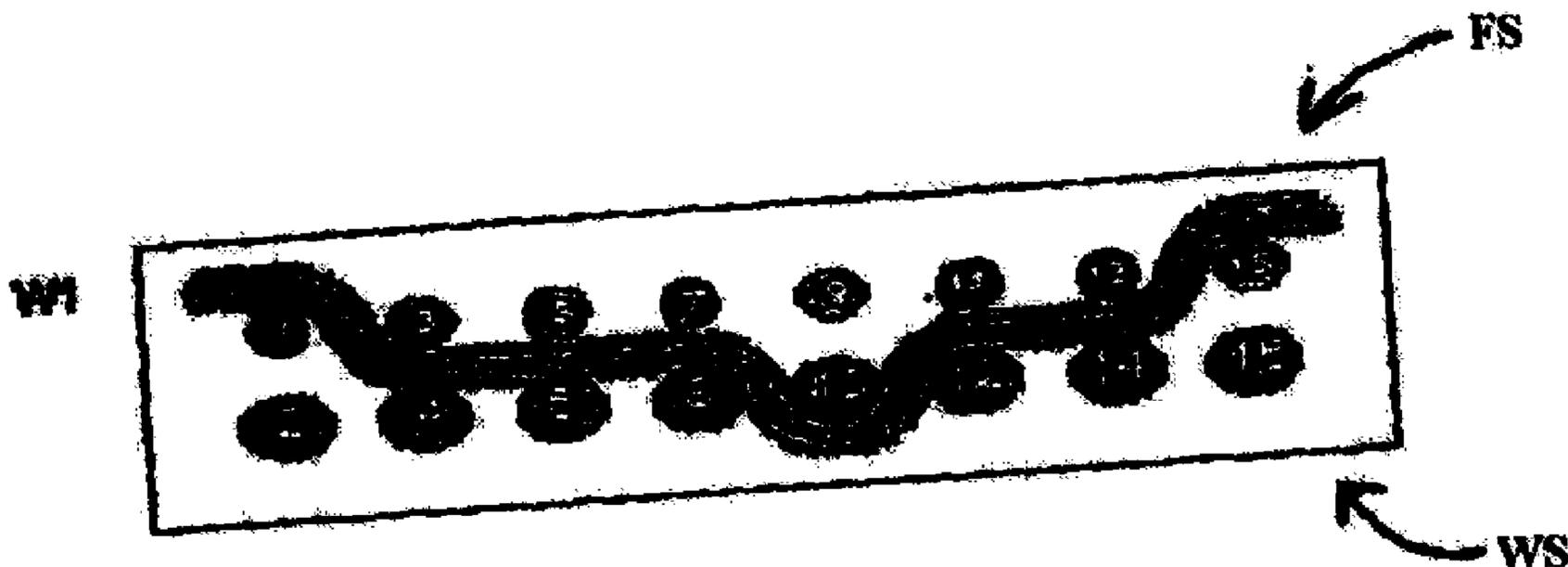




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(54) Titre : MODELE DE COURROIE DE LAVEUR DE PATE BRUNE STABLE DIMENSIONNELLEMENT, A DRAINAGE ELEVE  
 (54) Title: HIGH DRAINAGE DIMENSIONALLY STABLE BROWNSTOCK WASHER BELT DESIGN



(57) **Abrégé/Abstract:**

High drainage dimensionally stable brownstock washer belt and a method of producing the same are disclosed. The belt is produced from a multi-layer woven fabric that is woven in a high density weave pattern. The fabric may be seamed to form an endless structure or may be woven endless for belt use. The fabric is made from one or more of polyphenylene sulfide, polyetheretherketone and KEVLAR®. The belt exhibits high degree of fiber support and void volume to eliminate sheet sealing and to facilitate maximum drainage potential and production rate with minimum machine adjustment. Its high fiber support reduces the vacuum requirements in the formation zone resulting in the formation of a pulp sheet/mat, which creates optimal conditions for the subsequent counter current washing that occurs in the displacement zone and increases belt life. Its high fiber support also improves machine flexibility to handle larger variations in stock consistency.



**ABSTRACT**

High drainage dimensionally stable brownstock washer belt and a method of producing the same are disclosed. The belt is produced from a multi-layer woven fabric that is woven in a high density weave pattern. The fabric may be seamed to form an endless structure or may be woven endless for belt use. The fabric is made from one or more of polyphenylene sulfide, polyetheretherketone and KEVLAR®. The belt exhibits high degree of fiber support and void volume to eliminate sheet sealing and to facilitate maximum drainage potential and production rate with minimum machine adjustment. Its high fiber support reduces the vacuum requirements in the formation zone resulting in the formation of a pulp sheet/mat, which creates optimal conditions for the subsequent counter current washing that occurs in the displacement zone and increases belt life. Its high fiber support also improves machine flexibility to handle larger variations in stock consistency.

**HIGH DRAINAGE DIMENSIONALLY STABLE BROWNSTOCK**  
**WASHER BELT DESIGN**

5     Field of the Invention

          The present invention is directed towards the preparation of wood pulp for use in paper production, and more particularly, towards the brownstock washing of pulp to be used in paper  
10     production.

Background of the Invention

          The production of paper begins with the processing of wood. Wood is chiefly composed of two  
15     major substances; both are organic, that is, their molecules are built around chains and rings of carbon atoms. Cellulose, which occurs in the walls of the plant cells, is the fibrous material that is used to make paper. Lignin is a large, complex  
20     molecule; it acts as a kind of glue that holds the cellulose fibers together and stiffens the cell walls, giving wood its mechanical strength. In order to convert wood into pulp suitable for making paper, the cellulose fibers must be freed from the  
25     lignin. In mechanical pulping this is done by tearing the wood fibers apart physically to create groundwood pulp, leaving most of the lignin intact in the pulp. The high lignin content of groundwood pulp leaves the paper products weak and prone to  
30     degradation (e.g. yellowing) over time. Mechanical

pulp is used principally to manufacture newsprint and some magazines.

In most pulp production lignin is separated from the fibers chemically. For example, in the kraft process, wood chips are heated ("cooked") in a solution of sodium hydroxide and sodium sulfide. The lignin is broken down into smaller segments and dissolves into the solution. In the next step, "brownstock washing," the breakdown products and chemicals are washed out of the pulp and sent to the recovery boiler. Kraft unbleached pulp has a distinctive dark brown color, due to darkened residual lignin, but is nevertheless exceptionally strong and suitable for packaging, tissue and toweling.

For brighter and more durable products the pulp must be bleached. In the bleaching process, the color in the residual lignin is either neutralized (by destroying the chromophoric groups) or removed with the lignin. This process traditionally has been accomplished for kraft pulp by chlorine bleaching, usually followed by washing and extraction of the chemicals and breakdown products. This process is not much different than washing clothes, the stains imbedded in cloth fibers are either neutralized by bleach, or broken down and washed out.

In current pulp production processes, the lignin solution typically undergoes two or more separate washing operations. For example, the groundwood or wood chips are first processed with chemicals under pressure and temperature, usually

by either the kraft process or by the sulfite acid process. In either process, digestion dissolves the lignins thereby freeing the fibers and placing the lignin components into solution. In both processes  
5 the resulting liquid is dark in color, and the residual liquid which does not drain from the pulp and the remaining contaminants must be washed from the pulp. Further, it is desirable to recover spent liquid at as high a concentration as practical to  
10 minimize the cost of the subsequent recovery of chemicals.

Brown pulp which has been so washed retains a definite brown color and the pulp which remains is usually too highly colored for making white paper.  
15 Also, if any lignin is present, paper made from such pulp may not have a high degree of permanence and will yellow in time. Therefore, it is common and conventional to apply a bleaching process to the pulp, not only to improve whiteness, but to  
20 improve permanence of the whiteness.

The bleaching commonly is performed in a chlorination stage by applying a water in which chlorine gas has been dissolved. Other bleaching processes may be used, such as a sodium  
25 hydrosulphite process, as is well known in the art. Three chemicals that are commonly used in current bleaching operations are sodium hydroxide (NaOH), chlorine dioxide (ClO<sub>2</sub>) and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>). Bleaching may not be accomplished in a  
30 single stage and may be performed in two or more stages, each followed by washing. After bleach treatments, the pulp is subjected to a washing

action to remove the water which contains the spent bleaching agents and dissolved lignin.

U.S. Patent No. 5,275,024 shows an example of a current belt-type pulp washing machine that includes a dewatering stage (or "formation zone") and multiple of counter-current washing stages (or collectively "displacement zone"). The machine employs an endless moving foraminous belt which extends about a breast roll defining an on-running end and a couch roll defining an off-running end, with a generally horizontal upper run of the belt extending between the rolls. A series of suction boxes located underneath the belt provide for initial dewatering of the pulp in the formation zone, and combine with a series of showers to provide washing and dewatering in the displacement zone.

The machine downstream from the headbox and the forming zone is divided into a series of washing zones or stages to which a washing liquid is applied from above for drainage through the mat. The freshest or cleanest washing liquid is applied to the zone nearest the off-running end of the wire and the liquid drained through the mat at that zone is collected from the suction boxes and delivered to the immediately preceding washing zone. This is repeated from zone to zone, so that the cleanest pulp is treated with the cleanest water, and the dirtiest pulp is treated with the dirtiest water.

30

Summary of the Invention

The inventors of the present invention have recognized several deficiencies of prior tensioned belt brownstock washer belts.

5 In particular, the inventors have noted that current belt designs primarily include two alternative types, a high permeability, low support double layer type and a low permeability, high support single layer type. The double layer designs  
10 achieve a high drainage rate through high permeability and are appropriate for use with long wood fiber (soft wood), but exhibit sealing problems with short fiber (hard wood). The single layer designs prevent sealing with high support via  
15 low permeability, but sacrifice drainage rate.

More generally, the more open the prior art design, the less support it provides, thereby giving rise to "sealing" problems. That is, the open prior art designs allow the fibers in the pulp  
20 mat to impinge into the belt, increasing the pulp density locally between the filaments in the belt, and thus adding resistance to flow/drainage. The machine operators can turn up the vacuums to compensate, but this increases the drag on the  
25 belt, increases abrasion and reduces service life.

In addition, the inventors of the present invention have recognized that prior tensioned belt brownstock washers such as the washer discussed in U.S. Patent No. 5,275,024, typically employ belts  
30 that are fabricated from 100% polyamide based monofilaments (for caustic applications) or 100% polyester based monofilaments (for acidic

applications); and that there are significant design deficiencies with such belts.

One of the deficiencies associated with the materials used in prior washer belts is that  
5 polyamide based fabrics tend to be dimensionally unstable in both the machine direction (MD) and the cross-machine direction (CD), which make the belts difficult to install and cause run problems as a result of growth or shrinkage outside the machine  
10 design limits. For example, MD shrinkage can result in fabrics being too short for installation while MD stretch can result in fabric lengths in excess of equipment take-up mechanisms, causing unacceptably low running tensions.

15 Another deficiency is that CD growth, due to water absorption, can result in fabric end to end mismatch, creating seam pinning delays, misaligned loops during pinning (weak seam), and excess width leading to excessive edge wear, abrasion,  
20 unraveling, lost production time to trim excess width, and seam rupture.

Other deficiencies include: CD shrinkage resulting in direct exposure of the pulp to the vacuum box, corrupting the basic washing process;  
25 lack of MD and CD stability, as a result of water absorption which occurs over the first few hours after installation, requiring that a break-in period be endured prior to applying stock to start washing production; the inherently hydrophilic  
30 nature of polyamide materials resulting in increased contaminant surface adhesion and a continuous decrease in drainage performance over

the life of the product; and the short life span of polyester based fabrics in the presence of acidic chemical degradation giving rise to the need for adding high levels of hydrolytic chemical stabilizer to the monofilaments of the fabric.

In order to overcome the drawbacks of prior washer belts, the washer belt of the present invention is produced from a high-density multilayer woven fabric.

10

### **Brief Description of the Drawings**

Thus by the present invention, its objects and advantages will be realized, the description of which should be taken in conjunction with the drawings wherein:

15

Figure **1A** is a graphic representation of the weave pattern of a first embodiment of a belt fabric according to the invention when viewed along the direction of the shute filaments;

20

Figure **1B** is a graphic representation of the weave pattern of a first embodiment of a belt fabric according to the invention when viewed along the direction of the warp filaments;

Figure **2A** is a perspective view of the forming side **FS** of the belt fabric of Figures **1A** and **1B**;

25

Figure **2B** is a perspective view of a the wear side **WS** of the of the belt fabric of Figures **1A** and **1B**;

Figure **3A** is a cross-sectional view of the belt fabric of Figures **1A** and **1B** when viewed along the direction of the shute filaments;

30

Figure 3B is a cross-sectional view of the belt fabric of Figures 1A and 1B when viewed along the direction of the warp filaments;

5 Figure 4A is a graphic representation of the weave pattern of a second embodiment of a belt fabric according to the invention when viewed along the direction of the warp filaments;

10 Figure 4B is a graphic representation of the weave pattern of a second embodiment of a belt fabric according to the invention when viewed along the direction of the shute filaments;

15 Figure 5A is a graphic representation of the weave pattern of a third embodiment of a belt fabric according to the invention when viewed along the direction of the warp filaments;

Figure 5B is a graphic representation of the weave pattern of a third embodiment of a belt fabric according to the invention when viewed along the direction of the shute filaments;

20 Figure 6A is a graphic representation of the weave pattern of a fourth embodiment of a belt fabric according to the invention when viewed along the direction of the warp filaments;

25 Figure 6B is a graphic representation of the weave pattern of a fourth embodiment of a belt fabric according to the invention when viewed along the direction of the shute filaments;

30 Figure 7A is a graphic representation of the weave pattern of a fifth embodiment of a belt fabric according to the invention when viewed along the direction of the warp filaments; and

Figure 7B is a graphic representation of the weave pattern of a fifth embodiment of a belt fabric according to the invention when viewed along the direction of the shute filaments.

5 Detailed Description of the Preferred Embodiments

In view of the deficiencies of prior washer-belt designs, the present invention details a set of fabric design and material selection for a washer belt that provides greatly improved  
10 brownstock washing performance on a brownstock washer machine. Although the belt of the invention is applicable to a wide range of brownstock washers, it is envisioned that the belt would be particularly advantageous in washers like the Black  
15 Clawson Chemi-Washer®.

The belt is produced from a high-density multi-layer woven fabric. The fabrics may be seamed to form an endless structure for belt use or may be woven endless. In seamed embodiments, a woven seam,  
20 a pin seam or a pin spiral seam may be used. In any event, the fabric provides high fiber support via a high warp-density/long-warp-float while achieving high drainage/resistance-to-sealing through increased void volume. The structure of the fabric  
25 may be referred to as "long warp knuckle up."

A preferred fabric design of the present belt is an eight-shed, double layer design. Figure 1A is a graphic representation of the weave pattern for the preferred fabric when viewed along the  
30 direction of the shute filaments. As can be seen from Figure 1A, a warp filament w1 traverses a path between two layers of shute filaments, a first

layer defined by shute filaments **1, 3, 5, 7, 9, 11, 13** and **15**, and a second layer defined by shute filaments **2, 4, 6, 8, 10, 12, 14** and **16**. This pattern repeats every time the warp yarn crosses  
5 eight shute filaments of a layer.

Figure **1B** is a graphic representation of the weave pattern of the fabric of Figure **1A** when viewed along the direction of the warp filaments. As can be seen from Figure **1B**, a shute filament **s1**  
10 of the upper shute layer traces a first path through warp filament's **1-8**, and a shute filament **s2** of the lower shute layer traces a second path through warp filaments **1-8**. The pattern for each of shute filaments **s1** and **s2** repeats every time the  
15 shute filament crosses eight warp filaments.

In Figures **1A** and **1B**, the side of the fabric that will contact the wood pulp is denoted as the "forming side" or **FS**, and the side of the fabric that will contact the machine rolls is denoted as the  
20 "wear side" or **WS**.

It should be noted that, although the term "filament" is being used to describe the invention, the invention is not limited to filaments as defined in the strict sense. Rather, the term  
25 filament is used to denote fibers, threads, yarns, filaments, monofilaments, multifilaments, and the like. Thus, the belt fabric of the invention may be woven from anyone of these types of materials or from any combination of these types of materials.  
30 Furthermore, the materials used to weave the fabric may be naturally occurring or synthetic. Still further, it is possible to use metal as a material

in the formation of the belt. For instance,  
metallic or sintered metallic yarns may be used, or  
a yarn having a sintered metal sheath on a mono  
core can be used. It is also possible to use  
5 combinations of various types of metal materials in  
the formation of the belt.

Referring back to the figures, Figures **2A** and  
**2B** are perspective views of the fabric of Figures  
**1A** and **1B**. Figure **2A** is a perspective view of the  
10 forming side **FS** of the fabric and Figure **2B** is a  
perspective view of the wear side **WS** of the of the  
fabric. In each of Figures **2A** and **2B**, the path of  
warp filament **w1** and of shute filaments **s1** and **s2**  
is shown.

15 Figure **3A** is a cross-sectional view of the  
belt fabric of Figures **1A** and **1B** when viewed along  
the direction of the shute filaments. The path of  
warp filament **w1** is shown.

Figure **3B** is a cross-sectional view of the  
20 belt of Figures **1A** and **1B** when viewed along the  
direction of the warp filaments. The paths of shute  
filaments **s1** and **s2** are shown.

Figures **4A** and **4B** are graphic representations  
of the weave pattern of a second embodiment of a  
25 belt fabric according to the invention, a double  
layer design including a support shute. Figure **4A**  
shows the pattern when viewed along the direction  
of the warp filaments. As can be seen from Figure  
**4A**, a shute filament **s1'** of the first shute layer  
30 traces a first path through warp filaments **1-8**, a  
shute filament **s2'** of the second shute layer traces  
a second path through warp filaments **1-8**, and a

support shute s3' traces a third path through warp filaments 1-8. The pattern for each of shute filaments s1', s2' and s3' repeats every time the shute filaments cross eight warp filaments.

5           Figure 4B shows the double layer with support shute embodiment when viewed along the direction of the shute filaments. As shown in Figure 4B, a warp filament w1' traverses a path between two layers of shute filaments and a multiple of support shute  
10 filaments. The first layer is defined by shute filaments 2, 5, 8, 11, 14, 17, 20 and 23, the second layer is defined by shute filaments 1, 4, 7, 10, 13, 16, 19 and 22, and the support shute  
15 filaments are defined by filaments 3, 6, 9, 12, 15, 18, 21 and 24. This pattern repeats every time the warp yarn crosses eight shute filaments of a layer.

          Figures 5A and 5B are graphic representations of the weave pattern of a third embodiment of a belt fabric according to the invention, a triple  
20 layer design. Figure 5A shows the pattern when viewed along the in the direction of the warp filaments. As can be seen from Figure 5A, a shute filament s1'' of the first shute layer traces a first path through warp filaments 1-8, a shute  
25 filament s2'' of the second shute layer traces a second path through warp filaments 1-8, and a shute filament s3'' of the third shute layer traces a third path through warp filaments 1-8. The pattern for each of shute filaments s1'', s2'' and s3''  
30 repeats every time the shute filaments cross eight warp filaments.

Figure 5B shows the triple layer when viewed along the direction of the shute filaments. As shown in Figure 5B, a warp filament  $w1''$  traverses a path between three layers of shute filaments. The first layer is defined by shute filaments 3, 6, 9, 12, 15, 18, 21 and 24, the second layer defined by shute filaments 2, 5, 8, 11, 14, 17, 20 and 23, and the third layer is defined by shute filaments 1, 4, 7, 10, 13, 16, 19 and 22. This pattern repeats every time the warp yarn crosses eight shute filaments of a layer.

Figures 6A and 6B are graphic representations of the weave pattern of a fourth embodiment of a belt fabric according to the invention, a triple layer design including a stuffer shute. Figure 6A shows the pattern when viewed along the direction of the warp filaments. As can be seen from Figure 6A, a shute filament  $s1'''$  of the first shute layer traces a first path through warp filaments 1-8, a shute filament  $s2'''$  of the second shute layer traces a second path through warp filaments 1-8, a shute filament  $s3'''$  of the third shute layer traces a third path through warp filaments 1-8, and a stuffer shute filament  $s4'''$  traces a fourth path through the warp filaments 1-8. The pattern for each of shute filaments  $s1'''$ ,  $s2'''$ ,  $s3'''$  and  $s4'''$  repeats every time the shute filaments cross eight warp filaments.

Figure 6B show the triple layer with stuffer shute embodiment when viewed along the direction of the shute filaments. As shown in Figure 6B, a warp filament  $w1'''$  traverses a path between three

layers of shute filaments and a multiple of stuffer  
shute filaments. The first layer is defined by  
shute filaments 3, 7, 11, 15, 19, 23, 27 and 31,  
the second layer defined by filaments 2, 6, 10, 14,  
5 18, 22, 26 and 30, the third is layer defined by  
filaments 1, 5, 9, 13, 17, 21, 25 and 29, and the  
stuffer filaments are defined by filaments 4, 8,  
12, 16, 20, 24, 28 and 32 This pattern repeats  
every time the warp yarn crosses eight shute  
10 filaments of a layer.

Figures 7A and 7B are graphic representations  
of the weave pattern of a fifth embodiment of a  
belt fabric according to the invention, a triple  
layer design including a support shute. Figure 7A  
15 shows the pattern when viewed along the direction  
of the warp filaments. As can be seen from Figure  
7A, a shute filament  $s1''''$  of the first shute  
layer traces a first path through warp filaments 1-  
8, a shute filament  $s2''''$  of the second shute  
20 layer traces a second path through warp filaments  
1-8, a shute filament  $s3''''$  of the third shute  
layer traces a third path through warp filaments 1-  
8, and a support shute filament  $s4''''$  traces a  
fourth path through the warp filaments. The pattern  
25 for each of shute filaments  $s1''''$ ,  $s2''''$ ,  $s3''''$   
and  $s4''''$  repeats every time the shute filaments  
cross eight warp filaments.

Figure 7B shows the triple layer with support  
shute embodiment when viewed along the direction of  
30 the shute filaments. As shown in Figure 7B, a warp  
filament  $w1''''$  traverses a path between three  
layers of shute filaments and a multiple of support

shute filaments. The first layer is defined by  
shute filaments 3, 7, 11, 15, 19, 23, 27 and 31,  
the second layer defined by filaments 2, 6, 10, 14,  
18, 22, 26 and 30, the third layer is defined by  
5 filaments 1, 5, 9, 13, 17, 21, 25 and 29, and the  
support filaments are defined by filaments 4, 8,  
12, 16, 20, 24, 28 and 32 This pattern repeats  
every time the warp yarn crosses eight shute  
filaments of a layer.

10 The filaments/yarns/fibers of the invention  
are preferably made from polyethylene terephthalate  
(PET), polypropylene (PP), and/or polyphenylene  
sulfide (PPS) for pH < 7.5 applications; and from  
polyamide (PA) 6, 6-6, 6-10, 6-12 etc., PP, and/or  
15 PPS for pH > 7 applications. The preferable range  
of filament size is 0.30mm - 1.00mm, although  
filaments as fine as 0.12mm and as large as 1.20mm  
are envisioned. Further, it is preferable that the  
filaments are woven to a fabric permeability in the  
20 range of 300 to 700cfm.

Another material suitable for use in the  
filaments/yarns/fibers of the invention is  
polyetheretherketone (PEEK). In one embodiment,  
PEEK is used in sheath-core yarns that have a  
25 sheath of pH protective material (PEEK) and a core  
of high modulus material (polyester), or a  
contaminant resistant PET sheath over a high  
modulus polymer such as DuPont's KEVLAR®. The belt  
made from such yarns will run clean and maintain a  
30 good drainage rate over time.

It is further noted that PEEK is the preferred  
material for forming any seams that may be employed

in a belt according to the invention. The preferred type of PEEK seam is a spiral seam.

The washer belt of the invention possesses many advantages over prior washer belts. For one, 5 experimental field trials have shown that drainage increases of greater than 30% have been achieved with this new design concept due to its ability to drain freely in all washing zones over a wide range of stock types. Another advantage is more 10 consistent drainage over the run life (typically 3-12 months) of the product in operation due to the use of materials which resist contaminant adhesion in the brownstock process (PET, PP, PPS).

Further, field trials have shown no drop in 15 drainage or washing efficiency after 5 months of operation versus the typical 5 - 10% drop typically reported using standard designs.

Another advantage is that belts made in accordance with the invention are easier to install 20 due to CD dimensional stability which provides for seam end-to-end matching and easy pinning in pin seam designs.

Still another advantage is MD and CD dry to wet stability at start up and in normal operation. 25 The belts exhibit less than 0.5% dimensional change at start up for MD or CD, 0.5% maximum MD stretch at 100 pli, and 0.1% maximum CD growth at 100 pli.

Yet another advantage is that a brownstock washer employing a belt according to the invention 30 is easier to start up due to the elimination of a break-in period which is typically needed for water absorption equilibrium to occur.

Moreover, the belts of the invention exhibit a high degree of fiber support and void volume to eliminate sheet sealing and to facilitate maximum drainage potential and production rate with minimal machine adjustment with current industry standard designs, drainage in the formation zone is primarily achieved with the assist of vacuum, which can result in fabric sealing causing poor drainage and/or flooding the displacement zone. The high fiber support of the invention reduces the vacuum requirements in the formation zone resulting in the formation of a pulp sheet/mat that does not seal the fabric. This creates optimal conditions for the subsequent counter current washing that occurs in the displacement zone, while reducing the vacuum needed to drain in the subsequent washing zones and increasing belt life. High fiber support also improves machine flexibility in terms of its ability to handle large variations in stock consistency (freeness, fiber type/length, chip quality, H-factor, etc.).

**In the Claims:**

1. A washer belt for use in a brownstock washer, comprising a fabric having a multiple layer weave and being woven in a high density weave pattern, wherein said fabric is made from one or more materials selected from the group consisting of: polyphenylene sulfide, polyetheretherketone and KEVLAR®.
2. A washer belt as claimed in claim 1, wherein said fabric is made from sheath-core yarns having a sheath of pH protective material and a core of high modulus material.
3. A washer belt as claimed in claim 2, wherein said pH protective material is polyetheretherketone and said high modulus material is polyester.
4. A washer belt as claimed in claim 1, wherein said fabric is made from sheath-core yarns having a sheath of contaminant resistant material and a core of high modulus polymer.
5. A washer belt as claimed in claim 4, wherein said contaminant resistant material is polyethylene terephthalate and said high modulus polymer is KEVLAR®.
6. A washer belt as claimed in claim 1, wherein said fabric is made from one or more materials selected from the group consisting of metallic yarns, sintered metallic yarns, and yarns having a sintered metallic sheath over a mono core.
7. A washer belt as claimed in claim 1, wherein said fabric is woven in an eight-shed double layer weave pattern.
8. A washer belt as claimed in claim 1, wherein said fabric has a two layer weave.
9. A washer belt as claimed in claim 8, wherein said fabric includes a support shute.
10. A washer belt as claimed in claim 1, wherein said fabric has a three layer weave.
11. A washer belt as claimed in claim 10, wherein said fabric includes a support shute.
12. A washer belt as claimed in claim 10, wherein said fabric includes a stuffer shute.

13. A washer belt as claimed in claim 1, wherein said fabric is woven from monofilaments having a diameter in the range of 0.12mm to 1.20mm.
14. A washer belt as claimed in claim 13, wherein said fabric is woven from monofilaments having a diameter in the range of 0.30mm to 1.00mm.
15. A washer belt as claimed in claim 1, wherein said fabric is woven such that the permeability of said fabric is in the range of 300cfm to 700cfm.
16. A method of producing a washer belt for use in a brownstock washer, comprising weaving a multi-layer fabric in a high density weave pattern, wherein said fabric is made from one or more materials selected from the group consisting of: polyphenylene sulfide, polyetheretherketone, and KEVLAR®.
17. A method of producing a washer belt as claimed in claim 16, wherein said fabric is made from sheath-core yarns having a sheath of pH protective material and a core of high modulus material.
18. A method of producing a washer belt as claimed in claim 17, wherein said pH protective material is polyetheretherketone and said high modulus material is polyester.
19. A method of producing a washer belt as claimed in claim 16, wherein said fabric is made from sheath-core yarns having a sheath of contaminant resistant material and a core of high modulus polymer.
20. A method of producing a washer belt as claimed in claim 19, wherein said contaminant resistant material is polyethylene terephthalate and said high modulus polymer is KEVLAR®.
21. A method of producing a washer belt as claimed in claim 16, wherein said fabric is made from one or more materials selected from the group consisting of: metallic yarns, sintered metallic yarns, and yarns having a sintered metallic sheath over a mono core.
22. A method of producing a washer belt as claimed in claim 16, wherein said fabric is woven in an eight-shed double layer weave pattern.
23. A method of producing a washer belt as claimed in claim 16, wherein said step of weaving includes weaving a two-layer fabric.
24. A method of producing a washer belt as claimed in claim 23, wherein said step of weaving includes weaving a support shute into said fabric.

25. A method of producing a washer belt as claimed in claim 16, wherein said step of weaving includes weaving a three-layer fabric.

26. A method of producing a washer belt as claimed in claim 25, wherein said step of weaving includes weaving a support shute into said fabric.

27. A method of producing a washer belt as claimed in claim 25, wherein said step of weaving in includes weaving a stuffer shute into said fabric.

28. A method of producing a washer belt as claimed in claim 16, wherein said fabric is woven from monofilaments having a diameter in the range of 0.12mm to 1.20mm.

29. A method of producing a washer belt as claimed in claim 28, wherein said fabric is woven from monofilaments having a diameter in the range of 0.30mm to 1.00mm.

30. A method of producing a washer belt as claimed in claim 16, wherein said fabric is woven such that the permeability of said fabric is in the range of 300cfm to 700cfm.

31. A washer belt for use in a brownstock washer, produced by weaving a multi-layer fabric in a high density weave pattern, wherein said fabric is made from one or more materials selected from the group consisting of: polyphenylene sulfide, polyetheretherketone, and KEVLAR®.

32. A washer belt as claimed in claim 31, wherein said fabric is made from sheath-core yarns having a sheath of pH protective material and a core of high modulus material.

33. A washer belt as claimed in claim 32, wherein said pH protective material is polyetheretherketone and said high modulus material is polyester.

34. A washer belt as claimed in claim 31, wherein said fabric is made from sheath-core yarns having a sheath of contaminant resistant material and a core of high modulus polymer.

35. A washer belt as claimed in claim 34, wherein said contaminant resistant material is polyethylene terephthalate and said high modulus polymer is KEVLAR®.

36. A washer belt as claimed in claim 31, wherein said fabric is made from one or more materials selected from the group consisting of: metallic yarns, sintered metallic yarns, and yarns having a sintered metallic sheath over a mono core.

37. A washer belt as claimed in claim 31, wherein said fabric is woven in an eight-shed double layer weave pattern.

38. A washer belt as claimed in claim 31, wherein said fabric has a two layer weave.

39. A washer belt as claimed in claim 38, wherein said fabric includes a support shute.

40. A washer belt as claimed in claim 31, wherein said fabric has a three layer weave.

41. A washer belt as claimed in claim 40, wherein said fabric includes a support shute.

42. A washer belt as claimed in claim 40, wherein said fabric includes a stuffer shute.

43. A washer belt as claimed in claim 31, wherein said fabric is woven from monofilaments having a diameter in the range of 0.12mm to 1.20mm.

44. A washer belt as claimed in claim 43, wherein said fabric is woven from monofilaments having a diameter in the range of 0.30mm to 1.00mm.

45. A washer belt as claimed in claim 31, wherein said fabric is woven such that the permeability of said fabric is in the range of 300cfm to 700cfm.

46. A washer belt as claimed in claim 1, wherein said fabric comprises side knuckles of the warp yarns float over at least three of the forming side weft yarns, thereby forming long warp floats on the forming side of the fabric.

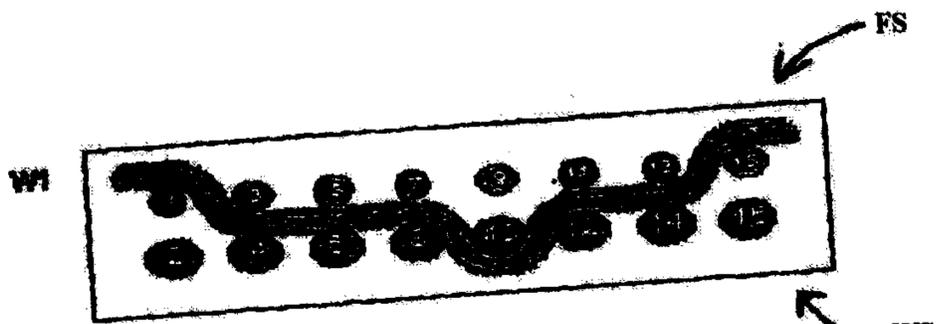


Fig. 1A

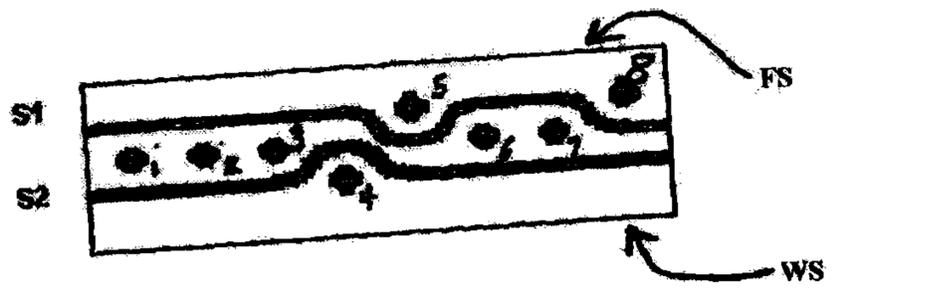


Fig. 1B

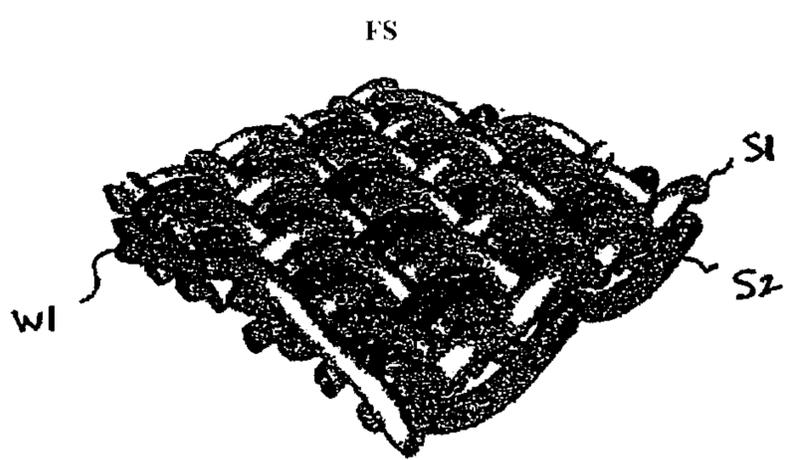


Fig. 2A

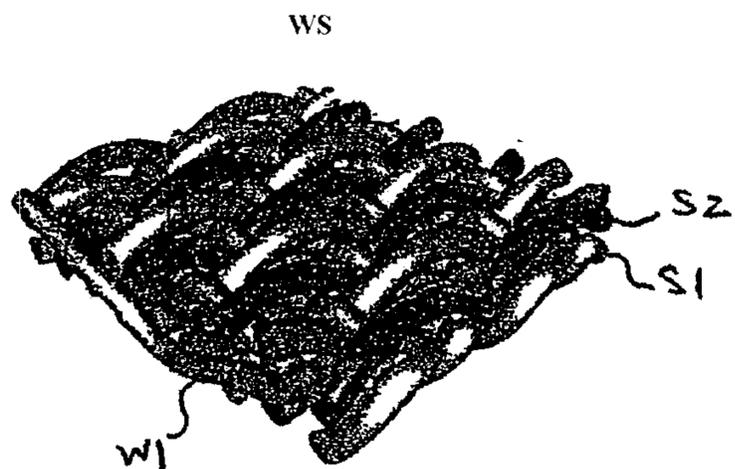


Fig. 2B



Fig. 3A

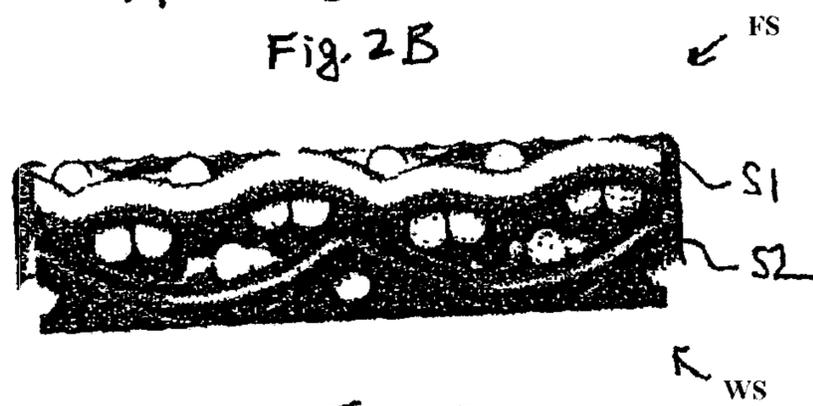


Fig. 3B

WS

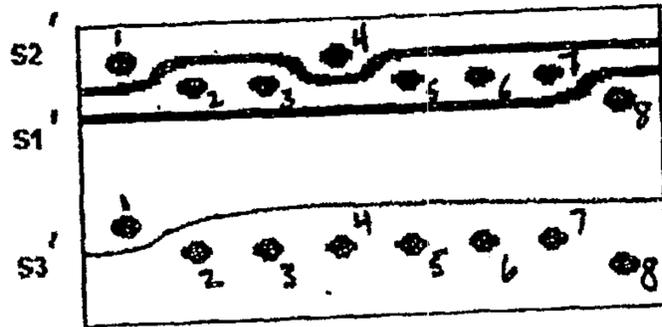


Fig. 4A.

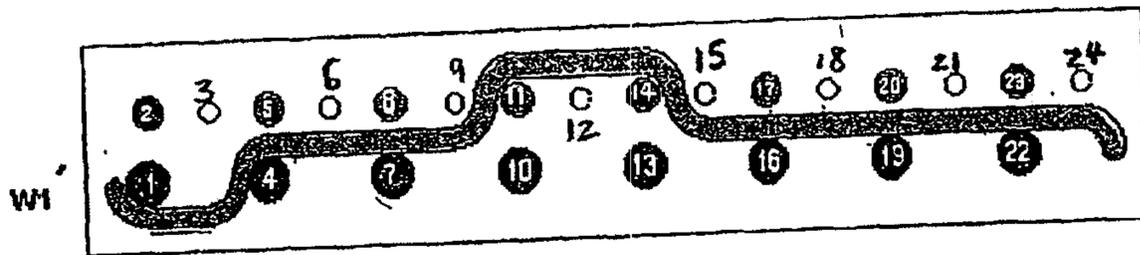


Fig. 4B

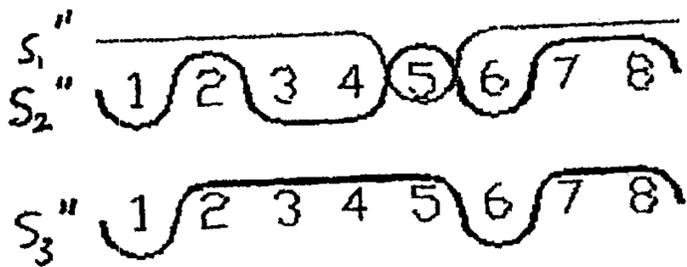


Fig. 5A.

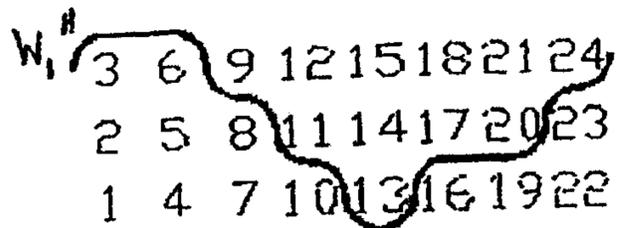


Fig. 5B

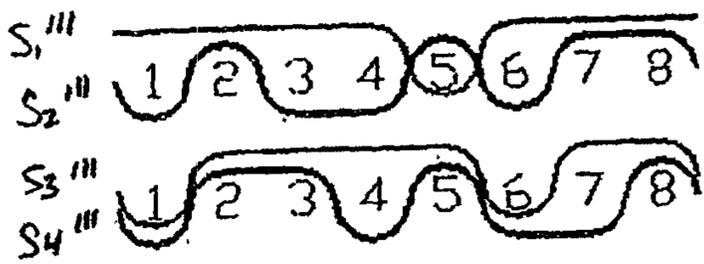


Fig. 6A

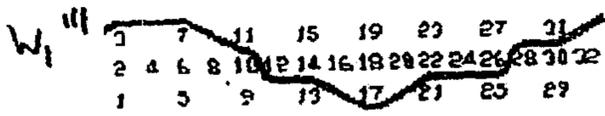


Fig. 6B

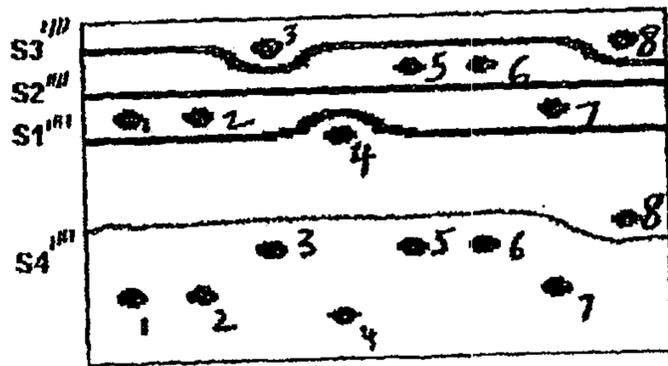


Fig. 7A

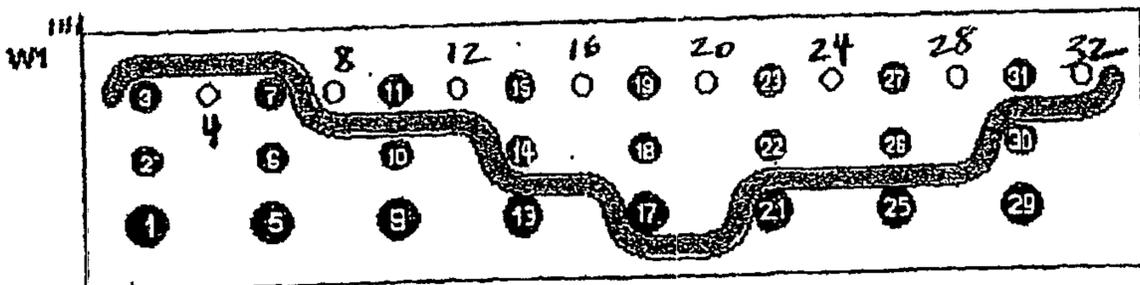
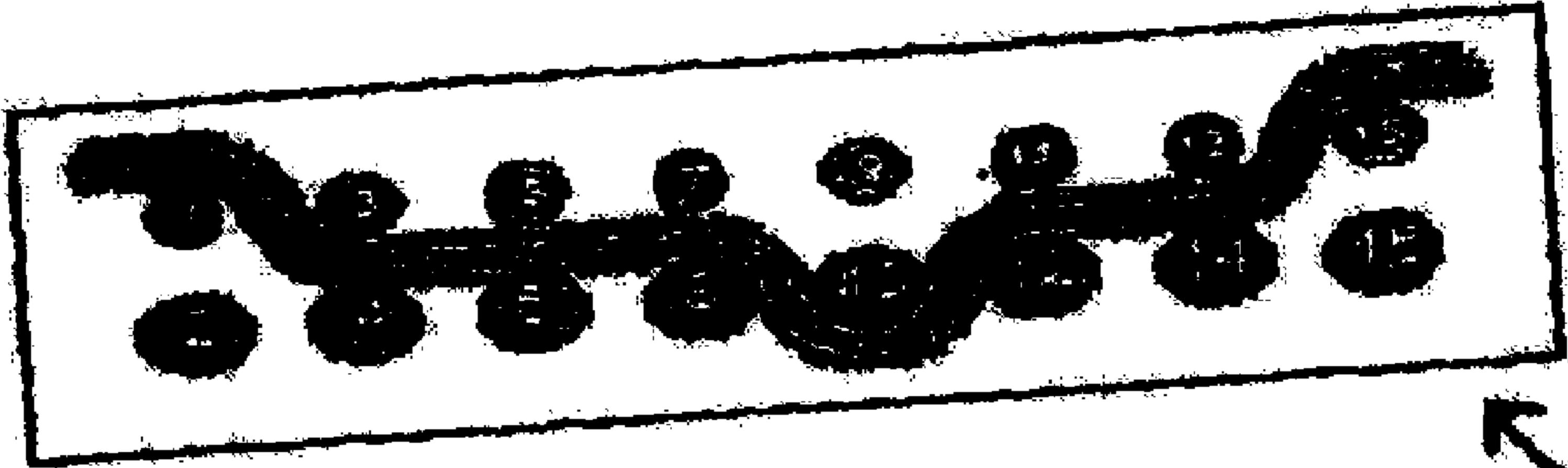


Fig. 7B

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