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54 **Low bulk seam for papermakers equipment fabrics and method of producing said seam.**

57 The present invention is directed to a low bulk pin-type seam for use with the flat woven fabric and to the method of producing said seam. The preferred fabric is woven with continuous or monofilament yarns in the machine direction. The seam is formed by interconnecting loops constructed from the machine direction warp yarns. In constructing the seam loops, a portion of the fabric is made free of cross machine direction yarns and the warp yarns are selected out as either a loop forming yarn (4b) or as binder yarns (4a). The fabric is then folded back upon itself in hem like fashion with the selected yarns being retained as loop forming yarns (4b) and the binder yarns (4a) being drawn back through the hem portion of the fabric to bind the hem and body portion of the fabric. If desired, a stitch pattern may be added to further secure the hem area.

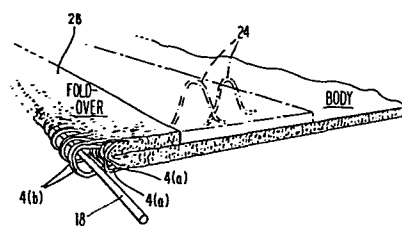


Fig. 7

LOW BULK SEAM FOR PAPERMAKERS EQUIPMENT FABRICS AND METHOD OF PRODUCING
SAID SEAM

The present invention relates to the field of low bulk seams for use with papermakers machine fabrics, and more particularly relates to such a seam for use in monofilament fabrics.

The prior art has for some time, recognized that papermakers fabrics may be flat woven and then seamed in order to produce an endless fabric on the papermaking machinery. The earliest attempts to form seamed fabrics utilized a technique of back weaving the flat woven fabric ends to produce essentially an endless belt. This technique was both time consuming and difficult. It was later recognized that flat woven fabrics could be made into an endless belt by use of hooks or loops which were affixed to the respective ends of the flat woven fabrics and then made to interleaf with each other so as to form a channel wherein a pintle hook or joining wire could be inserted. Other recent attempts to join flat woven fabrics to an endless belt have utilized a coil which was affixed to the respective ends of the flat woven fabric and interleafed to form a channel for receiving a pintle or joining wire. In recent years, some monofil fabrics have been seamed by a technique of selecting alternate warp ends which are formed into a loop and then back woven into the fabric so as to retain the end in the fabric. Once again, the loops so formed were interleafed to form a channel for receiving a pintle wire or joining wire.

As noted, one prior art attempt at making pin seams in papermakers felt has been to utilize alternating warp ends which are formed into a loop at the ends of the fabrics that are woven back to the body of the fabric. The loops formed on either end of 5 the fabric at the ends thereof are made complementary and mate with each other so that a long wire or pintle may be inserted through the channel formed by the loops to join the two ends of the fabric into an endless fabric belt. The seam thus formed is not substantially thicker than the normal thickness. However, the 10 process of weaving the warp ends back into the fabric in order to form the loops and the associated fabric weakness have lead to reduced wear characteristics for pin seams formed by this back weaving method.

Also as noted, a second prior art attempt used various 15 coil type seams wherein coils or spirals are inserted along a fold line and the fabric is folded back over itself or otherwise attached to itself so that the coil may matably receive a coil similarly attached to the other end of the fabric. A wire or pintle is then used to join the seam as mentioned previously. 20 While coil seams have achieved some success, the additional thickness and thickness irregularity attended with such seams has limited their applicability, their life, and/or the reliability thereof.

To date, the prior art attempts to produce a pin type 25 seam in a monofilament fabric have resulted in a high fabric bulk adjacent to the pin seam area and undesirable running

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characteristics for the belt as a result of the seam. It has long been recognized that the seam area of the flat woven fabric which has been joined to make an endless belt is a major contributor to product defects and fabric failure.

5 Fig. 1 is an orthographic projection of a fragment of a fabric end to be seamed in accordance with the invention.

Fig. 2 is an orthographic projection of the fabric of Fig. 1 with a pick free area.

Fig. 3 illustrates the separation of warp yarns
10 according to the invention.

Fig. 4 illustrates the insertion of a loop forming means according to the invention.

Fig. 5 illustrates the formation of a fold over or hem according to the invention.

15 Fig. 6 illustrates the pull through of selected warp yarns against the hem line according to the invention.

Fig. 7 illustrates the fabric seam end after pull through of the selected yarns and trimming of the hem.

Fig. 8 illustrates the fabric of Fig. 7 with beveled
20 edges and stitches according to the invention.

Fig. 9 illustrates an alternative embodiment according to the invention.

The present invention is directed to a fabric having a low bulk pin-type seam. The seam is constructed by forming loops
25 in each end of a flat woven papermakers fabric. The loops are formed from machine direction yarns which are selected from a portion of the fabric which had previously been freed of all

cross machine direction yarns. The fabric is folded back on itself in the manner of a hem and selected machine direction yarns are pulled through the fabric to bind the fabric body and fold over together. Both ends of the fabric are made similar and
5 when mated together, the loops forming yarns define a channel which receives the pin or pintle wire.

Although specific forms of the invention have been selected for illustration and the following description will refer in specific terms to those drawings, this description is
10 not intended to limit the scope of the invention which is defined in the claims appended hereto.

The invention will be set forth with references to the attached drawings, wherein like numerals indicate like elements in all views. The following description is intended to aid in an
15 understanding of the invention and it is understood that the invention may be utilized with weaves or fabrics not specifically described in detail.

Referring now to Fig. 1, there is shown a fragmentary view of one end of the fabric 2 which is to be seamed. The fabric
20 2 is woven in the usual manner with a plurality of warp yarns or machine direction yarns interlacing with a plurality of pick or cross machine direction yarns 6 and 8. The warp yarns are preferably monofilament or continuous filament yarns, however, they may be spun yarns which are twisted or treated so as to behave as a
25 continuous or monofilament yarns. Additionally, it will be understood that the warp yarns may be of any cross sectional

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shape, i.e. round, square, oval, rectangular, etc., according to fabric design. Likewise, the pick yarns may be any of the available yarns selected according to fabric design. As will be known to those skilled in the art, the fragmentary view of the fabric 2 shown in Fig. 1 is a duplex fabric having two pick systems, comprised of yarns 6 in one pick system and yarns 8 in the other pick system, interwoven with a single warp or machine direction system 4. As will also be known to those skilled in the art, the overall length of the fabric prior to seaming is somewhat longer than the length of the final seamed fabric in order to provide the material necessary for fabric seaming and subsequent treatment. While the fabric 2 may be cut to the predetermined width of the desired fabric, it has been found that it is advantageous to have approximately 50 mm of additional width in the unseamed fabric in order to facilitate the ease of seaming.

Generally, the fabric end is prepared for seaming by removing a plurality of picks 6 and 8 from a predetermined area of the fabric. The warp yarns which have been exposed by the removal of the picks are then segregated into loop forming yarns and binder yarns according to a predetermined pattern. A loop forming wire is inserted between the warp yarns which will essentially separate the fabric into 2 levels. The forming wire is located as close to the body of the fabric as possible. The fabric is then placed on a work table with the fabric faced down.

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The free end of the fabric is then folded back toward the body of the fabric in the manner of a hem. The folding back of the free end of the fabric thus produces a plurality of loops extending from the fabric fold or hem line. The binder warp ends noted
5 previously are then drawn back into the folded over section of the fabric. After the binder yarns have been pulled back into the fold over of the fabric, the fold over section of the fabric is cut to width. Stitches are then placed in the seam area to additionally secure the fold over and fabric together. The fold
10 over is then trimmed or cut to length and beveled or rounded as is known in the art.

With reference to Fig. 1, the preparation of one end of the fabric seam will be described in detail. It will be remembered that the other end of the fabric is prepared in a like
15 manner. Selected picks are removed at an area in from the free end of the fabric in order to provide sufficient material for the fold over section. In the preferred embodiment, the pick removal area is approximately 125 mm from the free end of the fabric. The picks to be removed, generally illustrated as 10 are
20 removed in both the face and back pick layers. Picks 10 are removed from the fabric for approximately (10 mm) starting from the end of the fold area previously described. Thus, picks are removed in the area between approximately 125 to 135 mm from the free end of the fabric, this pick free condition is illustrated
25 in Fig. 2 and generally identified as 12.

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Referring now to Fig. 3, a tool 14 such as a long stem awl or scribe, is used to separate pairs of the warp yarns 4. Alternating pairs of warp yarns 4(a) are raised from the plane of the fabric using the tool 14, likewise, alternating pairs of warp
5 yarns 4(b) are left within the plane of the fabric, as illustrated in Fig. 3. The operation of raising the warp yarns 4(a) out of the plane of the fabric is difficult to illustrate, however, this will be known to those skilled in the art. As shown in Fig. 3, after a number of the warp yarns 4(a) have been raised
10 from the plane of the fabric, a suitable needle or insertion tool 16 with a forming wire 18 attached is inserted between the raised warp yarns 4(a) and the remaining warp yarns 4(b). Note that since the warp yarns 4(b) have not been disturbed with respect to the plane of the fabric, the forming wire when inserted will
15 overlies the warp yarns 4(b). This condition is illustrated graphically in Fig. 4. The forming wire 18 is positioned as close to the body of the fabric as is reasonably possible. In this position the forming wire 18 will be adjacent the fold line or hem line 19 as will be described hereinafter. Warp yarns 4(a)
20 will be binder yarns and warp yarns 4(b) will be loop forming yarns.

After the fabric has been so prepared, the fabric is positioned on a work table with the fabric face down. Due to the bulk and weight of the flat woven fabric, it has been found
25 advantageous to secure the fabric to the work table such as by tacking or other securing means. With the fabric so positioned,

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the free end of the fabric is then folded back over the body of the fabric. Once again, it has been found that securing the free end by tacking or other means is advantageous.

With reference now to Fig. 5, there is shown the fabric 5 (without the work table) in the folded or hemmed condition just described. For purposes of clarity of illustration, the fabric has been shown with only the loop forming warp yarns 4(b) extending from the hem line 19 adjacent the forming wire 18. It will be understood that the warp yarns 4(a) are still part of the 10 fabric but they are not part of the loop forming warps shown in Fig. 5. Also it should be remembered that warp yarns 4(a) are to become the binding yarns which are tight against the fold or hem line and therefore would not appear in the area of the loops in the final configuration.

15 After the fabric has been secured to a work surface and has been folded as indicated in Fig. 5, the binder warp yarns 4(a), which are not part of the loop, are pulled through the fabric. With reference to Fig. 6, it can be seen that the warp yarns 4(a) can be pulled through the folded over portion or hem 20 of the fabric. For purpose of clarity, the yarns 4(a) are shown as the first yarns in the fabric, however, it will be understood that the yarns 4(a) are spaced across fabric at selected locations. The pulling of the warp yarns 4(a) through the fold of the fabric will serve to remove the excess warp length of yarns 25 4(a) in the area of the loop formed by the yarns 4(b). In pulling the warp yarns 4(a) through the fold over or hem it has been

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found beneficial to locate the outermost warp yarn and to begin pulling the slack out of the yarn created by the fold over. The pull through then proceeds across the width of the fabric until all of the binding yarns have had the slacks removed therefrom.

5 While it is not necessary, it has on occasion been found beneficial to spray the warp yarns to be pulled through with a silicone lubricant. However, in using a silicone lubricant, care should be exercised because an excess application of silicone lubricant has also been found to create a sticky or tacky surface

10 on the yarns which may actually hinder the pull through. The binder yarns 4(a) are pulled through the fold over with sufficient force to draw the fold over and body of the fabric into intimate contact. It has been found in constructing the seam that the appearance of a ripple may be noted in the fabric fold

15 over or hem on the back of the seam. This ripple phenomenon has not been found to be detrimental to the seam and in fact, it has been found to be a useful indicator that the warp yarns have been pulled with sufficient force against the fold or hem line. Thus, the ripple may be used as an indicator that the pull through has

20 been done correctly. The ripple is not always visible but can be felt with slight hand pressure or the finger tips. The pull through of the binder yarns 4(a) which has just been described should be completed so that the loops 24 of slack warp yarns are spaced approximately 50 mm from the position where the loop

25 yarns 4(b) enter the fold over. By so spacing the loops 24, it is then possible to trim the fold over so that it may be trimmed or cut at 28 approximately 25 mm from the point where the loop

yarns enter the fold over, see Fig. 7. As it will be recognized by those skilled in the art, the cut edge 28 of the fold over is preferably beveled, see Fig. 8, to aide in the running of the fabric on the papermaking machine.

5 In some applications, it may be possible to use the seam without additional reinforcement, however, it is preferred that the fold over and fabric body be stitched together in the area adjacent the loops. With reference to Fig. 8, in the preferred embodiment two rows of stitching 30 and 32 are
10 utilized. The first row of stitching 30 is located approximately
5 mm from the point where the loops 4(b) enter the fabric and a second row of stitching 32 is placed approximately
15 mm from the first stitch. In applications where a smooth seam surface is essential, it has been found to be
15 beneficial to remove a face pick in the position where the stitching 30 and 32 is to be located. If desired, the pick may be removed both from the body of the fabric and the fold over of the fabric. In this way, the stitching 30 and 32 will sink into the fabric and do not altar the surface characteristics thereof. In
20 addition, to preserving the surface characteristics of the fabric, it is believed that the recessed stitching will not be subjected to excessive wear.

It will be understood by those skilled in the art that the selection of stitch point location will be a matter of design
25 choice and will vary accordingly. For example, in a weave pattern such as shown in Figure 1, one stitch arrangement which has been employed is to place the stitches at the fourth and thirteenth

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pick of one and at the fourteenth and ninth pick of the other end. Once again the fabric design is free to selected stitch points according to weave design.

With respect to Figure 9, there is illustrated an
5 alternative embodiment which in all respects not set forth hereinafter will be the same as the fabric illustrated in Figure 4. In Figure 4, the forming wire 18 is positioned such that the warps are paired into alternating loop and binder yarns. At Figure 9, the forming wire 18 is positioned such that the warp
10 yarns are arranged according to the selected repeat pattern. In this repeat pattern, the warp yarns are arranged as two binder, two loop, three binder and one loop yarn per repeat. This repeat pattern provides approximately 25% more binder yarns per seam with and approximately 25% less loop forming yarns per seam with.
15 This alternative arrangement has been found to produce a seam which is fully acceptable with respect to strength and performance and which provides additional spacing between the loop forming yarns. The additional spacing between the loop forming yarns has found to be of some benefit in manipulating and
20 aligning the loops in the actual seam formation process.

It will be recognized that many various repeat patterns will be possible with the instant invention. The essential feature is that the repeat pattern selected provide sufficient loop forming yarns to achieve the necessary tensile strength and
25 maintain the seam stability. Likewise, it is required that sufficient binder yarns be provided to maintain the hem tightly and to assure the required tensile strength.

Seams according to the invention have been made in both single ply and multiply fabrics and could be installed in fabrics ranging from a 20x20 texture single ply fabric to a 72x30 texture multiply fabric. As noted previously, the fabric weave
5 construction may be according to design selection.

It will be understood that the other or remaining end of the flat woven belt will be prepared in the manner described above and that after such preparation, the two ends may be mated so that the loops are interleaved and thereby define a channel
10 through which a hinge wire or pintle may be inserted to complete the pin seam.

It will be understood that no back weaving is required to form the loop and that no additional clipper hooks or coils are in the insert seam.

CLAIMS :

1. A method of producing a pin-type seam in a fabric for use with papermaking equipment, comprising the steps of:
 - (a) providing a length of flat woven fabric comprising a plurality of continuous filament warp yarns interwoven with a plurality of pick yarns;
 - (b) removing selected pick yarns from a portion of said fabric to create a pick free area and define a fold line which corresponds to the fabric end of one of the sides of the seam to be formed, said fold line defining adjacent fabric body and fabric overlapped regions on said fabric;
 - (c) moving selected warp yarns in said pick free area from the plane of said fabric and inserting a separating means between said selected warp yarns and the remaining warp yarns in said pick free area;
 - (d) folding at least a portion of said overlapped region at said fold line to overlap the fabric body region to form seaming loops about said separating means;
 - (e) pulling said selected warp yarns of step (c) away from said loops and through said fabric



over lap region to bind said fabric body and
said fabric over lap regions;

- (f) performing at least steps (b) through (e)
with respect to a different position of the
fabric.

5

2. A method of producing a low bulk, pin-type seam in
a fabric for use with papermaking equipment, comprising the steps
of:

10

- (a) providing a length of flat woven fabric
comprising a plurality of warp yarns
interwoven with a plurality of ply forming
layers of pick yarns, said layers defining
at least two plies;

15

- (b) removing selected pick yarns from a portion
of said fabric to create a pick free area
and define a fold line which corresponds to
the fabric end of one of the sides of the
seam to be formed, said fold line defining
adjacent fabric body and fabric overlapped
regions on said fabric;

20

- (c) moving selected warp yarns in said pick free
area from the plane of said fabric and
inserting a separating means between said
selected warp yarns and the remaining warp
yarns in said pick free area;

25

- (d) folding at least a portion of said over



lapped region at said fold line to over lap the fabric body region to form seaming loops about said separating means;

(e) pulling said selected warp yarns of step (c) away from said loops and through said fabric over lap region to bind said fabric body and said fabric over lap regions;

(f) performing at least steps (b) through (e) with respect to a different position of the fabric whereby a second half of said pin-type seam is formed to matably receive said first half and define a channel for reception of a seam joining member.

3. A papermakers fabric comprising:

a woven fabric material having at least one system of monofilament machine direction yarns interwoven with at least system of cross machine direction yarns;

at least one end of said fabric having a portion of said fabric material folded back upon itself defining a hem and hem line;

said hem including an area free of cross machine direction yarns, said free area having segments of said machine direction yarns extending from said folded material portion to the remainder of the fabric material;

selected machine direction yarn segments being drawn against said hem line; and

selected machine direction yarn segments extending from said hem line in a defined series of loops.

4. A papermakers fabric comprising:

a selected woven fabric material having at least
5 one layer of monofilament machine direction yarns;

first and second fabric ends each end having a
portion of said fabric material folded back upon itself defining
a hem;

each said hem including unwoven segments of said
10 machine direction yarns extending from said respective folded
material portions to the remainder of said fabric material;

a selected array of said machine direction yarn
segments drawn against cross machine yarns of each said
respective folded material portion and the remainder of said
15 fabric material; and

a complementary array of said machine direction
yarn segments projecting from a respective selected array of
machine direction yarn segments and defining a uniform series of
loops whereby said first and second fabric ends may be seamed
20 together by interleaving the respective machine direction yarn
loops and inserting a pintle therethrough.

5. A papermakers fabric according to Claims 3 or 4
wherein said folded material portion is secured to the remainder
of said fabric by at least two rows of stitchings.

6. A papermakers fabric comprising:

a woven fabric having at least one system of monofilament yarns extending in the machine direction interwoven with at least one system of yarns extending in the cross machine
5 direction;

each end of said fabric having a portion of said fabric folded back upon itself defining a hem line with selected machine direction yarns drawn against said hem line and selected machine direction yarns having segments extending from said hem
10 line and defining a series of loops.

7. An improved flat woven papermakers fabric which may be joined by a pintle wire to form an endless papermakers fabric, the improvement comprising:

a flat woven fabric having at least one system of
15 monofilament machine direction yarns and at least one system of cross machine direction yarns interwoven;

each end of said flat woven fabric having a portion thereof folded back upon itself to define a hem;

each hem including segments of said machine
20 direction yarns extending from said respective folded material portions to the remainder of said fabric, said segments being approximately equal to one half of the number of machine direction yarns; and

each segment forming a loop projecting from said
25 folded portions such that the loops define a series of channel forming loops.

8. A method of producing a low bulk, pin type seam in a papermakers fabric, said method comprising the steps of:

- (a) providing a length of flat woven fabric having a plurality of monofilament warp yarns interwoven with a plurality of pick yarns;
- (b) creating a pick free area at a selected position to define a fold line which corresponds to the fabric end of one of the sides of the seam to be formed, said fold line defining adjacent fabric body and fabric overlap regions;
- (c) moving selected warps in said pick free area from the plane of said fabric and maintaining the remaining warps in said pick free area in the plane of said fabric;
- (d) folding at least a portion of said overlap region at said fold line to overlap the fabric body region and form the seaming loops from said remaining yarns;
- (e) pulling said selected yarns of step (c) away from said loops and through said fabric overlap region;
- (f) performing at least steps (b) through (e) with respect to a different portion of the fabric.

9. A papermakers fabric comprising:

a woven fabric having at least one system of yarns extending in the machine direction interwoven with at least one system of yarns extending in the cross machine direction;

5 each end of said fabric having a portion of said fabric folded back upon itself defining a hem line with selected machine direction yarns drawn against said hem line and selected machine direction yarns extending from said hem line to define loops.

10 10. An improved flat woven papermakers fabric which may be joined by a pintle wire to form an endless papermakers fabric, the improvement comprising:

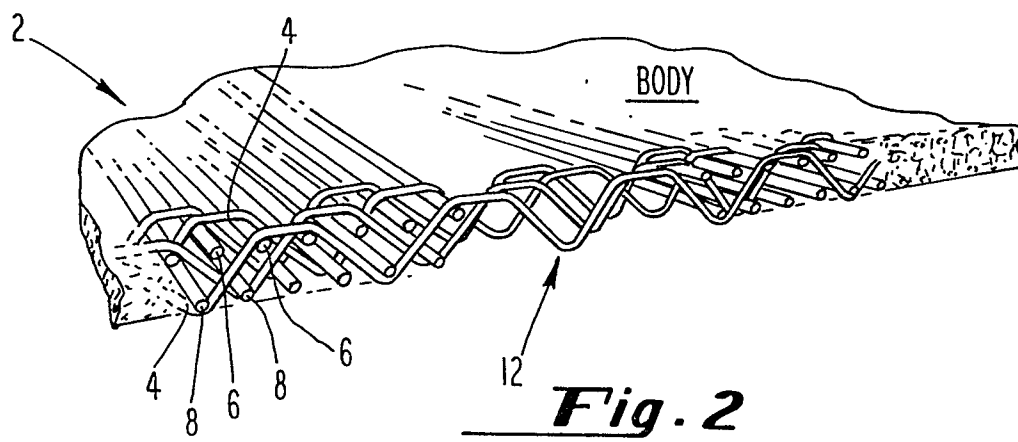
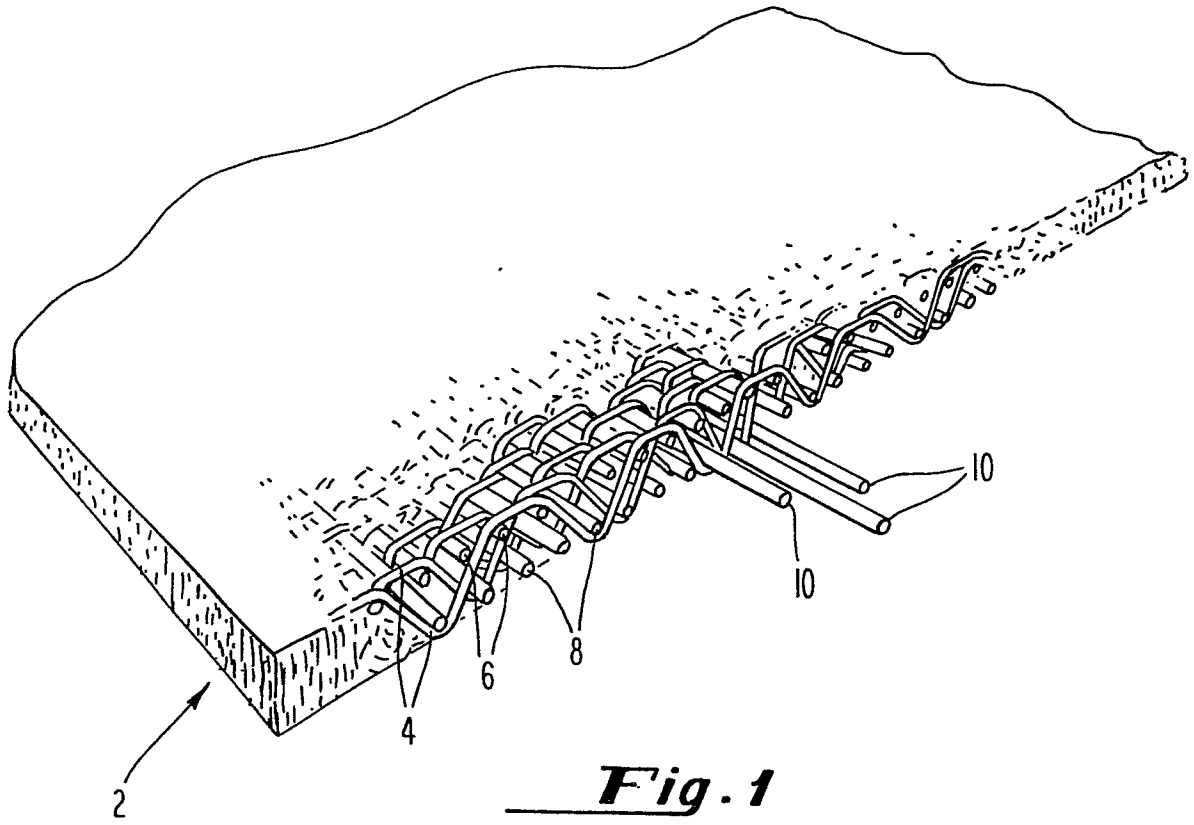
15 a flat woven fabric having at least one system of machine direction yarns and at least one system of cross machine directions yarns interwoven;

each end of said flat woven fabric having a portion thereof folded back upon itself to define a hem;

20 each hem including segments of said machine direction yarns extending from said respective folded material portions to the remainder of said fabric, said segments being approximately equal to one half of the number of machine direction yarns; and

25 each segment forming a loop projecting from said folded portions such that the loops define a series of channel forming loops.

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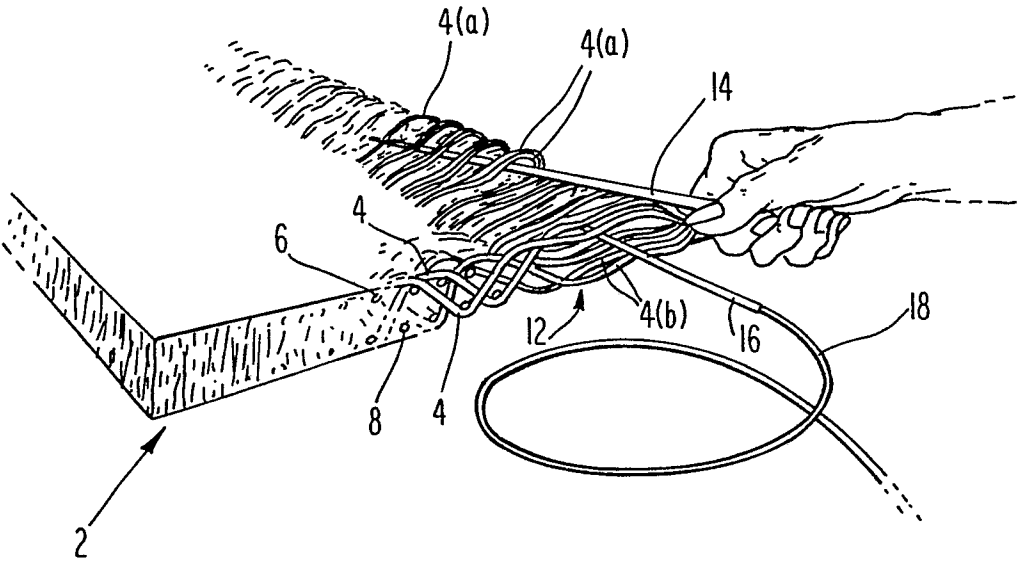


Fig. 3

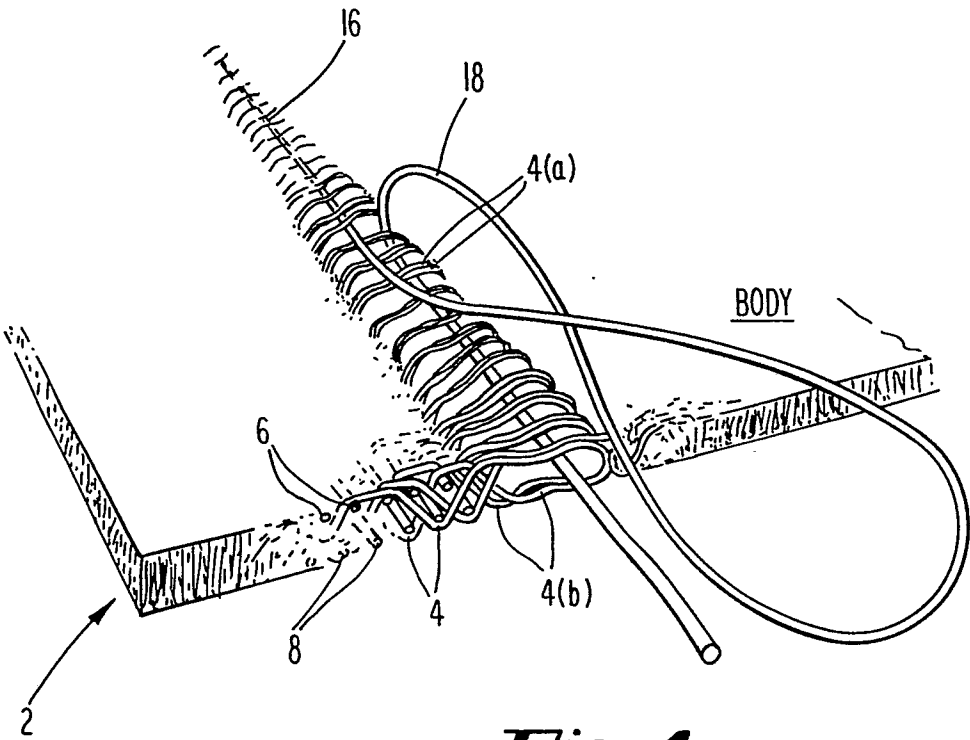
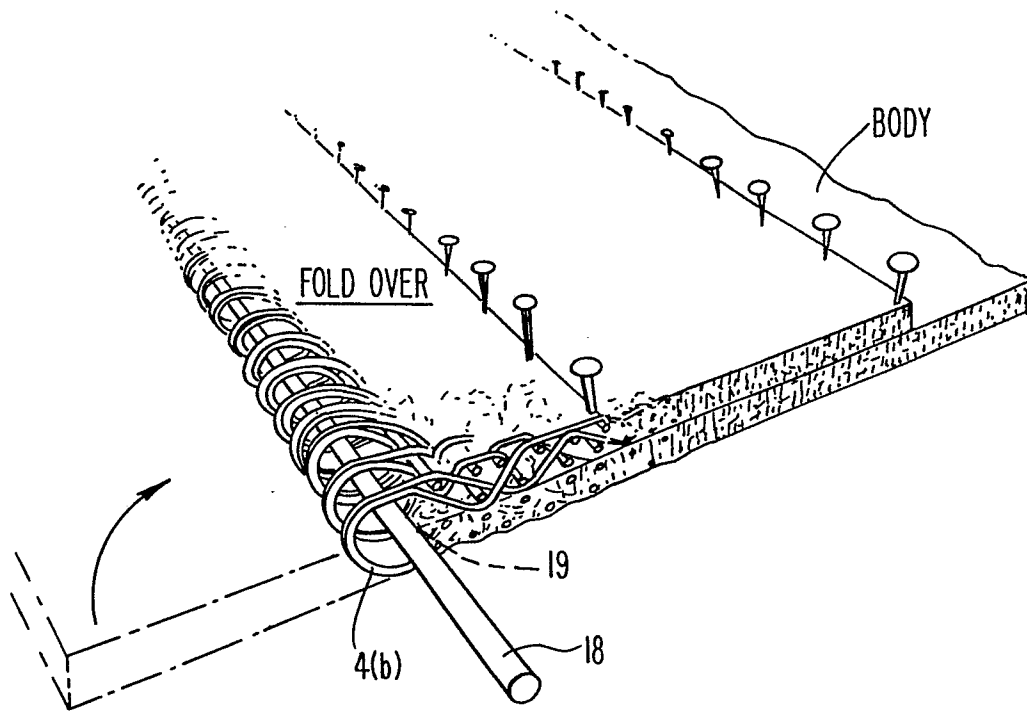
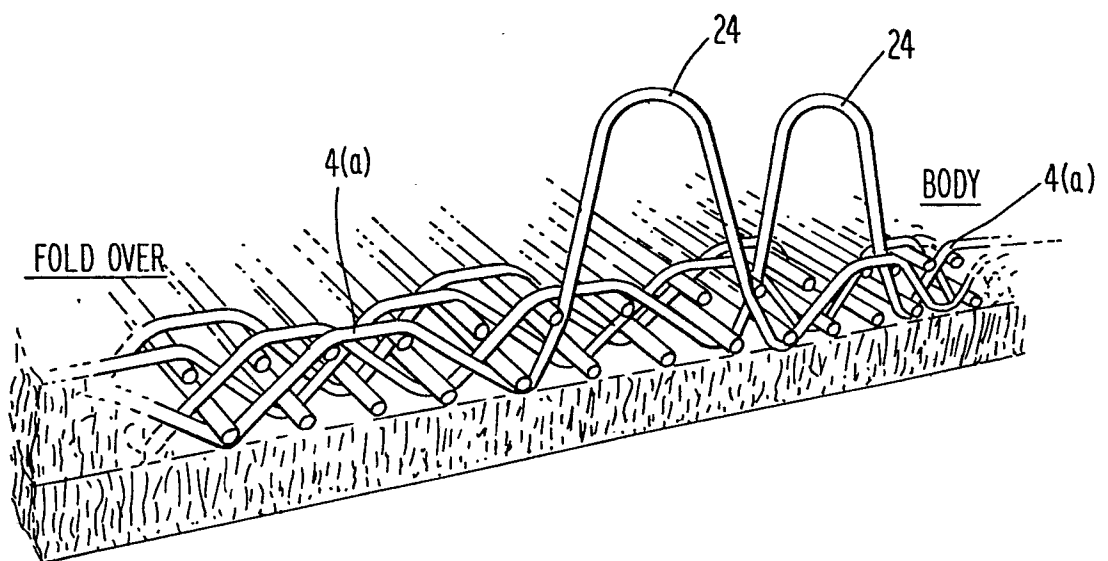


Fig. 4

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Fig. 5Fig. 6

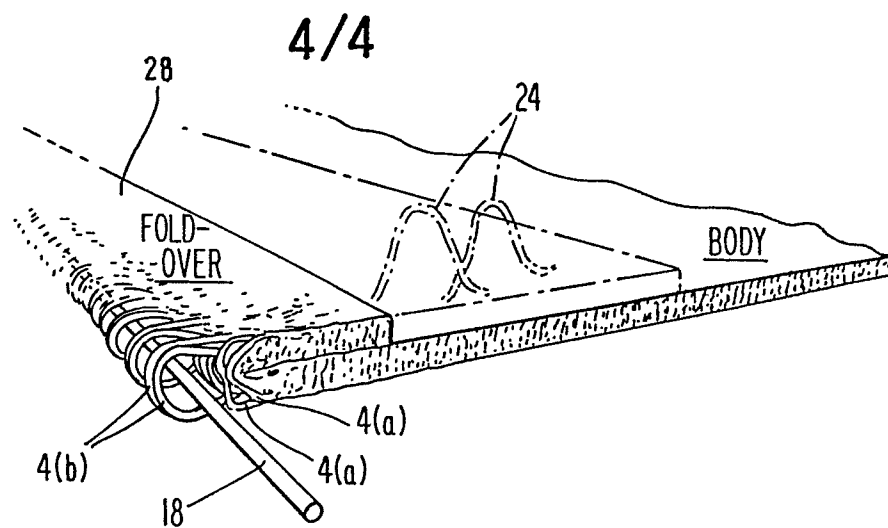


Fig. 7

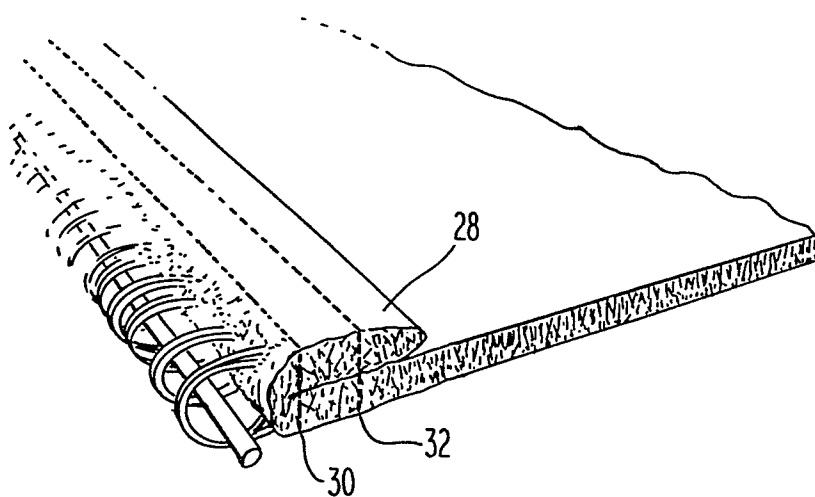


Fig. 8

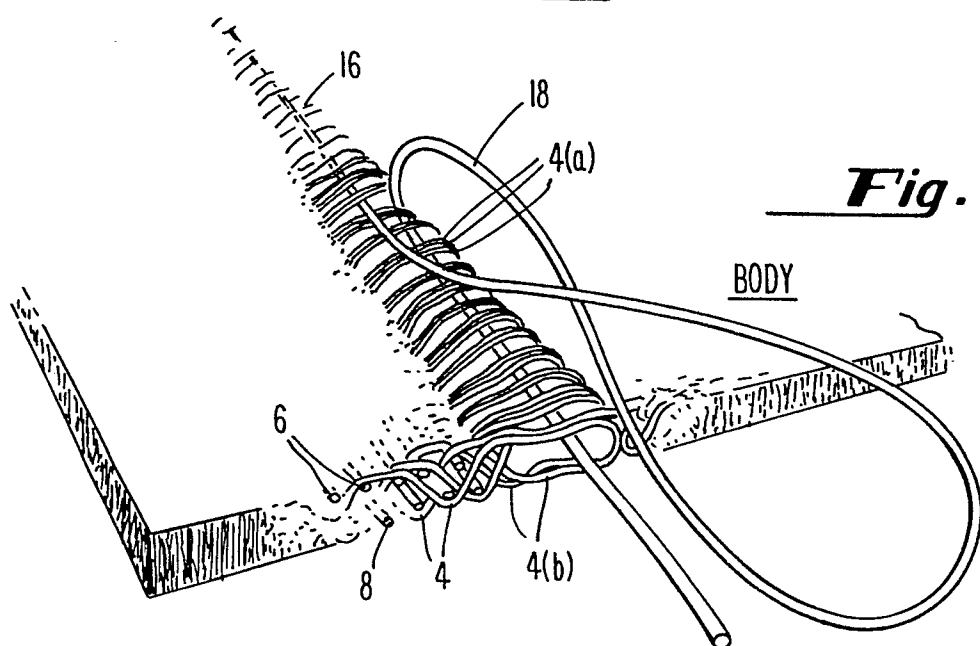


Fig. 9