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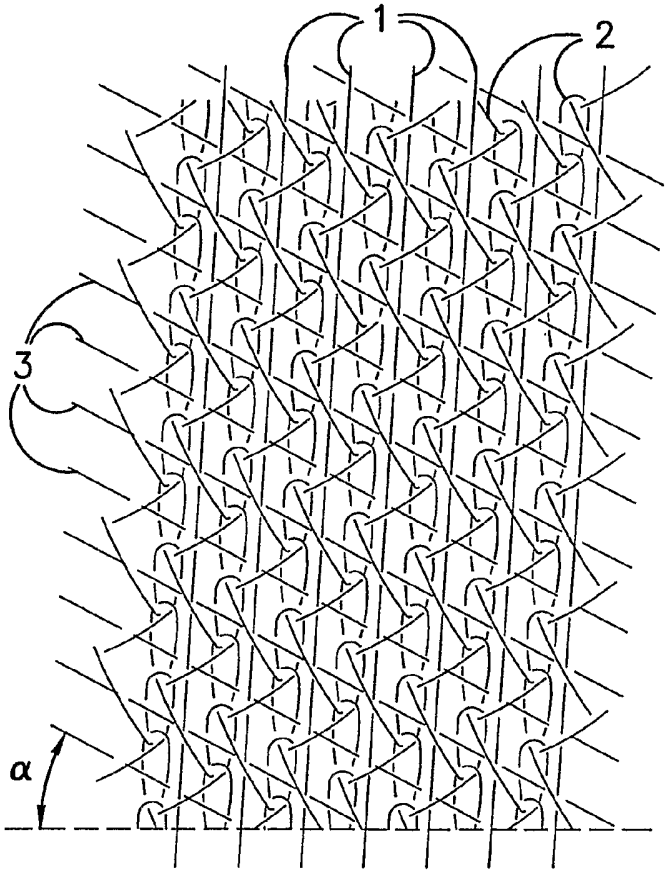

(57) Abstract: An adhesive tape (5) comprises a reinforcement fabric, optionally laminated to a polymer layer and one or two faces of the tape being coated with pressure sensitive adhesive. The reinforcement fabric is selected from the group comprising WIWK fabric and Leno weave fabric, and it is provided with oblique weft yarns held by the adhesive and by stitches or loops at an oblique angle (α) of 20 to 80 degrees to the warp stitching wales or warp yarn.

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ADHESIVE TAPE AND ITS REINFORCEMENT

Technical Field

This invention relates to the manufacture of an adhesive tape and to a fabric reinforcement substrate, especially a weft insertion warp knit (WIWK) fabric reinforcement, for such a tape, particularly to a tape including a reinforcement with weft yarns at an oblique angle to the warp direction of the stitching yarns of the WIWK fabric, the warp direction also normally corresponding to the longitudinal direction of the adhesive tape.

Background to the Invention

EP 0 379 478 describes a process for manufacturing fabric reinforcements. The reinforcements having oblique weft threads which are made to take up that orientation by the oblique drawing of fabric with a right angled (or orthogonal) arrangement of warp and weft threads using a rolling process which has an oblique pull-off from a deflection roll which is aligned substantially perpendicular to the direction of the original run.

US 4 055 697 describes a woven reinforcement with weft threads at an oblique angle. It is said to be useful for inextensible materials such as graphite, glass etc.

GB 2 159 845 describes the formation of a tape for manufacture of a reinforced plastics object. The tape consists of longitudinal mutually parallel yarns and transverse mutually parallel yarns, the latter yarns making an oblique angle with the longitudinal yarns. The process entails forming the reinforcement substrate with woven orthogonal yarns and then winding it up under tension at an angle to a nip roller. The take off angle can range from 20 to 70 degrees. The tape is optionally treated in line before it is wound onto a final winding roller. Preferred yarns are glass fiber but polymer materials may alternatively be used. The weft yarns are said to be about 10 times the decitex of the warp yarns, e.g. 1000 decitex and 100 decitex. An example of use of the reinforcement is given in which left and right handed oblique angled tapes are alternated with plain orthogonal tapes to build up a four layer tubular reinforcement structure. The number of yarns per centimeter is 4.0 in warp and 2.2 in weft.

Machines such as described in US 4 703 631 and 4 677 831 and 4 518 640 are capable of manufacturing fabrics in which reinforcement yarns may be oriented in multiple directions, including warp, weft and oblique. The fabric produced on such machines tends to be more expensive than that produced by the drawing methods described in EP 0 379 478, US 4 055 697 or GB 2 159 845.

None of the above fabrics is suggested or taught as a reinforcement for adhesive tape.

WIWK is a knitting technique that includes inserting a length of yarn across the width of the knitting elements and fastening this weft yarn between the needle loop and the underlap. The fabric may also, or alternatively, have an inlay warp.

An adhesive tape having a WIWK reinforcement substrate is described in US 4 304 813. The construction consists of a pressure sensitive tape comprising a polyethylene film; a warp knit, weft inserted, continuous filament fabric substrate and a pressure sensitive adhesive applied to the film through the fabric substrate. The fabric substrate is a WIWK fabric with a chain stitch knit, base construction using a 40 denier, continuous filament, polyester yarn. The inserted weft yarn is a 150 denier, textured, polyester continuous filament yarn. This provides a 100% synthetic fabric substrate. As explained in EP 0466 342 (US5017425) this substrate was expensive to produce because it had a weft inserted for every warp chain loop. The weft is perpendicular to the warp and is used in the tape so that it is perpendicular to the longitudinal direction of the tape.

EP 0 466 342 describes an improved WIWK reinforced technical tape comprising a layer of plastic film, a layer of WIWK all synthetic fabric laminated to said film and a pressure sensitive adhesive adjacent to said fabric. The fabric structure is relatively open, resulting in a cost-effective substrate. EP 0466 342 claims the selection of 5 to12, preferably 9 weft yarns per inch in the WIWK fabric, this gives a cheaper, lighter and more open fabric than was disclosed in US 4304 813. The improved fabric was produced on a Tricot knit machine using 150 denier (167 decitex) weft yarn. This WIWK construction is said to have the advantage of tearability across the production direction of the technical tape. This tearability is due to the presence of a weft yarn in the fabric, which guides the tear line. The bonding of the fabric to the film ensures that only a small number of warp yarns are loaded simultaneously when tearing the tape in cross direction. Resulting in a low tear resistance. Because the weft runs perpendicular to the direction of the tape any tear is perpendicular across the tape.

A problem with reinforced adhesive tapes, especially those with low elasticity, is that when they are wrapped around a substantially cylindrical object, such as a bundle of wires, any overlap in the tape onto the layer already formed will tend to skew the tape back on itself thus causing the amount of overlap to become progressively larger. This problem may increase the amount of tape required and may also result in having to terminate that wrapping and recommence with a fresh length of tape. Attempts to keep the tape running true result in unwanted creases in the tape, which may lead to weak spots in the wrapping and look unsightly.

A further problem with the prior art tearable reinforced tapes is that if the tear line follows a weft yarn that runs perpendicularly across the tape, this produces a torn end that cannot neatly abut the end of a cylinder. Thus there is a need to trim the end, or to leave the end untidy, or to overlay it with a further piece of tape.

It is an object of the present invention to solve the above problems by producing a substrate which helps the tape to be wrapped more truly and flatly and which, if tearablity is required, can be torn at an oblique angle.

Disclosure of the Invention

According to the present invention there is provided an adhesive tape according to claim 1. One advantage of such a tape is that the adhesive tape or "duct tape" is hand tearable, in the weft direction, along the oblique angle made by the weft. By making the tape hand tearable at a suitable oblique angle it is possible to avoid additional slitting and handling the tape can also be more easily and neatly joined to previously applied wrapping. The corresponding oblique angle made by a torn end of the tape will allow an easier way to start to wrap the tape around a round part; including without limitation: hoses, cables and tubes.

As an alternative to WIWK fabric the reinforcement fabric with a weft at an oblique angle may be any woven and/or Leno-woven fabric suitable for use in the manufacture of adhesive tape and having a weft fixed at an oblique angle. However, WIWK is the preferred construction for the reasons given below.

The adhesive tape has the warp ends aligned and parallel to the tape direction and the weft ends at an oblique angle chosen to suit the diameter of the object that the tape is going to be wound around. Ideally the hand tear side of the tape following the weft angle is applied to the object to be wrapped around in such a way that the angled torn end of the tape is aligned with the line perpendicular to the axis of a substantially cylindrical object. This ensures that all of the weft yarns in the tape reinforcement will wrap essentially around the cylinder at 90 degrees to the axis of the cylinder. This prevents the phenomenon of the tape following a non-helical path as it is wrapped and keeps the lateral shift between layers of tape substantially constant.

For tapes with adhesive on only one side, the tape is now "handed". A tape designed for a right handed person, who will wrap in a clockwise direction will have the oblique angle arranged so that the tape tears with the longer side at the leading edge, whereas a tape designed for a left handed person would have the oblique angle arranged to be in the opposite sense to make it the leading edge for anticlockwise winding. Thus, the reinforcement may advantageously be obtainable in a variety of oblique angles to suit this left and right handed use and to accommodate the various possible diameters of objects to be wrapped around.

This provision of a variety of oblique angles may conveniently be achieved by producing a WIWK fabric with warp ends (stitching yarns and with or without inlay yarns) in the vertical (machine way) direction as usual. The fabric is, in a preferred process, manufactured with orthogonal weft ends initially and then distorted by drawing it to give the required oblique weft angle. By means of such a process it is possible to get a WIWK fabric with all the weft ends having a regular oblique angle versus the normal cross direction of the fabric. The weft yarns will remain parallel and at an equal

distance from each other. This distance being equal to the original number of wefts per cm. All wefts could be at a positive or a negative oblique angle, according to requirements. The warp ends will stay in the vertical direction (machine direction) as normal. There is no limitation in material and type of yarns in use for the inlay warp ends and the weft ends for example: all natural, artificial, man-made yarns, spun (fibres), and/or continuous multifilaments or monofilaments yarns, flat, textured, and/or any other bulked yarns, single or twisted single yarn in greige state and/or in treated or coated state, in a range of 10 decitex (9 deniers) up to 33 000 decitex (30 000 denier), preferably up to 280 decitex (250 denier). The yarn is preferably polyester. It may alternatively be polyamide, for example polyamide 6,6, polyamide 6, polyamide 6,10, polyamide 6,12, polyamide 4.6, polyamide 11, polyamide 12, or it may be rayon, steel, polyethylene, polypropylene, PVA, glass fiber, aramide, carbon or any other raw material suitable for tape reinforcement. Yarns may have no twist, or may be entangled without twist, or be twisted, or be cabled. Yarns may also be stretchable, elastic-like, elastomeric yarns and may be treated for example to give non-flammability, anti static or anti wicking properties.

The preferred construction is from 0.5 up to 20 wales per cm in warp and from 0.5 up to 20 ends per cm in weft. In weft direction, the preferred yarn will be one single weft inserted in each stitch, but it is possible to knit one single weft inserted in each second stitch, (the first one will be without weft), or each third stitch, or each fourth stitch, etc. Also it is possible to knit multiple wefts together at a time inserted with the same options as for the single weft. In each of these constructions the stitches or loops ensure that the warp stitches and the oblique weft yarns are held in a fixed relationship with one another so that the density of reinforcement along and across the tape does not vary. This gives rise to a higher consistency of reinforcement than would be obtained, for example, by using an open woven fabric reinforcement. Thus, for the preferred construction of one weft for each warp stitch the relationship is 1:1 whereas if the construction of inserting a weft in every second warp stitch is used the relationship is 2 stitches per 1 weft. However, in both cases the ratio remains constant along the tape.

It is possible to knit one single weft inserted in each second stitch (the first one being without a weft), or each third stitch, or each fourth stitch, or a combination of these possibilities etc. Also it is possible to use multi-ply cabled yarns as weft 3.

Similarly in the warp direction, each inlay warp end could be inserted in each wale or each second wale, third wale, fourth wale, etc. (Each wale is made with each stitching yarn and has a corresponding needle).

For fabric with an inlay warp the preferred construction is from 0.5 up to 12.6 wales per cm in warp and from 2 to 18 ends per cm in weft.

Stitching yarns

The stitching yarns may be made with any kind of material, with a preference for man-made continuous filaments yarns in a range of 10 to 280 decitex, preferably 22 to 280 decitex, for an easier knitting capability.

During the distortion to give the oblique weft the width of the fabric will be reduced from the original width formed on the knitting machine. To allow for this the warp end count (stitching yarn count) on the knitting machine is correspondingly reduced. The preferred construction could be from 0.5 up to 20 ends per cm (or 1 to 50 needles per inch) in the case of one bar (or one end per needle), the most preferred construction being from 1 up to 12.6 ends per cm (or/and 3 up to 32 needles per inch) in the case of one bar (or one end per needle). Constructions made using multiple bars in the warp i.e. several warp ends working differently on the same or different needles are also possible. The stitching yarn may be for example multifilament or monofilament polyester or polyamide yarn or tape yarn.

As already discussed the inlay warps could be inserted in each second wale, third wale, fourth wale, etc. A wale being made with each stitching yarn and its corresponding needle. When using an inlay warp yarn between each wale made with the stitch yarns, the preferred pattern stitch to be used for the stitching yarn is a tricot stitch (1.0 / 1.2) with closed stitches and/or open stitches (0.1 / 2.1). With these chain, or pillar, stitches an inlay warp with a weft effect pattern stitch (0.0 / 1.1) may be added.

The inlay warp could be made with two different pattern stitches according to the aspect needed, a flat aspect with a straight warp between wale (0.0 / 0.0) and/or a round aspect with the inlay warp turning around the stitches (0.0 / 1.1).

When an inlay warp is not needed, the preferred pattern stitch for the stitching yarn is a chain stitch (pillar stitch) (0.1 / 0.1) with closed stitches, and/or a chain stitch (pillar stitch) (0.1 / 1.0) with opened stitches. Several bars (several stitching yarns working on the same needle) could be used with various pattern stitches, but this will increase the contribution of the stitching yarns to the weight of the WIWK fabric. Also several bars of inlay warp yarns could be used with various pattern stitches, given the same impact to the weight and tensile strength of the WIWK fabric.

It is advantageous to have an inlay warp as the tension equilibrates automatically with the inlay warp. However, for a hand tearable tape it is preferred not to have any inlay warp. In the case where no inlay reinforcement warp is present, the weft threads are preferably yarns that comprise less than 50% and preferably less than 30% by weight of the total fabric. In the case where an inlay warp is present, the relative amounts of weft to warp is between 1 to 4 and 4 to 1, and preferably, if the same yarn is used in both directions with the same construction per cm in weft and warp the weight is nearly the same: within a range of plus or minus 10%.

To obtain a weft with an oblique angle the WIWK fabric is passed through at least two pressure rollers before a batching device takes up the distorted fabric. Three rollers will give better results

than two and will avoid too much pressure on the rollers. Use of these rollers blocks the tension on the WIWK fabric being transmitted back to the knitting machine. Due to the oblique angle of take-off of the fabric after the pressure rollers we obtain the distortion of the WIWK. The batching device, normally situated in a parallel position with the knitting machine in a traditional fabric, will be now situated versus the knitting machine with the same angle α as the deviation needed for the weft. The weft stays parallel to the knitting machine.

The warp ends should preferably be maintained under a high tension, to be able to roll up the distorted WIWK fabric with the correct angle β for the warp direction and the correct angle α for the weft direction. Also, when the WIWK fabric is unrolled again for further treatment or to make tape it is important to maintain this high tension, at least until the reinforcement fabric has been coated or laminated to a support. In a variation of the distortion process the fabric can be knitted and taken up in the orthogonal configuration as normal and then the distortion can be done off-line by effectively replacing the knitting machine with a further batching device as the source of the fabric fed to the pressure rollers. Furthermore it is possible to distort the WIWK fabric at the needed oblique weft angle, just before the finishing and/or the treating and/or laminating and/or coating machine that comprises the following step in the process of tape manufacturing. After the knitting process, an in-line or off-line process, such as laminating and/or coating and /or printing may be used to produce the final pressure-sensitive adhesive tape product. Advantageously there is provided directly after the pressure rollers an in-line treating/ in-line finishing / in-line laminating / in-line coating machine to get a one-pass continuous process.

The adhesive tape may be used to wrap around a generally cylindrical object such as a tube, hose, bundle of wires, ducting etc.

To be able to wrap precisely around the cylinder the width of the adhesive tape should be proportional to the diameter of the cylinder. Furthermore the weft should have the appropriate angle to get the correct length to allow a perfect joined or slightly overlapped wrapping of the tape-wrap around the cylinder.

Ideally, the adhesive tapes are designed at the right width and weft angle corresponding to each desired diameter to wrap. The oblique angle of the weft should be defined specifically for each range of diameters to be wound around; the hand tearability of the tape follows the angle made by the weft.

The characteristics of the tape reinforcement, such as tensile strength, elongation at break, tensile modulus, thickness, weight, stiffness, etc will depend on the choice of construction (number of ends both warp and weft directions), type of raw material, size and type of yarns and type of pattern stitches used, and may also depend on the type of treating / finishing / printing / laminating and/or coating applied onto the substrate.

The advantages of forming the tape using a WIWK fabric as the starting point are: a thinner structure having the same strength as a woven reinforcement which can be distorted at an oblique angle without destroying the spacing of the yarns. This gives a saving of adhesive and more uniform properties to the resulting adhesive tape.

As there is no crimp in the fabric, the fabric shows no elongation at initial loading, unlike wovens. This elongation being due to the stretching of the yarns by removal or exchange of crimp during the initial loading. This makes it easier to maintain the uniform structure during the "distortion" due to pulling the fabric at an oblique angle.

In WIWK the stitching yarns connect the two sheets together to maintain a precise distance between each warp yarn (or wale) and between each weft yarn (or stitches or rows), this results in a perfect weft yarn geometry in the fabric because the yarns are always held in position by the stitching yarns. This is especially so if the fabric construction is very open and even more important in the present instance where the fabric would otherwise be distorted irregularly by the process to create the oblique angle.

The invention will now be further described by way of example only and with reference to the drawings, which are briefly described as:

Figure 1 is a plan view of a WIWK fabric being produced with the weft at an oblique angle

Figure 2 is a WIWK fabric with an oblique weft; an inlay warp and using tricot stitching yarn;

Figure 3 is a WIWK fabric with an oblique weft; an inlay warp and using chain stitching yarn;

Figure 4 is a WIWK fabric with an oblique weft, without inlay warp and using closed chain stitches;

Figure 5 is a plan view of the WIWK fabric passing through the pressure rollers;

Figure 6 is a roll of adhesive tape showing an oblique torn end;

Figure 7 is a cylinder being wrapped with adhesive tape prior to sticking down of the torn end; and

Figure 8 is a cylinder being wrapped with the adhesive tape after sticking down of the torn end.

Figure 1 shows a knitting machine (A), which is a WIWK machine. A knitted tape reinforcement fabric is taken off from the knitting machine in the direction of a batching device (B). The fabric comprises warp ends 2 (stitching yarns 2 and / or inlay yarns 1) in the machine direction as usual, and weft yarns 3 running across the fabric. In order to create weft ends at an oblique angle the knitted fabric is drawn through pressure rollers (C) before it is wound onto the batching device (B). To obtain an oblique weft 3 with an angle α after the knitting machine (A) in figure 1 and before the batching device (B), the WIWK fabric is passed through at least two pressure rollers (C), three rollers will give even better results and will avoid too much pressure on the rollers; which will block

the distortion of the WIWK fabric going back to the knitting machine (A). Only after the fabric has passed through these pressure rollers (C) we will obtain the oblique distortion of the WIWK fabric.

It is possible to swing the position of the batching device (B) so that the weft ends have an oblique angle, α, anywhere in the range from -70° to 70° versus the conventional weft direction. This conventional direction usually crosses the machine at 90° to the warp ends (angle β). Thus the oblique angle α is 0° and angle β is 90° when the weft is perpendicular to the warp. By use of the offset batching device (B) in combination with the pressure rollers (C) it is possible to produce a WIWK fabric with all its weft ends 3 having an angle α up to 70° either way from the normal 90° angle. Applying this method to a WIWK fabric has the advantage that all the weft yarns 3 will have the same angle α, so that they remain parallel and equidistant from each other. The distance they are apart being determined by their original spacing (wefts per cm), the oblique angle and to some extent by the tension applied between the pressure rollers (C) and the batching device (B). The warp ends must be maintained under a high tension to be able to roll up the WIWK fabric with the correct angle β for the warp direction and the correct angle α for the weft direction.

Figure 1 also shows stitching yarns 2. These are necessary to ensure the linking together of the inlay warp ends 1 and the weft ends 3. The stitching yarns 2 are 76 decitex polyester continuous filament yarns.

Figure 2 shows a WIWK fabric with oblique weft ends 3 and inlay warp 1 (0.0/0.0) and tricot stitching yarn 2 (0.1/2.1) open. The fabric has 8 wales per cm in warp and 12 ends per cm in weft.

Figure 3 shows a WIWK fabric with oblique weft ends 3 and inlay warp 1 (0.0/1.1) turning around chain stitching yarn 2 (0.1/1.0) open. Stitching yarns 2 are holding in place the oblique weft ends 3.

The fabrics of both figure 2 and figure 3, with inlay warp, have the preferred construction one single weft 3 inserted in each stitch. Also, as shown in figure 2 the inlay warp ends 1 are inserted in each wale. The stitching shown in figure 2 is a tricot stitch with open stitches (0.1 /2.1).

The inlay warp 1 could be made with two different pattern stitches according to the aspect needed. A flat aspect may be created with a straight warp 1 between wales 2 (0.0 / 0.0) as shown in figure 2. A round aspect may be created by having the inlay warp 1 turning around the stitches 2 (0.0 / 1.1) as shown in figure 3. The variations may be used together to create a mixed aspect fabric.

Use of several bars so several stitching yarns work on the same needle is possible, but this will increase the proportion of stitching yarns making up the weight of the WIWK fabric. As the stitching yarn weight is normally to be kept to a minimum, multiple bars are less preferred.

Figure 4 shows a fabric with an oblique weft 3 and without any inlay warp. The preferred pattern stitch for the stitching yarn 2 is a chain stitch (0.1 / 0.1) with closed stitches. Alternatively it could be a chain stitch (1.0 / 0.1) with opened stitches.

As possible variants of the process shown in figure 1, the knitting machine (A) may be replaced by a batching device to unroll the fabric and a finishing machine or any other treating machine may be substituted for the batching device (B). In that case, the WIWK fabric will be directly distorted with the needed weft angle (α), just before the finishing and/or the treating machine of the following step in the process. In another variant there is provided directly after the knitting machine (A) and the pressure rollers (C) a treating machine to get a one-pass process. However, this is less preferred for applications where the oblique angle may need to be varied from time to time to produce a range of reinforcement substrates with different oblique angles.

Figure 5 shows the distortion of the WIWK fabric after the pressure rollers (C). During the distortion to give the oblique weft the width of the fabric will be reduced from the original width formed on the knitting machine (machine width = mW). The oblique angle of the warp ends 2 necessary to get the weft ends under an angle α, will reduce mW to give a new fabric width: FW [FW = mW(sinα)]. Because of this width reduction, the number of warp ends per centimeter will increase. If nK is the number of warp ends (2) per centimeter on the knitting machine and if nF is the number of warp ends per centimeter in the final fabric (or tape), the formula will be: [nF = nK / (sinα)].

After this knitting process, an in-line or off-line process, such as laminating and/or coating and/or printing may be used to produce the adhesive tape product.

The final characteristics of the tape reinforcement, such as tensile strength, elongation at break, tensile modulus, thickness, weight, stiffness, etc will depend on the choice of construction (number of ends both warp and weft directions), type of raw material, size and type of yarns and type of pattern stitches used, and may also depend on the type of treating and/or finishing and/or printing and/or laminating and/or coating applied onto the reinforcement.

An example of use of the adhesive tape may be illustrated by reference to Figs 6, 7 and Fig 8. Fig 7 shows a cylinder 4 that it is necessary to have wrapped around with the duct tape 5 shown in Fig 6. Fig 6 shows the duct tape 5 with its free end 6 hand torn at the angle α made by the weft 3. In Fig 7 the beginning of wrapping is shown with the free end 6 not yet stuck to the cylinder 4. The weft ends 3 of tape 5 will follow the border or end of the cylinder and may be neatly stuck to the cylinder 4 as shown in Fig 8.

To be able to wrap precisely around the cylinder 4 (Fig 7 and Fig 8) the width (tW) of the tape 5 shown in Fig 6 should be proportional to the diameter (Q) of the cylinder 4 as shown in Fig 7 and Fig 8. Furthermore the weft 3 of tape 5 (Fig 6) should have the appropriate angle α to get the correct length (wW) to allow a perfect joined or slightly overlapped wrapping of the tape around the cylinder 4. The formula to determine the right width of tape (tW) to use, following the angle α to wrap, having the weft width (wW) of the tape (Fig 6) corresponding exactly with the circumference of the cylinder to be wrapped, with cylinder diameter Q, is:

Circumference of cylinder $= \pi Q = wW$

$tW = wW \cos \alpha$

Thus, the smaller angle α is, the bigger the width of the tape must be, particularly when the diameter to wrap is also large.

Ideally, the adhesive tape is designed at the right width and weft angle corresponding at each desired diameter to wrap.

Example Fabrics

Weft inserted warp knit fabric samples were made using polyester yarns in both the weft and in the inlay warp (see figures 2 and 3). The fabric was drawn at an angle as hereinbefore described in order to get the weft yarns at an oblique angle of 22° to the cross direction of the fabric. (Fabrics A and B)

A third fabric sample (Fabric C) was made without the use of the inlay warp. In this case, reinforcement yarns are only present in the oblique weft direction and not in warp, or production, direction (see figure 4). In the warp direction, only the stitching yarn creating the fabric via the stitches is present. However, due to the oblique weft running both across and along the tape the weft provides some degree of tensile support along the tape too.

Example Tapes

The following are examples of adhesive tapes obtainable with an oblique weft in the reinforcement. The tapes are obtainable in a conventional manner except that the reinforcement fabric is one of the example fabrics above and the tape is maintained at a high tension during the manufacturing process, at least until it is laminated to a polymer film.

Table 1 - Example Adhesive tapes

	Example 1	Example 2	Example 3
Reinforcement	Fabric C	Fabric A	Fabric B
Polymer film	Polyethylene 2 mil	Aluminium vapour coated polyethylene terephthalate 2 mil	Thick polyester 5 mil
Adhesive	Natural rubber base	Acrylate base	Butadiene-acrylate-isoprene base

The tape of Example 1 was compared with a tape having a conventional orthogonal reinforcement fabric by wrapping them both around a cylinder of 2cm diameter. The tape according to the invention was easier to apply uniformly without overlap and a shorter length of tape was used for a unit length of the cylinder. Furthermore the appearance of the covered cylinder was improved using Example 1 and the ends were much neater in appearance and did not require any trimming. The tape tore easily by hand at the oblique weft angle.

Claims

1. An adhesive tape comprising a reinforcement fabric, optionally laminated to a polymer layer and one or two faces of the tape coated with pressure sensitive adhesive, the reinforcement fabric being selected from the group comprising WIWK fabric and Leno weave fabric, characterised in that the reinforcement fabric is provided with oblique weft yarns held by the adhesive and by stitches or loops at an oblique angle of 20 to 80 degrees to the warp stitching wales or warp yarn.

2. An adhesive tape according to claim 1 wherein the reinforcement fabric is a WIWK fabric and the warp stitching wales are aligned substantially along the length of the tape.

3. An adhesive tape according to claim 2 which has a fixed relationship between the stitches of the warp stitching wales per cm and the number of oblique weft yarns per cm.

4. An adhesive tape according to claim 2 or claim 3 in which the WIWK reinforcement fabric further comprises inlay warp yarns running along the length of the adhesive tape between the warp stitching wales (0.0 / 0.0), or turning around the warp stitching wales (0.0 / 1.1 or 1.1 / 0.0)).

5. An adhesive tape according to claim 4, in which the warp stitching wale pattern is selected from the group comprising chain stitch, (0.1 / 0.1) closed, and chain stitch (0.1 / 1.0) open.

6. An adhesive tape according to claim 4, in which the warp stitching wale pattern is selected from the group comprising tricot stitch (1.0 / 1.2) with closed stitches, tricot stitch with open stitches (0.1 / 2.1), and combinations of tricot stitch with open and closed stitches.

7. An adhesive tape according to claim 2 or claim 3, in which the WIWK reinforcement fabric does not have any inlay warps, characterised in that the warp stitching wale pattern is selected from the group comprising chain stitch, (0.1 / 0.1) closed, and chain stitch (0.1 / 1.0) open.

8. An adhesive tape according to any preceding claim having a WIWK reinforcement fabric with a construction comprising from 0.5 to 20 warp stitching yarns per cm across the tape, from 0.5 to 20 oblique weft yarns per cm along the tape and optionally from 0.5 to 20 inlay warp yarns per cm across the tape.

9. An adhesive tape according to any one of claims 2 to 8 including a WIWK reinforcement fabric wherein the yarns in the reinforcement fabric are selected from the group comprising polyester, polyamide, for example polyamide 6,6, polyamide 6, polyamide 6,10, polyamide 6,12, polyamide 4.6, polyamide 11, polyamide 12, and aramid, carbon, rayon, steel, polyethylene, polypropylene and other suitable yarns.

10. An adhesive tape according to any one of claims 2 to 8 wherein the warp stitching wales comprise polyester yarn, the inlay warp comprises a yarn selected from the group comprising aramid and carbon and the oblique weft yarn comprises a yarn selected from the group comprising aramid and carbon.

11. An adhesive tape according to any one of claims 2 to 6 including a WIWK reinforcement fabric wherein the warp stitching wale yarn comprises a yarn selected from the group comprising polyester and polyamide, the inlay warp yarns and oblique weft yarns are mixed or blended materials selected from the group comprising polyester 45%/ polyamide 55%, or polyethylene 25% / polyamide 75%, and any other suitable mix or blend of the yarn materials.

12. An adhesive tape according to any preceding claim, in which the polymer layer is a polymer film, preferably a polyolefin film.

13. An adhesive tape according to any preceding claim in which the polymer layer is bonded to the fabric reinforcement by the adhesive and also by another bonding means, preferably by heat bonding.

14. A reinforcement fabric, the fabric being constructed according to the description of the reinforcing fabric in any one of claims 1 to 11.

15. Use of the reinforcement of claim 14 in the manufacture of an adhesive tape.

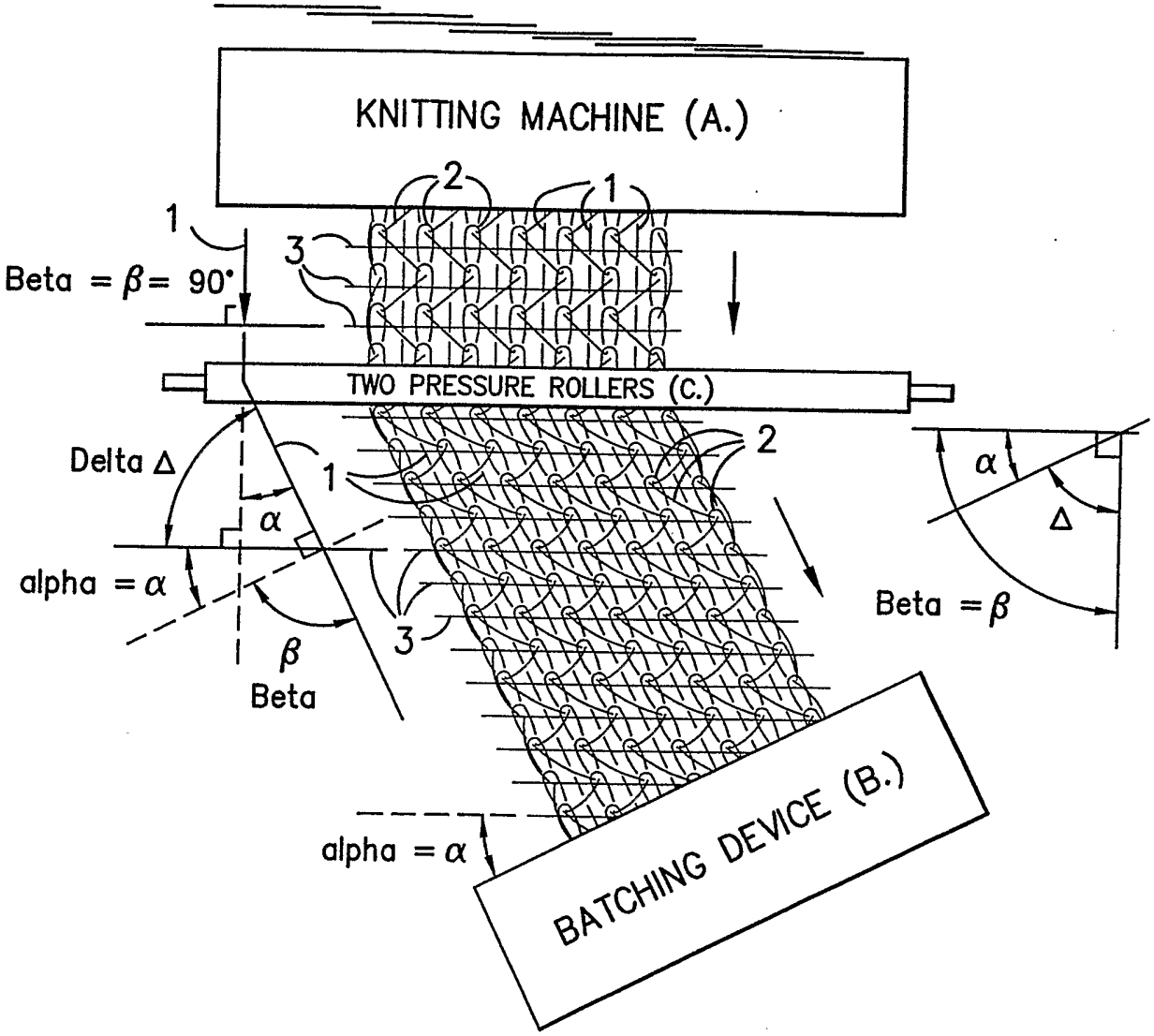
KNITTING MACHINE (A.)
2
1
1
3
Beta = β = 90°
TWO PRESSURE ROLLERS (C.)
Delta Δ
1
α
2
α
Δ
alpha = α
β
Beta
3
Beta = β
alpha = α
BATCHING DEVICE (B.)

Figure –1–

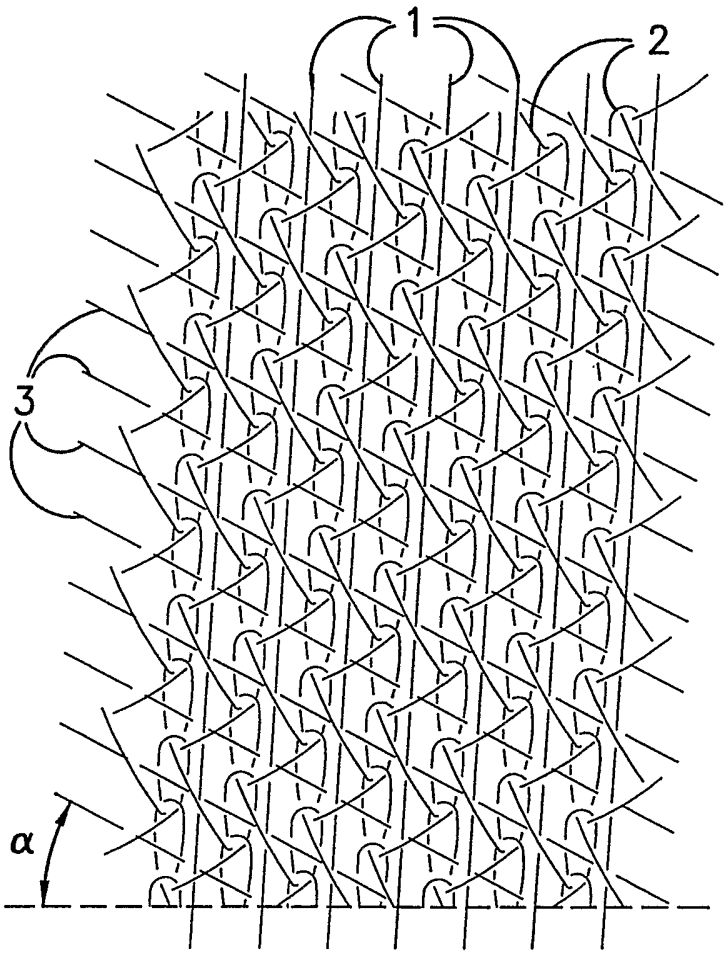

Figure -2-

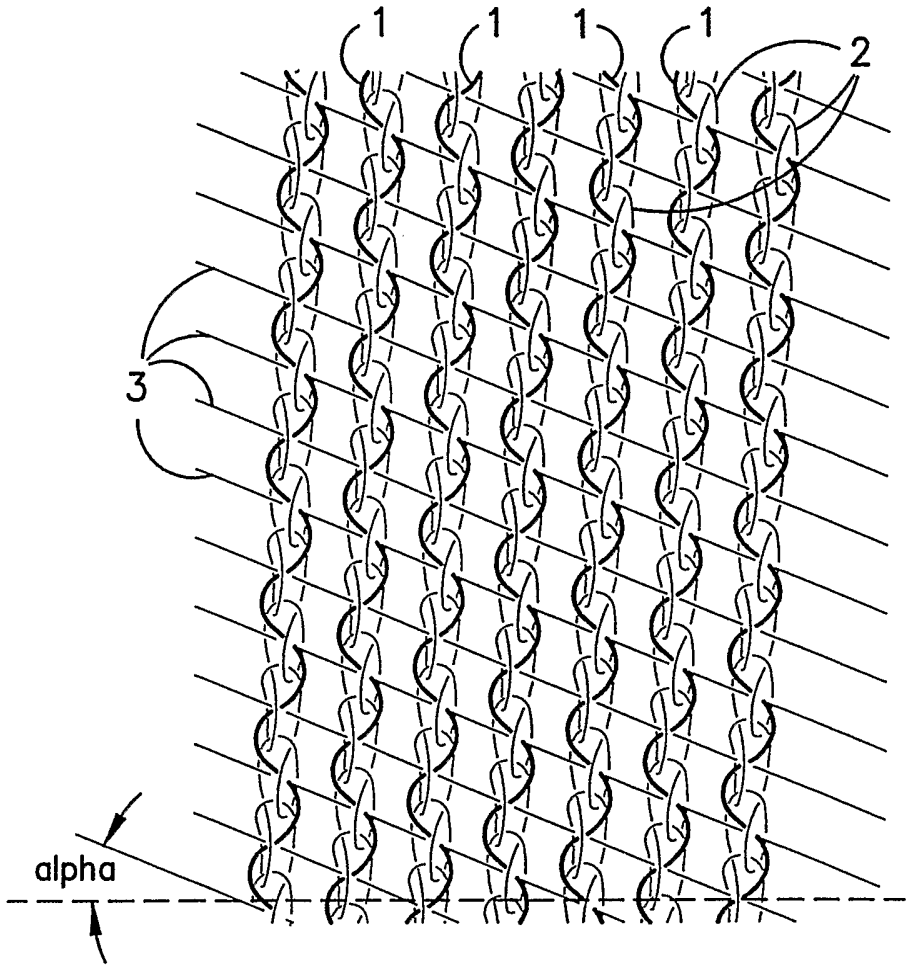

Figure –3–

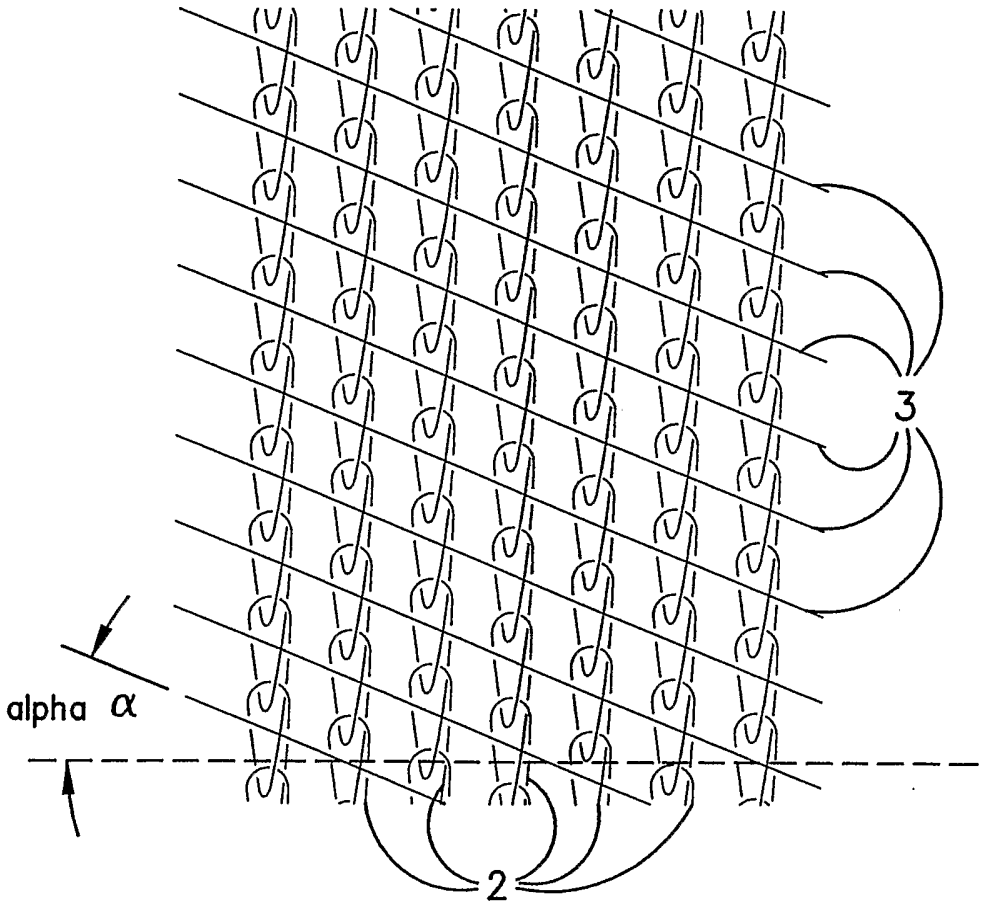

Figure –4–

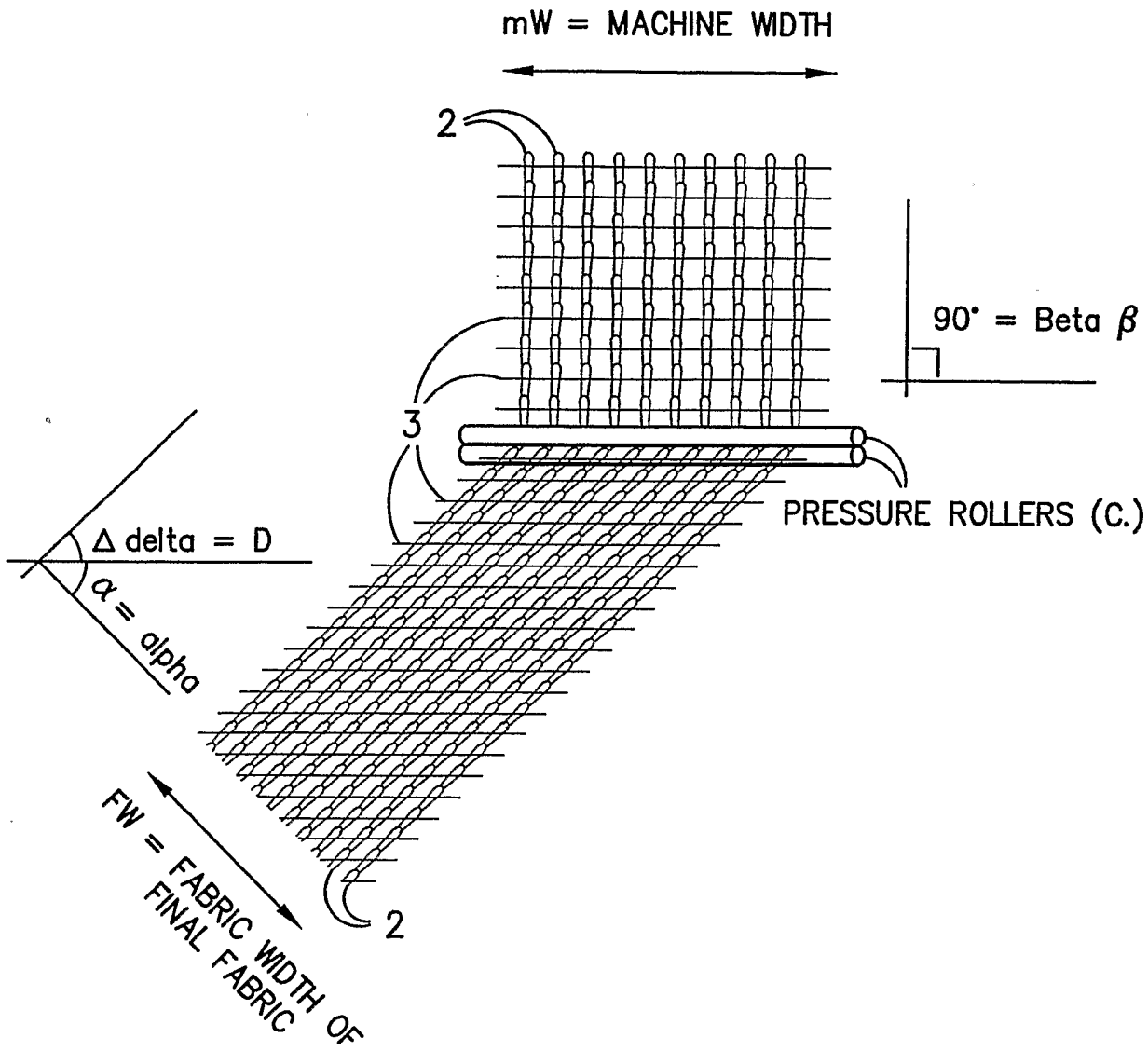
mW = MACHINE WIDTH
2
90° = Beta β
3
PRESSURE ROLLERS (C.)
Δ delta = D
α = alpha
FW = FABRIC WIDTH OF FINAL FABRIC
2

Figure –5–

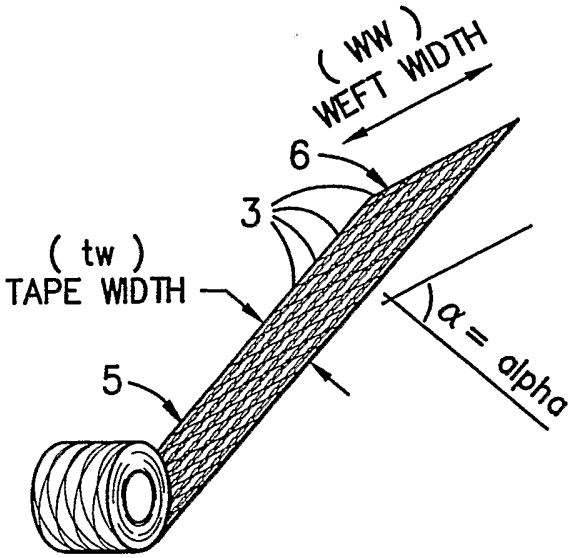

Figure -6-

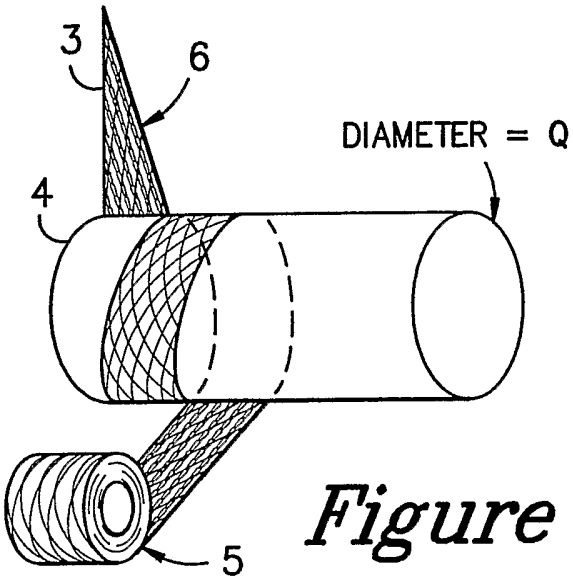

Figure -7-

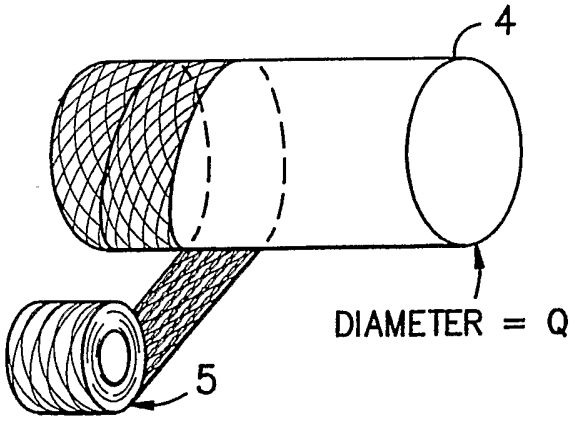

Figure -8-

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP2004/012996

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C09J7/04 D04B21/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C09J D04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 466 342 A (MILLIKEN RESEARCH CORPORATION) 15 January 1992 (1992-01-15) cited in the application claims 1-5	1-15
X	GB 2 159 845 A (* ASEA AKTIEBOLAG) 11 December 1985 (1985-12-11) cited in the application claim 1 page 1, line 56 - line 72 page 1, line 110 - page 2, line 24	14
P,X	WO 03/106580 A (MILLIKEN EUROPE N.V; MILLIKEN FABRICS S.A; TERNON, GERARD; KURJA, JENC) 24 December 2003 (2003-12-24) claims 1,4,5 page 7, line 12 - line 16	1-15

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 March 2005	18/04/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Schlicke, B

INTERNATIONAL SEARCH REPORT

Information on patent family members

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		EP	1511819 A1	09-03-2005