

July 10, 1962

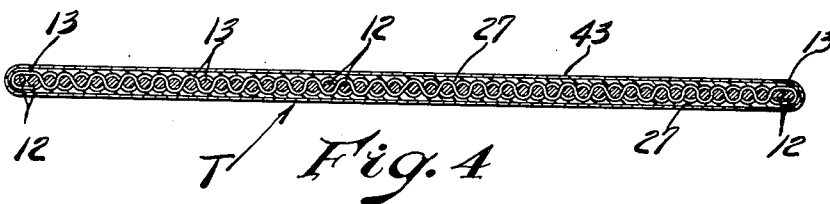
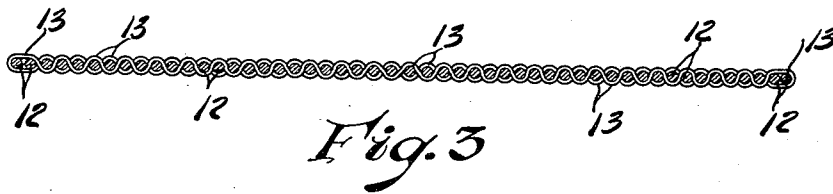
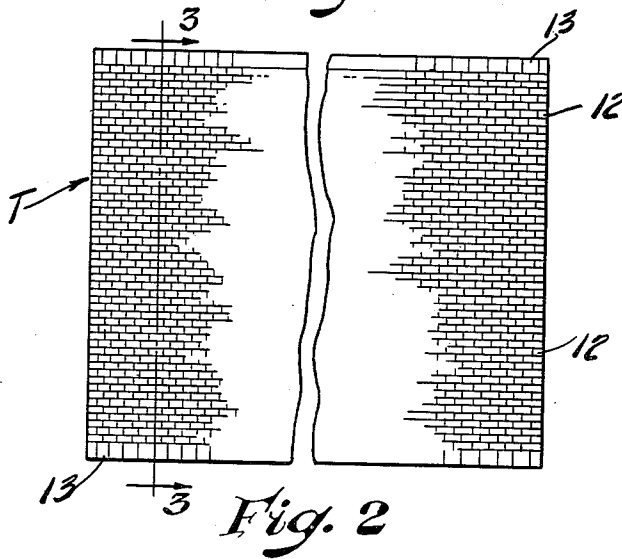
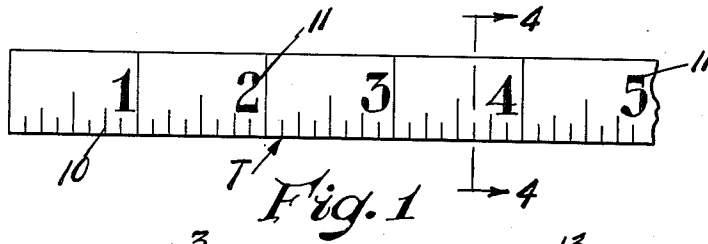
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3,042,990

WOVEN-TYPE MEASURING TAPE

Filed Sept. 7, 1956

2 Sheets-Sheet 1



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WOVEN-TYPE MEASURING TAPE

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2 Sheets-Sheet 2

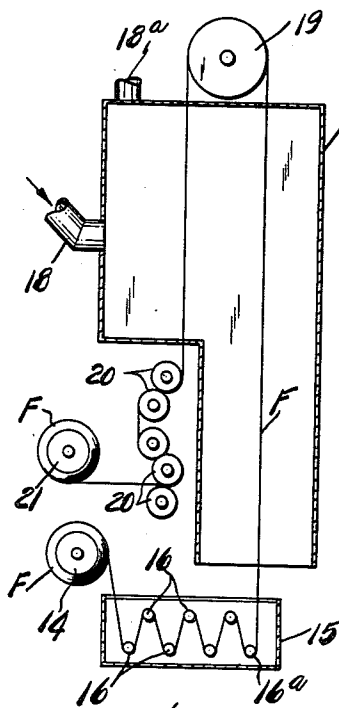


Fig. 5

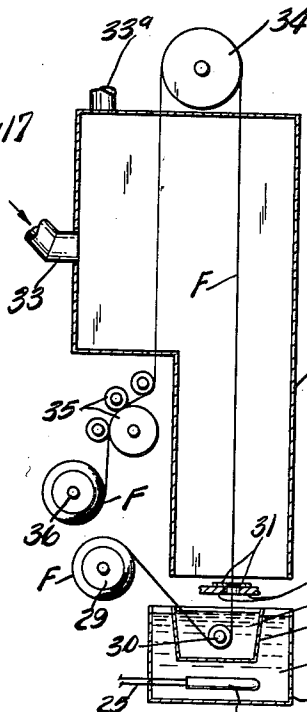


Fig. 6

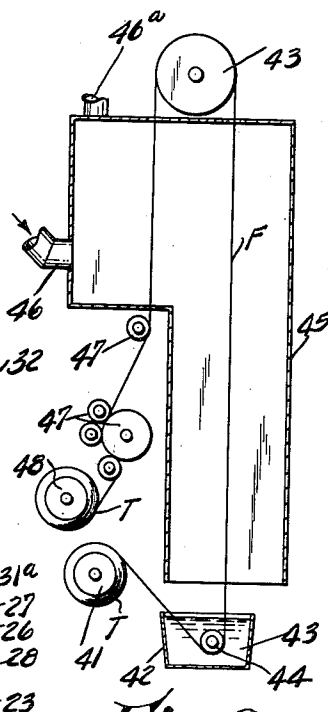


Fig. 8

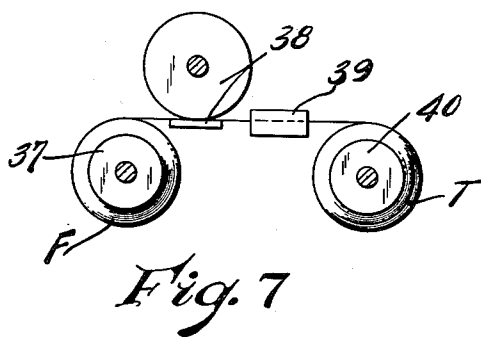


Fig. 7

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1

3,042,990

WOVEN-TYPE MEASURING TAPE

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16 Claims. (Cl. 28—74)

This invention relates to woven-type measuring tapes and more particularly to a greatly improved tape of increased dimensional stability and a novel method of forming the same.

As is well known in the art, manufacturers of woven-type tapes have for many years experimented with various fibrous threads and synthetic and non-synthetic strands of both organic and inorganic material with the ultimate goal of producing a woven tape which is dimensionally stable and for practical purposes cannot be permanently elongated or shrunk under the most adverse conditions a sufficient distance to affect the accuracy of tapes of considerable length.

Tapes in which the warp and weft elements were formed of natural textile materials such as cotton and linen have proved to be generally satisfactory only to obtain approximate measurements and cannot be used where accuracy is necessary. While the dimensional stability of woven tapes was improved by employing interlinear, inorganic materials such as glass fibre filaments or metallic strands in the warp, still the necessary presence of filler textile materials in the warp was objectionable since these latter materials have a high elongation factor and are highly absorbent. Further, the presence of the glass fibre filaments or metallic strands introduced undesirable characteristics into the tape such as an inability to kink or sharply bend without fracturing in the former case, and an electrical conductivity in the latter case.

More recently, an oriented saponified cellulose acetate or rayon thread has been substituted for the textile fibre threads in the warp and it was possible to increase the relative proportion of glass fibre warp threads in these tapes. The use of the oriented saponified cellulose acetate threads permits a greater percentage of glass threads to be employed so that the absorbency of the tape will be decreased. Such a tape, while an improvement over prior tapes, still does not have optimum characteristics, although the combination of these threads in the warp produces a much better tape than could be manufactured if either thread were used exclusively in the warp. However, the glass filament threads in the tape tend to fracture when the tape is creased and do not possess the resiliency necessary to return them to true length once they have been elongated under load, while the oriented saponified cellulose threads have a rather high moisture absorbency factor for the instant purpose and change in dimension an appreciable amount for tapes of considerable length when soaked, and particularly when soaked and placed under load. It is to be noted, also, that the elongation factor of the oriented saponified cellulose threads is considerably greater than that of the glass filament threads. I have discovered that if a synthetic yarn or strand of a certain type which can be thermally set is employed in the warp of a tape, the tape will have a greater dimensional stability than any tapes which have

2

been previously manufactured. The instant invention contemplates the provision of a woven strip having warp threads of a polymer which is known commercially as "Dacron."

One of the prime objects of the invention is to provide a highly accurate woven tape of remarkable dimensional stability, which when wet as well as when dry, is sufficiently flexible so that it can be creased or sharply bent without fracturing any of the fibres or filaments and is sufficiently resilient so that it returns to the dimension at which it has been thermally set if it is stretched.

Another object of the invention is to design a tape which is highly resistant to impregnation by aqueous fluids and has an extremely low moisture absorption factor.

A further object of the invention is to provide a tape which has a greater tensile strength and lower elongation factor than known tapes when wet as well as when dry.

Another object of the invention is to provide a tape of very smooth surface characteristics which will tend to slide over and avoid obstructions and will not readily pick up dirt.

A further object of the invention is to design a tape which is abrasion resistant, highly resistant to ultraviolet light or sunlight, is insoluble in and unaffected by most chemicals, and resists deterioration through action of micro-organisms and insects.

Another object of the invention is to provide a fast-drying tape which is wrinkle resistant and retains its shape under wet and dry conditions.

A further object of the invention is to design a tape of increased durability which has excellent wear qualities and what is known as a high flexure life.

A still further object of the invention is to provide a very economical and practical method of producing a tape of this type.

With the above and other objects in view, the present invention consists in the combination and arrangement of parts and steps, hereinafter more fully described, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims, it being understood that changes may be made in the form, size, proportion, and minor details of construction or procedure, without departing from the spirit or sacrificing any of the advantages of the invention.

In the drawings:

FIG. 1 is a plan view showing a measuring tape.

FIG. 2 is an enlarged plan view showing the woven fabric strip.

FIG. 3 is an enlarged, transverse sectional view taken on the line 3—3 of FIG. 2.

FIG. 4 is an enlarged, transverse sectional view taken on the line 4—4 of FIG. 1.

FIG. 5 is a schematic view illustrating one of the steps in the process of making the tape.

FIG. 6 is a schematic view illustrating another step in the process of making the tape.

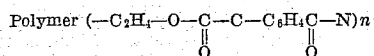
FIG. 7 is a schematic view of an apparatus that may be employed in this process for applying the indicia comprising graduations, numerals and the like to the coated strip.

FIG. 8 is a diagrammatic view of the apparatus that may be employed in this process for applying the top or

undercoat to the printed strip and drying this last employed coating.

This application is a continuation in part of application Serial No. 422,023 filed April 9, 1954.

Referring now more particularly to the accompanying drawings in which I have shown preferred forms of my invention, a letter T generally indicates the finished plastic strip, tape product which is shown in FIG. 1 as provided with indicia including graduations 10 and numerals 11. A strip of the woven plastic fabric F is illustrated in FIGS. 2 and 3 and as shown comprises parallelly disposed, linear, plastic, warp strands 12 of uniform length formed of a synthetic polyester fibre known commercially as "Dacron" which is made by the condensation of dimethyl terephthalate and ethylene glycol. This fibre, sometimes referred to as polyethylene terephthalate material which is manufactured by the Du Pont de Nemours and Co., Inc., of Wilmington, Delaware, is produced from a polymer formed from a chemical composition of ethylene glycol and terephthalic acid. It is believed to be of the following type:



The filling or weft strands 13 which sinuously interconnect the warp strands comprise nylon threads or filaments which are well known for their resistance to abrasion and excellent wearing qualities. The tape is woven in a conventional single weave with the plastic, weft threads interconnecting the respective plastic, warp threads except at the edges of the tape where double warp threads are enclosed by the weave.

The use of a woven strip wherein the warp threads are of Dacron fibres and the weft threads of nylon fibres results in a superior measuring tape which possesses greater dimensional stability than any tape known and which has an increased life because the Dacron fibres lend a flexibility which permits repeated bending or flexing without fracturing the fibres, while the nylon fibres lend a wear resistant quality which resists abrasion as the tape is drawn over rough surfaces. Such a tape will have a greater tensile strength and lower elongation than any known tape and its recovery from stretching under a load which is quickly released will be 100%. In some cases, it may be desirable to employ Dacron strands as the weft threads and such a tape would be only slightly less abrasion-resistant.

The fabric strip F is woven on conventional looms which permit a rigid control of the tension applied to each strand. The Dacron yarns are wound from a creeler onto a beam in the usual manner, and care is exercised in the stringing of the looms so that all strands are uniformly tensioned and the strands are perfectly straight before the weaving operation is begun. At the same time, the nylon yarn is wound onto bobbins and the bobbins are inserted into the shuttles of the looms in the usual manner.

Once the fabric F has been woven, it is spooled onto reels and is then strung through a tensioning assembly which stretches the tape to its elastic limit. It has been determined that at substantially the elastic limit where the woven strip and the Dacron warp strands therein have been stretched to a point that their resistance to further stretching is substantially at a maximum, the tape will have its greatest tenacity and maximum resistance to further stretching.

I have shown a tensioning device of the type which will suit my purposes in FIG. 5, and this assembly includes a payoff spool 14 which feeds the fabric F into a housing 15 in which are a series of vertically spaced, horizontally staggered rollers 16 which support the fabric in its sinuous travel and exert a tension thereon. In this type of equipment, a tension is applied to the spool 14 to prevent its rate of revolution beyond that necessary to produce a predetermined rate of feed and the rollers 16

are driven at progressively greater speeds to exert a progressively increasing tension on the fabric F which at the endmost roller 16a has stretched the fabric as near to its elastic limit as practical with this equipment. From the roller 16a, the fabric F is led upwardly out of the housing 15 through an oven 17 which is supplied with heat through a duct 18 leading from a heater unit and blower fan assembly (not shown) which is capable of heating the oven to a temperature slightly in excess of 375° F. The return duct is indicated at 18a and obviously the oven could be any suitable vertical or horizontal type.

It has been discovered that if the fabric and the Dacron warp threads therein are thermally set in a state in which they are stretched as near to the elastic limit as practical, the tape will possess a dimensional stability which is greatly superior to that of conventional woven tapes, since the maximum resistance to stretch is thermally set in the tape. Such a tape will not shrink and is capable of a remarkable recovery dimensionally if it should be stretched under application of a heavy load. At the upper end of the oven 17, the continuous fabric strip F passes over a pulley 19 and thence leads down through a series of pulling rollers 20 and to a slip type wind-up spool. It requires approximately 17 minutes in an oven where the temperature is approximately 375° F. to 400° F. to heat-set the fabric strip F, and in this time a fusing of the nylon weft threads with one another and the warp threads also occurs. Further, any sizing oils which may have been applied during the throwing or spinning of the yarns are fused at these temperatures.

To provide a maximum resistivity to the permeation of moisture, a nylon coating 22 (see FIG. 4) is then applied to the thermally set fabric F in the following manner. A water bath 23 which can be heated by an electric heating element 24 having wires 25 leading to a power source (not shown) has an inner bath 26 immersed therein. Provided in the bath 26 is what is known as a modified type nylon resin jelly which melts to a liquid 27 of paint-like consistency when heated above 130° F. by the water 28 in the outer bath 23. The temperature of the water in the tank 23 must not exceed 160° F. in order to maintain the nylon liquid at proper consistency for best coating results; and obviously, the temperature of the water can be very readily controlled. This coating 22 will be pigmented with white pigment particles to provide a very suitable background for the numerals and graduations which are later imprinted thereon.

The fabric F leads from a pay-off spool 29 into the bath 26 and around a pulley 30 whence it passes out of the bath through a set of doctor blades 31 which are supported by brackets 31a. Since the fabric F proceeds through the bath 26 at a relatively low rate of speed, the coating is very uniform and the doctor blades 31 further evenly distribute the coating and remove any excess of material which falls back into the tank. From the blades 31, the fabric F proceeds upwardly through an oven 32 in which it is heated to approximately 275° F. and causes the liquid nylon resin which is compatible with both the nylon and Dacron strands to fuse itself with the warp strands as well as the nylon weft strands.

Heating ducts 33 and 33a lead into and out of the oven 32 as usual. The temperature of the oven 32 must be quite rigidly controlled, since to exceed 285° F. might cause the nylon coating to turn yellow and also because the nylon coating will not fuse to the fabric at temperatures below 250° F. The fabric F leads over a pulley 34 above the oven and thence back through the oven through a set of calendering rollers 35 to a wind-up spool 36. This so-called "curing" of the fabric requires approximately 17 minutes at 275° F. and after the fabric leaves the lower oven the tape is wound loosely onto spools or could be permitted to fall into baskets where it remains for a period of approximately two days. While the fabric line cannot be permanently dimensionally elongated so

long as it does not enter an atmosphere of greater temperature than the temperature at which it was thermally set (375° F.), the fabric is stored for this period prior to printing to permit it to recover from any temporary "set" which may have occurred while it was passing through the oven 32 in an atmosphere at approximately 275° F. The thickness of the nylon resin coating is, of course, determined by the doctor blades 31 and clearly squeeze rolls or the like could also be used to insure the desired thickness of the nylon film or coating.

After sufficient time has elapsed for the fabric F to recover, it is passed from a spool 37 between a continuous type printer 38 which employs a non-bleeding type ink of a fast-drying nature to imprint the graduations 10 and 11 and thence through a drier 39 to a wind-up spool 40.

Finally, after it has dried and set, the printed tape T is passed from a pay-off spool 41 through a bath 42 in which is a transparent liquid lacquer 43 which forms a transparent coating to protect the printed surface from wear and abrasion. From a pulley 44 in the bath 42, the tape T passes into a drying tower or oven 45 heated to a temperature of from 160° F. to 175° F., the oven 45 including intake and output ducts 46 and 46a respectively as usual. The drying time is approximately 17 minutes and the completed tape, after passing over the pulley 46 above the tower, returns through the tower over idler rollers 47 to a wind-up spool 48 whence it is in completed form. The coat of abrasive resistance lacquer could have been sprayed, brushed or statically applied if desired. If the instant method is employed, the temperature of the lacquer is closely observed to maintain the lacquer at the proper viscosity to insure proper building and flow out on the tape.

By following the teachings of this invention, a dimensionally stable measuring tape can be produced in a convenient and inexpensive manner. Throughout the processing and thereafter throughout the long life of the product, the tape possesses the resistance to stretch which was heat set in it.

The apparatus shown and described in FIGS. 5-8 is also used to form a tape in which the weft material comprises treated Dacron strands instead of nylon threads and a tape line is provided which can be woven to exactly the width desired. FIGS. 1-3 may be considered to show such a tape with the understanding that the weft strands 13 are Dacron strands treated in a manner which will be described rather than nylon strands.

Even though nylon strands were employed as weft strands in the embodiment of the invention which has been described, it has been necessary to weave the line to a slightly greater width than actually desired because in practice the tape would shrink slightly in width during curing and when it became wet. Obviously, it is very difficult to control the ultimate width of a line or tape when it is necessary to estimate its shrinkage and to my knowledge no one has ever previously produced a tape line which can be simply woven to width. The width of the tape which will now be described as a second embodiment of the invention, will not vary nor will its width differ from the widths of other tapes which are woven initially to the same dimensions.

The second embodiment of the invention contemplates the employment of twisted and stretched Dacron yarn which has been heat-set in stretched condition as the filler. I have produced tapes in which an untreated Dacron yarn was used in place of the nylon yarn previously mentioned. The Dacron yarn, when twisted particularly, has considerable resistance to abrasion; however, it was found that such yarn has also considerable resilience and tended to return to coiled condition once it was unwound from its reel. When it was attempted to weave a flat tape with such a yarn the yarn tended to snarl and also to pull in or pucker the warp strands with the result that accurate printing of the tape was rendered difficult.

When the light denier, Dacron, filler yarn was initially twisted, stretched to substantially its elastic limit, and thence heat set at an elevated temperature, however, it was found that the inherent "return" characteristic of the yarn, and accordingly its tendency to snarl, was removed. The yarn could then be wound on a bobbin and installed in the shuttle of a loom, and would fall into proper position between the warp strands during the weaving operation without puckering the tape.

Apparatus which may be employed to so prepare the Dacron filler yarn is shown in FIG. 5 and has been described. The material F which is treated in FIG. 5 could be a single Dacron filler strand which is heat set in dimensionally stable condition after processing through the apparatus. The yarn would be passed through the oven 17 at such a speed that it would remain therein for about 17 minutes and the oven temperature during the heat setting period should be in the neighborhood of 375° F.-400° F.

Once the filler yarn is prepared in the manner disclosed, the tape is woven in the usual manner previously described and when finished comprises a fabric strip formed of Dacron warp strands which have not been stretched and heat set and Dacron weft strands which have been stretched and heat set. The tape is then stretched to approximately its elastic limit and heat set in this condition exactly in the manner described in the process of the first embodiment of the invention in the apparatus of FIG. 5. The warp strands are stretched in this operation and heat set in stretched condition. At the elevated temperature (375° F. to 400° F.) the weft strands readily fuse with one another and with the warp strands. Once the tape has been heat set in the apparatus of FIG. 5 it may then be processed as before through the apparatus shown in FIGS. 6-8 in exactly the same manner. The measuring tape produced will be permanently heat set with a maximum resistance to stretch so long as it is thereafter not subjected to the heat setting temperature and will never change in length or width. In this respect the Dacron strands are superior to nylon strands which can be heat set, however, not as permanently as can the Dacron strands. Once heat set the Dacron set is permanent and the tape cannot be elongated. It is not elastic as are conventional cloth tapes.

While the first tape described in the specification has proven highly satisfactory and greatly superior to other woven tapes, the tape last described is superior in some respects to the nylon-Dacron tape. For instance, if the nylon weft fibers are heated much above 375° F. in heat setting the Dacron warp strands, the nylon strands tend to yellow and lose some of their tear resistance. With heat set Dacron weft strands woven in the tape the width of the tape as well as the length thereof is dimensionally stable and the abrasion resistance of the twisted strands is greater. Because the heat set Dacron weft yarn exhibits less of a "return" characteristic than the nylon yarn the weaving operation is rendered simpler and can be better controlled. In a third embodiment of the invention both the weft strands and warp strands may comprise Dacron threads which are stretched to substantially their elastic limits and thence heat set at an elevated temperature in the apparatus shown in FIG. 5 as described prior to weaving them. After these tapes are woven they proceed immediately to the apparatus shown in FIG. 6 to receive the pigmented coating and thence are printed in the apparatus of FIG. 7 and finally clear coated in the apparatus of FIG. 8. The process is identical to that described as the second embodiment of the invention except that the warp strands are stretched and heat set prior to weaving rather than afterward. A tape made by this process is not of the quality of one made according to the second embodiment of the invention wherein the warp strands are stretched and heat set after the tape is woven because the warp strands will be in the sinuous form in which they are woven and can be

pulled tight. While the actual length of the strands does not change by pulling such a tape the effective length of the tape will change because the sinuous loops will flatten when the tape is subjected to tension forces. Such a tape is, however, superior to other known tapes than those described in the instant specification. Of course, once this tape is woven it may be processed through the apparatus depicted in FIGS. 5-8 in exactly the same manner as previously described. The tape will then be stretched to near the elastic limit of the warp strands and heat set in this dimensionally stable condition.

It is to be understood that the apparatus for accomplishing the manufacture of the tape may vary and is intended only as illustrative. Further, various equivalent steps in different order may be substituted for those described so long as the novel results described are attained, without departing from the spirit of the invention or the scope of the appended claims. It is contemplated that materials of a similar nature which have the necessary properties may be employed in place of the warp and weft strands described.

What I claim is:

1. A measuring tape having longitudinally extending, aligned, synthetic, plastic warp threads which can be heat set at an elevated temperature, the warp threads comprising fibres heat-set in a condition in which they are stretched to near their elastic limit to a point where resistance to further stretching is near maximum, a sinuous filling of threads interconnecting said warp threads, and graduations on said tape.

2. A measuring tape having aligned warp threads of uniform length, the warp threads comprising polyethylene terephthalate material threads stretched to near their elastic limit to a point where resistance to further stretching is near maximum and permanently heat-set while in this stretched state, and a sinuous filling of synthetic threads interconnecting said warp threads.

3. A measuring tape having aligned warp threads of uniform length, the warp threads comprising polyethylene terephthalate material fibres heat-set in a condition in which they are stretched to near their elastic limit to a point where resistance to further stretching is near maximum, a sinuous filling of synthetic threads interconnecting said warp threads, a synthetic coating on said tape fused to said warp and weft threads, and graduations on said coating.

4. A measuring tape comprising longitudinally extending and aligned synthetic, plastic warp threads which can be heat set at an elevated temperature and which have been stretched to substantially their elastic limit to a point where resistance to further stretching is near maximum and heat-set in said stretched condition at an elevated temperature, and synthetic, plastic weft filler strands which can be heat set at an elevated temperature stretched to near their elastic limit and heat-set in said condition.

5. The method of making a woven measuring tape, comprising synthetic warp strands of a type which can be heat-set and interwoven weft strands, including the step of weaving the strands into a fabric strip in which the weft strands sinuously interconnect the warp strands comprising, stretching the synthetic warp strands in a longitudinal direction until substantially the elastic limit of the warp strands is reached and resistance to stretching is near a maximum, heat-setting the warp strands in stretched condition at an elevated temperature, and printing graduations on the fabric strip.

6. The method of making a woven tape which comprises weaving a fabric strip with threads which include threads of a type which can be thermally set at an elevated temperature, said strip having warp strands and weft strands sinuously interconnecting the warp strands, threads which can be thermally set being employed as warp strands, stretching said warp strands in a lengthwise direction near to the elastic limit of the warp strands

where resistance to stretching is at a maximum, and heat-setting said warp threads at said elevated temperature while the same are in stretched condition.

7. The method of making a woven tape which comprises heat-setting warp yarn which can be heat set at an elevated temperature and which is stretched near the elastic limit of the warp strands where resistance to stretching is at a maximum at an elevated temperature, weaving a fabric strip with warp threads of said yarn and weft threads sinuously interconnecting the warp strands, coating the tape, and printing graduations on the coating.

8. The method of making a woven measuring tape which comprises weaving a fabric strip with threads of a type which can be thermally heat-set at an elevated temperature and threads which have been heat-set at an elevated temperature, said first threads being employed as warp strands and said second threads as weft strands sinuously interconnecting the first threads, stretching said warp strands in a lengthwise direction near to their elastic limit to a point where resistance to further stretching is near maximum, and heat-setting the warp threads while they are in stretched condition.

9. The method of making a woven measuring tape which includes warp strands of a type which can be thermally heat-set at an elevated temperature and weft strands of a type which can be heat set at an elevated temperature sinuously interconnecting the warp strands comprising, stretching said strands to substantially their elastic limit to a point where resistance to further stretching is near maximum, heat setting them in stretched condition at an elevated temperature, weaving them into a tape, coating said tape, and printing indicia on said coating.

10. The method of making a woven measuring tape which includes Dacron warp strands and Dacron weft strands sinuously interconnecting the warp strands comprising, stretching said strands to substantially their elastic limits where resistance to elongation is near a maximum, heat setting said stretched strands at an elevated temperature, and weaving them into a tape.

11. The combination defined in claim 5 in which said fabric is woven with weft strands compatible with said warp strands which fuse one to the other and to said warp strands within said elevated temperature.

12. The method of making a woven measuring tape which comprises weaving a fabric strip with polyethylene terephthalate material warp threads and filler threads, polyethylene terephthalate material threads being employed as warp strands with the filler threads constituting weft strands sinuously interconnecting the warp strands, stretching said warp strands in a lengthwise direction until substantially the elastic limit of the warp strands is reached and resistance to elongation is near a maximum, and heating said strip to substantially 375° F. to thermally set the fabric strip with the warp strands at substantially the elastic limit and fuse the weft strands one to the other and to the warp strands.

13. The method of making a measuring tape which comprises, weaving a strip with synthetic, plastic warp threads which can be heat set at an elevated temperature and synthetic, plastic weft threads fusible with said warp threads at an elevated temperature, elongating the strip to near its elastic limit lengthwise to a point where resistance to further stretching is near maximum, heating said strip to an elevated temperature to thermally set the strip while it is in said stretched condition and fuse the weft strands one with the other and with the warp strands, and printing graduations on said tape.

14. The method of making a measuring tape which comprises elongating a fabric strip comprised of synthetic warp threads of a type which can be heat-set at an elevated temperature and filler weft threads sinuously interconnecting the same to substantially the elastic limit of said warp threads, thermally setting said warp threads

9

at an elevated temperature while the same are in stretched condition, and imprinting graduations on said strip.

15. The method of making a measuring tape which comprises, weaving a fabric strip with Dacron warp strands and compatible weft strands, elongating the warp strands to substantially their elastic limit to a point where resistance to further stretching is near maximum, thermally setting the warp strands while in said state of elongation by heating them above 375° F., applying a coating to said tape at a temperature below 375° F., and imprinting graduations on said tape.

16. A measuring tape comprising a narrow, elongate strip having synthetic, plastic warp threads which can be heat set at an elevated temperature interwoven with weft threads; the tape being stretched lengthwise after weaving to near its elastic limit to a point where it has dimensional stability for a tape and being heat set in this condition; and graduations on said strip.

10

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