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

(11) EP 0 939 155 A2

(12) # EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.09.1999 Bulletin 1999/35

(51) Int. Cl.[6]: D03D 47/27

(21) Application number: 99100360.9

(22) Date of filing: 15.01.1999

(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: 18.02.1998 JP 3607498

(71) Applicant:
Kabushiki Kaisha
Toyoda Jidoshokki Seisakusho
Aichi-ken (JP)

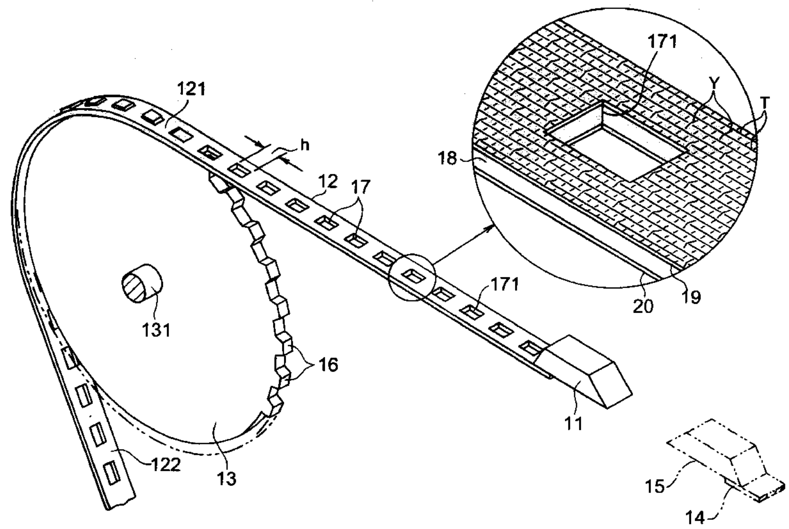
(72) Inventors:
- Tsuzuki, Makoto
Kariya-shi, Aichi-ken (JP)
- Yasue, Masahiko
Kariya-shi, Aichi-ken (JP)
- Kimbara, Masahiko
Kariya-shi, Aichi-ken (JP)
- Niida, Eiki
Kariya-shi, Aichi-ken (JP)

(74) Representative: HOFFMANN - EITLE
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) **Weft insertion apparatus and rapier band for rapier loom**

(57) A highly abrasion-resistant rapier band (12) is provided. The rapier band (12) has a laminated structure including a core member (18) and a pair of woven fabrics (19,20), the core member (18) being made of a three-dimensional fabric. Each woven fabric (19,20) is a satin fabric made of warp threads (T) and weft threads (Y). The warp threads (T) of each woven fabric (19,20) extend along the longitudinal direction of the rapier band (12), and the weft threads (Y) extend across the width direction of the rapier band (12). A warp thread (T) is exposed at an obverse side of each woven fabric (19,20) by leaping over a plurality of weft threads (Y).

FIG. 1



EP 0 939 155 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a weft insertion apparatus and a rapier band for a rapier loom.

2. Description of the Related Art

[0002] A weft insertion apparatus for a rapier loom includes a rapier band holding a rapier head and a rapier wheel around which the rapier band is wrapped. To drive a rigid but flexible band such as a rapier band, a wheel that allows such a band to be wrapped around is used. The rapier wheel is rotated forward and backward, so that the rapier head held by the rapier band is advanced into and retracted from a warp shedding to allow a weft thread to be inserted into the warp shedding.

[0003] Japanese Patent Application Laid-open No. 8-296150 discloses a weft insertion apparatus having a mechanism that engages power transmitting teeth formed side by side around the circumference of the rapier wheel with power receiving holes formed side by side in the rapier band. In such a apparatus, the rapier band must be wrapped partially around the circumference of the rapier wheel. However, if the rapier band having no power receiving holes is wrapped around the rapier wheel, the rapier band must be wrapped around the entire circumference of the rapier wheel. Further, even if the rapier band is wrapped around the entire circumference of the rapier wheel, the diameter of the rapier wheel becomes considerably larger than that of the rapier wheel around which the rapier band having power receiving holes is wrapped. When the diameter of the rapier wheel increases, its inertial moment also increases and this prevents high-speed operation of the loom. Therefore, the rapier band having power receiving holes is advantageous in increasing the speed of the loom.

[0004] When the rapier band is curved, the rapier band does not expand or contract in the middle as viewed thicknesswise, but expands and contracts at its curved surfaces (i.e., its obverse and reverse sides). That is, the curved surface toward the inside of the curved rapier band contracts, and the curved surface toward the outside of the curved rapier band expands. With respect to the longitudinal direction of the rapier band having power receiving holes, the bending rigidity differs between the range in which holes are present and the range in which holes are absent. As a result, the rapier band curves exclusively in the range in which holes are present. In such a curved state, stress concentrates along borders between the range in which holes are present and the range in which holes are absent on both obverse and reverse sides of the rapier band, and especially at corner portions of the holes. As a result, cracks are liable to appear from such corners to the rapier band.

[0005] A rapier band disclosed in Japanese Patent Application Laid-open No. 8-296150 is such that the entire band is made up of laminated woven fabrics. The woven fabrics are effective in preventing the occurrence of the cracks.

[0006] Both the obverse and reverse sides of the rapier band sliding contact a band guide that regulates the travelling path of the rapier band (exemplary band guides include a fixing guide disclosed in Japanese Patent Application Laid-open No. 9-324342, and spaced teeth disclosed in Japanese Patent Application Laid-open No. 5-209341). Abrasion of the rapier band caused by such sliding contact shortens the life of the band. Japanese Utility Model Application Laid-open No. 62-114079 discloses a rapier band having a polytetrafluoroethylene coating on its surfaces. The polytetrafluoroethylene coating reduces the frictional resistance of the rapier band during sliding contact with the band guide. However, polytetrafluoroethylene has a shortcoming in that it abrades quickly, and thus is not a suitable material for preventing abrasion of the surfaces of the rapier band.

SUMMARY OF THE INVENTION

[0007] An object of the present invention is, therefore, to provide a highly abrasion-resistant rapier band in order to overcome the aforementioned problems.

[0008] To achieve the above object, a major aspect of the present invention is directed to a rapier loom having a weft insertion apparatus that inserts a weft thread into a warp shedding by first inserting a rapier head held by a rapier band into the warp shedding and then retracting the rapier head from the warp shedding. For such a rapier loom, the present invention provides a weft insertion apparatus in which the rapier band is formed by laminating woven fabrics on both obverse and reverse sides of a core member; either warp threads or weft threads of each woven fabric are arranged to extend along the longitudinal direction of the rapier band; a total exposed length of the threads extending along the longitudinal direction of the rapier band is larger than that of the threads extending across the width direction of the rapier band on the obverse side of each woven fabric; and at least one of the threads extending along the longitudinal direction of the rapier band leaps over at least two threads extending across the width direction of the rapier band.

[0009] The amount of abrasion in the case where threads are brought into sliding contact in a direction of the threads is smaller than that in the case where the threads are brought into sliding contact in a direction orthogonal to the direction of the threads. In a woven fabric in which the total amount of exposed threads extending along the longitudinal direction of the rapier band and exposed to the obverse side of the woven fabric is larger than that of threads extending across the width direction of the rapier band, abrasion of the threads caused by their sliding contact along the longitudinal direction of the rapier band is smaller than plain weave fabric. Hence, the rapier band has excellent abrasion resistance and thus its life can be extended.

[0010] It is preferred that the woven fabrics be made of satin weave. This is because the satin weave is the optimum woven fabric for preventing abrasion.

[0011] Also, the pitch of the warp can also be made substantially the same as that of the weft. This is because such pitch arrangement is effective in preventing break down of the structure of the woven fabrics.

[0012] Further, the warp can be arranged to extend along the longitudinal direction of the rapier band because such arrangement is effective in improving the bending rigidity along the longitudinal direction of the rapier band.

[0013] Still further, it is desirable that the core member be a three-dimensional fabric because three-dimensional fabrics are suitable for core members.

[0014] Yet further, it is preferred that the woven fabrics be made of carbon fiber because carbon fiber is a suitable abrasion-resistant material.

[0015] According to another aspect of the present invention, there is provided a rapier band for a rapier loom having a weft insertion apparatus that inserts a weft thread into a warp shedding by first inserting a rapier head held by the rapier band into the warp shedding and then retracting the rapier head from the warp shedding. The rapier band includes a core member, and woven fabrics laminated on both obverse and reverse sides of the core member. In such rapier band, either warp threads or weft threads of each woven fabric are arranged to extend along the longitudinal direction of the rapier band; a total exposed length of the threads extending along the longitudinal direction of the rapier band is larger than that of the threads extending across the width direction of the rapier band on the obverse side of each woven fabric; and at least one of the threads extending along the longitudinal direction of the rapier band leaps over at least two threads extending across the width direction of the rapier band.

[0016] The rapier band of the above structure has excellent abrasion resistance and thus its life can be extended.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] In the accompanying drawings:

Fig. 1 is a perspective view showing a weft insertion apparatus for a rapier loom according to a first embodiment of the present invention;

Fig. 2 is an enlarged longitudinal sectional view of an essential portion showing the relationship between a rapier wheel and a rapier band;

Fig. 3 is a sectional view taken along the line A-A of Fig. 2 showing a structure of the rapier band;

Fig. 4 is an exploded perspective view of an essential portion showing a structure of the rapier band;

Fig. 5 shows a woven fabric according to the first embodiment of the present invention, in which part (a) is an enlarged plan view of an obverse side of a woven fabric and part (b) is an enlarged plan view of a reverse side of the woven fabric;

Fig. 6 shows a weft insertion apparatus for a rapier loom according to a second embodiment of the present invention, in which part (a) is an enlarged plan view of an obverse side of a woven fabric and part (b) is an enlarged plan view of a reverse side of the woven fabric; and

Fig. 7 shows a weft insertion apparatus for a rapier loom according to a third embodiment of the present invention, in which part (a) is an enlarged plan view of an obverse side of a woven fabric and part (b) is an enlarged plan view of a reverse side of the woven fabric.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] Embodiments of the present invention currently considered preferable will be described in detail with reference to the accompanying drawings.

[0019] In the following description, the same reference numerals are used to indicate like components in each drawing. It should be noted that terms such as "right," "left," "upper," and "lower" are used for the sake of convenience and are not to be interpreted in a limiting fashion.

Embodiment 1

[0020] A first embodiment of the present invention will now be described with reference to Figs. 1 to 5.

[0021] Fig. 1 is a perspective view showing a weft insertion apparatus for a rapier loom according to a first embodiment of the present invention. Reference numeral 11 in Fig. 1 denotes a weft feeding rapier head that is inserted into a warp shedding (not shown) from a weft insertion start end. The weft feeding rapier head 11 is held at an end of a rapier band 12. The rapier band 12 is wrapped around a rapier wheel 13 that rotates forward and backward about a pivot 131. At a weft insertion tail end, a rapier band 14 is also wrapped around a rapier wheel (not shown) that rotates forward and backward. A weft receiving rapier head 15 is held at the front end of the rapier band 14. As a result of the forward and backward rotation of both rapier wheels, the weft feeding rapier head 11 and the receiving rapier head 15 are inserted into the warp shedding, allowing the feeding and receiving rapier heads 11 and 15 to meet each other at the center of the weaving width. The weft thread inserted into the warp shedding by the feeding rapier head 11 is delivered to the receiving rapier head 15. As a result of the forward and backward rotation of both rapier wheels, the feeding rapier head 11 and the receiving rapier head 15 are retracted from the warp shedding, allowing the weft thread to be inserted into the warp shedding.

[0022] Trapezoidal power transmitting teeth 16 are arranged side by side over the circumference of the rapier wheel 13 around which the rapier band 12 is wrapped. On the other hand, rectangular power receiving holes 17 are formed side by side in the rapier band 12. The power transmitting teeth 16 engage with the power receiving holes 17 within the range in which the rapier band 12 is wrapped around the rapier wheel 13. As a result, the forward and backward rotation of the rapier wheel 13 is transmitted to the rapier band 12 through the power transmitting teeth 16 and the power receiving holes 17. A band guide (not shown) regulates the travelling path of the rapier band 12.

[0023] Fig. 2 is an enlarged longitudinal sectional view of an essential portion showing the relationship between the rapier wheel and the rapier band, and Fig. 3 is a sectional view taken along the line A-A of Fig. 2 showing a structure of the rapier band. As shown in these drawings, the rapier band 12 is, as disclosed in, e.g., Japanese Patent Application Laid-open No. 2-259248, of a laminated structure including a core member 18, and a pair of woven fabrics 19 and 20. The core member 18 is a three-dimensional fabric made by a three-dimensional braider. Further, the core member 18 is interposed between the woven fabrics 19 and 20. The surfaces of the woven fabrics 19 and 20 constitute curved surfaces 121 and 122 of the rapier band 12. The fibers of the core member 18 are such that the component thereof extending in the longitudinal direction of the rapier band 12 is larger than the component extending in the width direction or thickness direction of the rapier band 12.

[0024] Fig. 4 is an exploded perspective view showing an essential portion of the structure of the rapier band, Fig. 5 (a) is an enlarged plan view of an obverse side of the woven fabric according to the first embodiment and Fig. 5 (b) is an enlarged plan view of a reverse side of the same woven fabric. As shown in these drawings, the woven fabrics 19 and 20 are of a satin weave consisting of warp threads T and weft threads Y. In Figs. 5 (a) and (b), the weft threads Y are hatched. "Satin weave" means a texture in which four or more warp threads T leap over the weft threads Y or the weft threads Y over the warp threads T and the points of intersection between the warp threads T and the weft threads Y are staggered at regular intervals. The warp threads T of the woven fabrics 19 and 20 extend along the longitudinal direction of the rapier band 12, and weft threads Y extend across the width direction of the rapier band 12. Fig. 5 (a) shows the obverse sides of the woven fabrics 19 and 20, and Fig. 5 (b) shows reverse sides. The reverse side of each of the woven fabrics 19 and 20 is adhered to the core member 18. On the other hand, the obverse side of each of the woven fabrics 19 and 20 sliding contact with the band guide. As shown in Fig. 5 (a), the warp threads T are exposed at the obverse side of each of the woven fabrics 19 and 20 while leaping over seven continuous weft threads Y. As shown in Fig. 5 (b), the weft threads Y are exposed at the reverse side of each of the woven fabrics 19 and 20 while leaping over seven continuous warp threads Y. The warp threads T and the weft threads Y are the same kind of thread, and have the same diameter. Further, as shown in Figs. 5 (a) and (b), the warp threads T and the weft threads Y have the same pitch P.

[0025] The fiber of the core member 18, warp threads T and weft threads Y are all made of carbon fiber. The core member 18 and the woven fabrics 19 and 20 contain thermosetting resins such as epoxy resins and bismaleimide resins. The rapier band 14 is also a laminated structure similar to the rapier band 12.

[0026] Embodiment 1 provides the following advantages.

(1-1) In the woven fabrics 19 and 20, the diameter and pitch of the warp threads T are the same as those of the weft threads Y. As a result, in the woven fabrics 19 and 20, the total length of the warp threads T is substantially the same as that of the weft threads Y. In addition, since the warp threads T are the same kind as the weft threads Y, in the woven fabrics 19 and 20, the total weight of the warp threads T is substantially the same as that of the weft threads Y. However, the total length of the warp threads T exposed at the obverse sides of the woven fabrics 19 and 20 is larger than that of the weft threads Y exposed at the obverse sides of the woven fabrics 19 and 20.

Seven warp threads T and a single weft thread Y are exposed within a rectangle W shown by a chain line in Fig. 5 (a). A single warp thread T and a single weft threads Y are exposed within a rectangle H that has the same area as the rectangle W. The total length of the warp threads T exposed within the rectangle W on the obverse side of each of the woven fabrics 19 and 20 is substantially seven times that of the weft threads Y exposed within the rectangle W. Similarly, the total length of the warp threads T exposed within the rectangle H on the observe side of each of the woven fabrics 19 and 20 is about seven times that of the weft threads Y exposed within the rectangle W. That is, the total length of the warp threads T exposed in a plurality of predetermined area portions obtained by defining the total surface of each woven fabric as the rectangle W or H is substantially seven times that of the weft threads Y. Therefore, the total length of the warp threads T exposed at a certain area portion expressed by a rectangle with an area that is a multiple integral of the area of the rectangle W or H is substantially seven times that of the weft threads Y exposed in the same certain area portion.

When a thread is put into sliding contact in a direction of its length, the amount of abrasion it suffers is less than that when it is put in sliding contact in a direction orthogonal to the direction of its length. The fabrics 19 and 20 of satin weave according to this embodiment abrade less than fabrics of plain weave when the fabrics 19 and 20 are put into sliding contact along the longitudinal direction of the rapier band 12. The inventors of the present application obtained test results that the amount of abrasion on the obverse sides of the woven fabrics 19 and 20 according to this embodiment is about half that of fabrics of plain weave.

(1-2) The weft threads Y arranged to extend across the width direction of the rapier band 12 contribute to the improvement of the bending rigidity across the width direction of the rapier band 12. The satin fabrics 19 and 20 according to this embodiment are such that the pitch of the weft threads Y is the same as that of the warp threads T, and that the density of the warp threads T is the same as that of the weft threads Y. Such density arrangement of the weft threads Y is effective in improving the bending rigidity across the width direction of the rapier band 12. In addition, the satin fabrics 19 and 20, which have a smaller degree of intermingle of the weft threads Y than fabrics of plain weave, have an increased bending rigidity across the width direction of the rapier band 12. Therefore, in order to improve the bending rigidity across the width direction of the rapier band 12, there is no need to put another piece of fabric over the woven fabrics 19 and 20. Thus, the woven fabrics 19 and 20 alone having the aforementioned densities of the warp threads T and the weft threads Y can ensure better bending rigidity across the width direction of the rapier band 12 than fabrics of plain weave having the same thread density. Further, the satin fabrics 19 and 20 having a smaller degree of intermingle of the warp threads T than fabrics of plain weave have an increased straightness along the longitudinal direction of the rapier band 12, thereby improving the straightness of the rapier bands 12 and 14 as a whole. Hence, the satin fabrics 19 and 20 are the best abrasion-resistant fabrics.

(1-3) Since the pitch of the warp threads T is made substantially the same as that of the weft threads Y, break down of the structure of the woven fabrics 19 and 20 can be effectively prevented.

(1-4) The bending rigidity of the rapier band 12 portion within the range of length h of each power receiving hole 17 (see Fig. 1) is smaller than the bending rigidity outside the range of length h. A difference between the bending rigidity of the rapier band 12 within the range of length h and the bending rigidity outside the range of the length h causes a stress concentration at corners 171 of the power receiving holes 17, particularly over the curved surfaces 121 and 122 of the rapier band 12. The stress concentration causes tiny cracks in the thermosetting resin impregnated in the woven fabrics 19 and 20 when the corners 171 are observed micrographically. However, the texture consisting of the warp threads T and the weft threads Y of the woven fabrics 19 and 20 covering peripheral portions 172 and 173 of the power receiving holes 17 is hard to break even if stress concentration is caused at the corners 171. Therefore, the woven fabrics 19 and 20 can prevent the tiny cracks in the thermosetting resin from growing larger. Hence, the woven fabrics 19 and 20 forming the curved surfaces 121 and 122 substantially prevent the occurrence of cracks at the corners 171.

(1-5) Besides the corners 171, the woven fabrics 19 and 20 provided over the entire curved surfaces 121 and 122 of the rapier band 12 also prevent the occurrence of the cracks in other parts of the curved surfaces 121 and 122.

(1-6) In the satin fabrics 19 and 20, a higher tension is given to the warp threads T than to the weft threads Y at the time of their manufacture. Therefore, the woven fabrics 19 and 20 are more resistant against a tensile force applied along the longitudinal direction of the warp threads T than to that applied along the longitudinal direction of the weft threads Y. With the rapier band 12 wrapped around the rapier wheel 13, the woven fabric 19 is pulled along the longitudinal direction of the rapier band 12. The arrangement such that the warp threads T of the woven fabric 19 extend along the longitudinal direction of the rapier band 12 is effective in improving the crack preventing function of the woven fabric 19.

(1-7) The core member 18 equipped with fibers that predominantly extend in the longitudinal direction of the rapier band 12 gives rigidity to the rapier band 12 at both left and right sides of the array of power receiving holes 17. Such direction of the fibers of the core member 18 is desirable in improving the bending rigidity required for quickly bringing the rapier band 12 into a straight state from a curved state quickly. The presence of the core member 18 quickly straightens the rapier band 12 that is curved. Therefore, the rapier band 12 according to this embodiment is advantageous in improving looming speed.

(1-8) The curved surfaces 121 and 122 of the rapier band 12 come into sliding contact with the band guide that guides the rapier band 12. Further, when the rapier band 12 is wrapped around the rapier wheel 13, the woven fabric 19 receives a tensile force along the longitudinal direction of the rapier band 12, and the woven fabric 20 receives a compressive force along the longitudinal direction of the rapier band 12. A highly tensile carbon fiber is strong not only against abrasion but also against compression. Therefore, carbon fiber is preferred as a material of the abrasion-resistant fabric.

(1-9) A shearing force produced within the rapier bands 12 and 14 due to repetitive bending is maximal at substantially the center of the cross section of the rapier bands. However, the three-dimensional fabric core member 18 is not subjected to delamination as in the conventional laminated rapier band. Therefore, the core member 18 of the invention is the best material for a core member of a rapier band.

Embodiment 2

[0027] Figs. 6 (a) and (b) show a second embodiment in which a woven fabric 23 is adhered to both surfaces of the core member 18. In these drawings, the woven fabric 23 is made of a combination satin weave. Fig. 6 (a) shows the obverse side of the woven fabric 23, and Fig. 6 (b) shows the reverse side. A warp thread T leaps over six weft threads Y on the obverse side of the woven fabric 23 and over two weft threads Y on the reverse side. A weft thread Y leaps over four and then two warp threads T on the reverse side of the woven fabric 23.

[0028] Within a rectangle W shown by a chain line in Fig. 6 (a), six warp threads T and two weft threads Y are exposed. Within a rectangle H with an area that is the same as that of the rectangle W, a single warp thread T and two weft threads Y are exposed. The total length of the warp threads T exposed within the rectangle W is about three times that of the weft threads Y exposed in the rectangle W on the obverse side of the woven fabric 23. Similarly, the total length of the warp threads T exposed within the rectangle H is about three times that of the weft threads Y exposed in the rectangle W on the obverse side of the woven fabric 23. That is, in any part of the obverse side of the woven fabric 23, the total length of the warp threads T exposed in a predetermined area portion defined as a rectangle whose area is a multiple integral of the area of the rectangle W or H is about three times that of the weft threads Y exposed in the same predetermined area portion.

[0029] In the second embodiment, abrasion resistance is impaired compared with that of the first embodiment. However, further increasing the degree of intermingle between the warp threads and the weft threads stabilizes the texture of the fabric and prevents a break down of the structure during the resin impregnating step.

Embodiment 3

[0030] Figs. 7 (a) and (b) show a third embodiment in which a woven fabric 24 is adhered to both surfaces of the core member 18. In these drawings, the woven fabric 24 is a fabric of a twill weave. Fig. 7 (a) shows an obverse side of the woven fabric 24, and Fig. 7 (b) shows the reverse side. A warp thread T leaps over two weft threads Y on the obverse side of the woven fabric 24.

[0031] Within a rectangle W shown by a chain line in Fig. 7 (a), two warp threads T and a single weft thread Y are exposed. Within a rectangle H with an area that is the same as that of the rectangle W, a single warp thread T and a single weft thread Y are exposed. The total length of the warp T exposed within the rectangle W is about two times that of the weft Y exposed within the rectangle W on the obverse side of the woven fabric 24. Similarly, the total length of the warp T exposed within the rectangle H is about two times that of the weft Y exposed within the rectangle W on the obverse side of the woven fabric 24. That is, in any part of the obverse side of the woven fabric 24, the total length of the warp threads T exposed in a predetermined area portion defined as a rectangle with an area that is a multiple integral of the area of the rectangle W or H is about two times that of the weft threads Y exposed in the same predetermined area portion.

[0032] In the third embodiment, abrasion resistance is impaired compared with those of the first and second embodiments. However, further increasing the degree of intermingle between the warp threads and the weft threads stabilizes the texture of the fabric and prevents a break down of the structure during the resin impregnating step.

[0033] The present invention may also be embodied in the following modes.

(1) The weft threads are arranged to extend along the longitudinal direction of the rapier band of a satin fabric.

(2) Besides fabrics of satin weave and twill weave, a fabric may be used in which the total length of threads extending along the longitudinal direction of the rapier band and exposed in a predetermined area portion at the obverse side thereof is larger than the total length of threads extending across the width direction of the rapier band, and at least one of the threads extending along the longitudinal direction of the rapier band in the predetermined area portion leaps over at least two threads extending across the width direction of the rapier band.

(3) The pitch of the warp threads is made smaller than that of the weft threads.

(4) The diameter of the warp threads is made larger than that of the weft threads.

(5) A plurality of woven fabrics are laminated on each of the curved surfaces of the rapier band.

(6) Aramid fibers or glass fibers may be used as materials of the woven fabrics.

(7) The material of the warp threads and that of the weft threads are different.

(8) The rapier band is laminated so that a single woven fabric is folded to interpose the core member

between its folded portions.

(9) The present invention is applied to a rapier band having no power receiving holes.

[0034] While the preferred embodiments of the present invention and other embodiments that may replace such preferred embodiments have been described in detail with reference to the drawings, the present invention is not limited to these embodiments. It may be mentioned that additional embodiments and modifications of a weft insertion apparatus and a rapier band in a rapier loom can easily be contrived and implemented by those skilled in the art without departing from the spirit and scope of the present invention.

Claims

1. A weft insertion apparatus for a rapier loom which inserts a weft thread into a warp shedding by first inserting a rapier head (11) held by a rapier band (12) into the warp shedding and then retracting the rapier head from the warp shedding, wherein:

said rapier band (12) is formed by laminating woven fabrics (19, 20) on both obverse and reverse sides of a core member (18); and

either warp threads (T) or weft threads (Y) of said woven fabric (19, 29) are arranged to extend along the longitudinal direction of said rapier band (12); a total exposed length of the threads extending along the longitudinal direction of said rapier band (12) is larger than that of the threads extending across the width direction of said rapier band (12) on the obverse side of said woven fabric (19, 20); and at least one of the threads extending along the longitudinal direction of said rapier band (12) leaps over at least two threads extending across the width direction of said rapier band (12).

2. A weft insertion apparatus for a rapier loom according to claim 1, wherein said woven fabrics (19, 20) are made of satin weave.

3. A weft insertion apparatus for a rapier loom according to claim 1 or 2, wherein a pitch of said warp threads (T) is substantially the same as that of the weft threads (Y).

4. A weft insertion apparatus for a rapier loom according to any one of claims 1 to 3, wherein a direction of said warp threads (T) is such as to extend along the longitudinal direction of said rapier band.

5. A weft insertion apparatus for a rapier loom according to any one of claims 1 to 4, wherein said core member (18) is a three-dimensional fabric.

6. A weft insertion apparatus for a rapier loom according to any one of claims 1 to 5, wherein said woven fabrics (19, 20) are made of carbon fiber.

7. A rapier band for a rapier loom having a weft insertion apparatus that inserts a weft thread into a warp shedding by first inserting a rapier head (11) held by said rapier band (12) into the warp shedding and then retracting the rapier head (11) from the warp shedding, comprising:

a core member (18); and

woven fabrics (19, 20) being laminated on both obverse and reverse sides of said core member(18); wherein:

either warp threads (T) or weft threads (Y) of said woven fabrics (19, 20) are arranged to extend along the longitudinal direction of said rapier band (12); a total exposed length of the threads extending along the longitudinal direction of said rapier band is larger than that of the threads extending across the width direction of said rapier band on the obverse side of said woven fabrics; and at least one of the threads (T) extending along the longitudinal direction of said rapier band leaps over at least two threads (Y) extending across the width direction of said rapier band.

8. A rapier band according to claim 7, wherein said woven fabrics (19, 20) are made of satin weave.

9. A rapier band according to claim 7 or 8, wherein a pitch of the warp threads (T) is substantially the same as that of the weft threads (Y).

10. A rapier band according to any one of claims 7 to 9, wherein a direction of the warp threads (T) is such as to extend along the longitudinal direction of said rapier band.

11. A rapier band according to any one of claims 7 to 10, wherein said core member (18) is a three-dimensional fabric.

12. A rapier band according to any one of claims 7 to 11, wherein said woven fabrics (19, 20) are made of carbon fiber.

FIG. 1

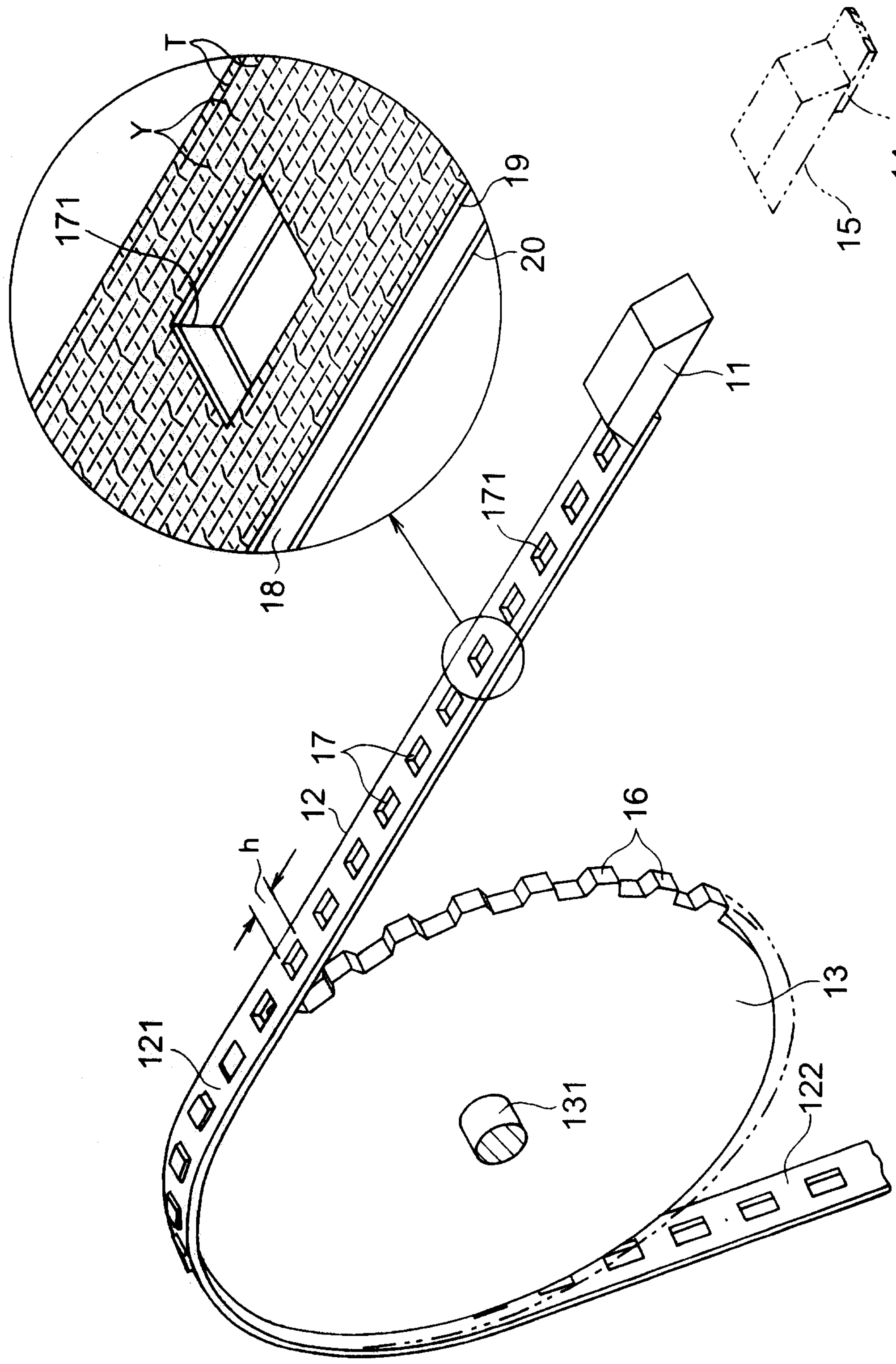


FIG. 2

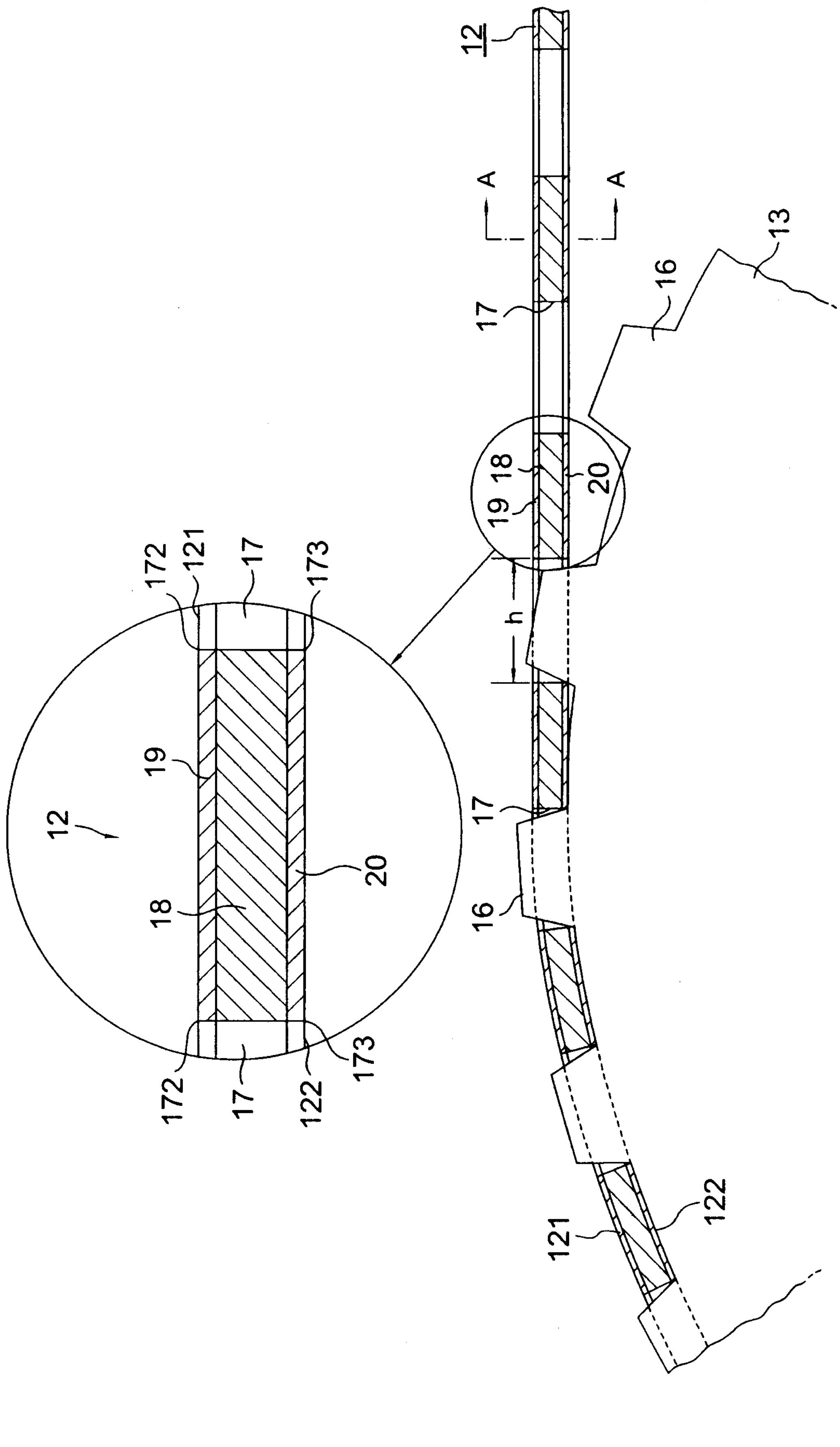

12
A
A
17
13
16
18
19
20
h
17
16
121
122
172
121
17
173
19
12
18
20
172
17
122
173

FIG. 3

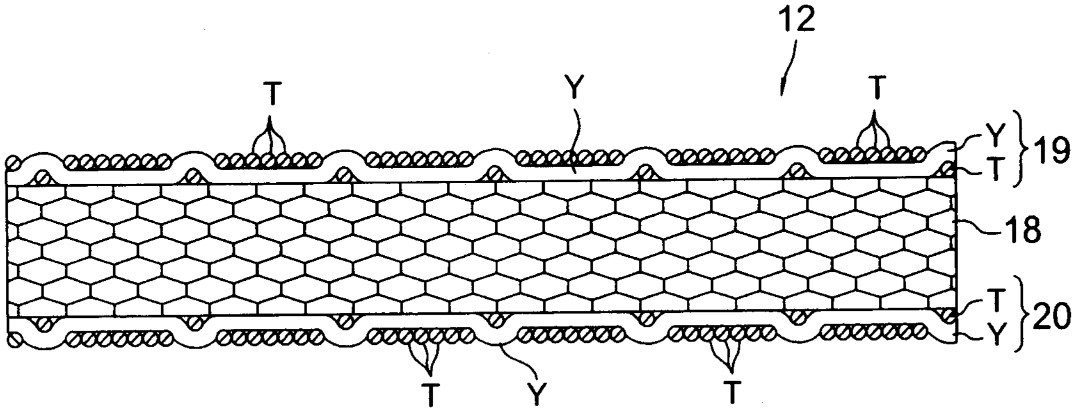


FIG. 4

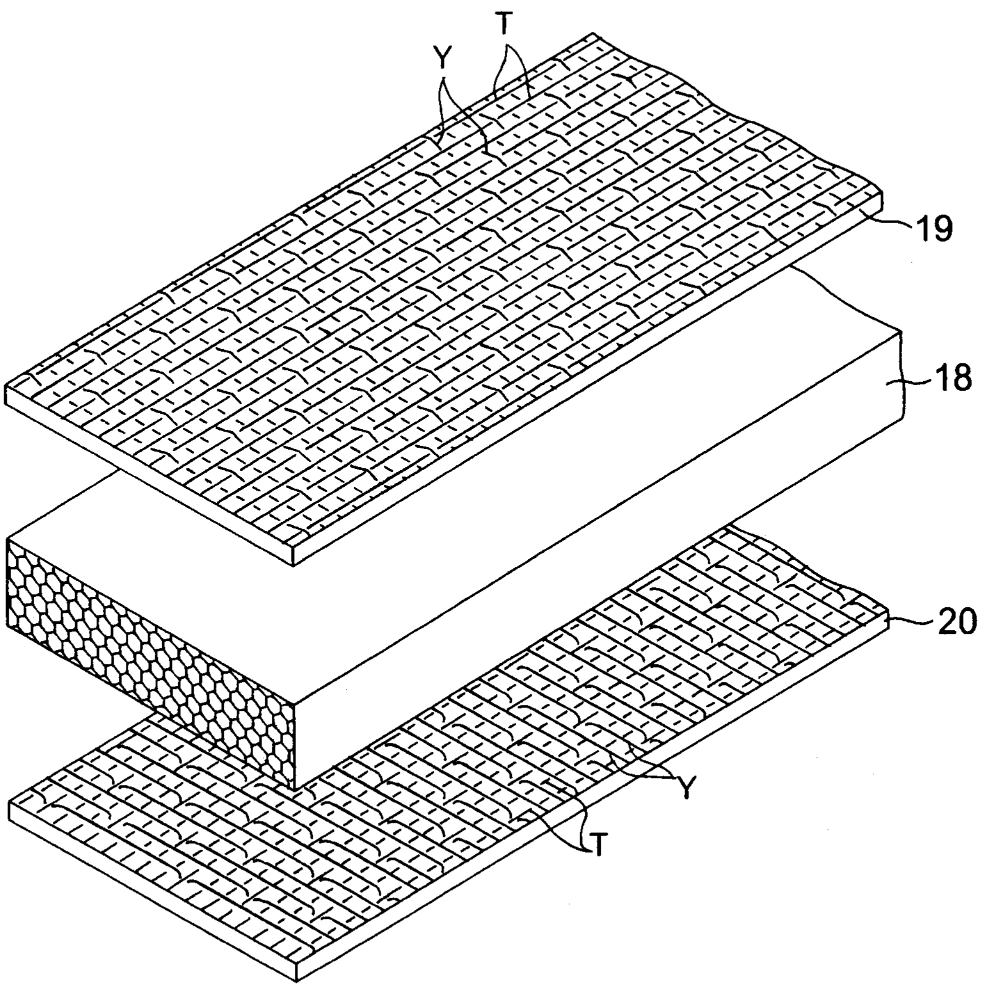


FIG. 5A

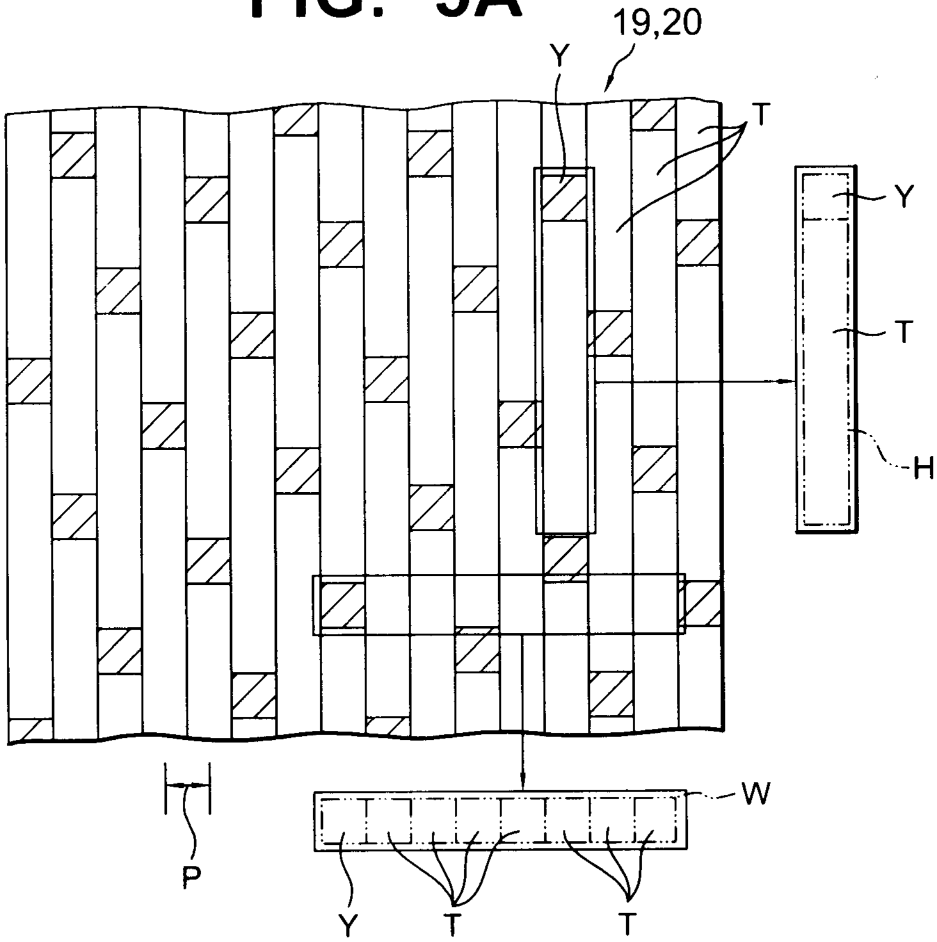


FIG. 5B

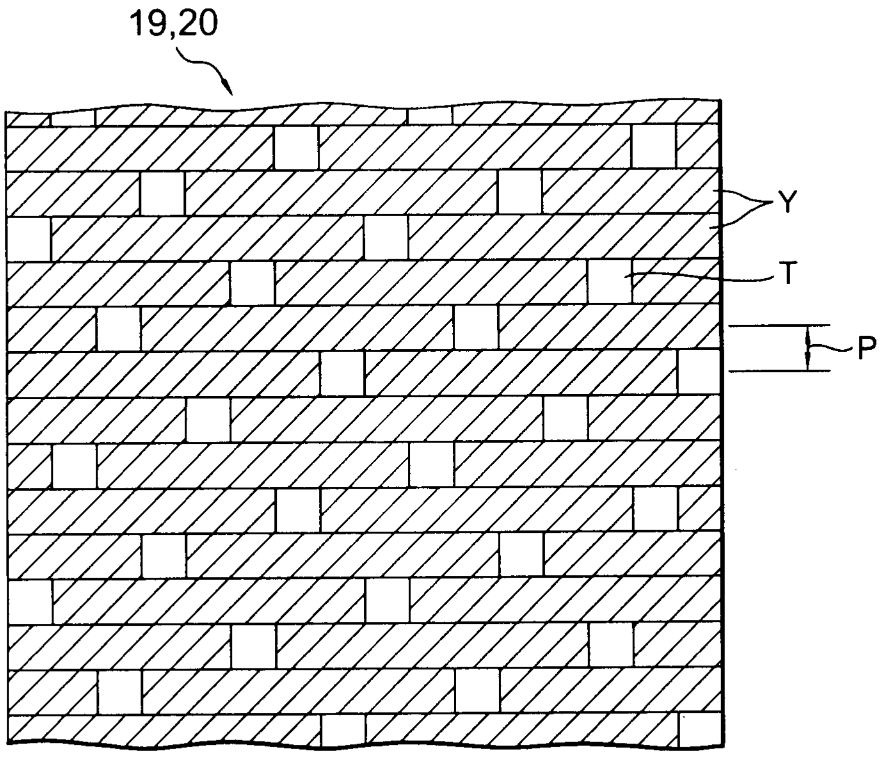


FIG. 6A

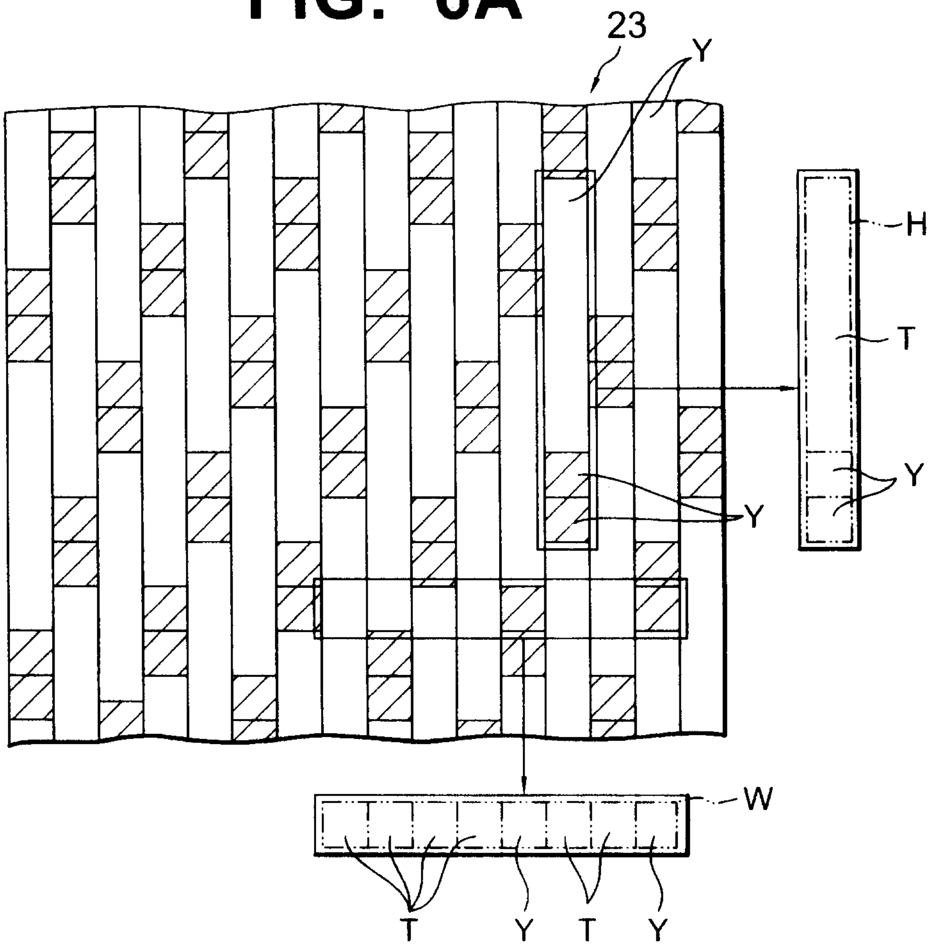


FIG. 6B

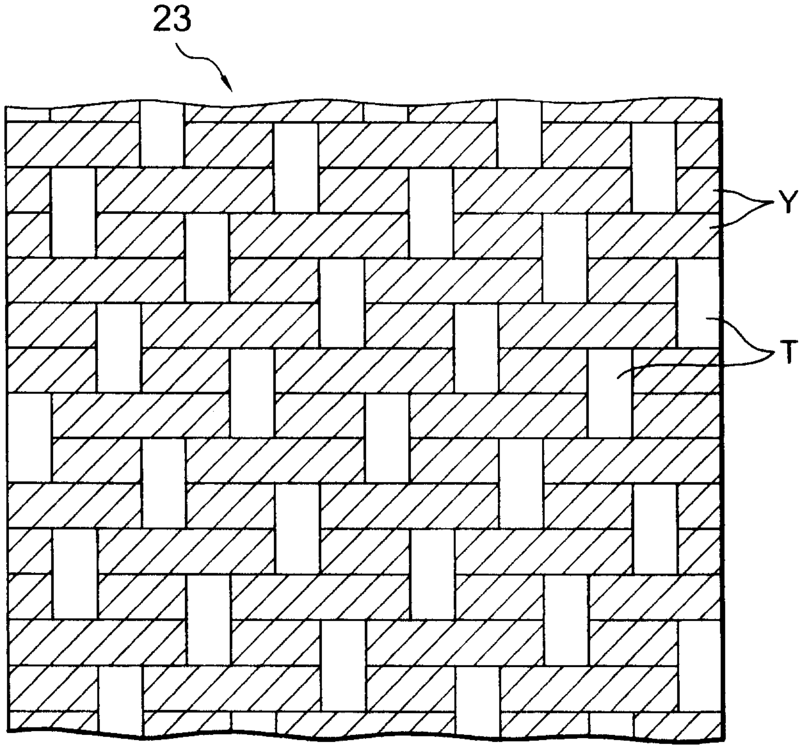


FIG. 7A

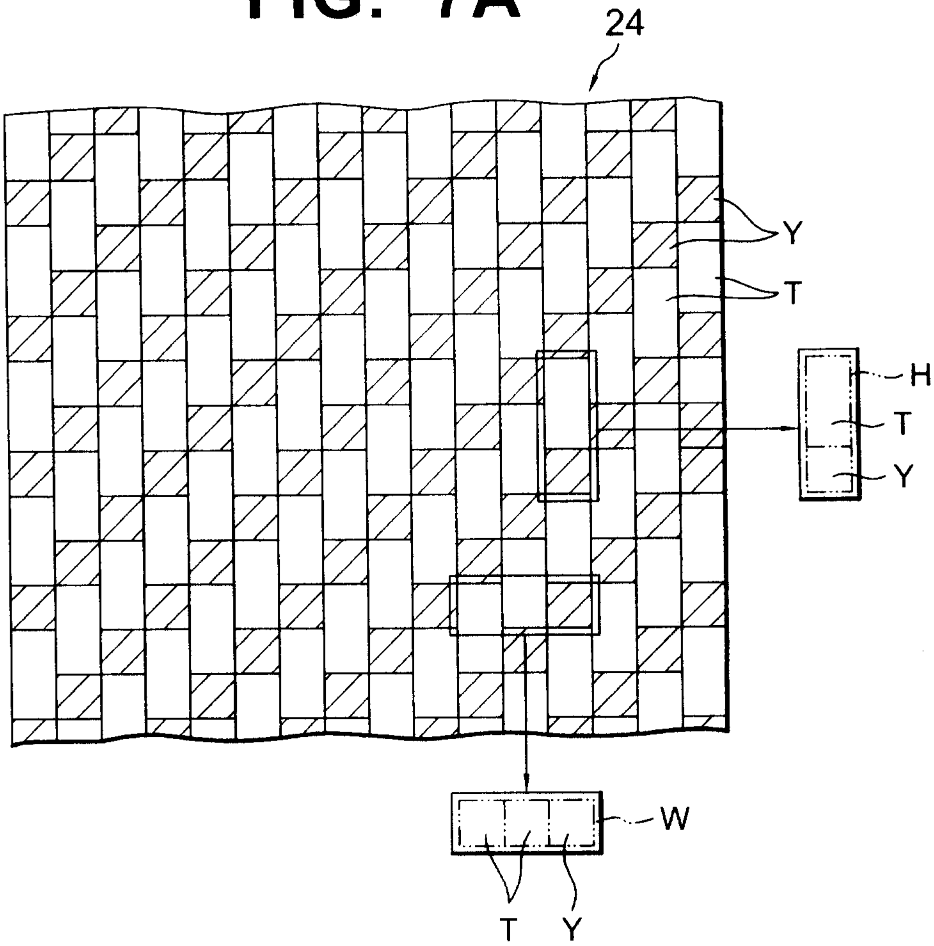


FIG. 7B