June 23, 1942. G. F. FRENCH 2,287,519

MULTIPLE WARP LADDER WEB

Filed April 22, 1938 3 Sheets-Sheet 1

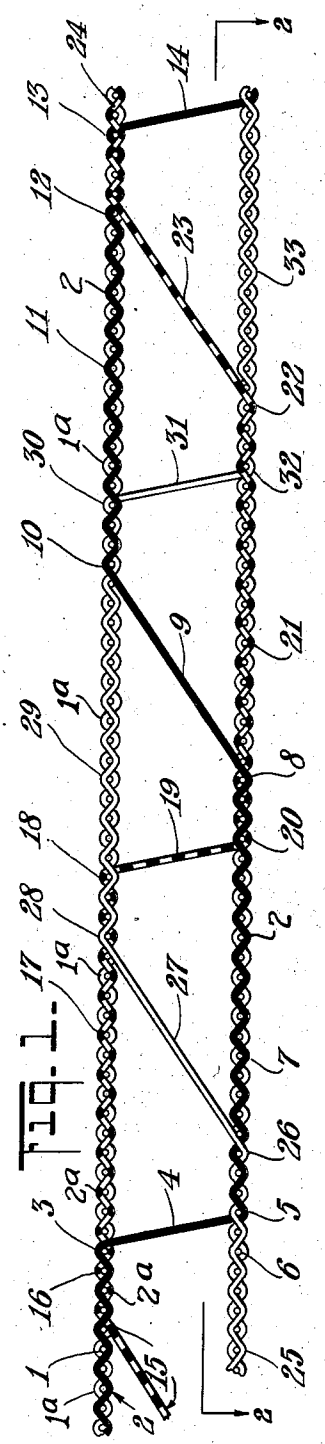


Fig. 1.

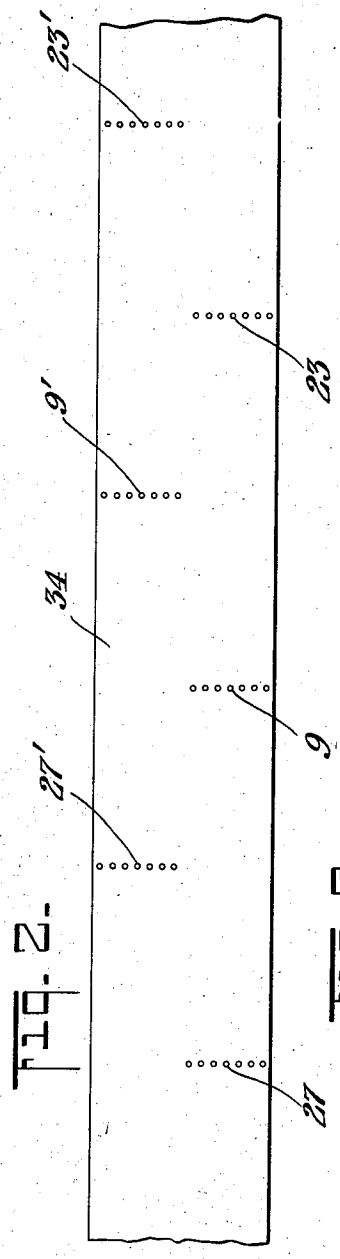


Fig. 2.

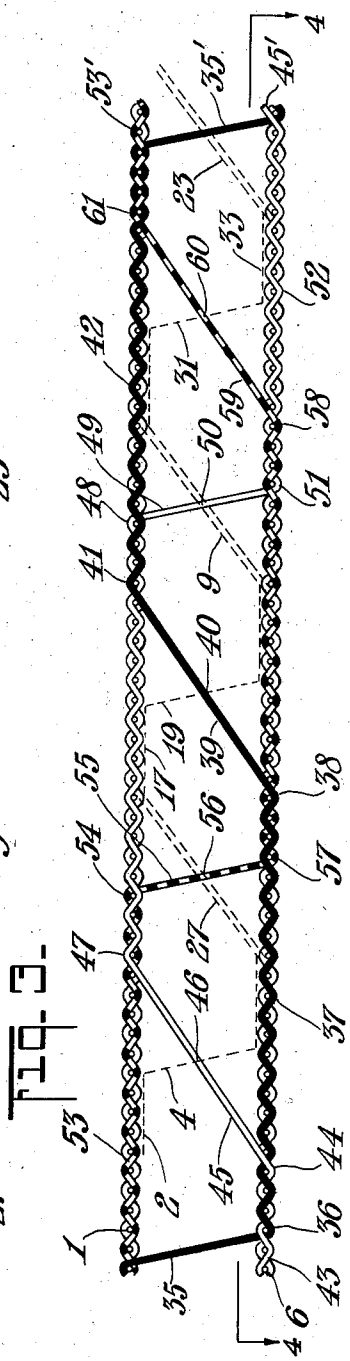


Fig. 3.

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MULTIPLE WARP LADDER WEB

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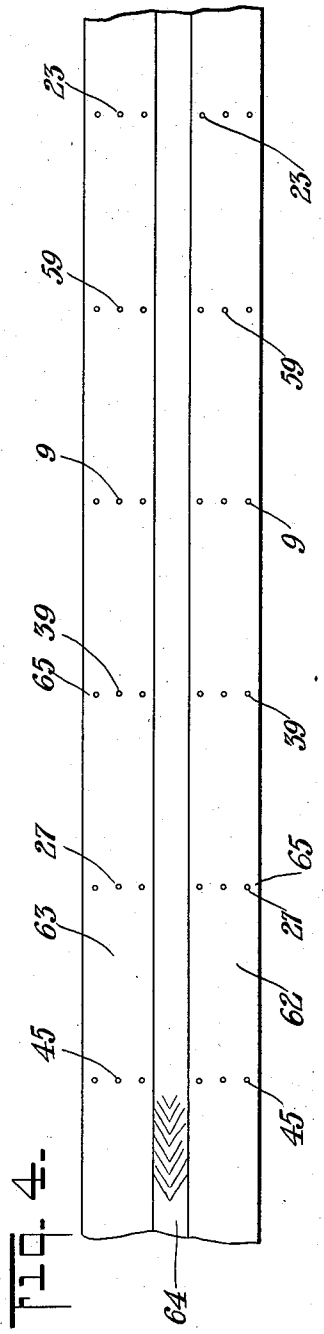



Fig. 4.

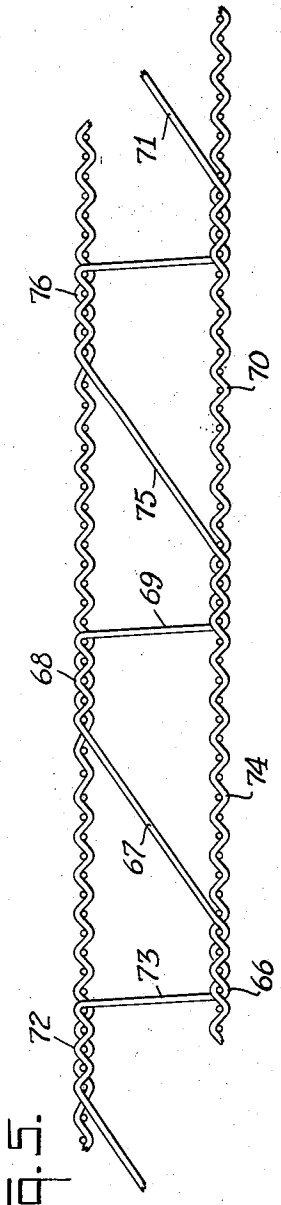



Fig. 5.

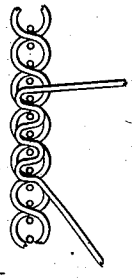


Fig. 7.

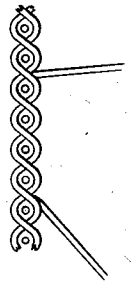


Fig. 6.

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MULTIPLE WARP LADDER WEB

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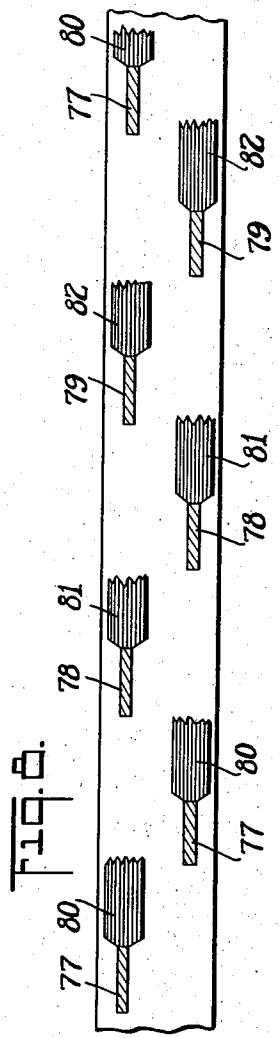



Fig. 8.

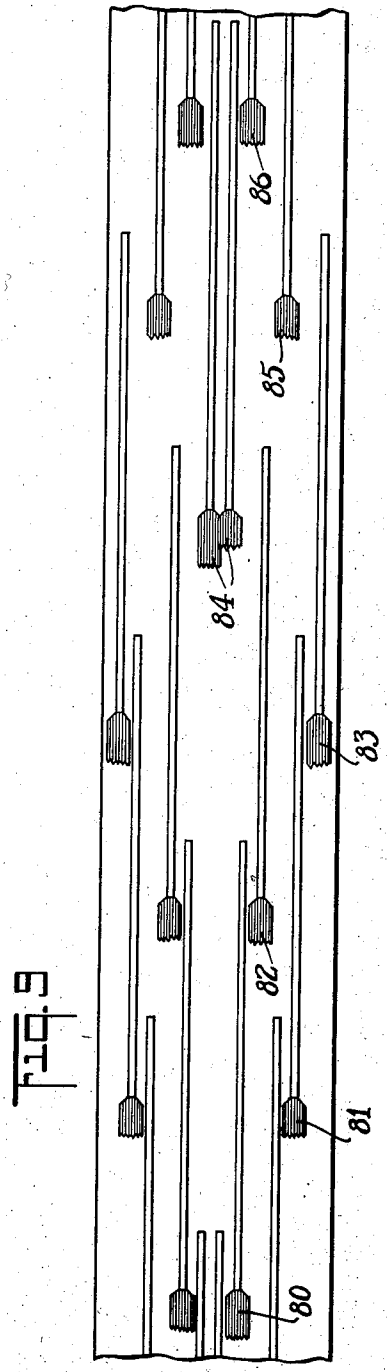



Fig. 9.

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Patented June 23, 1942 2,287,519

# UNITED STATES PATENT OFFICE

2,287,519

## MULTIPLE WARP LADDER WEB

George Frederick French, Manchester, England, assignor, by mesne assignments, to Roger French, Manchester, England, and himself

Application April 22, 1938, Serial No. 203,584
In Great Britain December 22, 1937

16 Claims. (Cl. 139—384)

This invention relates to ladder web, as for example, such as is used for supporting the laths of Venetian blinds or for holding pieces of cork or the like in sun helmets. The present invention is closely related to that described in my copending application Serial No. 203,583, filed April 22, 1938, entitled "Triple warp ladder web," now Patent No. 2,141,038, dated December 20, 1938.

The previously known make of webbing consisted of two lengths of wide outer webbing, usually called "bands" or "bandings," joined at intervals by narrow cross-straps arranged in rows, one near each edge. The connections of the cross-straps with the bandings consisted of short portions of the warp threads of each cross-strap superimposed upon and interwoven with a few of the weft threads of the bandings. The lengths of the connections were at most about half to three quarters of an inch for the largest size of webbing, or longest length of strap, and shorter for smaller sizes of webbing, or shorter lengths of straps. Owing to such short connections and owing to the strap warp threads being only superimposed upon the bandings and only held thereto by the banding weft, the straps were liable to pull out, or become disconnected from the bandings. The weakness of the connections was further accentuated by the use of relatively fine yarn for the cross-straps, and especially in webbing with short cross-straps. Moreover, owing to the superimposing and weft binding-in method of connection, plain weave for strength, the joinings of the cross-strap threads showed through and disfigured the weave of the bandings. A further fault of the known webbing was that, owing to the difficulty of binding-in the cross-straps close to the edges of the bandings, and at the same time retaining perfect selvedges, it was usual for the bandings to overlap the cross-straps at each selvedge by about one-eighth of an inch, thus making the bandings one quarter of an inch wider than they otherwise needed to be, with consequent increase in the cost of production.

In the making of the prior art webbing only one lot of warp threads was used to weave each row of cross-straps, such warp threads being continuous for the whole length of the webbing and, after a cross-strap was woven, being superimposed upon the bandings and bound thereto by the banding wefts, short free cross-warp threads being left between successive bindings-in, which were afterwards cut away to free the bandings from each other where so joined.

With such make of webbing, each binding-in lay opposite a plain part of the opposite banding, and the distance between the cross-straps was determined by the length of successive bindings-in with opposite bandings. Any lengthening of the bindings-in with such known method of production would increase the distance between the cross-straps for a given width of blind lath, and interfere with the required over-lap of the laths.

In the aforesaid copending application I have described ladder webbing which is produced by providing at least three sets of warp threads, each of which successively forms a portion of an outer band, a cross-strap, a portion of the opposite outer band, then crossing over to the first named outer band, and the cycle is repeated. The present invention utilizes the principles involved in said application and provides further improvements and developments which give greater flexibility in operation and allows considerable variation in the manufacture of ladder web.

It is, therefore, among the objects of the present invention to produce ladder webbing in which, without altering the usual spacing of the cross-straps for a given width of blind lath and overlap, the connections of the cross-strap warps with the outer bandings are lengthened and strengthened, and their liability to pull out, or become disconnected from the bandings, thereby reduced to a minimum, if not entirely obviated. A further object is to make use of the increased strength of strap-warp connections to allow of the webbing being produced more cheaply than heretofore, and without the blemishes of the known make of webbing.

It is still further among the objects of the present invention to provide a ladder webbing which allows of a firmer and stronger connection of the cross-straps with the outer bands, wherein the cross-straps may be weftless, narrower outer bands may be utilized, giving greater flexibility in the operation of forming ladder web, allowing greater production from a loom, and resulting in a lower cost of production.

As an example of the practice of the present invention, the warp threads of each cross-strap interchange with, or displace a like number of warp threads of one outer band, and are then interwoven with the other warp threads of the same outer band for a distance equal to the distance from the start of such interweaving to a point where the interweaving of the warp threads of the next strap with the same outer band commences. Where the interchange takes place, the

displaced band warp threads pass over, in the form of short free warps, to the opposite outer band, when a like number of warp threads of such opposite outer band are displaced, and used to form the next succeeding cross-strap, whilst such displaced warps are replaced by the warp threads of the previous interweaving with the first outer band, after which the third cross-strap is formed. The interweaving of the warp threads of one strap with one outer band, followed by free warp threads extending from such band to the opposite band, then by the interweaving of the same warps with such opposite band, followed by the formation of a cross-strap between the bands, form a cycle, which is repeated throughout the length of the webbing for every first and fourth cross-strap, and the same cycle occurs for each of the two intermediate cross-straps.

In such example, three separate sets of warp threads are used, one for the first and each succeeding first cross-strap, another for the second cross-strap, and a third for the third cross-strap, and so on.

The foregoing description applies to the cross-straps lying in one row and at or near one edge of the webbing, and the same applies to the other row of cross-straps at or near the other edge of the webbing, and, as usual, the cross-straps in one row will usually lie opposite the spaces between the cross-straps in the other row, although, as hereinafter described, the straps in one row may lie opposite those in the other row, or slightly in advance. Or, there may be one row of cross-straps only, especially in the case of webbing for small blind laths. For conveniently giving effect to the foregoing method of connecting the cross-strap warp threads to the bands, a multiple warp-shedding motion will be used.

In carrying out the invention according to a further example, the cross-strap warp threads, after forming a cross-strap, are superimposed upon the warp threads of one outer band and bound thereto by the bad weft in like manner to the usual binding-in, but instead of for a short distance only, for a distance reaching to the binding-in of the next cross-strap warp threads with the same outer band, after which they pass to the opposite outer band in the form of short free warp threads. The same length of strap warp thread binding-in then takes place with such opposite outer band, previous to another cross-strap being formed, when, after such cross-strap is formed, the cross-strap warp threads are again bound into the opposite outer band, and so on continuously throughout the entire length of the webbing. As in the first example, there will be a cross-strap between the binding-in of the cross-strap warp threads with one outer band of the preceding cross-strap, and the binding-in with the opposite outer band of the warp threads of the succeeding cross-strap. The same operations take place in the formation of each row of cross-straps. In this last described example, there will also be three sets of cross-strap warp threads.

The cross-strap warp threads, after being interwoven, or bound-in with an outer band, instead of crossing over immediately, as free warp threads, to the opposite outer band, may then be superimposed upon such band for the distance normally required with the old type of binding-in, thereby giving an additional length of connection as well as reducing the length of free cross-warps and the consequent cutting of such warps to a minimum.

Although preferring that the bindings-in shall be of uniform length, those of one outer band may be shorter than the bindings-in of the other outer band, and in such case (as in the others), the cross-strap warp connections with one outer band may be by the warp-interchange method, and the connections with the other outer band may be by the warp-thread superimposing the weft-binding method. In this example, two sets only of cross-strap warp threads may be used.

As usual, the cross-over portion of the free warps between the bands will be cut away after the webbing is fully formed.

In the accompanying drawings, constituting a part hereof and in which like reference characters indicate like parts:

Fig. 1 is a side elevational view, diagrammatic in character, showing one form of the present invention;

Fig. 2 is a horizontal cross-sectional view taken along the line **2—2** of Fig. 1 with the omission of certain details and also of the cross-over threads, and exaggerating the distance between the outer bands;

Fig. 3 is a view similar to Fig. 1 showing a modification of the invention, wherein the structure of Fig. 1 is shown in dotted lines and additional structure is shown in full lines; and

Fig. 4 is a horizontal cross-sectional view taken along the line **4—4** of Fig. 3 with the omission of the cross-over threads.

Fig. 5 is a diagrammatic side elevation of another example of the invention.

Figs. 6 and 7 are side sectional views of portions of one of the outer webbing bands, and show the manner of binding in the cross-strap warps.

Figs. 8 and 9 are diagrammatic sectional plan views of two further examples of the invention.

In accordance with the embodiment shown in Fig. 1, there is provided a weft thread **1** for the upper outer band, said weft thread being woven continuously into a plurality of sets of warp threads **1***a* to form the upper outer band. There is also provided a set of warp threads **2** which are woven with weft thread **1** up to point **3** and the warp threads **2** then cross over at **4**, entering the lower outer band at **5** and being interwoven with the weft thread **6** of said lower outer band, the weft thread being continuously interwoven to form the lower outer band. Said warp threads **2** are continued in the lower outer band over an area **7** leaving said lower outer band at **8** and crossing over to form cross-strap **9**, and entering the upper outer band at **10**. The warps **2** are continuously interwoven over the area **11** to form said upper band past the point **12** and leaving said upper band at **13**, forming a cross-over **14**, whereby the cycle is repeated.

A second set of warp threads **2***a* enter the upper outer band at **15** and are interwoven with the first set **1***a* and **2** between points **15** and **3**, forming a reinforced section **16**. Said warp threads **2***a* continue in the upper band over the area **17**, leaving the same at **18**, crossing over at **19**, and entering the lower outer band at **20**. They are woven into the lower band over the area **21** and between points **20** and **18** form a reinforced section with the first set of warp threads. Said second warp threads **2***a* continue to the point **22**, where they leave the lower outer band, forming cross-strap **23**, and entering the upper outer band at point **12**, continuing in the same as shown at **24**, repeating the cycle. The section

between points 12 and 13 constitutes a reinforced area.

A third set of warp threads 25, forming an area of the lower outer band, leave the same at point 26, forming a cross-strap 27, and entering the upper outer band at point 28 and continuing therein over the area 29. The section between points 28 and 18 constitutes a reinforced area. Said warp threads 25 leave the upper outer band at point 30, forming the cross-over 31. The section between points 10 and 30 constitutes a reinforced area. Said threads then enter the lower outer band at point 32, and are woven in over an area 33, thus repeating the cycle. The section between points 32 and 22 constitutes a reinforced area.

Said reinforced areas serve not only for the purpose of strengthening the entire structure, but they also have the effect of providing a ladder web in which the spacing of the several elements is or may be identical with the spacing of the elements in the old and previously known ladder web.

In the description in connection with Fig. 1, I have set forth the weaving of but a single set of cross-straps, whereas ordinarily there are two sets of cross-straps, alternating along each side of the ladder web. The omission of the second set of cross-straps was in order to clearly illustrate the manner of formation of the present ladder web, and it is understood that a duplicate set of warp threads are to be provided to form the opposite half of the ladder web. In Fig. 2 I have illustrated diagrammatically the entire combination. Outer band 34 has cross-straps 27, 9 and 23, which are formed as shown in Fig. 1 and described herein. Said cross-straps have been indicated as extending from practically the edge of the outer band and extending to practically the centre of the ladder web. A similar set of cross-straps 27', 9' and 23' are formed at the opposite edge of the ladder web by the same process as illustrated in Fig. 1.

In Fig. 3 I have illustrated a form of the invention which does not require staggered or alternate cross-straps, but all of the cross-straps may be in alignment. There is shown in dotted lines the weaving-in of one set of warp threads to form portions 2, 4 and 9, which are respectively, the weaving-in, the cross-over, and the cross-strap of one set of warp threads (see Fig. 1). There is also shown in dotted lines the elements 27, 31 and 33, which are respectively, the cross-strap, cross-over, and weaving-in of the second set of warp threads. There is further shown in dotted lines the elements 17, 19 and 23 which are, respectively, the weaving-in, the cross-over, and the cross-strap of the third set of warp threads.

At the same time that the above-mentioned sets of warp threads are being woven in order to produce the structure shown in Fig. 1, there is provided an additional plurality of sets of warp threads which are woven into the structure and which cross over and through the sets of warp threads of Fig. 1. This is shown in Fig. 3, wherein the warp threads 35 cross over into the lower band at 36, continue therein over the area 37, leaving the same at point 38, and forming cross-strap 39. The threads of the cross-strap pass through and interlace with the threads of the cross-over 19, and they interlace at point 40. Said warp threads then continue, entering the upper band at 41, being interwoven therein over the area 42, and leaving the same to form cross-over 35', repeating the cycle.

A second set of warp threads 43 form part of the lower band, leaving the same at point 44, forming a reinforced section between points 43 and 44, and constituting cross-strap 45. These threads interlace with the cross-over threads 4 at point 46 and continue, entering the upper band at point 47. They are woven into the upper band, leaving the same at point 48, forming cross-over 49, and interlacing at 50 with the threads of cross-strap 9. They enter the lower band at 51, continue therein to form an area 52 of the lower band, leaving the same to form a cross-strap 45', and repeating the cycle.

A third set of warp threads 53 form an area of the upper band, leaving the same at 54, while providing a reinforced section between bands 47 and 54. They then form the cross-over 55 which interlaces with the cross-strap 27 at point 56 and enter the lower band at 57. They continue therein forming an area thereof to point 58, leaving the same and forming a cross-strap 59, and interlace at 60 with the cross-over threads 31. They then enter the upper band at 61 and continue therein over the area 53', repeating the cycle.

From this it will be seen that the two sets of cross-straps which previously were staggered by reason of necessity, may now be placed in alignment, and the width of the ladder web may be decreased by at least half, by reason of this structure alone. It is, of course, essential in this modification of the invention that the portions where interlacings occur, namely, points 46, 56, 40, 50, 60, and so forth, must be constituted by weftless portions of the cross-straps.

In Fig. 4 I have illustrated, diagrammatically, the structure resulting from this modification. The outer band is provided with sets of cross-straps 45, 27, 39, 9, 59 and 23, which are in the positions of the equivalent elements shown in Fig. 3. These sets of cross-straps are shown in Fig. 4 as being divided into two portions 62 and 63 of the outer band, with an intermediate section 64 not containing any cross-strap threads. Usually, section 64 is of twill weave and the warp threads thereof are continuously bound into their respective outer band. The cross-straps have been shown as spaced a short distance 65 back of the edges of the outer band. This is in accordance with prior practice, but is here shown only for purposes of illustration, it not being necessary to have such spacing since no detrimental effects result from placing the cross-straps up to the very edges of the outer bands.

As shown in Fig. 5, two sets only of warp threads may be used for each row of cross-straps, each set first forming part of, or being bound in with one outer band, then crossing over to the other outer band to form a cross-strap, then forming part of, or being bound in with such other band, and finally passing back to the first band as free warps. In this example, one cross-strap formed by one set of warps lies between the cross-straps formed by the first and third set of warps, and whilst the union or binding on of each set of warps with one outer band is relatively long, and approximately equal in length to the distance between successive cross-straps, the union or binding-in with the other band is comparatively short, and parts of such outer band are of single thickness. It is, therefore, preferred to use three or more sets of warp

threads for the cross-straps so that all parts of the webbing bands shall be uniform.

When the cross-strap warp threads are united with the outer bands by binding-in, the binding-in may be as shown in Fig. 6 for a plain weave, and as shown in Fig. 7 for a "twill" weave, the cross-strap warp threads being engaged in both cases by each weft of the bands.

As shown in Fig. 8, in place of using warp threads for the cross-straps, a series of lengths of braid, narrow tape or the like may be used, each length of braid or tape being first superimposed upon and bound to an outer band, then passed over to the other outer band to form a cross-strap and then superimposed upon and bound to the other outer band, afterwards passing back to the first outer band, and again being superimposed upon and bound to such outer band, and so on continuously.

As shown in Fig. 9, a series of no less than six narrow lengths of braid or narrow tape are used in each half of the width of the webbing, and those in one half are arranged so as to cause their cross-strap portions to lie opposite the cross-strap portions of the companion lengths of braid or tape, every seventh cross-strap in each half width being a repeat of the first cross-strap. The dispositions of the cross-straps in the two half parts of the webbing may be other than opposite each other, such as one in one half slightly in advance of one in the other half, or one in one half centrally opposite the spaces between the cross-straps in the other half.

As a result of the longer cross-strap connections, much firmer and stronger unions of the cross-straps with the outer bands are obtained, and with such increase of strength, the webbing (bands and cross-straps) may be made to narrower or lighter proportions. Again, especially in the case of the warp thread interchange method of connection, the points of connection with the outer bands will be less visible, and will not interfere with, or spoil the continuity of the weave of the bands, which may be plain or twill.

The improved warp-thread connection will also allow of the cross-straps being connected at points nearer to, or at the edges of the outer bands, without distorting such edges. Coarser strap warp threads may also be used, and thus give further strength to the connections, or finer yarn may be used for the cross-straps, or both for the outer bands, and the cross-straps.

If desired, the cross-straps may be weftless, in which case the webbing may be formed in one loom slot. And, to further help to lower the cost and expedite production, there may be two wefts laid in each warp shed of the outer bands, and the loom take-up motion speeded up to suit. By making the webbing and cross-straps narrower, they will be further reduced in cost. Each strap is integral with the body webs for a length equal to the distance between the straps, plus the distance required for a lath overlap; consequently giving a much greater purchase of the straps and body than hitherto.

Although I have described my invention setting forth several specific embodiments thereof, my invention is not limited thereto, as said examples were intended to illustrate and not to limit the invention.

Various changes and modifications thereof are possible, for instance, in the case where the warp threads cross over from one outer band to the other and pass through cross-straps, certain of the cross-straps may be composed partly of warp and weft and partly of warp only, and others may be composed of warp only.

When the cross-straps are weftless, and especially when the cross-straps lie in one row and extend across the full width of the webbing, the connetions of the strap warp threads with each band may be somewhat shorter than the distance between successive cross-straps, since the free warps in crossing over from one band to the other may pass through the weftless cross-strap. The cross-straps may be in rows opposite to each other, in which case a lath may be placed between the same to be held firmly in position, or if desired, one row of cross-straps may be slightly in advance of the adjacent row to allow of a lath passing between them and being held thereby.

With weftless cross-straps, the web can be made with two shuttles and the harness tie-up accommodated on a twelve jack dobby with two jacks connected to each of the six cross-strap shafts. The body or outer-band webs are controlled from tappets in either plain, twill or check, whilst the pattern chain or lags for any size will always be three times the number used to make the size by the prior art method.

From the above it will be apparent that my invention is to be broadly construed and not to be limited except by the character of the claims appended hereto.

What I claim is:

1. In ladder web including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises three sets of warp threads, each set forming successively a section of an outer band, a binding-in thereon, a cross-strap, the opposite binding-in and a section of the opposite outer band, and additional warp threads continuously forming part of the respective outer bands.

2. In ladder web including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of sets of warp threads, each set forming successively a section of an outer band, a binding-in thereon, a cross-strap, a section of the opposite binding-in and the opposite outer band, and a cross-over to said first outer band, the cross-over of each set interlacing with the cross-strap of the adjacent set.

3. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of sets of warp threads, each set forming successively part of an outer band, a cross-strap and part of the opposite outer band, and a cross-over, the sets of cross-straps so formed being in alignment along the length of said webbing, the length of binding-in area of each of said sets of warp threads being substantially greater than the distance between adjacent longitudinally spaced cross-straps.

4. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of sets of warp threads, each set forming successively part of an outer band, a cross-strap and part of the opposite outer band, and a cross-over, the sets of cross-straps so formed being in alignment along the length of said webbing, the length of binding-in area of each of said sets of warp threads being substantially greater than the distance between adjacent cross-straps, a portion of said area being woven with two of said sets of warp threads.

5. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of sets of warp threads, each set forming successively part of an outer band, a cross-strap and part of the opposite outer band, and a cross-over, the sets of cross-straps so formed being in alignment along the length of said webbing, the length of binding-in area of each of said sets of warp threads being substantially greater than the distance between adjacent cross-straps, a portion of said area being woven with two of said sets of warp threads adjacent to each cross-over on both of the outer bands.

6. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of separated strap-forming elements taken from the class consisting of sets of warp threads, lengths of braid and narrow tape, each element being successively woven into an outer band, then crossing over to the opposite outer band to form a cross-strap, then being woven into said opposite outer band, and finally passing back to the first band to start a fresh cycle, each of said elements forming a set of cross-straps, the cross-strap of each set alternating with the corresponding cross-strap of the other sets, said cross-straps being equally spaced and in longitudinal alignment on said webbing, the longitudinally adjacent cross-straps being formed from different strap-forming elements.

7. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of separated strap-forming elements taken from the class consisting of sets of warp threads, lengths of braid and narrow tape, each element being successively woven into an outer band, then crossing over to the opposite outer band to form a cross-strap, then being woven into said opposite outer band, and finally passing back to the first band to start a fresh cycle, each of said elements forming a set of cross-straps, the cross-straps of each set alternating with the corresponding cross-straps of the other sets, said cross-straps being equally spaced and in longitudinal alignment on said webbing, the longitudinally adjacent cross-straps being formed from different strap-forming elements, each of said cross-strap elements being woven into the outer bands for a distance at least equal to the distance between said successive cross-straps.

8. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises three separate sets of separated strap-forming elements taken from the class consisting of sets of warp threads, lengths of braid and narrow tape, each element being successively woven into an outer band, then crossing over to the opposite outer band to form a cross-strap, then being woven into said opposite outer band, and finally passing back to the first band to start a fresh cycle, each of said elements forming a set of cross-straps, the cross-strap of each of the three sets alternating with the corresponding cross-strap of the other sets, said cross-straps being equally spaced and in longitudinal alignment on said webbing, the longitudinally adjacent cross-straps being formed from different strap-forming elements.

9. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises two separate sets of separated strap-forming elements taken from the class consisting of sets of warp threads, lengths of braid and narrow tape, each element being successively woven into an outer band, then crossing over to the opposite outer band to form a cross-strap, then being woven into said opposite outer band, and finally passing back to the first band to start a fresh cycle, each of said elements forming a set of cross-straps, the cross-straps of each of the two sets alternating with the corresponding cross-straps of the other sets, said cross-straps being equally spaced and in longitudinal alignment on said webbing, the longitudinally adjacent cross-straps being formed from different strap-forming elements.

10. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of separated strap-forming elements taken from the class consisting of sets of wrap threads, lengths of braid and narrow tape, each element being successively woven into an outer band, then crossing over to the opposite outer band to form a cross-strap, then being woven into said opposite outer band, and finally passing back to the first band to start a fresh cycle, each of said elements forming a set of cross-straps, the cross-straps of each set alternating with the corresponding cross-straps of the other sets, said cross-straps being equally spaced and in longitudinal alignment on said webbing, the longitudinally adjacent cross-straps being formed from different strap-forming elements, those portions of each of said strap-forming elements woven into one outer band being shorter than those portions thereof which are woven into the opposite outer band.

11. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of separated sets of warp threads, each set forming successively part of the warp of a woven outer band, a cross-strap and part of the warp of the opposite outer band and a cross-over, the sets of cross-straps being in longitudinal alignment along said webbing, said cross-straps being weftless, the successive longitudinally aligned cross-straps being formed from different sets of cross-strap warp threads.

12. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises three separated sets of warp threads, each set forming successively part of the warp of a woven outer band, a cross-strap and part of the warp of the opposite outer band and a cross-over, the sets of cross-straps being in longitudinal alignment along said webbing, said cross-straps being weftless, the successive longitudinally aligned cross-straps being formed from different sets of cross-strap warp threads.

13. In ladder webbing including two woven outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of separated sets of warp threads, each set forming successively part of the warp of a woven outer band, a cross-strap and part of the warp of the opposite outer band and a cross-over, the sets of cross-straps being in longitudinal alignment along said webbing, said cross-straps being weftless, the successive longitudinally aligned cross-straps being formed from different sets of cross-strap warp threads, said cross-straps extending substantially to the lateral edges of said outer bands.

14. In ladder webbing including two woven

outer bands and cross-straps therebetween at spaced intervals, the improvement which comprises a plurality of separated strap-forming elements taken from the class consisting of sets of warp threads, lengths of braid and narrow tape, each element being successively woven into an outer band, then crossing over to the opposite outer band to form a cross-strap, then being woven into said opposite outer band, and finally passing back to the first band to start a fresh cycle, each of said elements forming a set of cross-straps, the cross-strap of each set alternating with the corresponding cross-strap of the other sets, said cross-straps being equally spaced and in longitudinal alignment on said webbing, the longitudinally adjacent cross-straps being formed from different strap-forming elements, the components of said strap-forming elements being spaced apart transversely of the webbing, thereby providing a plurality of transversely aligned cross-straps from each of said elements.

15. A ladder tape including: first and second main tapes each formed of warp strands woven with weft strands, part of which warp strands of each tape consist of at least three warpwise-aligned sets of ladder-warp strands which sets also form ladders connecting said main tapes and each of which sets is successively woven with weft strands of said first main tape, then forms a ladder as it extends over to said second main tape where it is woven with weft strands of said second main tape, then forms a cross-over to said first main tape where it is woven with weft strands of said first main tape, and so on, each woven-in section of each of said sets of ladder warp strands being of substantially greater length than the distance between two adjacent warpwise-aligned ladders and having portions in overlapping woven relation with the immediately preceding and following woven-in sections of sets of ladder warp strands of a main tape.

16. A ladder tape including: first and second main tapes each formed of groups of warp strands woven with weft strands, part of which warp strands of each tape consist of at least three warpwise-aligned sets of ladder-warp strands which sets also form ladders connecting said main tapes and each of which sets is successively woven with weft strands of said first main tape, then forms a ladder as it extends over to said second main tape where it is woven with weft strands of said second main tape, then forms a cross-over to said first main tape where it is woven with weft strands of said first main tape, and so on, each woven-in section of each of said sets of ladder warp strands being of substantially greater length than the distance between two adjacent warpwise-aligned ladders and having portions in overlapping woven relation with the immediately preceding and following woven-in sections of sets of warp strands of a main tape, and substantially each woven-in section of substantially each ladder warp strand of said sets of ladder warp strands forming a section of a said group of warp strands.

GEORGE FREDERICK FRENCH.