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A. W. KEUFFEL ET AL.

2,321,920

MEASURING TAPE

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FIG. 1.

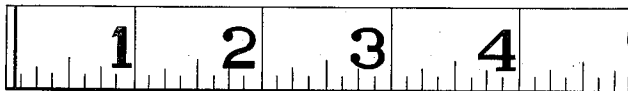


FIG. 2.

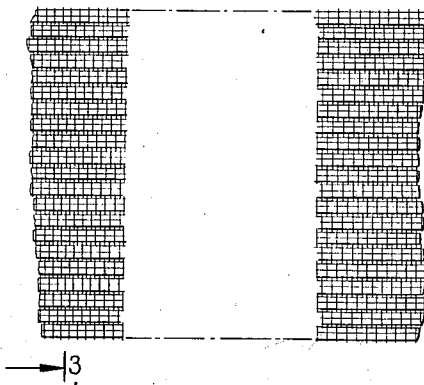
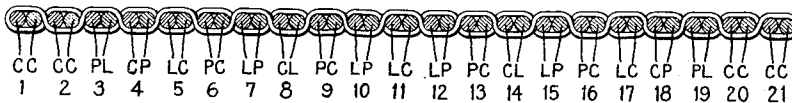


FIG. 3.



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MEASURING TAPE

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8 Claims. (Cl. 33—137)

This invention relates to measuring tapes made from woven strips of narrow fabric.

Heretofore woven measuring tapes have been made in a number of ways as for example, by weaving an ordinary narrow strip as a more or less conventional tape and printing graduations and numerals thereon. Obviously such tapes were useful only to give approximate measurements and could never be used where accuracy was necessary. To improve the accuracy of these tapes, metallic strands have been introduced in certain types. The inclusion of metallic strands produced a conductive tape that made it dangerous for measurements around electrical apparatus.

This invention is directed particularly to woven measuring tapes with increased durability able to withstand the severe conditions in mining, lumbering, dock building, railroad construction, carpet laying and other industrial operations where a high degree of accuracy is desired but not necessarily that of a steel tape, or where metal tapes cannot be used.

It is an object of this invention to provide an improved woven measuring tape that has a smaller elongation or strain for a given stress applied than other woven tapes thereby insuring greater accuracy in use.

Another object of this invention is to provide an improved woven measuring tape of great strength and highly resistant to wear under normal conditions of use.

An important object of this invention resides in the provision of a measuring tape which can stand extended exposure to aqueous liquids without changing its properties and when so treated that any of its measuring properties are affected the variation is only temporary, or at the most of a minor nature.

Also an object of this invention is to provide a woven strip having warp threads of two types, the fibres of one of which are inorganic filaments, which warp threads are substantially straight and held together with a weft or filler which weaves the warp threads together without causing them to vary from a straight line.

The invention seeks to provide a woven strip wherein threads of organic fibre are combined with threads of inorganic fibre to produce a strip with novel properties particularly useful in woven measuring tapes.

A further object is to provide a woven measuring tape with high resistance to stretch or elongation and high resistance to water, comprising a woven strip in which the warp ends are woven in pairs the first two pairs at each edge of cotton, some of the intermediate pairs combining a filament glass thread with an organic fibre thread and held together with a specially woven weft or filler to provide a straight

warp, a coating for the strip, and graduations and numerals thereon.

Additional objects will be hereinafter set forth or made clear from the following more particular description of the invention.

We have found that where at least part of the warp threads of a strip are made from fibres of an inorganic material such as glass that an improved product results. In one of the preferred forms of the invention at least some of the warp threads are made from continuous glass filaments suitably combined to form threads which have only a slight twist. Inorganic fibres have been made into threads of two principal types. In one case extremely fine filaments of, for example, glass are drawn to any desired length and a number of these continuous filaments combined to form a strand or ply of yarn and several of these may be twisted together to give a thread. Such threads, in which each filament is extremely long and may be as long as the thread, are very smooth, free from projecting fibres and generally preferred as warp threads. The second type of thread is spun from glass fibres which individually are only a few inches long. Spun glass thread is fuzzy and produces a correspondingly fuzzy fabric and coating. Such threads of inorganic fibres either alone or preferably combined with threads of organic fibres when employed as a straight warp held together with a light weight loosely woven filler produce strips having unusually desirable properties for measuring tapes.

In the accompanying drawing Fig. 1 is a view of a measuring tape, Fig. 2 a plan view of the woven strip, and Fig. 3 a sectional view of Fig. 2 all with explanatory legends.

While the invention is illustrated and described by reference to certain preferred embodiments, it is to be understood that variations may be made from the specific disclosures herein without departing from the spirit and scope of the invention as set forth in the broader outlines of this disclosure.

Example I

On a tape loom capable of weaving a large number of such tapes simultaneously, the forty-two warp threads, of which there were thirty of cotton (C) and twelve of filament glass (P), were arranged as twenty-one double ends in the following order:

1 2 3 4 5 6 7 8 9 10 11
CC-CC-PC-CP-CC-PC-CP-CC-PC-CP

CC-CC-PC-CP-CC-PC-CP-CC-PC-CP

The threads were run through the harness in pairs as indicated. The strip is slightly more

closely woven near the edges for additional strength which may be further increased by using a longer fibre cotton thread for the edge threads.

Example II

Another tape loom was threaded with cotton (C), linen (L), and glass fibre threads (P) in the following manner:

1 2 3 4 5 6 7 8 9 10 11
CC-CC-LP-LC-LC-LC-PL-LC-LC-LL
CC-CC-LP-CL-CL-CL-LC-PL-CL-CL

with the threads arranged through the harness as in Example I.

In each of the foregoing examples, the tape was woven with a cotton weft, the filling passing over and under the straight warp. It is important that the tension on the various warp threads be so adjusted that after the strip is woven the various types of thread in the warp will be very nearly, if not exactly, the same length. This is shown where the filler is stripped from several inches on any section of woven tape and a moderate tension applied to the tape a few inches from each end of the stripped section. All of the warp threads will align themselves if the original tensions on the warp threads during weaving were correct.

It is also necessary to adjust the tension on the filler or weft threads against the tension on the warp. In this manner the woven tape becomes a series of substantially straight warp threads with all of the weaving, i. e., sinuous form, as such, in the filler. With this construction, tension applied at the ends of the strip will not permit stretching due to taking the waves out of the warp threads.

In one of the foregoing examples, there were only five threads of inorganic fibre out of a total of forty two ends yet tapes so prepared when finished as hereinafter described produced marked improvement in many important respects over tapes constructed solely of organic fibres but otherwise identical.

In addition to the warp arrangements suggested in Examples I and II above, a number of other possible combinations illustrative of the invention are suggested as follows:

1 2 3 4 5 6 7 8 9 10 11
CC-CC-PC-PC-PC-PC-PC-PC-PC-PC-PC
CC-CC-PC-PC-PC-PC-PC-PC-PC-PC-PC
1 2 3 4 5 6 7 8 9 10 11
CC-CC-PL-CP-LC-PC-LP-CL-PC-LP
CC-CC-PL-CP-LC-PC-LP-CL-PC-LP
1 2 3 4 5 6 7 8 9 10 11
CC-CC-PC-CP-CC-PC-CP-CC-PC-CP
CC-CC-PC-CP-CC-PC-CP-CC-PC-CP

In the construction of tapes according to the teachings of this invention, the warp threads are arranged on the loom in the manner indicated and each of the threads put under tension. In practical operation a single weight is applied to several or all of the same kind of threads.

In the weaving of the tapes it should be borne in mind that long fibre cotton threads are preferred for the edges. One reason is that subsequent finishing treatments tend to draw the filler threads into the edge threads which could be done only when the edge threads are of a soft cotton. Such thread is stronger than short fibre. A 24/2 ply long fibre cotton thread of 2 1/4 pound test which in four feet elongates 1 7/8 inches when a one pound weight is applied is very good as an edge thread.

The tension applied to the warp threads during the weaving operation should be such that the filament glass threads are under the greatest stress because they are most important in controlling measuring properties of the tape. Glass filament thread (900/4/4) testing about six pounds per thread and which lengthened one-eighth inch in four feet when stretched with a one pound weight is very satisfactory in the warp. While tapes can be made with all of the warp threads of glass filament thread we prefer to use cotton edge threads and also to mix inorganic fibre threads throughout the strip. The organic fibre threads keep the filling from sliding along the warp and are more receptive to the impregnating coating and printing during the finishing steps. The cotton threads other than the edge threads may have a shorter fibre such as in a 24/2 ply combed peeler with a breaking test of one and one-half pounds. Such a thread will elongate 2 1/2 inches in four feet when a one pound weight is applied. This relatively great elongation requires careful adjustment on the tension of such warp threads because if the tension is too high during weaving the tape will be bumpy and wavy and if the tension is too loose the warp will not be straight. In the preferred constructions a filament glass thread and a cotton or a linen thread are paired, the two ends acting as one warp end, and woven together as such. It will be understood that the glass filament thread is not affected by wetting. Cotton thread is the most elastic and in tape fabrics is most easily stretched again after wetting and drying. Linen thread, on the other hand, while stronger (5# test) and stretching less (1# elongates a four foot thread one-half inch) is subject to shrinkage when wet and is harder to stretch when dried.

After the tape has been woven as a ribbon, a number of steps are necessary to convert it into a measuring tape. The first step is to expose the ribbon to a direct flame for singeing the free fibers on the surface whereupon the strip may be passed through a sizing bath containing starch preferably with a small amount of wax after which the tape is dried. The dry tape is now calendered which includes passing the tape through heated rolls one of which may or may not be travelling at a greater or less speed than the tape which is, in effect, an ironing operation. This tends to reduce the thickness of the strip by flattening the threads both of the warp and the filler which latter is also slightly tightened. From the calender the strip is preferably passed into an impregnating solution which may be primarily an oxidizing oil such as China-wood oil with a drier. When the strip has been thoroughly impregnated with an oil, it is permitted to dry until it can be calendered again.

The impregnated calendered tape is now coated with a paint containing a pigment, a drying oil and a thinner. A typical paint may be made from one hundred pounds of white lead base, two

gallons of linseed oil and two gallons of turpentine. When the paint has been dried, the tape is calendered and given a second coat. When this coat is dry the strip is again calendered and exposed to the atmosphere preferably for several days to insure thorough drying. The strip is then printed with numerals and indicia which are preferably protected by the application of a top coat of relatively non-yellowing drying varnish and again dried to produce the finished measuring tape which may then be put in suitable cases or on reels for commercial use.

The method for making a measuring tape from the woven strip has been set forth in great detail to illustrate the preferred steps. These steps accomplish two principal purposes. The first, involving impregnating with or without a separate coating, sets the fibres and gives the threads protective coatings. Thus the strip becomes relatively unaffected by water and the like and is provided with a surface receptive to the indicia and numerals. The application of the indicia serves the second purpose of making the prepared strip useful for measuring. While the indicia might be applied to the raw strip it is advantageous to give the strip preliminary treatment.

It will be evident that the number of warp threads may be varied and each may be woven singly instead of in pairs. Similarly organic and inorganic fibres may be combined in a single thread. Other variations will also suggest themselves.

One comparative test which illustrates the superiority of the tapes constructed as herein described including inorganic fibre threads involves putting a fifty foot tape under the stress of a three pound pull applied at the end of the horizontal supported strip. The fifty foot mark now becomes the point of reference. The pull is then increased to five pounds and the tape permitted to stretch until it is at rest which occurs in a relatively short time. The increase in length is then noted and the pull increased to seven pounds and the maximum elongation noted. Thereafter, the seven pound pull is reduced to three pounds and the tape will shorten but not to the same extent that it was elongated, and so the length when the weight is reduced to three pounds is always greater than the original length for a three pound weight. Thereafter, all weight is removed and the tape is permitted to stand without any stress applied to it over night and the same procedure as just described is repeated. It will uniformly be found that the tape has recovered to a certain extent and that the subsequent application of three pounds is nearer to the original fifty foot reference mark than was the point noted when the weight was reduced to three pounds in the previous test, but the tape probably will not have recovered so that it is identical with the original measurement of fifty feet. The same operations are repeated daily and the tape permitted to recover over night.

The foregoing tests were made on two commercial woven tapes constructed solely of organic fibre. The maximum elongation in tests repeated day after day gradually and uniformly increased from almost one inch elongation or strain with seven pound stress the first day to one and one-half inches on the fifth day. In each case the residual elongation when the weight was reduced to three pounds gradually increased but the recovery over night brought the tapes back to substantially the same length of about one-fifth of an inch over fifty feet.

Two tapes including filament inorganic fibre threads were also subjected to the same tests. One of these tapes contained thirty warp threads of cotton and twelve of filament glass fibre more or less uniformly distributed across the tape as in Example I. The other tape had nineteen cotton threads, eighteen linen threads and five filament glass fibre threads substantially as in Example II. Both tapes were woven in the manner described above. Since the results obtained were substantially identical the results of the tests as applied to only one of these need be given. With the application of a three pound tension on the tape the measurement of fifty feet was the reference point. Increasing the weight from three pounds to five pounds and from five pounds to seven pounds as above described produced an elongation of the tape of four-tenths of an inch. When the weight was reduced to three pounds, the tape promptly returned to within one-tenth of an inch of the fifty foot reference mark. Over night there was a slight recovery so that the initial length of the tape when the three pound weight was again applied was just barely over the fifty foot length. Upon repeating this operation for five successive days, the increase in elongation when the seven pound weight was applied over the first day's maximum was one-tenth of an inch.

At the end of the fifth day, the commercial organic fibre tapes and the tapes manufactured as herein described were given an eight hour water immersion which was considered as not sufficient to thoroughly penetrate through the coating on the tape and the tests were then repeated. One of the commercial tapes when the three pound weight was first applied and while the tape was still wet showed an increase in length of four-tenths of an inch. The other commercial tape was shrunk so that when the three pound weight was applied the tape was four-tenths of an inch short. Both tapes containing the glass filament threads were less than one-fifth of an inch short. When the weight was increased on the organic fibre tapes to seven pounds both of these tapes were stretched until they were two and two-tenths inches longer than fifty feet. Both of the tapes which included the filament glass threads increased their length less than one-half inch beyond the reference point.

Repeating the increase in weights without any further immersion for six more days for a total of seven tests, the organic fibre tapes recovered to the point where their maximum daily elongation was to one and six-tenths inches and their maximum recovery over night restored them to fifty feet and six-tenths inches. At the same time the tapes containing the filament glass threads never elongated more than six-tenths of an inch and recovered to either exactly fifty feet or less than one-tenth of an inch over the fifty feet. At the end of this period the several tapes were given a twenty-four hour immersion in water and while still wet the three pound weight was applied to each of the tapes. Both commercial all organic fibre tapes were one and two-tenths inches short. The tape containing the linen and the filament glass thread was nine-tenths of an inch short while the cotton and filament glass thread tape was two-tenths of an inch short. Upon increasing the tension to seven pounds, both of the all organic fibre tapes stretched until one was two and one-half inches too long and the other was one and seven-tenths inches too long. Both of the filament glass fibre tapes elongated only three-tenths of an inch over

the fifty foot mark. After a repetition of the test, the maximum elongation was limited to four-tenths of an inch and the recovery was to the exact fifty foot mark while with the commercial tapes the maximum elongation in one case was just short of an inch and in the other case was about an inch and a half with recoveries to one-half inch too long and one-half inch too short.

The foregoing tests show that a woven tape varies considerably in length depending upon the tension or force exerted on the tape when the measurement is made and that if a tape is wet and put under tension it elongates all out of proportion to the stress applied. Similarly, if the tape is wet too much it may permanently shrink. On the other hand, tapes constructed according to the teachings of this invention having as few as five filament glass fibre threads out of forty-two warp threads vary only slightly upon increasing tension and uniformly recover. Furthermore, the soaking or immersion in water has little permanent effect on the accuracy of the measurements thereafter made with the tape.

The weft thread or filling has been referred to as loosely woven. This should be understood as a relative definition comparing it to the warp. Actually the filling will not freely slide on the warp threads, is closely woven along the length and only sufficiently loose across the width to permit the elliptical flattening deformation of the straight warp threads during calendering without breaking the filling, which, loose as it is, embeds itself in the edge cotton threads. The calendering steps improve the appearance and reduce the thickness of the tape so it can be accommodated in a small case.

Although the invention has been described with reference to certain preferred embodiments and by specific examples, these are to be considered as illustrative of the invention and not in limitation thereof.

What is claimed is:

1. A woven measuring tape comprising organic edge warp threads, certain of the intermediate warp threads being organic fibre threads, other of the intermediate warp threads being glass fibre threads, all warp threads being substantially straight, a filler of sinuous path which retains the warp substantially straight, a coating on the tape and graduations and numerals depicted on the tape.

2. A woven measuring tape having a high resistance to elongation and a high resistance to water comprising a woven strip wherein the warp threads are straight and lie in pairs, the two pairs at each edge being of cotton, certain of the intermediate pairs being of both filament glass thread and organic fibre thread, a filler retaining the respective pairs of threads, a coating on the strip,

and graduations and numerals depicted on the coating.

3. A woven measuring tape comprising a woven strip in which the warp threads are straight and lie in pairs, some of the pairs being a filament glass thread and an organic fibre thread, a filler of sinuous path retaining the warp relatively straight, a coating filling the interstices between the threads and forming a surface on the strip, and graduations and numerals depicted thereon.

4. A woven measuring tape having high resistance to elongation comprising a woven strip wherein the warp threads are straight and lie in pairs, one thread of each of predetermined pairs being of filament glass and the other thread of said pair being of organic fibre and a filler of organic fibre thread retained relative to the warp by the engagement of organic fibres of warp threads with fibres of the filler.

5. A woven measuring tape having a high resistance to elongation and a high resistance to water comprising a woven strip wherein the warp threads are straight, the edge warp threads being of organic fibre, certain of the intermediate warp threads being of filament glass and others of organic fibre, a filler retaining the respective warp threads, a coating on the strip, and graduations and numerals depicted on the coating.

6. A woven measuring tape comprising a woven strip in which the warp threads are straight, some of the warp threads being of filament glass, others of the warp threads being of organic fibre, a filler of sinuous path retaining the warp relatively straight, a coating filling the interstices between the threads and forming a surface on the strip, and graduations and numerals depicted thereon.

7. A woven measuring tape comprising a woven strip in which the warp threads are straight, the straight warp threads being of filament glass and organic fibre, a filler of sinuous path retaining the warp relatively straight and retained relative to the warp by the engagement of organic fibres of the warp threads with the fibres of the filler, a coating filling the interstices between the threads and forming a surface on the strip, and graduations and numerals depicted thereon.

8. A woven measuring tape having high resistance to elongation comprising a woven strip wherein the warp threads are straight, certain of the warp threads being of filament glass and other of the warp threads being of organic fibre, a filler of organic fibre thread retained relative to the warp by the engagement of organic fibres of warp threads with fibres of the filler and graduated indicia thereon.

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