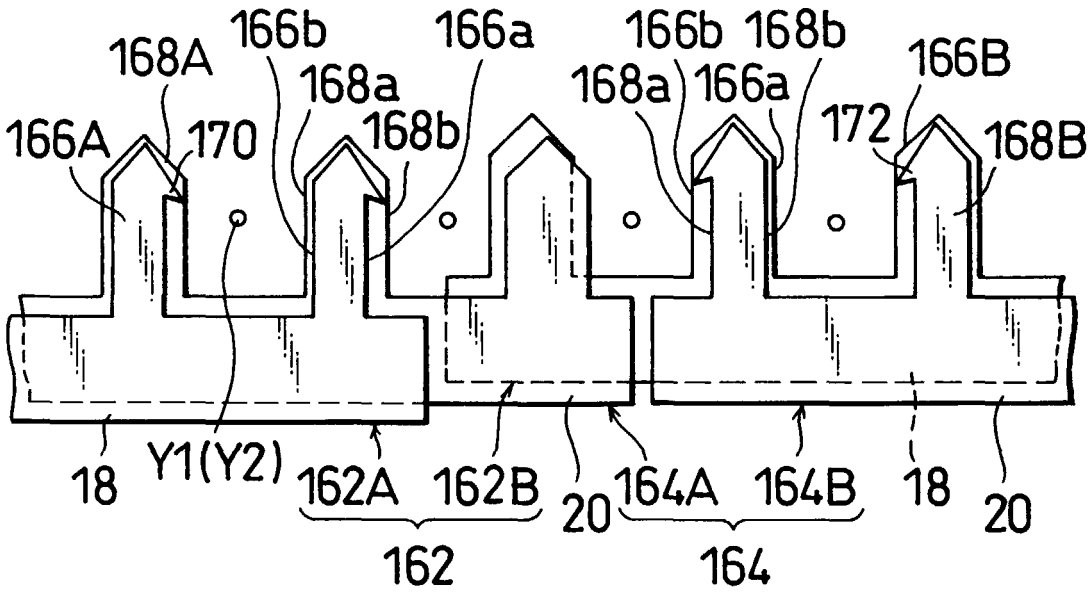


FIG. 27


166b
166a
166b
168b
168A
168a
168a
166a
166B
166A
170
168b
172
168B
18
Y1(Y2)
162A
162B
20
164A
164B
18
20
162
164

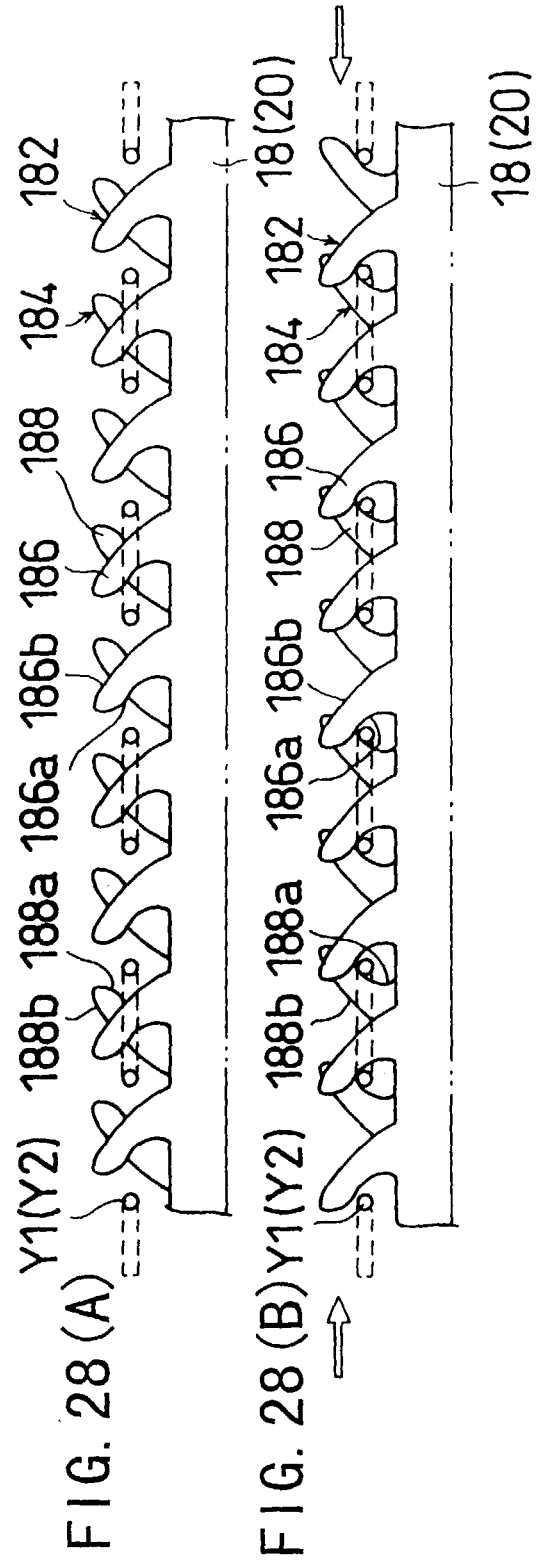


FIG. 28 (A)

FIG. 28 (B)

FIG. 29 (A)

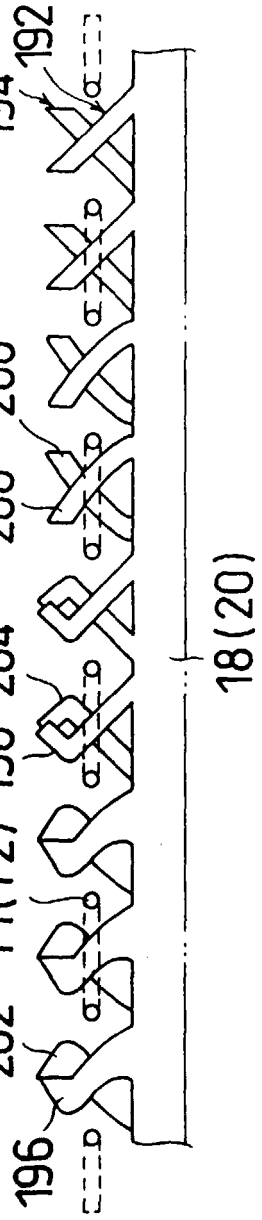


FIG. 29 (B)