Oct. 30, 1956 L. J. RASERO 2,768,419

WOVEN LADDER TAPE AND METHOD OF AND APPARATUS FOR MAKING THE SAME

Filed April 19, 1954 4 Sheets-Sheet 1

Fig. 1.

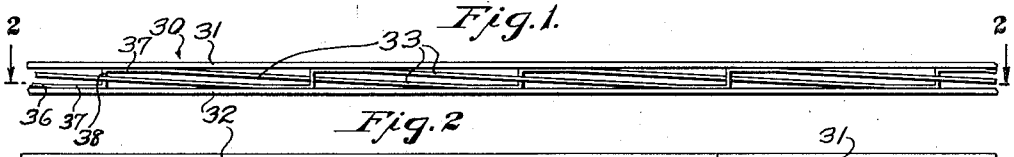


Fig. 2

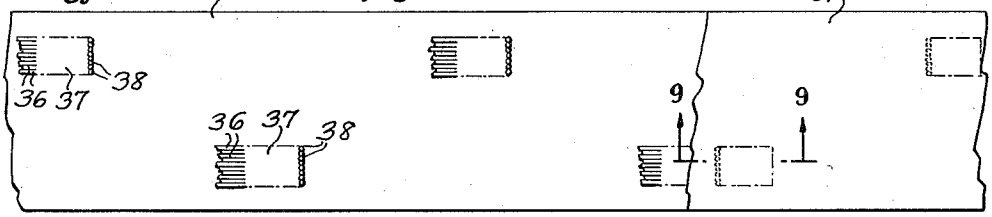


Fig. 3.

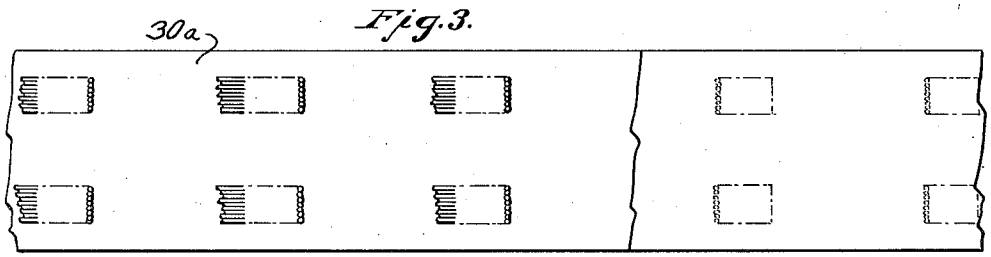


Fig. 4.

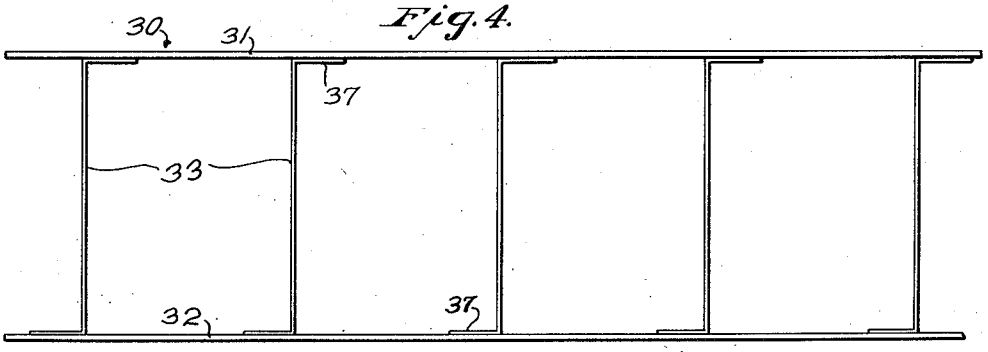


Fig. 5.

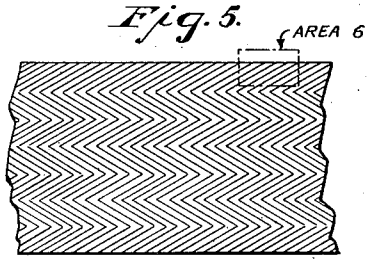


Fig. 9.

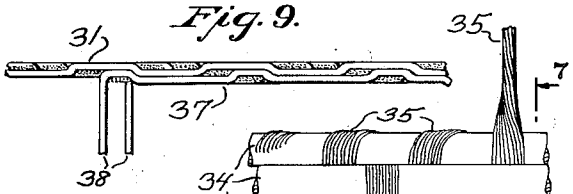


Fig. 6.

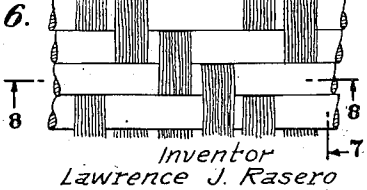


Fig. 8

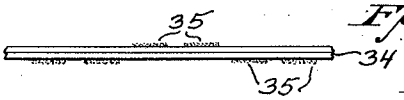
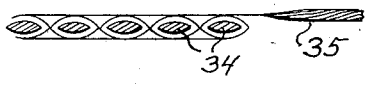


Fig. 7.

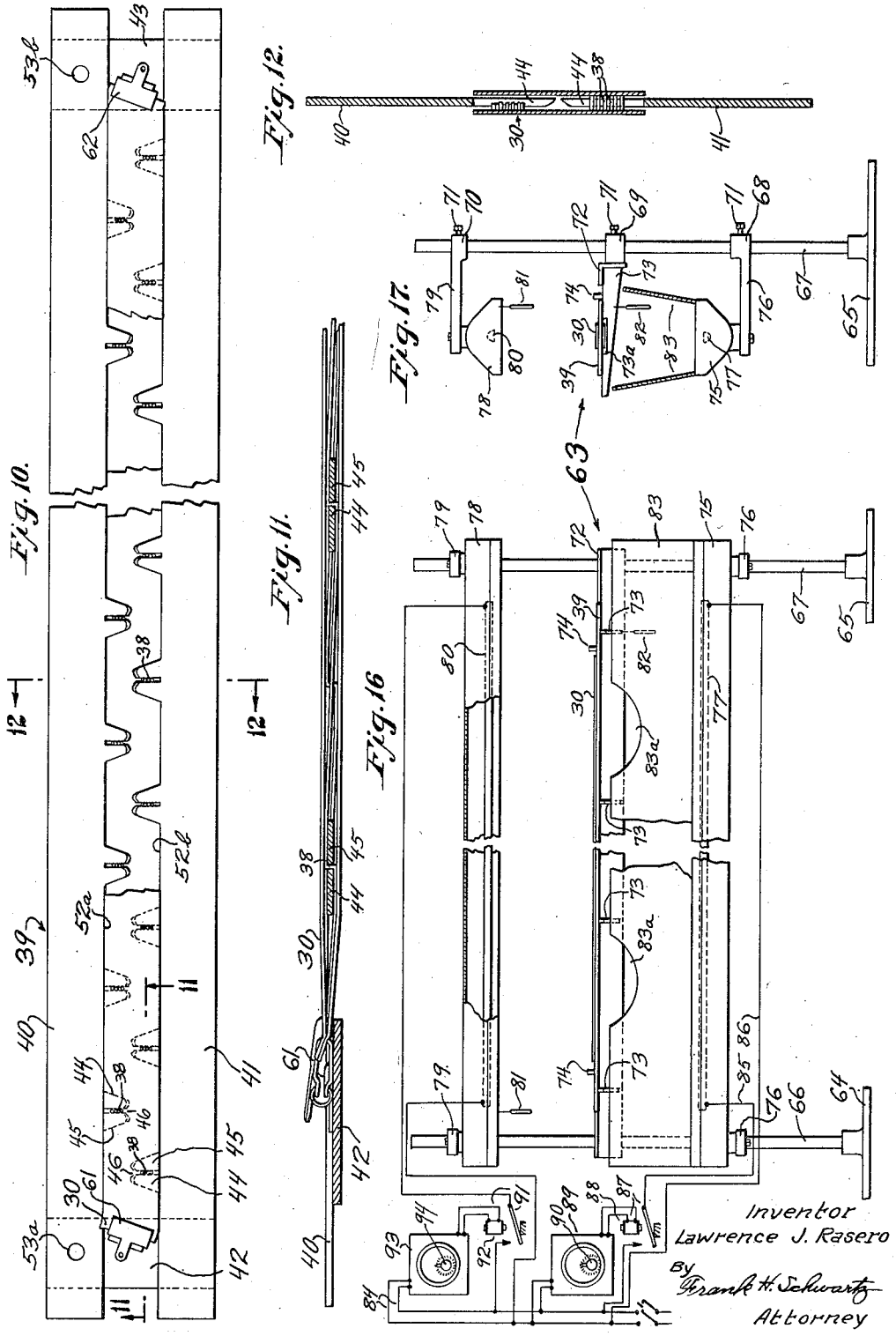


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Oct. 30, 1956 L. J. RASERO 2,768,419

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Filed April 19, 1954 4 Sheets-Sheet 2



Oct. 30, 1956 L. J. RASERO 2,768,419

WOVEN LADDER TAPE AND METHOD OF AND APPARATUS FOR MAKING THE SAME

Filed April 19, 1954 4 Sheets-Sheet 3

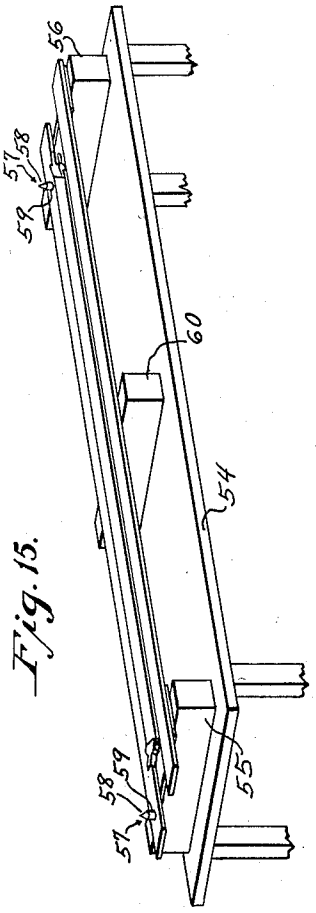


Fig. 15.

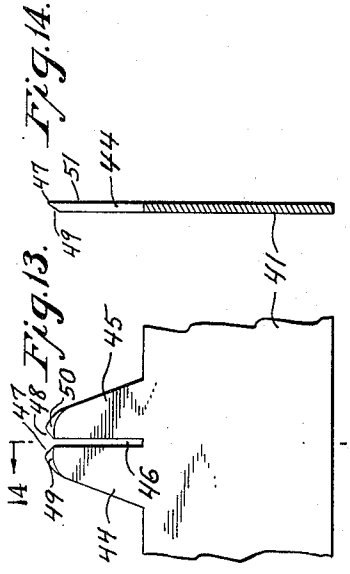


Fig. 14.

Fig. 13.

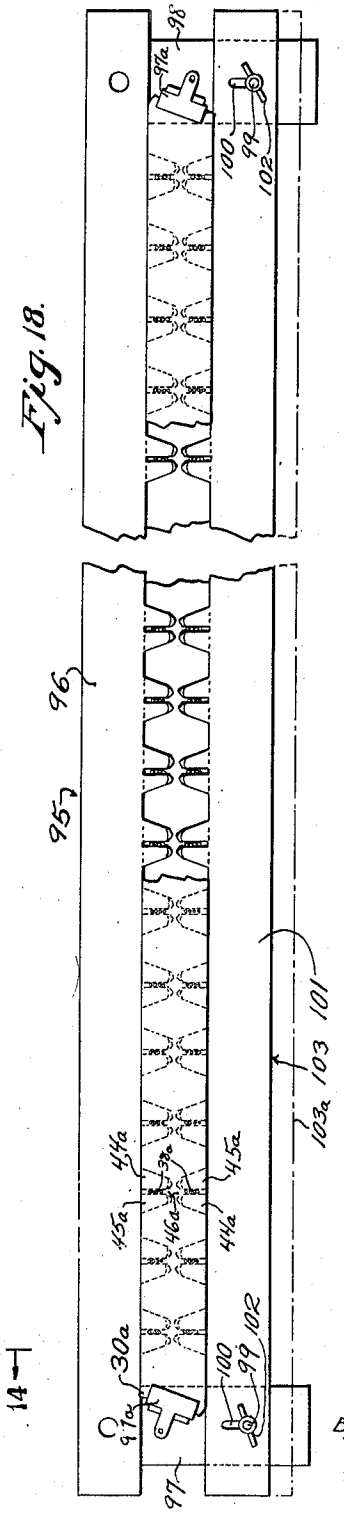


Fig. 18.

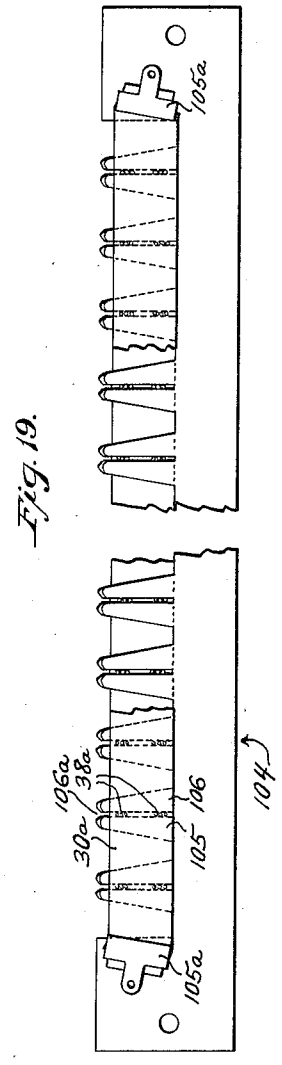


Fig. 19.

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Oct. 30, 1956 L. J. RASERO 2,768,419

WOVEN LADDER TAPE AND METHOD OF AND APPARATUS FOR MAKING THE SAME

Filed April 19, 1954 4 Sheets-Sheet 4

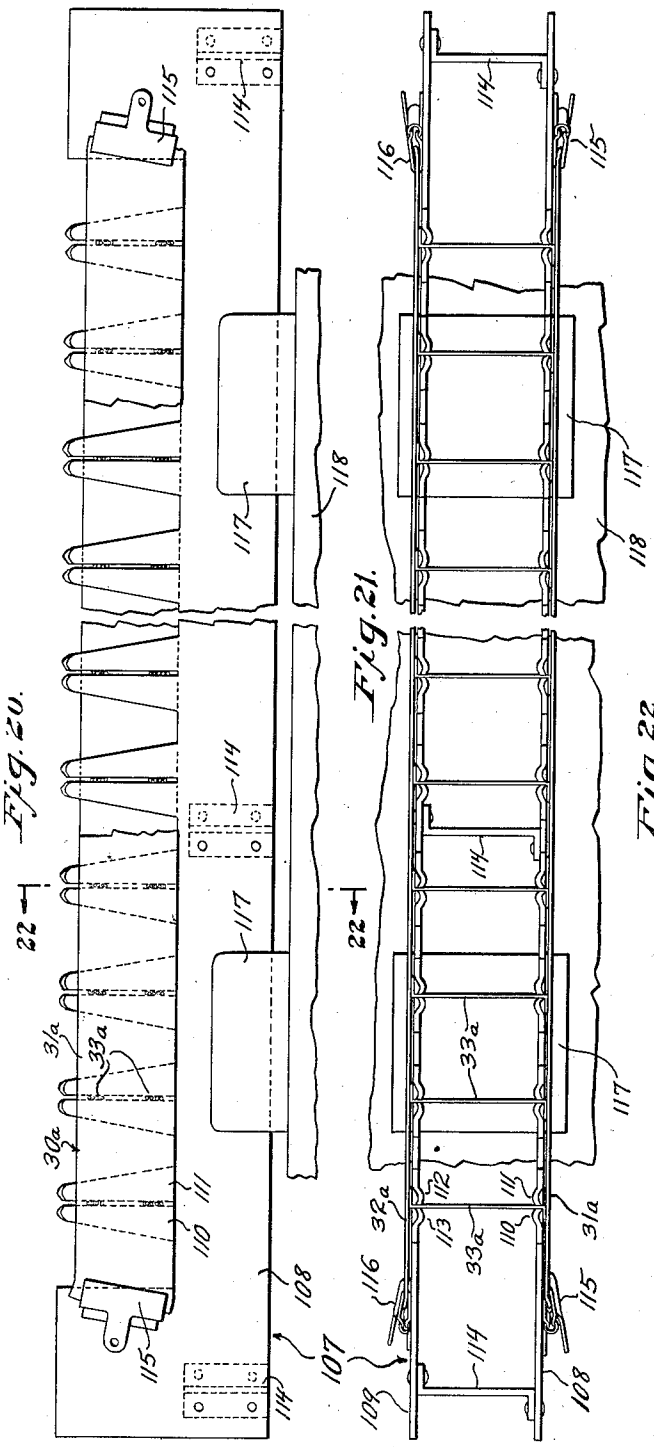
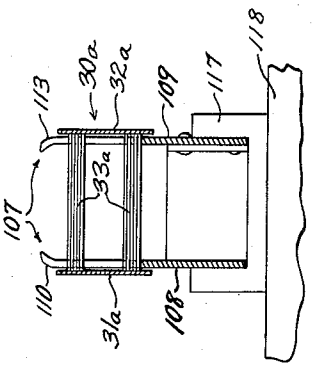


Fig. 21.



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2,768,419

WOVEN LADDER TAPE AND METHOD OF AND APPARATUS FOR MAKING THE SAME

Lawrence J. Rasero, Middletown, Conn., assignor to The Russell Manufacturing Company, Middletown, Conn., a corporation of Connecticut

Application April 19, 1954, Serial No. 423,959

5 Claims. (Cl. 28—72)

This invention relates to improvements in woven ladder tape or webbing also known as Venetian-blind tape, and to methods of and apparatus for making such tape. Such tape comprises a pair of front or face, and back or rear main tapes, beween which extend the rungs or ladders which interconnect the two main tapes, and which also support the slats of the blind.

In the making of woven ladder tape, it has not been possible to weave it with all the ladders substantially uniformly spaced apart a predetermined distance, due to a number of variable factors which have prevented doing so. Such uncontrolled irregularity of spacing has frequently been so great as to result in light showing through between the slats when the blind is closed, a defect that is so serious as to be commercially unacceptable.

One object of this invention, therefore, is to make woven ladder tape in which the ladders are substantially uniformly spaced apart.

Another object of this invention is to provide a method and apparatus for making woven ladder tape in which the ladders are substantially uniformly spaced apart.

Other objects and advantages will appear to those skilled in the art from the following, considered in conjunction with the accompanying drawings.

In the description and claims, the various parts and steps are identified by specific terms for convenience, but they are intended to be as generic in their application as the prior art will permit.

In the accompanying drawings forming part of the present disclosure, in which certain ways of carrying out the invention are shown for illustrative purposes:

Fig. 1 is a full-scale side-edge view of a fragment of staggered-rung or ladder, ladder tape made in accordance with the present invention, before the cross-over floats have been cut to permit the tape to be opened up for use;

Fig. 2 is a sectional view on line 2—2 of Fig. 1;

Fig. 3 is a sectional view similar to Fig. 2, of a fragment of twin-rung ladder tape;

Fig. 4 is a view similar to Fig. 1 but with the ladder tape opened out after the cross-over floats have been cut;

Fig. 5 is a top plan view showing one weave-pattern, of a fragment of the upper main tape of the ladder tape shown in Fig. 1;

Fig. 6 is a view similar to Fig. 5, of an enlarged view of the area 6 thereof;

Fig. 7 is a schematic sectional view on line 7—7 of Fig. 6;

Fig. 8 is a sectional view on line 8—8 of Fig. 6;

Fig. 9 is an enlarged schematic sectional view on line 9—9 of Fig. 2, through a weave-in area of the upper main tape thereof;

Fig. 10 is a top plan view on about a one-third scale, of a heat-setting bar made in accordance with this invention, with a piece of staggered-rung ladder tape shown in heat-setting position thereon;

Fig. 11 is an enlarged sectional view on line 11—11 of Fig. 10;

Fig. 12 is a further enlarged sectional view on line 12—12 of Fig. 10, showing the construction in full-scale;

Fig. 13 is an enlarged top plan view of a fragment of Fig. 10, showing in full-scale, a portion of the heat-setting bar with one pair of holding fingers;

Fig. 14 is a sectional view on line 14—14 of Fig. 13;

Fig. 15 is a perspective view of a table with supporting blocks thereon, and with a heat-setting bar having ladder tape mounted on the bar, and with the bar supported on the supporting blocks;

Fig. 16 is a front elevation, with some parts shown schematically, of a radiant heater for heating ladder tape mounted on a heat-setting bar or the like, to bring about the shrinking and setting of the ladder tape;

Fig. 17 is a right end view of Fig. 16;

Fig. 18 is a top plan view of a modified form of heat-setting bar with a piece of twin-rung ladder tape mounted thereon;

Fig. 19 is a top plan view of another modified form of heat-setting bar with a piece of twin-rung ladder tape mounted thereon;

Fig. 20 is a front elevation of another modified form of heat-setting bar with a piece of twin-rung ladder tape mounted thereon, and shown mounted in upright position on a support for mounting the ladder tape on, and for removing it from, the heat-setting bar;

Fig. 21 is a top plan view of Fig. 20; and

Fig. 22 is a sectional view on line 22—22 of Fig. 20.

Referring to Figs. 1 to 9 of the drawings, the woven, staggered-rung ladder tape 30 includes a front or face main tape 31, and a back or rear main tape 32, with the two main tapes interconnected by ladders or rungs 33 which are connected to the main tapes by weaving at weave-ins 37, in a way well understood by those skilled in the art.

Each of the main tapes 31 and 32 is formed by having main-tape warp strands 34 (Figs. 6 to 8) extending throughout the length of the main tapes and interwoven with the weft picks of a main-tape weft strand 35. Each main-tape warp strand preferably is a plastic strand, preferably a monofilament plastic strand, and preferably of saran plastic which chemically is composed of copolymers of vinylidene chloride and vinyl chloride. Each warp strand also preferably is of considerably less maximum thickness than width, that is, of considerably greater width than maximum thickness.

Each main tape weft strand preferably is a continuous-multi-filament strand, preferably of nylon, and preferably of less twist than seven turns per inch, so that its flattens out where it crosses over and under and between the warp strands.

Each ladder or rung 33 has a group or plurality of ladder-warps or ladder-warp strands 36 which are woven into one main tape, as for example 32 (at the left end of Fig. 1), to form a weave-in or weave-in area 37, which ladder-warps then extend across to the other main tape 31 as cross-over floats 38, and then are woven into the other main tape 31 as a weave-in 37, and which ladder-warps then extend as a ladder or rung 33 back to the main tape 32 where they are woven into main tape 32 as another weave-in 37, and so on throughout the length of the tape. The main difference, so far as this invention is concerned, between the twin-rung ladder tape of 30a of Fig. 3 and the staggered-rung ladder tape 30 of Figs. 1 and 2 is that the twin-rung ladder tape has twice as many ladders or rungs, weave-ins, and cross-over floats per unit of length, as the staggered-rung ladder tape of Figs. 1 and 2 has, as is well known to those

skilled in the art. The form of the ladders shown in this application, is the well-known string-ladder which consists solely of a plurality of ladder-warp strands in side-by-side relation. Another well-known form of ladder is the woven ladder, which has ladder weft strands woven with the ladder warps, but this is not shown in this application as the string ladder is simpler and adequate to illustrate the present invention.

As hereinbefore stated, it has not been found possible to weave ladder tape with all the ladders substantially uniformly spaced apart, that is, with the distance or longitudinal distance or spacing between each two successive places of connection of the ladders with each main tape, a predetermined, substantially constant distance. This is true in a high degree where the main-tape warp strands are of plastic, and particularly where each main-tape warp strand is a monofilament plastic strand, and particularly where such strands are of saran plastic.

Expressions such as longitudinal distance between two successive ladders, means the distance parallel to a side edge of a main tape of the ladder tape, between the two parallel lines at right angles to the said side edge of the tape and respectively passing through the centers of the ladder warp strands of two groups of ladder-warp strands where they extend out from their connections at the weave-ins. In other words, the longitudinal distance between two successive but staggered ladders in Fig. 2 is the same as the longitudinal distance between two successive longitudinally-aligned ladders of Fig. 3. The longitudinal distance between two successive ladders, whether the ladder tape be staggered tape or twin-rung tape, has the same function as concerns the width of a Venetian-blind slat which extends crosswise between such successive ladders.

While I have not been able to weave ladder tape having the previously explained desirable uniformity of ladder spacing as woven, I have found a way of making woven ladder tape that has such desired substantially uniform spacing of the ladders, by first weaving what may be referred to as initial-stage ladder tape with a predetermined and controlled irregularity of spacing of the ladders, and then subjecting such woven ladder tape to controlled shrinking or setting or molding, whereby the spacing between the successive ladders becomes a predetermined substantially constant distance.

In a preferred way of accomplishing the foregoing described result, I first weave the initial-stage ladder-tape with each of the two main tapes substantially shrinkable, and I accomplish this by having each main-tape warp strand, a monofilament saran plastic strand, which is readily shrinkable by heat, and preferably is of the cross-sectional form illustrated in Fig. 7, and preferably about .005" thick by about .020" wide.

The ladder tape illustrated in the drawings is of standard dimensions, and the standard spacing between the ladders is 1⅝". While this tape cannot be woven with such a substantially uniform spacing of the ladders, I can, by a later shrinking and setting operation, give it such a substantially uniform ladder-spacing, by first weaving the tape with spacings preferably varying from about 1²³⁄₃₂" to about 1²⁷⁄₃₂". In other words, I preferably first weave this tape with a minimum ladder-spacing of 1²³⁄₃₂" which is ³⁄₃₂" more than the desired 1⅝" spacing, and a maximum spacing of 1²⁷⁄₃₂", which is ⁷⁄₃₂" more than the desired 1⅝" spacing, although the minimum spacing can be even less than 1²³⁄₃₂", and the maximum spacing can be more than 1²⁷⁄₃₂".

But the originally stated range of about 1²³⁄₃₂" to 1²⁷⁄₃₂" is preferred, because this range of variation as woven, can be maintained in production, and because such woven tape can be shrunk to produce the desired substantially uniform 1⅝" spacing. If the minimum spacing as woven were to be substantially 1⅝", it would result in difficulty in mounting the woven tape on the heat setting means to be presently described, and thus slow up and interfere with maximum speed of production. And if the maximum spacing as woven were to be substantially more than 1²⁷⁄₃₂", it would require a longer heat-treatment to adequately shrink the tape, thus also slowing up and interfering with maximum speed of production.

One form of heat-setting means suitable for heat-setting staggered-rung ladder tape, comprises a heat-setting bar **39** which is illustrated in Figs. 10, 11 and 12, with a piece of staggered-rung ladder tape **30** mounted thereon. The heat-setting bar **39** is formed of two substantially identical steel bar-members **40, 41**, connected together in spaced-apart relation by being secured to end cross-bars **42, 43**. Each of bar-members **40, 41** is formed with a plurality of pairs of heat-setting fingers **44, 45** integrally formed with their respective bar-members **40, 41**, the fingers **44** and **45** of each pair being spaced-apart to form a narrow slot **46** which may be as narrow as about ¹⁄₃₂", or even less, depending on the thickness of the cross-over floats. The narrower the slot, the more nearly accurate the spacing of the ladders will be set to the desired 1⅝" spacing. The slots can be as narrow as will permit the cross-over floats **38** to freely slide into and out of them. The free ends of the fingers **44, 45** are respectively provided with oppositely outwardly flared-end edges **47, 48** to properly guide the cross-over floats **38** into the slots **46**, and the sloping surfaces **49, 50** respectively slope down to the edges **47, 48** which latter are in the plane of the under surfaces **51** of the fingers **44, 45** to cause the ladders, whether consisting solely of groups of ladder warps, or of woven ladders, to ride up along the surfaces **49, 50** on to the tops of the fingers **44, 45** when the upper (inner) surface of the lower main tape **32** is caused to slide along the under surfaces **51** of the fingers **44, 45**, and thus permit the floats **38** to slide into the slots **46**, when the length of ladder tape **30** is being mounted on the heat-setting bar **39**. The distance between the inner edges **52*a*, 52*b*** of the bar-members **40, 41** is preferably a little greater than the width of the ladder-tape to be heat-set, thus permitting the ladder tape to lie between the edges **52*a*, 52*b*** except in the region of the fingers **44, 45**.

The heat-setting bar **39** is provided with a pair of cylindrical holes **53*a*, 53*b*** for a purpose to be presently described. In order to easily mount a piece of ladder tape on, and later remove it from, the heat-setting bar **39**, a table **54** (Fig. 15) is provided with two spaced-apart supporting blocks **55, 56** of wood or other suitable material, secured to the table by screws or otherwise. The two blocks **55, 56** are each provided with an anchor pin **57** having a top conical guide portion **58** to facilitate the holes **53*a*, 53*b*** of the heat-setting bar **39** being readily passed over the tops of the pins **57**, and a cylindrical portion **59** which freely fits in a corresponding one of the cylindrical holes **53*a*, 53*b*** of the bar-member **40** to prevent horizontal displacement of the heat-setting bar **39** during the operation of mounting ladder type on, and removing it from, the heat-setting bar **39**. Preferably, a third supporting block **60** is secured to the table intermediate the two supporting blocks **55, 56**, to support the central portion of the heat-setting bar **39**.

A length of ladder tape to be heat-set, is readily mounted on the heat-setting bar **39** by sliding successive portions of a length of ladder tape, edgewise in successive opposite directions to slide groups of cross-over floats into one or another of slots **46** between each successive pair of fingers **44, 45**, whereupon the opposite ends of the ladder tape are cut on the bias, to the proper length, and secured to the tape-clamps **61, 62**. The tape is cut and clamped on the bias, in order to avoid unravelling the ends of the ladder tape. After the ladder tape has been heat-set, as will be presently described, the ladder tape can be removed from the heat-setting bar by unclamping it and sliding successive portions of it

oppositely edgewise to slide the cross-over floats out of the slots 46, as will be obvious.

The radiant heater 63 shown in Figs. 16 and 17, which can be used for the heat-shrinking and setting operation, comprises two base-supports 64, 65, to which are respectively secured, upstanding cylindrical rod supports 66, 67, along which rod-supports, pairs of collars 68, 69 and 70 are adjustably secured by set screws 71. An angle iron 72 is secured by welding or otherwise to the middle pair of collars 69 carried on the rods 66, 67, and the horizontal support bars 73 each has one end secured to the angle iron 72, and upstanding limit pins 74 are secured to the support bars 73. The heat-setting bar 39, with a piece of ladder tape 30 mounted thereon, is shown on the upper edges of the support bars 73, with the rear edge of bar 39 back against the limit pins 74, ready for a heat-shrinking and setting operation, as will be later described.

A lower radiant heater unit 75 is mounted on a pair of support arms 76 which are secured to the adjustable collars 68. The radiant heater element 77 of the unit 75 is about seventy-nine inches long and has a wattage rating of 3600 watts. The upper radiant heater unit 78 is carried by the pair of support arms 79 which are secured to the adjustable collars 70. The radiant heater element 80 of the upper heater unit 78 is of the same length and wattage rating as the lower heater element 77. The heater units 75 and 78 are adjusted to bring each of the heater elements 77 and 80 about nine inches distant from that main tape of the ladder tape 30 on the heat-setting bar 39, which is nearest. Each of the radiant heater units 75 and 78 is a Chromalox Radiant Heater unit of 3600 watts rating, made by Edwin L. Wiegand Co., Pittsburgh, Pa.

Two thermometers 81 and 82 each capable of withstanding a temperature of above 250° F. without breakage, are respectively hung in positions somewhat as shown in Figs. 16 and 17. The portion of the radiant heater 63 below the support bars or arms 73, is preferably enclosed by a sheet-metal enclosure or plates 83 to hold heat in and reduce the upward travel of heated air, in order to prevent excessive and irregular fluctuation in temperature of different parts of the ladder tape being heated. The notches or cut-outs 83*a* in the front enclosure plate 83 is to accommodate the operator's hands and arms when inserting and removing the heat-setting bar 39 with the ladder tape thereon.

The lower heater element 77 is connected to the alternating current electric supply wires 84 by wires 85 and 86, the wire 85 having a magnetic switch 87 normally open except when closed by its solenoid 88 receiving current from the supply wires through a Cramer Percentage Timer 89 made by The R. W. Cramer Company, Inc., Centerbrook, Conn. This percentage timer is a means for adjusting and controlling the temperature of the heating element 77. By turning the dial knob and pointer 90 to a desired adjusted position, the current to the heater element 77 can be set to automatically be turned on and off for any desired percentages of each successive thirty-second period. In the same way, the temperature of the upper heating element 80 can be controlled independently of that of the lower heating element 77 by the magnetic switch 91 by its solenoid 92, percentage timer 93, and adjustable knob and pointer 94.

In order to start the heat shrinking and setting operation, the power is turned on to heat up the heating elements 77, 80, and left on until the thermometers 81, 82 reach temperatures in the range of 230° F. to 240° F., which may take ten minutes more or less. If necessary, by different adjustment of one or both of the percentage timers, both thermometers can be brought within the desired range of temperature stated. If during use, either thermometer starts to go higher than 240° F., the percentage timer for such heating element will be adjusted to have the heating current on a suitably smaller percentage of the successive thirty-second periods, until the thermometer readings remain satisfactorily within the 230° F. to 240° F. range. Where the two main tapes of a piece of ladder tape are respectively of different colors which have different rates of heating by radiant heat, adjustment of one or both of the percentage timers may be necessary so that the darker colored of the two main tapes will not be overheated.

Next, the operator lifts the heat-setting bar 39 with a length of ladder tape mounted thereon as hereinbefore explained, off of the supporting blocks on the table 54, and places it on the support bars 73 of the radiant heater 63 and back against the limit pins 74, which brings the center of the ladder tape in the vertical line through the center of the heating elements 77, 80, and the operator leaves it there for about twenty-four seconds or such other period as the operator finds to best completely heat-shrink and set the ladder tape, whereupon he removes the bar 39 and places it back on the support blocks on the table 54. After the tape and bar have cooled sufficiently, he removes the piece of heat shrunk and set ladder tape, and mounts a new piece of ladder tape on the bar and puts it back in the heater 63, as previously described, and so on indefinitely.

Inasmuch as the successive ladders, and the corresponding groups of cross-over floats, as woven, are more than the desired final distance apart of 1⅝", the ladder tape as mounted on the heat-setting bar 39, will have the main tapes of crumpled or wavy appearance until after the heat has caused the main-tape warps to shrink until the groups of cross-over floats in the slots 46 hold the main tapes from further shrinkage, thus resulting in the main tapes becoming flat throughout their lengths, and with the distance of spacing between corresponding parts of each two successive groups of cross-over floats substantially 1⅝", and with the distance of spacing between each two successive places of connection of the ladders along each main tape, also substantially 1⅝". And after the hot heat-setting bar 39 with the shrunken ladder tape thereon has been removed from the heater 63 and placed on the supporting blocks on the table 54, and as soon as the main tapes have cooled down well below 150° F., they will not shrink any further, and the ladder tape can safely be removed from the heat-setting bar when the bar and tape are cool enough to be handled by the operator. The crossover floats 38 can then be cut so that the ladder tape can be opened up as shown in Fig. 4, ready for use in a Venetian blind. Lengths of ladder tape can be and have been made by this method, of any needed length for a Venetian blind, by having the heat-setting bar of the proper length.

The modified form of heat-setting bar 95 shown in Fig. 18 is for the purpose of heat-setting twin-rung ladder tape (Fig. 3) which has twice as many ladders per foot of length of ladder tape, as the staggered-rung ladder tape heat-set by the heat-setting bar 39 of Fig. 10. The heat-setting bar 95 has a bar-member 96 fixedly secured to two end cross bars 97, 98, each of which has secured to it, an upstanding screw-threaded pin or screw 99 which extends up through a slot 100 in each end of a movable bar-member 101, so the movable bar-member 101 can be slid back and forth within the range provided by the slots 100, and locked in both its closed and open positions by tightening the wing-nuts 102 which screw down on the screws 99 to clamp the movable bar-member 101 to the end cross bars 97, 98 in any desired adjusted position. Each bar member 96, 101 has a series of pairs of fingers 44*a*, 45*a*, respectively identical with the previously described pairs of fingers 44, 45 of Fig. 10, and arranged as shown in Fig. 18 for heat shrinking and setting twin-rung ladder tape, a piece 30*a* of which is shown mounted thereon with its twin sets of cross-over floats 38*a* in the slots 46*a*, and its opposite ends held by the clamps 97*a*. By sliding the movable bar member 101 back to bring its rear edge 103 to the position indicated by the dotted line

103*a*, ladder tape can be readily placed on the heat-setting bar **95** of Fig. 18, after which the bar **101** is moved back to its full-line position shown in Fig. 18, and the wing nuts **102** are clamped down to prepare the heat-setting bar **96** and its mounted piece of twin-rung ladder tape **30***a* ready for the heat setting operation.

In Fig. 19 is shown a modified form of heat-setting bar **104** which has pairs of setting fingers **105**, **106** which are respectively much the same as the previously described pairs of setting or limit-holding fingers **44**, **45**, except that the fingers **105**, **106** are longer as shown, so they are long enough to be inserted from one edge to extend completely across through a piece of ladder tape, such as the piece of twin-rung ladder tape **30***a* shown mounted thereon with its twin sets of cross-over floats **38***a* in the slots **106***a* and its opposite ends held by the clamps **105***a*. And, of course, the heat-setting bar **104** can also obviously be used to heat-set staggered-rung ladder tape.

In the case of heat-setting bars such as those of Figs. 10 and 18, if it is desired to increase the longitudinal stiffness of such a bar for easier handling, this can readily be accomplished by securing a suitable size of angle iron by riveting or otherwise, to the upper face of each bar member along near the opposite outside edges of the bar members. In the case of a heat-setting bar such as that of Fig. 19, one angle iron could be secured to the upper face of the bar along near the continuous edge opposite from the location of the setting fingers.

In the form of the invention shown in Figs. 20, 21 and 22, the heat-setting bar **107** is for heat-setting ladder tape after it has had its cross-over cut and can be opened out into the position shown in Fig. 4. In this instance, the ladder tape will be heat-set by holding the ladders instead of the cross-over floats. After the cross-over floats have been cut, as in the present instance, there are no longer any cross-over floats which could be engaged for heat-setting purposes.

The heat-setting bar **107** comprises two bar-members **108**, **109**, each very much the same as the heat-setting bar **104** of Fig. 19, but with the outer end portions of the pairs of fingers **110**, **111** of bar-member **108**, and the outer end portions of the pairs of fingers **112**, **113** of the bar-member **109**, bent oppositely toward one another as shown in Figs. 21 and 22 to facilitate the mounting of ladder tape on the heat-setting bar **107** for heat-setting. The bar-members **108** and **109** are rigidly secured together by any desired number of spacing **114**. The bar-member **108** has a pair of tape clamps **115**, and the bar-member **109** has a pair of tape clamps **116**.

Where it is stated herein that the distance between successive ladders or other parts is to be 1⅝", it means corresponding portions of such parts, and regardless of whether or not each two successive ladders are staggered, as in Fig. 2, or in line as in Fig. 3. Thus in Fig. 2, the distance between each two successive ladders that are in line, will be wice 1⅝", that is 3¼". And similarly, as concerns the distances between the slots of successive pairs of setting fingers. In considering distances between such successive slots, the distance between the center lines of the successive slots is considered.

The heat-setting bar **107** is shown as supported in the two channel-shape supporting blocks **117** which are secured to a support **118**, in which position, either twin-rung or staggered-rung ladder tape can be readily mounted on, or removed from, the heat-setting bar **107**. A piece of twin-rung ladder tape **30***a* shown, is opened out to a position similar to that shown in Fig. 4, and is slid down over the ends of the fingers **110**, **111**, **112**, **113**, to the position shown in Figs. 20, 21 and 22, with the ladders or rungs **33***a* in the slots between the pairs of fingers **110**, **111** and **112**, **113**, as shown. Then one main tape **31***a* is secured to one pair of tape clamps **115**, and the other main tape **32***a* is secured to the other pair of tape clamps **116**, and the heat-setting bar **107** with the piece of mounted ladder tape is ready to be lifted by the operator and placed in the radiant heater in a position similar to the way the heat-setting bar **104** of Fig. 19 is placed for the heat setting operation, but in the present case owing to the greater distance between the two main tapes which are to be heat-set, it will be desirable to re-adjust the positions of the heater units **75** and **78** to bring their respective heater elements **77**, **80** to the proper distances of about nine inches from the respective main tapes they are to heat.

If so desired, the pairs of limit-holding or setting fingers, instead of being formed integral with the bar members, can be made as each pair of fingers formed integral with a strip of metal, which strips of metal can be riveted or otherwise secured to the top faces of the setting bars or bar elements, crosswise thereof.

Preferably, the support bars **73** of the radiant heater **63**, will each have a clearance depression or space **73***a* below where the ladder tape to be heat-set is located, in order to be clear of and not press against the tape being heat-set, since the warp strands of the main tapes become somewhat soft during the heat shrinking and setting operation. Also, in the case of using heat-setting bars such as in Figs. 19 and 20, care will be taken to have a support bar **73** under each of the wide opposite end portions of the heat-setting bars in order to properly support such heat-setting bars. Also, in supporting any of the heat-setting bars of Figs. 10, 18 and 19 as shown in Fig. 15, care will be taken to provide any needed clearance depressions or spaces, to avoid pressure of the supports against the ladder tape, as the ladder tape is hot when first placed thereon after the heat-setting operation.

While radiant heat is a preferred way of heating the ladder tape for the heat shrinking and setting operation, other heating means such as steam and other heated fluids such as hot air and hot water can be employed instead. The heating and setting operation can be carried out at the temperature of boiling water, and even lower, the lower the temperature, the longer the time the heating and setting operation requires.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all the changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. The method of making woven ladder tape having two woven main tapes with rungs interconnecting the main tapes by ladder-warp strands woven to the main tapes at spaced-apart weave-ins along each main tape, and with corresponding parts of each two successive weave-ins along each main tape spaced-apart a predetermined distance that is substantially constant, comprising: weaving two main tapes that are substantially shrinkable longitudinally, by weaving warp strands that are substantially shrinkable longitudinally, with weft strands to form each main tape; weaving ladder-warp strands in interconnecting relation with the main tapes at spaced-apart weave-ins along each main tape to form said rungs, with distances between corresponding parts of at least some successive weave-ins along each main tape varying substantially from one another but being greater than the said predetermined distance; limit-holding spaced-apart parts of said ladder tape with holding-means constructed and arranged to permit said main tapes when subjected to shrinking treatment, to shrink to cause the distance between corresponding parts of each two successive weave-ins along each main tape to be substantially equal to said predetermined distance; and subjecting said ladder tape while so held, to said shrinking treatment.

2. The method of making woven ladder tape having two woven main tapes with rungs interconnecting the main tapes by ladder-warp strands woven to the main

tapes at spaced-apart weave-ins along each main tape, and with corresponding parts of each two successive weave-ins along each main tape spaced-apart a predetermined distance that is substantially constant, comprising: weaving two main tapes that are substantially shrinkable longitudinally, by weaving warp strands that are substantially shrinkable longitudinally, with weft strands to form each main tape; weaving ladder-warp strands in interconnecting relation with the main tapes at spaced-apart weave-ins along each main tape to form said rungs and weaving said ladder-warp strands as cross-over floats at said weave-ins, with distances between corresponding parts of at least some successive weave-ins along each main tape varying substantially from one another but being greater than the said predetermined distance; limit-holding said cross-over floats with holding-means constructed and arranged to permit said main tapes when subjected to shrinking treatment, to shrink to cause the distance between each two successive cross-over floats along each main tape to be substantially equal to said predetermined distance; and subjecting said ladder tape while so held, to said shrinking treatment.

3. The method of making woven ladder tape having two woven maintapes with rungs interconnecting the main tapes by ladder-warp strands woven to the main tapes at spaced-apart weave-ins along each main tape, and with corresponding parts of each two successive weave-ins along each main take spaced-apart a predetermined distance that is substantially constant, comprising: weaving two main tapes that are substantially heat-shrinkable longitudinally, by weaving warp strands that are substantially heat-shrinkable longitudinally, with weft strands to form each main tape; weaving ladder-warp strands in interconnecting relation with the main tapes at spaced-apart weave-ins along each main tape to form said rungs, with distances between corresponding parts of at least some successive weave-ins along each main tape varying substantially from one another but being greater than the said predetermined distance; limit-holding spaced-apart parts of said ladder tape with holding-means constructed and arranged to permit said main tapes when subjected to heat-shrinking treatment, to shrink to cause the distance between corresponding parts of each two successive weave-ins along each main

tape to be substantially equal to said predetermined distance; and subjecting said ladder tape while so held, to said heat-shrinking treatment.

4. The method of making woven ladder tape having two woven main tapes with rungs interconnecting the main tapes by ladder-warp strands woven to the main tapes at spaced-apart weave-ins along each main tape, and with corresponding parts of each two successive weave-ins along each main tape spaced-apart a predetermined distance that is substantially constant, comprising: weaving two main tapes that are substantially heat-shrinkable longitudinally, by weaving plastic warp strands that are substantially heat-shrinkable longitudinally, with weft strands to form each main tape; weaving ladder-warp strands in interconnecting relation with the main tapes at spaced-apart weave-ins along each main tape to form said rungs, with distances between corresponding parts of at least some successive weave-ins along each main tape varying substantially from one another but being greater than the said predetermined distance; limit-holding spaced-apart parts of said ladder tape with holding-means constructed and arranged to permit said main tapes when subjected to heat-shrinking treatment, to shrink to cause the distance between corresponding parts of each two successive weave-ins along each main tape to be substantially equal to said predetermined distance; and subjecting said ladder tape while so held, to said heat-shrinking treatment.

5. Apparatus for treating ladder tape composed of a pair of woven main tapes with spaced members interconnecting said main tapes, comprising an elongated bar having a series of fingers projecting laterally therefrom at predetermined spacings along said bar corresponding to the correct spacing of said interconnecting members, said fingers being adapted to extend between said main tapes and having slots therein to receive said interconnecting members to hold said members correctly spaced, and means clamping the ends of said tape to the ends of said bar.

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