

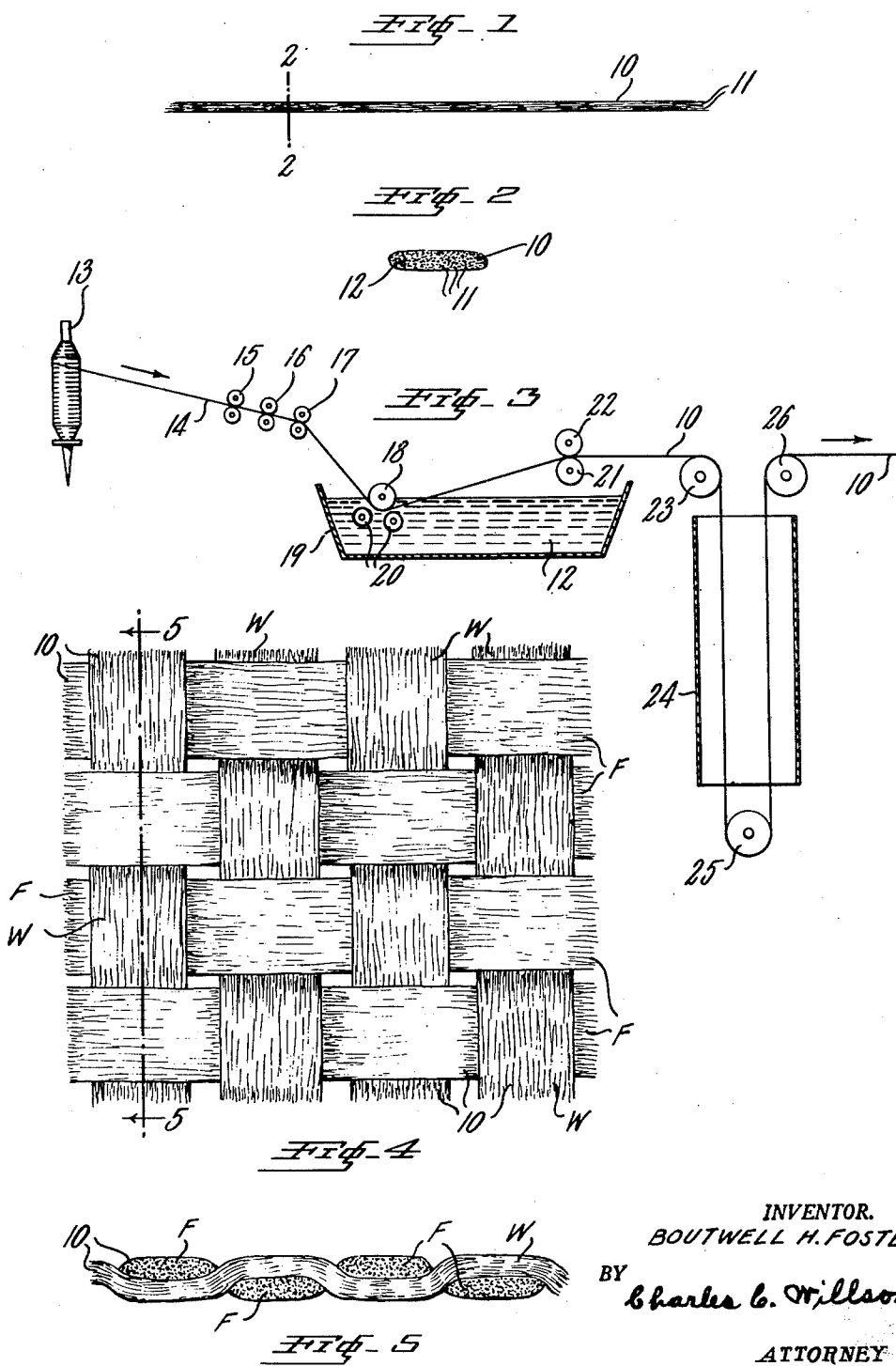
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TEXTILE FABRIC

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## UNITED STATES PATENT OFFICE

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## TEXTILE FABRIC

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1

This invention relates to flat textile strands formed of untwisted fibers that are adhesively bonded together in parallel relation, and to fabric made of such strands.

For thousands of years yarn has formed the basis of woven textile fabrics. If the yarn used in the fabric was made of non-continuous fibers such as cotton or wool, then a substantial amount of twist was employed to hold the fibers together and prevent one from slipping upon another. If the yarn was made of continuous strands such as natural or artificial silk then twist was employed to hold the strands together in the form of a yarn.

The present invention contemplates a flat textile strand adapted for use in place of yarn and formed of non-continuous parallel textile fibers adhesively bonded together to make a highly flexible strand which is devoid or practically devoid of twist, and an extremely important feature of the present strand resides in the construction whereby it is devoid of twist to such an extent that it will lie flat and without twist like a very narrow ribbon in a woven fabric; that is without twist which would cause an edge of the strand to rise at the face of the fabric and disturb the smoothness of such face.

It is old to form webs of fibers in which the fibers are adhesively bonded together to produce a flexible sheet, but the present invention contemplates not a sheet but a flat narrow fibrous strand that is adapted to be woven like yarn in a fabric but will lie flat and without twist in the fabric.

The flat textile strands contemplated by the present invention are ideally suited for use as warp or as weft or as both warp and weft in a woven fabric to produce a thin flexible fabric having good physical properties, and since these strands are thin and flat, a closely constructed fabric can be produced by the interweaving of a relatively few strands to the inch. That is, since these strands lie flat in the fabric, they will occupy much greater space therein than the ordinary yarn of corresponding weight. It will therefore be seen that a fabric constructed of such strands is relatively lighter in weight and can be woven quickly due to the low number of strands required per inch in the fabric and this will result in a saving in the cost of weaving. Similar advantages are secured in a braided fabric.

In the commercial manufacture of textile yarn from non-continuous fibers the practice for many years has been to straighten the fibers on

2

a carding machine so as to form them into a thin web, then to condense this web into a soft round strand called sliver which is devoid of twist. Such sliver is drafted and then given a small amount of twist, of the order of two or three twists per inch, to form a roving, the twist being provided to give enough strength to the roving to make it self-supporting so that it can be handled. Such roving is then converted into yarn by drafting or attenuating the fibers which reduces the size of the strand and lays the fibers more nearly parallel, and then considerable twist is imparted to the fibers to compress them into a small rounded yarn in which the twist serves to prevent the fibers from slipping one relative to the other. These twisting operations are usually carried out on a number of successive twisting devices all of which add to the cost of producing the final yarn.

The flat twistless strand contemplated by the present invention may be formed directly from the sliver abovementioned, or from the roving abovementioned, and in either case the cost of the twisting operations commonly employed heretofore will be avoided. By making the present strand flat and not round and by making it without twist it will be highly flexible, and when woven into a fabric it will produce a strong, thin, flexible and well constructed fabric having unexpectedly high tear resistance due to the fact that the present strand of untwisted fibers has a much higher resistance to tear than the usual yarn of the same weight.

Since the word yarn as commonly used in the textile industry means a twisted strand, and since the present strand is devoid or practically devoid of all twist, the present strand is not a yarn but is a flat textile strand that may be used in place of yarn and is formed of non-continuous textile fibers which are held in parallel relation to each other by an adhesive bonding material rather than by twist as in yarn. The present strand is preferably several times as wide as it is thick and in this respect resembles a flat very narrow ribbon, so that when it is woven into a fabric as warp or weft, or both, it will lie flat without twist like the weave of a cane seat used in chairs.

The flat textile strand contemplated by the present invention may be formed of vegetable or animal fibers or of cut fibers such as cut silk or cut artificial silk, all of which non-continuous fibers are hereinafter to be considered as covered by the words "staple textile fibers."

The bonding solution or liquid used should be

3

of sufficiently low viscosity, near that of water, to permit the attenuated fibrous strand to ride through a bath of such agent about a rotating roll without adhering to the roll or pulling apart, but such water-thin liquid should have sufficient tack when it dries to impart substantial strength to the strand. Any one of a number of organic adhesive bonding agents may be used for this purpose.

As above stated the twistless flat strand of the present invention may be formed from sliver or from roving, but in either case the fibers will have to be drafted or attenuated to a considerable degree to form a strand that is comparable in weight to ordinary yarn. The flat strand of the invention may be made in a wide range of weights, corresponding for example to the weight of cotton yarns of sizes in the range from 1's to 50's, that is, running from about 840 to about 42,000 yards per pound. The width of such flat strands will vary correspondingly between a maximum of about 0.10 inch for 1's, and about 0.015 inch for 50's. If the present strand is formed from roving, one ordinary drafting unit may serve to reduce the weight of the strand sufficiently but if a sliver is used it may be necessary to pass the sliver successively through two or more drafting units to reduce the weight of the fibrous strand to the desired degree. In any case the thin drafted and twistless strand will be so low in strength that it will hardly support its own weight and will part under the slightest tension in the absence of a binder. Therefore one problem that had to be solved in order to carry out the present invention was how to handle these loose fibers without breaking the strand before the fibers are bonded. One means of accomplishing this will be hereinafter described.

It will be seen from the foregoing that the present invention contemplates a flat textile strand which is neither a roving nor a yarn, since roving has a low twist and yarn has a much higher twist, whereas the strand contemplated by the present invention is flat and twistless and is formed of non-continuous parallel fibers in which the fibers are retained in their strand-forming relation by a bonding agent distributed uniformly throughout the strand. The width of such strand may vary extensively, but since it is intended to be used in place of yarn its weight should remain within the range of various size yarns. When such strands are woven into a fabric so that they lie flat without twist in the fabric, an extremely thin fabric for its strength, durability and wearing properties can be produced and the faces of the fabric will be surprisingly smooth and pleasing to the touch. This is also true if the strands are braided.

Among the advantages of the present strand and fabric are the following: (1) low production cost of strand due to high production rate and the absence of twisting and spinning operations; (2) low weaving cost due to the low number of strands required per inch to produce a closely constructed fabric; (3) exceptionally thin, flat and flexible fabric; (4) fabric having high tear-resisting properties; (5) fabric having superior surfaces for coating purposes.

The various features of the present invention will be further understood from the following description when read in connection with the accompanying drawing wherein:

Fig. 1 is a plan view of a short length of a flat textile strand constructed in accordance with the present invention;

4

Fig. 2 is an enlarged sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a side elevation with parts in section of one form of mechanism adapted to produce the strand of Fig. 1;

Fig. 4 is a greatly enlarged plan view of a piece of woven fabric having the strand of Fig. 1 in both the warp and weft thereof; and

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4.

The strand 10 constructed in accordance with the present invention is designated in each view of the drawing by the numeral 10. This strand is made up of the non-continuous fibers 11 which fibers are bonded together by a suitable bonding agent 12.

One good practical form of apparatus for producing the strand 10 is shown more or less diagrammatically in Fig. 3 of the drawing. This apparatus is adapted to produce the strand of Fig. 1, from an ordinary roving which may be formed of staple textile fibers such as cotton, wool, cut natural fibers or cut artificial silk, such for example as cut rayon. In this view the numeral 13 designates a bobbin filled with a roving 14 such as a 3.5 hank cotton roving. This bobbin is rotatably supported and serves to supply its roving to the ordinary drafting rolls consisting of the successive pairs of rolls 15, 16 and 17 which are driven at successively higher surface speeds in the order cited to draft and attenuate the roving 14 in a well known manner. The amount of drafting imparted to the strand may be for example, approximately 3, in which case the strand leaving the front delivery rolls 17 will be about 3 times as long as the roving entering the rolls 15. The amount of draft employed however may be varied extensively as desired. If the roving 14 has a twist of about two turns per inch as it is supplied to the drafting rolls 15 and the strand is drafted to three times its previous length then the twist obviously will be reduced to considerably below one turn per inch. This twist however will be further reduced as the strand leaves the delivery rolls 17 due to the fact that the twist is now so low that the fibers may tend to straighten out and rearrange themselves to produce a further disappearance of the twist.

This untwisted or substantially untwisted strand, which is now hardly strong enough to support its own weight, upon leaving the rolls 17 passes downwardly, in the construction shown, about a driven roll 18 placed below the level of the coating material 12, such for example as latex, contained in the receptacle 19. Below the roll 18 and slightly spaced therefrom are preferably provided a pair of spaced rolls 20 which lie close to but do not touch the strand passing between them and the roll 18. All three of these rolls are preferably driven at a speed slightly in excess of the speed at which the strand issues from the delivery rolls 17. This slightly higher speed of the roll 18 will help to draw the twistless strand downwardly into the bath 12, and the rotation of the lower rolls 20 serves to cause a flow of the bonding liquid in the direction of the strand as it passes about the roll 18. These three rolls form a self feeding device capable of handling a very weak strand. The wetting action of the thin binder will serve immediately to increase the strength of the strand to some extent so that it may be drawn out of the bath 12 by the cooperating rolls 21 and 22.

The lower of these rolls is power driven and the upper roll may rest floatingly upon the lower roll or upon the strand passing therebetween. This upper roll serves to flatten out the strand and to squeeze the excess liquid therefrom.

This flat binder-treated strand 10 may pass from the nip of the rolls 21 and 22 to a power driven roll 23, and then back and forth in one or more passes through a drying chamber 24. In the construction shown this strand 10 passes downwardly from the roll 23 to a lower driven roll 25 and then upwardly about the driven roll 26. When the strand 10 is thoroughly dry its manufacture is completed and it may be wound up upon a package, not shown, ready for future use. If, however, it is desirable to further increase the strength of this strand by treating it with a second bonding agent, it may be passed again through a dipping tank and drying apparatus similar to that shown in Fig. 3. The amount of binder that is incorporated in the strand may vary widely, suitable amounts for many purposes being from about 2% to about 50% (dry weight) of the weight of the fibers.

The finished strand 10 may be used for a number of purposes but it is particularly well adapted for use as warp or weft or as both warp and weft in a woven fabric, where the strands 10 may be introduced in the fabric to form a square weave or a twill or other type of weave as desired. In the greatly enlarged view of a woven fabric shown in Figs. 4 and 5 the warp is marked W and the weft or filling is marked F and both the warp and weft are constructed of yarns 10 which are shown as being interlocked by a square weave. Due to the wide flat condition of the strands 10 these strands will have very low weaving crimp in the fabric, and the fabric shown while having a relatively few warps and wefts to the inch will have a close construction with small apertures between the crossing threads. This fabric may be exceptionally thin for its body, strength and wearing properties, and the number of warp and weft strands per square inch will be much lower than would be the case if yarns of the same weight were used to construct the fabric. This permits the manufacture of a high grade textile fabric in accordance with the present invention at low strand cost and low weaving cost.

It is necessary to exert some care in weaving the fabric shown in Fig. 4 so as to lay both the warp and weft strands flat in the fabric. This is accomplished as to the warps W by winding them in a flat condition on to the let-off beam; and although they may turn slightly as they pass through the heddles of the harness they will enter the fabric in a flat condition as they slide over the breast-beam or a bar near this beam. In order to keep the weft or filling F from turning in the fabric it is necessary to so wind the bobbins or quills that the weft will pull off the end thereof in an untwisted condition. The bobbins are prepared to so deliver the strands by winding the strand on a bobbin in the ordinary manner, and such strand is then pulled off this bobbin endwise or lengthwise, and wound on to a second bobbin which is used in the loom shuttle to deliver this weft F in a flat condition through the warp shed.

For a further understanding of the construction of the strand and fabric of the present invention the following tables are given as illustrative of one practical embodiment of each.

TABLE I

*Analysis of bonded flat cotton strand*

|   |                             | Average                |
|---|-----------------------------|------------------------|
| 1 | Width.....                  | 3/42" (.031) ± 1/64"   |
| 2 | Thickness.....              | 1/125" (0.008) ± .001" |
| 3 | Yards per pound.....        | 6100 ± 400.            |
| 4 | Fiber Content.....          | 70% ± 10%.             |
| 5 | Bonding Ingredient.....     | 30% ± 10%.             |
| 6 | Ratio—Width: Thickness..... | 3.9, Min. 2, Max. 6.   |

The bonding agent used for the attenuated twistless fibers to enable them to be handled as a continuous strand should be in the form of a thin liquid which will quickly wet these fibers without subjecting them to any appreciable drag that would pull them apart, and this same liquid as it dries out should possess considerable tack to strengthen the strand. Any of a great number of organic adhesive bonding agents may be used and examples of the same are as follows: aqueous solution or dispersions of glue, adhesive, casein, natural rubber, synthetic rubber, asphalts, cellulose esters, cellulose ethers, vinyl resins, and many other materials well known as adhesives and bonding agents. For most purposes the bonding agent upon the strand should be water insoluble, such as latex, so as to form a permanent bonding adhesive.

TABLE II

*Analysis of woven fabrics after laundering and ironing*

|   |                             | Made from Strands of Table I | Commercial 40"-2.85 yard Cotton Sheeting |
|---|-----------------------------|------------------------------|------------------------------------------|
| 1 | Warp ends per inch.....     | 30                           | 48                                       |
| 2 | Weft ends per inch.....     | 22                           | 48                                       |
| 3 | Threads per sq. inch.....   | 52                           | 96                                       |
| 4 | Gauge of Fabric.....        | .018"                        | .0168"                                   |
| 5 | Wt., Ozs./sq. yd.....       | 5.4                          | 5.1                                      |
| 6 | Tear strength, warp.....    | 40.7                         | 10.1                                     |
|   | Tear strength, filling..... | 26.5                         | 8.5                                      |

For the same weight and gauge the fabric made from the present flat strands has many fewer threads to the square inch and is much faster and therefore cheaper to weave. The fabric is soft and closely constructed and has good tear resistance, and since the strands forming the same are flat and twistless the fabric is well adapted for use as a backing fabric for coated fabrics, for dress goods and for many other purposes. In comparing the two fabrics of Table II, the fabric of the present invention has 63% less crimp, contains 47% heavier threads, and has 46% fewer threads to the square inch.

By employing the construction of the present invention fabrics can be made surprisingly strong for their thin gauge, and strong durable mechanical fabrics constructed in accordance with the present invention may have a gauge of not more than 0.025 inch.

The fact that the present strand makes an exceptionally thin flat fabric is not only highly desirable for certain woven fabrics but also makes it well adapted for use as a thin braided jacket for conductor wires, and also for use as a flat serving or wound cover for conductor wires.

It will be seen from the foregoing that the present invention makes available a low cost, twistless textile strand formed of bonded paral-

lel fibers, which strand is well adapted for use in weaving and braiding inexpensive fabrics that have many desired properties, and the strand may also be employed for other purposes.

Having thus described my invention what I claim and desire to protect by Letters Patent is:

1. A thin, strong, highly flexible, closely constructed fabric having a gauge of about .018" and woven of flat warp and weft strands so that there are about fifty of such strands to the square inch and each lies as a flat non-twisted ribbon in the fabric, each strand being a compact strong, flat textile strand several hundredths of an inch wide and formed of longitudinally parallel staple textile fibers permanently bonded together without twist solely by a dried organic adhesive.

2. A thin, strong, highly flexible, closely constructed fabric having a gauge of not over 0.025 inch and woven of flat warp and weft strands so that there are about fifty of such strands to the square inch and each lies as a flat non-twisted ribbon in the fabric, each strand being a compact strong, flat textile strand several hundredths of an inch wide and formed of longitudinally

parallel staple textile fibers permanently bonded together without twist solely by a dried organic adhesive.

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