

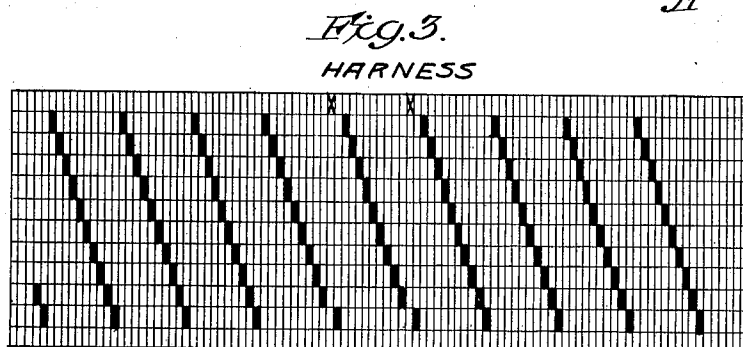
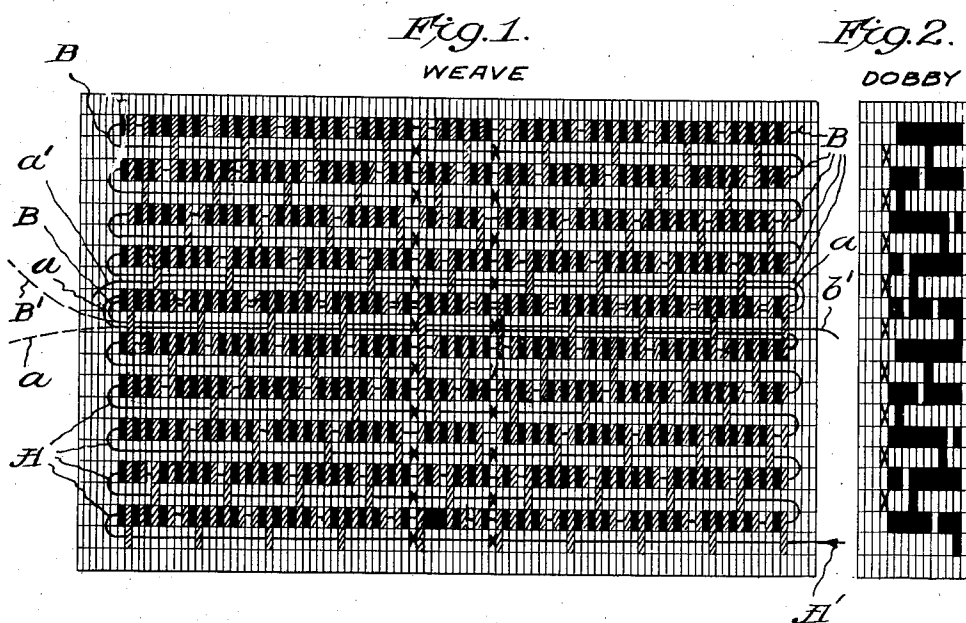
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WOVEN FABRIC TUBE AND METHOD OF MAKING THE SAME

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WOVEN FABRIC TUBE AND METHOD OF
MAKING THE SAME

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This invention has to do with the weaving of tubes on looms. In the weaving of tubes there is employed a desired number of warp threads, commonly referred to as "ends," with which are interwoven weft threads, commonly referred to as "fillers" or "filling." The weaving of tubes through the employment of looms is well known. The warp threads are passed through heddles mounted on beams which are vertically reciprocated to properly position the several ends in selected relations for the passage of the shuttle through appropriate "sheds."

When the quill of any particular shuttle is exhausted, the free end of the filler thread of the exhausted quill has heretofore been tied to the beginning end of the next quill to form therewith a knot. This knot is manually pulled through the eyes on the springs and the eye of the shuttle itself and is then drawn through the shed during the next passing of the shuttle. Thereafter, when weaving again starts, two ends of said filler threads remain in the form of a continuous loop at one side of the tube and this loop is cut away to leave two loose ends where the thread of the previous quill ended and the thread of the new quill started.

The difficulty with this practice is that these loose ends are not attached in any way except by such slight friction as may be present between them and contiguous warp threads and, after the tube goes into use, it is not uncommon for these free ends to work free from the weave, thereby opening holes or gaps in the weave. These are not only unsightly but result in weak points in the weave where they are formed.

The primary object of the invention is to eliminate this formation of weak points by eliminating the localization of free ends and to so locate such ends that they cannot weaken the tube even though they do work loose to some extent. This I accomplish by what I term a multiple lock which will presently be described.

Generally speaking, the method of this invention may be described as follows: the tube weaving proceeds in the manner hereinbefore described until a quill is practically exhausted. At this time the loom is stopped while the shuttle is, e. g., at the left of the shed and the trailing end, which I call the "idle end," of the filler thread as it leaves the quill, is therefore also at the left hand side of the "shed." While the loom is at rest with the threads in this condition, a new quill is introduced into the shuttle and the leading end of the filler thread thereof tied to the trailing idle end and the knot is thereupon drawn through the

eye of the shuttle and through the eye of the springs by pulling the idle end therethrough. The two threads are then cut apart and the leading end of the thread of the new quill is manually drawn through the shed. This leaves the idle end at the left and the leading end of the new quill thread at the right hand side of the tube in the example given.

The loom is now started to shift the shed for the next shuttle passage and the shuttle is passed to the right through the shed. As the shuttle finishes its passage to the right, the loom is again stopped and the idle end, which has up to this time remained at the left, is manually passed through the shed to the right so that it lies parallel and directly next to the thread which has just been passed therethrough by the shuttle to form a double lock according to this invention. The idle end is now at the right hand side of the tube.

The machine is again started and may continue thereafter to weave continuously until the quill, now in operation, has been used up, or, if desired, the loom may be stopped after the shuttle has again passed to the left and the idle end manually carried through parallel to and directly next to the shuttle thread which has just passed through the shed, so as to produce a triple lock. This operation may be continued to produce any number of passages of both filler threads in parallel relation through the same shed positions to provide any desired number of locks.

As the weaving continues in the conventional way beyond the lock, two threads (i. e., the trailing end of the old thread and the leading end of the new thread) are left protruding from one or both sides of the tube and these threads are cut off by the operator without stopping the loom.

By following the method specified, it will be noted that at the point in the tube weaving operation where one quill discontinues these operations and another quill takes over, there is an overlapping of the weaving of the quill thread ends for at least two passes, so that there is, in effect, a reinforcing of the weave at the connecting point of the filling. This is in marked contradistinction to prior practice where there is a weakening rather than a reinforcing. With the present invention, it will be apparent that, even though one of the free ends (left after cutting off said trailing and leading ends), work loose with respect to one or more of the warp threads, no weakening of the tube will result. The contrary is the case under prior practice.

The multiple lock which I have described is useful in the weaving of threads of all kinds, but is

of especial importance in the manipulation of nylon, rayon and other extruded filaments which are of such slippery nature that extreme difficulty is encountered in properly anchoring the ends due to the tendency of the thread to work loose by sliding—a fact inherent in a noticeable lack of friction between woven threads of these materials.

This invention is fundamentally directed to the multiple locking feature to which I have referred, but also embodies another feature which I find highly important in the weaving of tubes for many purposes where a flat tube is preferable. This latter feature provides for the weaving of the tube in such manner that the opposite sides of the tube are bound to one another while the tube is in flat condition by a weaving operation which progresses as the weave proceeds. This binding operation may be along one or more lines medially or non-medially of the flat tube, and involves the employment of one or more added independent warp threads which are utilized as binder threads.

In practice, I find it desirable to bind the tube along a plurality of longitudinal lines utilizing a plurality of warp threads in this operation. I accomplish these results by so operating the harnesses of the added binder warp threads that these binder threads are bound in by the filler as the weaving proceeds. For example, when employing an eleven shaft harness I may use five for the upper warp, five for the lower warp and one for the binder, the binder harness simultaneously operating the two or more warp threads selected for the binding function. In this way I obtain distinct lines of binding longitudinally of the tube as an inherent part of the weaving operation. This not only serves to hold the tube flat, but also materially increases the longitudinal tensile strength of the tube by so binding together the upper and lower sides thereof as to equalize the pull throughout the length of both sides of the tube, and consequently to equalize the strains throughout the entire tube.

This feature is of great importance in certain fields where maximum tensile strength is desired with minimum size and weight.

Features of the invention, other than those adverted to, will be apparent from the hereinafter detailed description and appended claims when read in conjunction with the accompanying drawing.

For a specific example of the operation of the method of this invention in the manufacture of a flat, reinforced, double locked tube, reference is made to the annexed drawing which shows "drafts" of the character commonly employed by those skilled in the art of weaving to illustrate the desired weave and the proper set up of the loom to produce the same. These drafts illustrate one manner of practising the present invention, but are to be understood as illustrative only and not as defining the limits of the invention.

In said drawing:

Figure 1 shows a draft of the weave.

Figure 2 is a draft of the dobby showing two repeats for twenty cards.

Figure 3 is a draft of the harness for ten ground shafts and one binder shaft.

Figure 4 is a draft of the front reed, 18 dents per inch, and the number of reeds for each dent.

In order that the drafts may be perfectly clear to the mill man, they have been laid out on designing mill paper. In Figure 1 the vertical lines of this paper separate intervening spaces corre-

sponding to the positions of the warp heddles, while the intervening spaces between the horizontal lines indicate the successive passes of the filler. In this figure, moreover, the black rectangles indicate the up positions of the heddles of the lower warp threads of the tube, the spaces with the 45° cross section indicate the up positions of the heddles of the warp threads of the upper part of the tube, and the white spaces indicate the down positions of the warp threads of both the upper and lower portions of the tube. The crosses indicate the up positions of the heddles of the binder threads, while the vertically intervening blank spaces indicate the down positions thereof.

The reference character A of Figure 1 indicates the filler thread which comes from the shuttle at A' at the lower right hand corner thereof and passes back and forth from right to left and from left to right, etc. in a serpentine manner as it is carried by the shuttles back and forth through the shed in a progressive weaving operation. This filler thread A continues uninterrupted until the quill from which it is fed is practically exhausted. At that time the trailing end of this thread, removed from the quill, becomes the loose idle end shown in dotted lines at a in Figure 1. This end is shown in Figure 1 as quite short, although in practice it is left long enough for one or more manual passes through the shed.

A new quill having been introduced into the shuttle, as hereinbefore described, the leading end of the thread thereof is carried along the dotted line B' from the quill to, and threaded by hand through, the shed to project beyond the opposite right side thereof, as indicated at b', so that the part thereof which passes through the shed will lie directly along side of the last passage of the thread A through the same shed. The end b' is left in this position while the heddles are shifted for the next passage of the shuttle. The shuttle is then moved to the right carrying with it the new filler thread B shown in full lines. The idle end a is thereupon manually passed through the shed, as hereinbefore described, to lie alongside of the new thread B. The shuttle is then moved to the left through the next shed and the idle end a is then manually passed through the same shed, so as to again lie directly alongside of the thread B therein. The idle end is preferably left in the full line position shown in full lines at a' in Figure 1 as the weaving proceeds in a normal fashion. Thus, as shown in Figure 1, the idle end has been manually passed twice through the shed to, in each instance, lie directly adjacent the new thread in the same shed, to produce the double lock which I have described. The process of locking may be carried through an additional number of sheds, if desired, but ordinarily this is not required. One or two passes are in practice adequate for all purposes.

While the weaving indicated in Figure 1 is proceeding, independent heddles with associated additional binding warp threads are operated in the manner indicated by the crosses and vertically intervening blank spaces in Figure 1 to alternately position these binder threads above and below the filler threads as they successively pass back and forth through the sheds. As the weaving proceeds, there are thus two distinct lines of binding formed intermediate the lateral edges of the tube to effectually secure the upper and lower portions of the tube together.

In Figure 2, the blackened spaces indicate the holes in the cards appropriate to the weaving indicated in Figure 1. This card shows two repeats for the 20 cards indicated in Figure 1.

Figure 3 shows the harness set up for 10 ground shafts and one binder shaft, the black spaces indicating the heddles for the warp threads and the spaces marked X indicating the heddles for the binder threads.

In Figure 4, the front reed is indicated, the spaces showing the number of warp threads corresponding to a single bend of the reed.

In the illustrative form of the invention which I have chosen to show in the drawing, the loom is so set up as to produce a satin type weave on the interior of the tube. This arrangement is preferred in practice for the sake of economy without appreciable loss of bulk, but it is to be understood that the invention is not limited to this particular weave as the satin finish may be placed on the exterior of the tube or the weave may be so constituted as to eliminate the satin finish entirely, as will be clearly understood by those skilled in the art from the foregoing description.

The foregoing detailed description sets forth the invention in its preferred practical form, but the invention is to be understood as fully commensurate with the appended claims.

Having thus fully described the invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of loom weaving a fabric tube which comprises passing a quill-carrying shuttle back and forth through a successively changing shed of warp threads to interweave a filler thread therewith until the quill carrying such filler thread is substantially exhausted, detaching the trailing end of said filler thread from its quill and leaving said detached trailing end as an idle end at one side of the shed, then passing the leading end of the filler thread of a new quill through the shed parallel to and in side by side relation with the filler thread last passed through the shed, then changing the shed for the passage of the shuttle with the new quill therein and thereupon passing the shuttle with said new quill through the shed, thereupon passing the idle or trailing end of the first mentioned filler thread through the shed parallel and directly adjacent to the new filler thread which has just been passed therethrough, and thereafter continuing to pass the shuttle back and forth to interweave the new filler thread with the warp threads while the shed is successively changed as the shuttle moves back and forth.

2. The method of loom weaving a fabric tube which comprises passing a quill-carrying shuttle back and forth through a successively changing shed of warp threads to interweave a filler thread therewith until the quill carrying such filler thread is substantially exhausted, detaching the trailing end of said filler thread from its quill and leaving said detached trailing end as an idle end at one side of the shed, then passing the leading end of the filler thread of a new quill through the shed parallel to and in side by side relation with the filler thread last passed through the shed, then changing the shed for the passage of the shuttle with the new quill therein and thereupon passing the shuttle with said new quill through the shed, thereupon passing the idle or trailing end of the first mentioned filler thread through the shed parallel and directly adjacent to the new filler thread which has just been

passed therethrough, thereafter changing the shed and passing the shuttle back therethrough, again passing the idle end through the shed in parallel relation and directly adjacent to the new filler thread which has just passed therethrough, and thereafter continuing to pass the shuttle back and forth to interweave the new filler thread with the warp threads while the shed is successively changed as the shuttle moves back and forth.

3. The method of loom weaving a fabric tube which comprises passing a quill-carrying shuttle back and forth through a successively changing shed of warp threads to interweave a filler thread therewith until the quill carrying such thread is substantially exhausted, detaching the trailing end of said filler thread from its quill and leaving said detached trailing end as an idle end at one side of the shed, then passing the leading end of the filler thread of a new quill through the shed in a direction opposite to the last passage of the preceding filler thread through the shed and in parallel side by side relation to said preceding filler thread, then changing the shed for the passage of the shuttle with the new quill therein and thereupon passing the shuttle with said new quill through the thus changed shed, thereupon passing the idle or trailing end of the first mentioned filler thread through the shed parallel and directly adjacent to the new filler thread which has just been passed therethrough, and thereafter continuing to pass the shuttle back and forth to interweave said new filler thread with the warp threads while the shed is successively changed as the shuttle moves back and forth.

4. The method of loom weaving a fabric tube which comprises passing a quill-carrying shuttle back and forth through a successively changing shed of warp threads to interweave a filler thread therewith until the quill carrying such thread is substantially exhausted, detaching the trailing end of said filler thread from its quill and leaving said detached trailing end as an idle end at one side of the shed, then passing the leading end of the filler thread of a new quill through the shed in a direction opposite to the last passage of the preceding filler thread through the shed and in parallel side by side relation to said preceding filler thread, then changing the shed for the passage of the shuttle with the new quill therein and thereupon passing the shuttle with said new quill through the thus changed shed, thereupon passing the idle or trailing end of the first mentioned filler thread through the shed parallel and directly adjacent to the new filler thread which has just been passed therethrough, thereafter changing the shed and passing the shuttle back therethrough, again passing the idle end through the shed in parallel relation and directly adjacent to the new filler thread which has just passed therethrough, and thereafter continuing to pass the shuttle back and forth to interweave the new filler thread with the warp threads while the shed is successively changed as the shuttle moves back and forth.

5. The method of loom weaving a fabric tube which comprises passing a quill-carrying shuttle back and forth through a successively changing shed including warp threads adapted to occupy the upper portion of the tube, additional warp threads adapted to occupy the lower portion of the tube, and at least one additional warp thread constituting a binding thread, to pass a filler thread from the quill between selected warp

threads of the upper part of the tube and between selected warp threads of the lower part of the tube and to pass said filler thread alternately over and under the binding warp thread, as the shuttle moves back and forth through the shed until the quill carrying such filler thread is substantially exhausted, detaching the trailing end of said filler thread from its quill and leaving said detached trailing end as an idle end at one side of the shed, then passing the leading end of the filler thread of a new quill through the shed parallel to and in side by side relation with the filler thread last passed through the shed, then changing the shed for the passage of the shuttle with the new quill therein and thereupon passing the idle or trailing end of the first mentioned filler thread through the shed parallel and directly adjacent to the new filler thread which has just been passed therethrough, and thereafter continuing to pass the shuttle back and forth to interweave the new filler thread with the warp threads while the shed is successively changed as the shuttle moves back and forth to provide a flat woven tube with at least one line of binding extending longitudinally thereof and intermediate its lateral edges.

6. The method of loom weaving a fabric tube which consists in passing a quill-carrying shuttle back and forth through a successively changing shed including warp threads adapted to occupy the upper portion of the tube, additional warp threads adapted to occupy the lower portion of the tube, and at least one additional warp thread constituting a binding thread, to pass a filler thread from the quill between selected warp threads of the upper part of the tube and be-

tween selected warp threads of the lower part of the tube and to pass said filler thread alternately over and under the binding warp thread, as the shuttle moves back and forth through the shed to provide a flat woven tube with at least one line of binding extending longitudinally thereof and intermediate its lateral edges.

7. A woven fabric tube comprising warp threads, and successive filler threads interwoven with the warp threads, with the beginning portion of each successive filler thread positioned directly adjacent and in parallel relation to the finishing end portion of the next preceding filler thread with which it is thus overlapped in the weave for a distance at least equal to the width of the tube when the latter is in flat condition.

8. A woven fabric tube comprising warp threads, and successive filler threads interwoven with the warp threads, with the beginning portion of each successive filler thread positioned directly adjacent to and in contact with the finishing end portion of the next preceding filler thread with which it is thus overlapped in the weave for a distance at least equal to the width of the tube when the latter is in flat condition.

9. A woven fabric tube comprising warp threads, and successive filler threads interwoven with the warp threads, with the beginning portion of each successive filler thread positioned directly adjacent to and in contact with the finishing end portion of the next preceding filler thread with which it is thus overlapped in the weave for a distance at least equal to the circumference of the tube.

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