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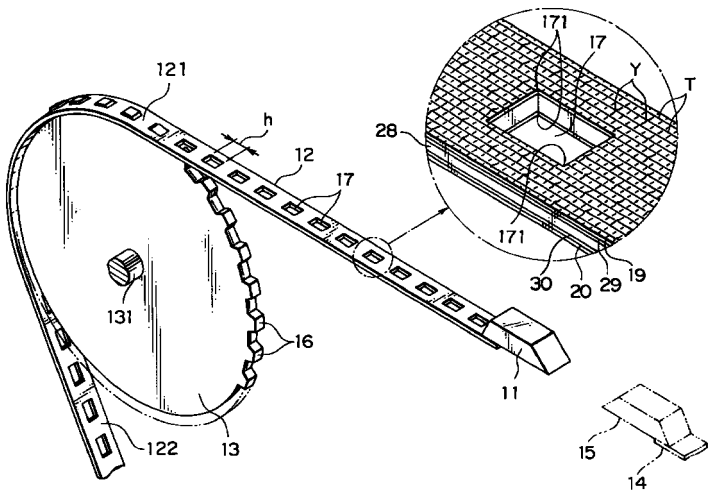
(54) Weft insertion apparatus and rapier band for rapier loom

(57) A highly abrasion-resistant rapier band having a high bending rigidity across the width direction thereof even after abrasion, and a long life is provided. The rapier band (12) has a laminated structure including a core member (28) and a pair of woven fabrics for preventing abrasion (19, 20). The woven fabrics for preventing abrasion (19, 20) are of satin weave consisting of warp threads (T) and weft threads (Y). A reinforcing compensation layer (t1) made of fibers for compensating for the bending rigidity across the width direction of the rapier band (12) lies beneath each woven fabric for preventing abrasion (19, 20), with the surface of the reinforcing compensation layer (t1) away from the center (S1) of the thickness (S) of the rapier band (12).

FIG. 1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

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

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. In order to drive a rigid but flexible band such as a rapier band, a wheel that allows such a band to be wrapped therearound 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 a 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, a rapier band having power receiving holes is advantageous for 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 in 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 slidingly 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 having a high bending rigidity across the width direction thereof even after abrasion, and a long life 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 for preventing abrasion on both obverse and reverse sides of a core member; either warp threads or weft threads of each woven fabric for preventing abrasion 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; and a reinforcing compensation layer made of fibers for compensating for bending rigidity across the width direction of the rapier band lies beneath each of said woven fabric for preventing abrasion, the surface of the reinforcing compensation layer being away from the center of the thickness of the rapier

band, the reinforcing compensation layer having a larger number of fibers in the width direction of the rapier band than fibers in the longitudinal direction of the rapier band.

[0009] Even if the woven fabrics for preventing abrasion are abraded to cut off the weft threads extending across the width direction of the rapier band, the bending rigidity across the width direction of the rapier band can be compensated for due to fibers across the width direction of rapier band in the reinforcing compensation layer. This allows the life of the rapier band to be extended.

[0010] Preferably, the reinforcing compensation layer is a portion of woven fabrics for reinforcing compensation, such that on any of a plurality of predetermined area sections defining one surface of the woven fabric for reinforcing compensation, a total exposed length of the threads extending along the longitudinal direction of the rapier band which is exposed at the predetermined area section is larger than that of the threads extending across the width direction of the rapier band which is exposed at the predetermined area section; and at least one of the threads extending along the longitudinal direction on the predetermined area sections leaps over at least two threads extending across the width direction on this surface, the other surface of the woven fabric for reinforcing compensation is arranged to correspond to the side of the woven fabric for preventing abrasion as the reinforcing compensation layer.

[0011] A larger number of threads extending across the width direction of the rapier band than the threads extending across the longitudinal direction of the rapier band are exposed on the above other surface of the woven fabrics for reinforcing compensation. This surface on which a larger number of threads extending across the width direction of the rapier band than the threads extending across the longitudinal direction of the rapier band are exposed becomes the reinforcing compensation layer side. The resulting woven fabrics for reinforcing compensation are suitable to form a reinforcing compensation layer thereon.

[0012] Further, the woven fabrics for reinforcing compensation are preferably made of satin weave. Satin weave is the optimum woven fabric for reinforcing compensation.

[0013] Still further, the woven fabrics for preventing abrasion are preferably laminated on both the obverse and reverse sides of the core member. This is because the bending rigidity across the longitudinal direction of the rapier band can be preserved by the core member.

[0014] Still further, the reinforcing compensation layer may be interposed between the core member and the woven fabrics for preventing abrasion. This is because the arrangement between the core member and the woven fabrics for preventing abrasion is the optimum position where the reinforcing compensation layer is located.

[0015] Still further, it is desirable that the core member be a three-dimensional fabric because three-dimensional fabrics are suitable for core members.

[0016] Yet further, it is preferred that the woven fabrics for preventing abrasion be made of carbon fiber because carbon fiber is a suitable abrasion-resistant material.

[0017] 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 for preventing abrasion laminated on both obverse and reverse sides of the core member. In such a rapier band, either warp threads or weft threads of each woven fabric for preventing abrasion 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 for preventing abrasion; 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; and a reinforcing compensation layer made of fibers for compensating for the bending rigidity across the width direction of the rapier band lies beneath each of the woven fabrics for preventing abrasion, the surface of the reinforcing compensation layer being away from the center of the thickness of the rapier band, the reinforcing compensation layer having a larger number of fibers in the width direction of the rapier band than fibers in the longitudinal direction of the rapier band.

[0018] The rapier band of the above structure has excellent abrasion resistance and high bending rigidity across the width direction thereof after abrasion, and thus its life can be extended.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] 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 (a) is an enlarged plan view of an obverse side of a woven fabric for preventing abrasion; and
Fig. 3 (b) is an enlarged plan view of a reverse side of the woven fabric for preventing abrasion;
Fig. 4 is an exploded perspective view of an essential portion showing a structure of the rapier band;
Fig. 5 is an exploded sectional view of an essential

portion showing a structure of the rapier band; and

Fig. 6 is an exploded sectional view of an essential portion showing a rapier band according to a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] Embodiments of the present invention currently considered preferable will be described in detail with reference to the accompanying drawings.

Embodiment 1

[0021] A first embodiment of the present invention will now be described with reference to Figs. 1 to 4.

[0022] 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. Whereupon, the weft thread inserted into the warp shedding by the feeding rapier head 11 is delivered to the receiving rapier head 15. Then, also 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 drawn through the warp shedding.

[0023] 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.

[0024] Fig. 2 is an enlarged longitudinal sectional view of an essential portion showing the relationship between the rapier wheel and the rapier band. As shown in Fig. 2, 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 28, a pair of woven fabrics for preventing abrasion 19 and 20, and a pair of woven fabrics for reinforcing compensation 29 and 30. The core member 28 is a three-dimensional fabric made by a three-dimensional braider. The woven fabrics for reinforcing compensation 29 and 30 are interposed between the woven fabrics for preventing abrasion 19 and 20. The core member 28 is interposed between the woven fabrics for reinforcing compensation 29 and 30. On the other hand, the surfaces of the woven fabrics for preventing abrasion 19 and 20 constitute curved surfaces 121 and 122 of the rapier band 12. The fibers of the core member 28 are such that the component thereof extending in the longitudinal direction of the rapier band 12 is larger than the component extending across the width direction of the rapier band 12. The woven fabrics for reinforcing compensation 29 and 30 are made of the same material as that of the woven fabrics for preventing abrasion 19 and 20. Further, the woven fabrics for reinforcing compensation 29 and 30 have the same textural structure as that of the woven fabrics for preventing abrasion 19 and 20. The structure of the woven fabrics for preventing abrasion 19 and 20 will be described in detail with reference to Figs. 3 (a) and (b).

[0025] Fig. 3 (a) is an enlarged plan view of an obverse side of the woven fabric for preventing abrasion according to the first embodiment and Fig. 3 (b) is an enlarged plan view of a reverse side of the same woven fabric for preventing abrasion. As shown in these drawings, the woven fabrics for preventing abrasion 19 and 20 are of a satin weave consisting of warp threads T and weft threads Y. In Figs. 3 (a) and (b), the weft threads Y are shown by hatching. "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 for preventing abrasion 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. 3 (a) shows the obverse sides of the woven fabrics for preventing abrasion 19 and 20, and Fig. 3 (b) shows reverse sides of the woven fabrics for preventing abrasion 19 and 20. The reverse side of each of the woven fabrics for preventing abrasion 19 and 20 is adhered to the woven fabrics for reinforcing compensation 29 and 30. On the other hand, the obverse side of each of the woven fabrics for preventing abrasion 19 and 20 slidingly contact with the band guide (not shown). As shown in Fig. 3 (a), the warp threads T are exposed at the obverse side of each of the woven fabrics for preventing abrasion 19 and 20 while leaping over seven continuous weft threads Y. As shown in Fig. 3 (b), the weft threads Y are exposed at the reverse side of each of the woven fabrics for preventing abrasion 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. 3 (a) and (b), the warp threads T and the weft threads Y have the same pitch P.

[0026] Referring now to Figs. 4 and 5, the structure of the woven fabrics for reinforcing compensation 29 and 30 will be described with reference to Figs. 3 (a) and (b). As described above, the woven fabrics for reinforcing compensation 29 and 30 have the same issue structure as that of the woven fabrics for preventing abrasion 19 and 20, that is, the satin weave. More specifically, the pitch of the warp threads T1 of the woven fabrics for reinforcing compensation 29 and 30 and the pitch of the weft threads Y1 of the woven fabrics for reinforcing compensation 29 and 30 is the same, and the diameter of the warp threads T1 thereof and the diameter of the weft threads Y1 thereof is the same. The weft threads Y1 of the woven fabrics for reinforcing compensation 29 and 30 extend along the width direction of the rapier bands 12 and 14, and the warp threads T1 of the woven fabrics for reinforcing compensation 29 and 30 extend along the longitudinal direction of the rapier bands 12 and 14. Further, the warp threads T1 of the woven fabrics for reinforcing compensation 29 and 30 leap over seven continuous weft threads Y1 of the woven fabrics for reinforcing compensation 29 and 30, to thereby be exposed at one surface 291 and 301, respectively, of the woven fabrics for reinforcing compensation 29 and 30. The weft threads Y1 of the woven fabrics for reinforcing compensation 29 and 30 leap over seven continuous warp threads T1 of the woven fabrics for reinforcing compensation 29 and 30, to thereby be exposed at the other surface 292 and 302, respectively, of the woven fabrics for reinforcing compensation 29 and 30. As shown in Figs. 4 and 5, the core member 28 of rapier band 12 can be composed of a plurality of fabrics of plain weave 25, 26 and 27 (three fabrics in the present embodiment).

[0027] The fiber of the core member 28, warp threads T and weft threads Y is carbon fiber. The core member 28, the woven fabrics for preventing abrasion 19 and 20, and the woven fabrics for reinforcing compensation 29 and 30 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.

[0028] The woven fabric for reinforcing compensation 29 interposed between the core member 28 and the woven fabric for preventing abrasion 19 is arranged in opposite relation in textural structure to the woven fabric for preventing abrasion 19. That is, the reverse side of the woven fabric for preventing abrasion 19 is opposed to the other surface 292 of the woven fabric for reinforcing compensation 29 while the reverse side of the woven fabric for preventing abrasion 20 is opposed to the other surface 302 of the woven fabric for reinforcing compensation 30.

[0029] As shown in Fig. 5, a thickness t of each of the woven fabrics for reinforcing compensation 29 and 30 includes a layer t1, which is half that thickness, at the side of each of the other surfaces 292 and 302, substantially seven eighths of which is occupied with the weft threads Y1. As a result, the layer t1 functions as a reinforcing compensation layer having a larger number of fibers in the width direction of the rapier band 12 than fibers in the longitudinal direction of the rapier band 12. The pair of the woven fabrics for preventing abrasion 19 and 20 includes the reinforcing compensation layer t1 beneath each of the woven fabrics for preventing abrasion 19 and 20, with the surface of the reinforcing compensation layer t1 away from the center S1 of the thickness S of the rapier band 12 (or 14). As used herein, "beneath the woven fabric for preventing abrasion 19" indicates the core member 28 side as viewed from the position of the woven fabric for preventing abrasion 19, and "the beneath the woven fabric for preventing abrasion 20" indicates the core member 28 side as viewed from the position of the woven fabric for preventing abrasion 20.

[0030] Embodiment 1 provides the following advantages:

(1-1) The weft threads Y of the woven fabrics for preventing abrasion 19 and 20 which extend along the width direction of the rapier band 12 (or 14) contribute to improved bending rigidity across the width direction of the rapier band 12 (or 14). In particular, the weft threads Y are closer to the curved surface of the rapier band 12 (or 14), leading to an increase in bending rigidity. However, as the surfaces of the woven fabrics for preventing abrasion 19 and 20 are being abraded, the weft threads Y of the woven fabrics for preventing abrasion 19 and 20 are broken. In this case, it the rapier band 12 (or 14) has a laminated structure including only the core member 28 and the pair of the woven fabrics for preventing abrasion 19 and 20, the bending rigidity across the width direction of the rapier band 12 (or 14) will be reduced due to breakage of the weft threads Y. In other words, the reduced bending rigidity across the width direction of the rapier band 12 (or 14) contributes to determining the life of the rapier band 12 (or 14).

However, according to the present embodiment, even if the surfaces of the woven fabrics for preventing abrasion 19 and 20 are being abraded to break the weft threads Y of the woven fabrics for preventing abrasion 19 and 20, the weft threads Y1 of the woven fabrics for reinforcing compensation 29 and 30 will compensate for the bending rigidity across the width direction of the rapier bands 12 and 14. Hence, the bending rigidity across the width direction of the rapier band 12 (or 14) can be preserved, thereby extending the life of the rapier band 12 (or 14).

(1-2) The fibers in the width direction of the rapier band 12 (or 14) are closer to the curved surface of the rapier band 12 (or 14), leading to an increase of the bending rigidity. With the structure in which the reinforcing compensation layer t1 occupying half of the thickness t of the woven fabrics for reinforcing compensation 29 and 30 is opposed to the woven fabrics for preventing abrasion 19 and 20, the reinforcing compensation layer t1 may be as close as possible to the curved surface of the rapier band 12 (or 14). Therefore, the structure in which the other surface 292 and 302 sides of the woven fabrics for reinforcing compensation 29 and 30 which function as the reinforcing compensation layer t1 are arranged to correspond to the sides of the woven fabrics for preventing abrasion 19 and 20 allows the weft threads Y1 to effectively increase the bending rigidity across the width direction of the rapier band 12 (or 14).

(1-3) The satin fabrics for reinforcing compensation 29 and 30 according to the first embodiment are such that the pitch of the weft threads Y1 is the same as that of the warp threads T1, and that the density of the warp threads T1 is the same as that of the weft threads Y1. Such a density arrangement of the weft threads Y1 is effective in improving the bending rigidity across the width direction of the rapier band 12 (or 14). In addition, the woven fabrics for reinforcing compensation 29 and 30 made of satin weave, which have a smaller degree of intermingle of the weft threads Y1 than fabrics of plain weave, have an increased bending rigidity across the width direction of the rapier band 12 (or 14). Further, the woven fabrics for reinforcing compensation 29 and 30 made of satin weave, which have a smaller degree of intermingle of the warp threads T1 than fabrics of plain weave, have an increased rigidity along the longitudinal direction of the rapier band 12 (or 14), thereby improving the longitudinal rigidity of the rapier band 12 (or 14) as a whole. Hence, the woven fabrics for reinforcing compensation 29 and 30 made of satin weave are the best fabrics for forming the reinforcing compensation layer t1.

(1-4) Arrangement of the reinforcing compensation layer t1 between the core member 28 and the woven fabrics for preventing abrasion 19 and 20 is the optimal position because the reinforcing compensation layer t1 can be as close as possible to the curved surface of the rapier band 12 (or 14).

(1-5) A shearing force produced within the rapier band 12 (or 14) due to repetitive bending is maximum at substantially the center of the cross section of the rapier bands. However, the three-dimensional fabric core member 28 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

[0031] A second embodiment of the present invention will now be described with reference to Fig. 6. The same components as those in the first embodiment are designated by the same reference numerals.

[0032] A woven fabric for reinforcing compensation 31 according to the second embodiment is arranged with the same relationship of textural structure as the woven fabric for preventing abrasion 19. For this reason, a reinforcing compensation layer t2 corresponding to the reinforcing compensation layer t1 according to the first embodiment is positioned opposite to the core member 28. A woven fabric for reinforcing compensation 32 is also arranged with the same relationship of textural structure as the woven fabric for preventing abrasion 20, and the reinforcing compensation layer t2 is thus positioned opposite to the core member 28.

[0033] The reinforcing compensation layer t2 according to the second embodiment is farther from the curved surface of the rapier band 12 (or 14) than the reinforcing compensation layer t1 according to the first embodiment. However, the reinforcing compensation layer t2 has a sufficient compensating effect for the bending rigidity across the width direction of the rapier band 12 (or 14).

[0034] 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 used as a woven fabric for preventing abrasion or a woven fabric for reinforcing compensation.

(2) Instead of fabrics of satin weave and twill weave, a fabric may be used as a woven fabric for preventing abrasion or a woven fabric for reinforcing compensation 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 of the woven fabrics for preventing abrasion is made smaller than that of the weft threads.

(4) The diameter of the warp threads of the woven fabrics for preventing abrasion is made larger than that of the weft threads.

(5) The pitch of the weft threads of the woven fabrics for reinforcing compensation is made smaller than that of the warp threads.

(6) The diameter of the weft threads of the woven fabrics for reinforcing compensation is made larger than that of the warp threads.

(7) The reinforcing compensation layer is formed of fiber layers extending only along the width direction of the rapier band.

(8) Aramid fibers or glass fibers may be used as materials of the woven fabrics for preventing abrasion or the woven fabrics for reinforcing compensation.

(9) The material of the warp threads of the woven fabrics for preventing abrasion or the woven fabrics for reinforcing compensation and that of the weft threads are different.

(10) The rapier band is laminated so that a single woven fabric for preventing abrasion is folded to interpose the core member between its folded portions.

(11) The rapier band is laminated so that a single woven fabric for reinforcing compensation is folded to interpose the core member between its folded portions.

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

[0035] 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 should be noted 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 for preventing abrasion (19, 20) on both obverse and reverse sides of a core member (28);

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

a reinforcing compensation layer (t1) made of fibers for compensating for bending rigidity across the width direction of said rapier band (12) lies beneath each of said woven fabrics for preventing abrasion (19, 20), the surface of said reinforcing compensation layer (t1) being away from the center (S1) of the thickness (S) of said rapier band (12), said reinforcing compensation layer (t1) having a larger number of fibers (Y1) in the width direction of said rapier band (12) than fibers (T1) in the longitudinal direction of said rapier band (12).

2. A weft insertion apparatus for a rapier loom according to claim 1, wherein said reinforcing compensation layer (t1) is a portion of woven fabrics for reinforcing compensation (29, 30), such that on any of a plurality of predetermined area sections defining one surface of said woven fabrics for reinforcing compensation (29, 30), a total exposed length of said threads (T1) extending along the longitudinal direction of said rapier band (12) which is exposed at said predetermined area section is larger than that of the threads (Y1) extending across the width direction of said rapier band (12) which is exposed at said predetermined area section; and at least one of said threads extending along the longitudinal direction on said predetermined area sections leaps over at least two threads extending across said width direction on said one surface, the other surface of said woven fabrics for reinforcing compensation (29, 30) being arranged to correspond to the side of said woven fabrics for preventing abrasion (19, 20) as said reinforcing compensation layer (t1).

3. A weft insertion apparatus for a rapier loom according to claim 2, wherein said woven fabrics for reinforcing compensation (29, 30) are made of satin weave.

4. A weft insertion apparatus for a rapier loom according to any one of claims 1 to 3, wherein said woven fabrics for preventing abrasion (19, 20) are laminated on both the obverse and reverse sides of said core member (28).

5. A weft insertion apparatus for a rapier loom according to claim 4, wherein said reinforcing compensation layer (t1) is interposed between said core member (28) and said woven fabrics for preventing abrasion (19, 20).

6. A weft insertion apparatus for a rapier loom according to claim 4 or 5, wherein said core member (28) is a three-dimensional fabric.

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

8. 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 (28); and
woven fabrics for preventing abrasion (19, 20) being laminated on both obverse and reverse sides of said core member(28); wherein:
either warp threads (T) or weft threads (Y) of said woven fabrics for preventing abrasion (19, 20) are arranged to extend along the longitudinal direction of said rapier band (12); a total exposed length of said 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 on the obverse side of said woven fabrics for preventing abrasion (19, 20); and at least one of said threads (T) extending along the longitudinal direction of said rapier band leaps over at least two threads (Y) extending across said width direction of said rapier band on said obverse side; and
a reinforcing compensation layer (t1) made of fibers for compensating for bending rigidity across the width direction of said rapier band (12) lies beneath of each of said woven fabrics for preventing abrasion (19, 20), the surface of said reinforcing compensation layer (t1) being away from the center (S1) of the thickness (S) of said rapier band (12), said reinforcing compensation layer (t1) having a larger number of fibers (Y1) in the width direction of said rapier band (12) than fibers (T1) in the longitudinal direction of said rapier band (12).

9. A rapier band according to claim 8, wherein said reinforcing compensation layer (t1) is a portion of woven fabrics for reinforcing compensation (29, 30), such that on any of a plurality of predetermined area sections defining one surface of said woven fabrics for reinforcing compensation (29, 30), a total exposed length of said threads extending along the longitudinal direction (T1) of said rapier band (12) which is exposed at said predetermined area section is larger than that of the threads extending across the width direction (Y1) of said rapier band (12) which is exposed at said predetermined area section; and at least one of said threads extending along the longitudinal direction on said predetermined area sections leaps over at least two threads extending across said width direction on said one surface, the other surface of said woven fabrics for reinforcing compensation (29, 30) being arranged to correspond to the side of said woven fabrics for preventing abrasion (19, 20) as said reinforcing compensation layer (t1).

10. A rapier band according to claim 9, wherein said woven fabrics for reinforcing compensation (29, 30) are made of satin weave.

11. A rapier band according to any one of claims 8 to 10, wherein said woven fabrics for preventing abrasion (19, 20) are laminated on both the obverse and reverse sides of said core member (28).

12. A rapier band according to claim 11, wherein said reinforcing compensation layer (t1) is interposed between said core member (28) and said woven fabrics for preventing abrasion (19, 20).

13. A rapier band according to claim 11 or 12, wherein said core member (28) is a three-dimensional fabric.

14. A rapier band according to any one of claims 8 to 13, wherein said woven fabrics for preventing abrasion (19, 20) are made of carbon fiber.

FIG. 1

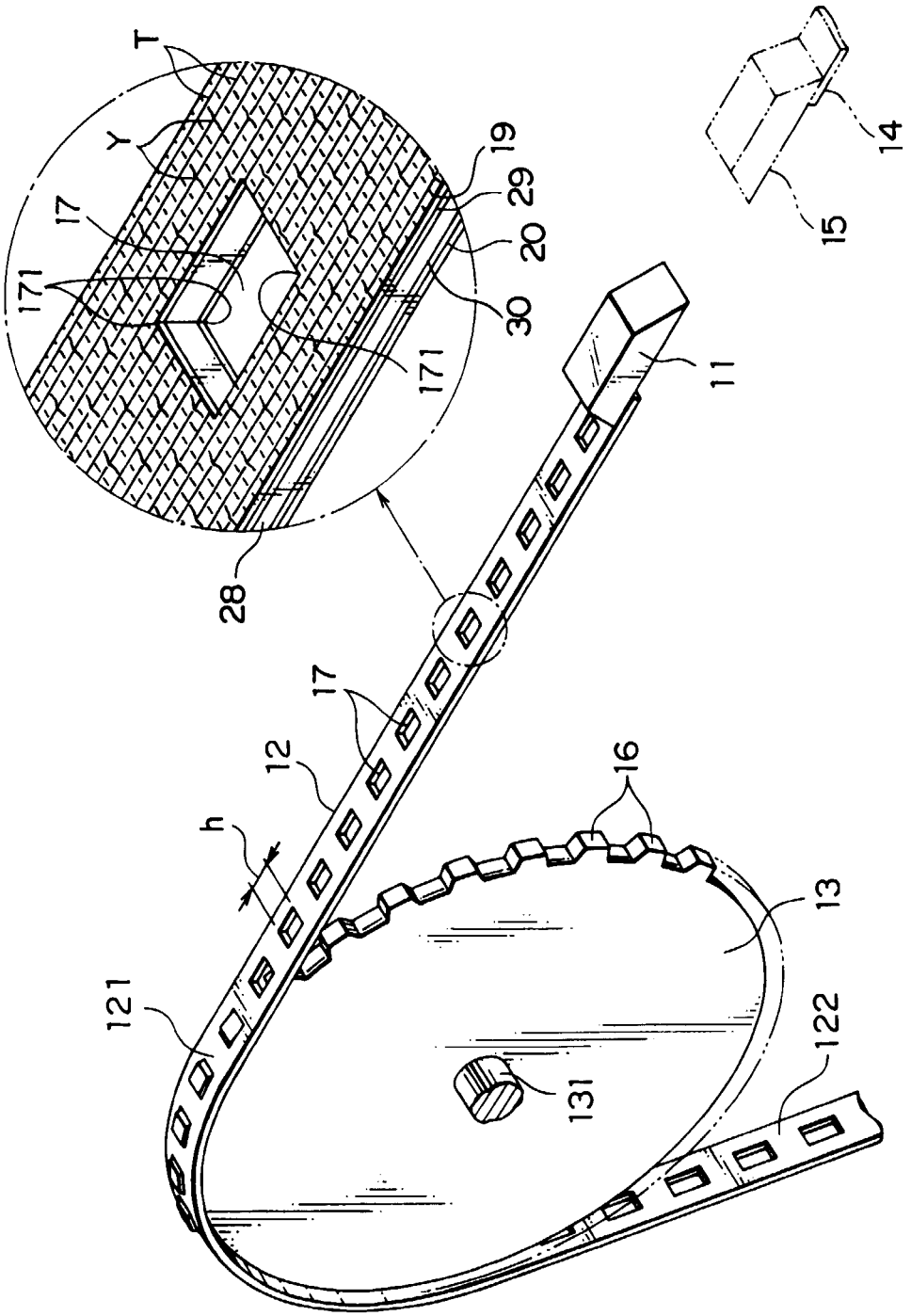
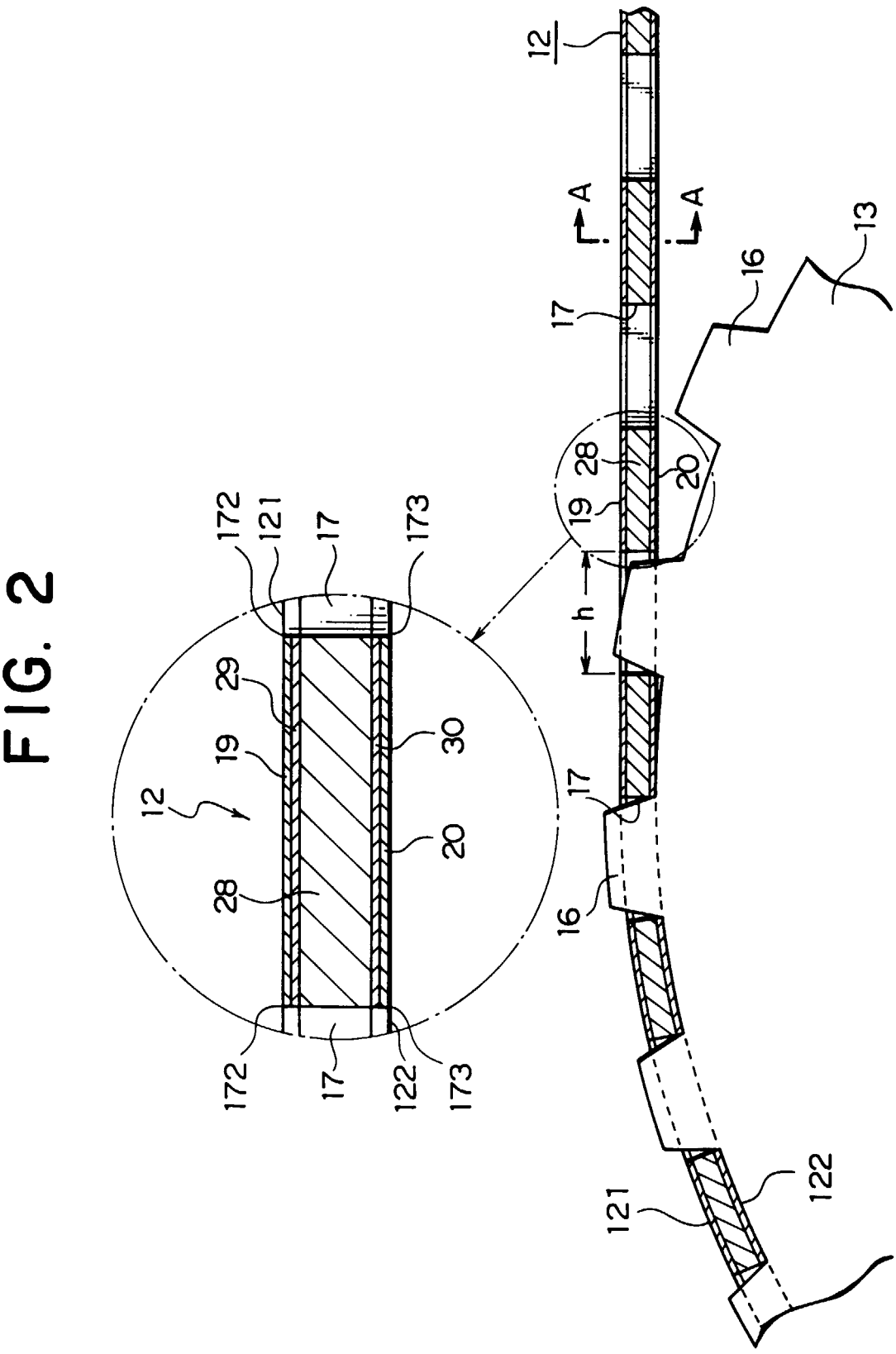


FIG. 2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A
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28
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h
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FIG. 3(A)

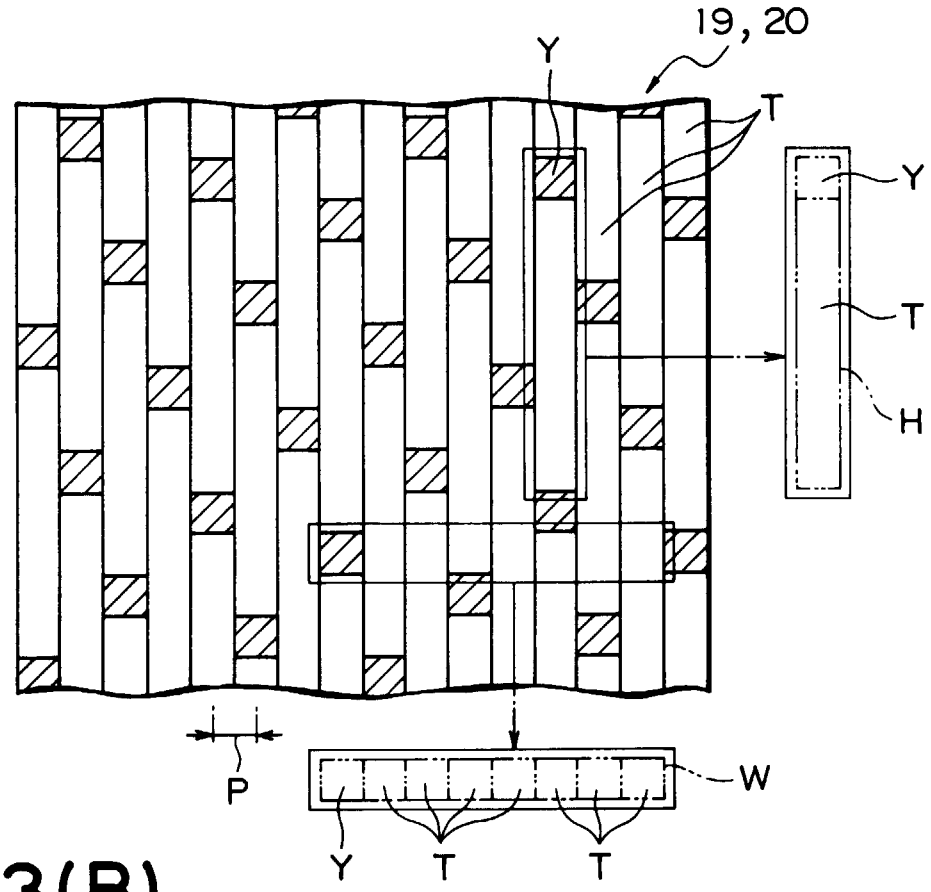


FIG. 3(B)

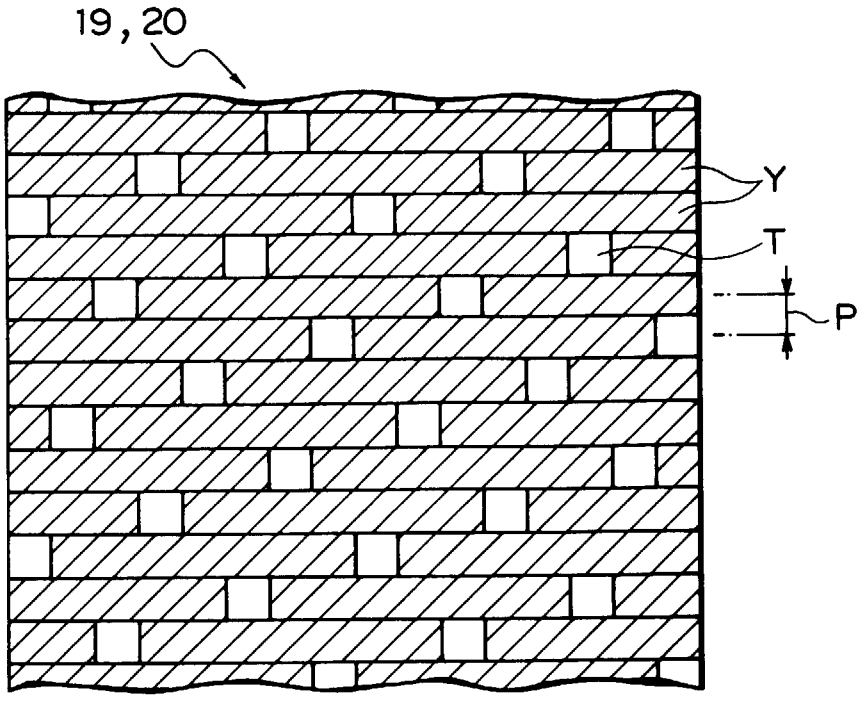


FIG. 4

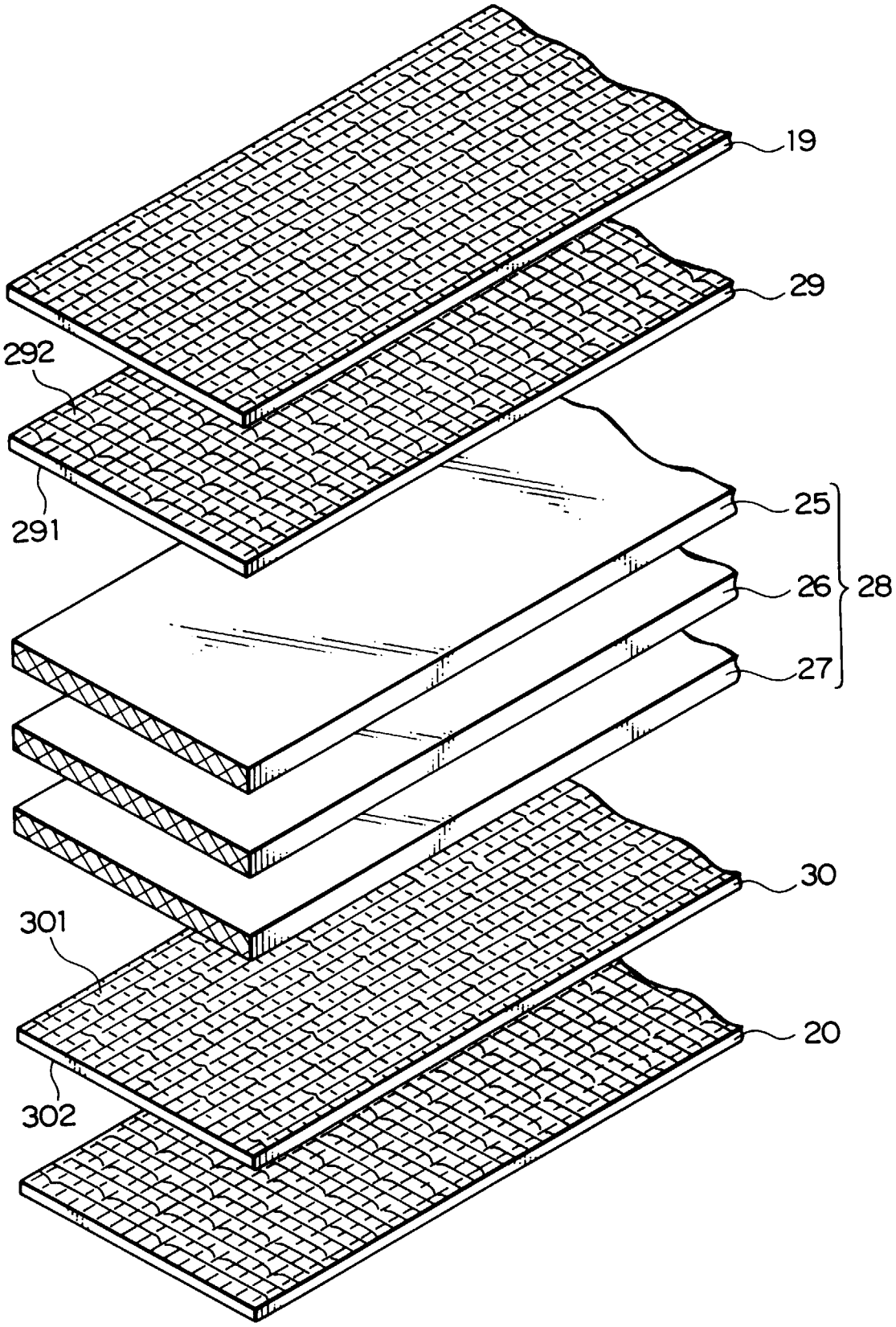
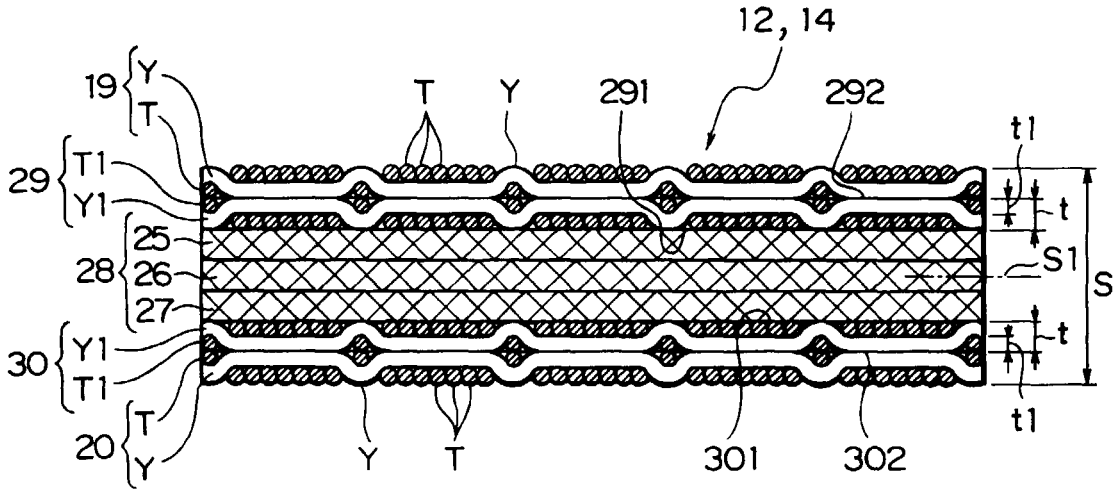


FIG. 5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Y
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292
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302
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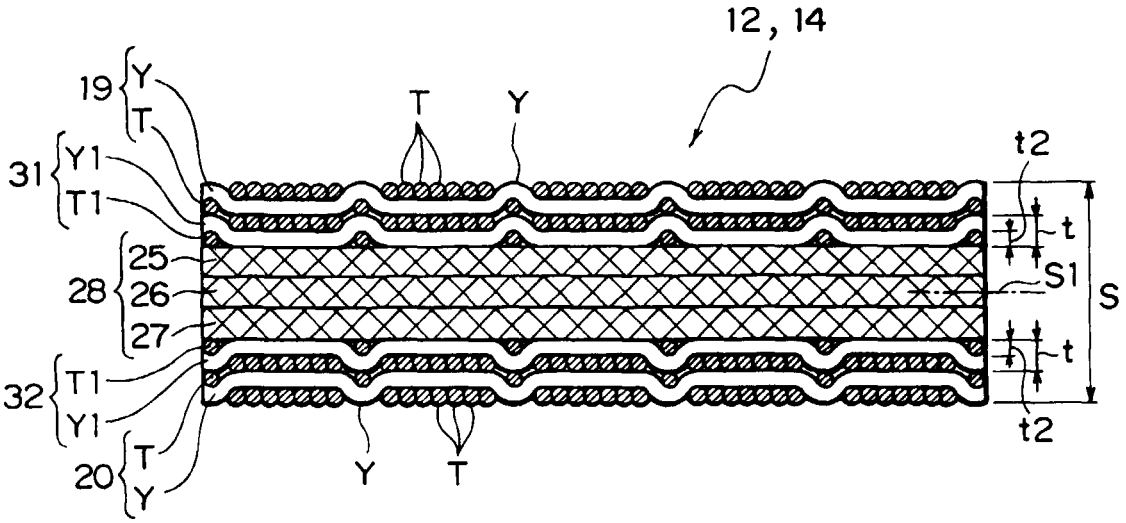
S1
S
t
t1

FIG. 6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S1
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EUROPEAN SEARCH REPORT

Application Number
EP 00 10 1649

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A	EP 0 414 214 A (NESTE OY) 27 February 1991 (1991-02-27) * abstract * * column 4, line 11 - line 44; figures 1B,1D,2C,3 *	1,7,8,14	
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D03D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28 April 2000	Boutelegier, C

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