April 27, 1948. F. W. CLARK 2,440,393

PROCESS OF MAKING LAST-FITTING FABRIC UPPERS

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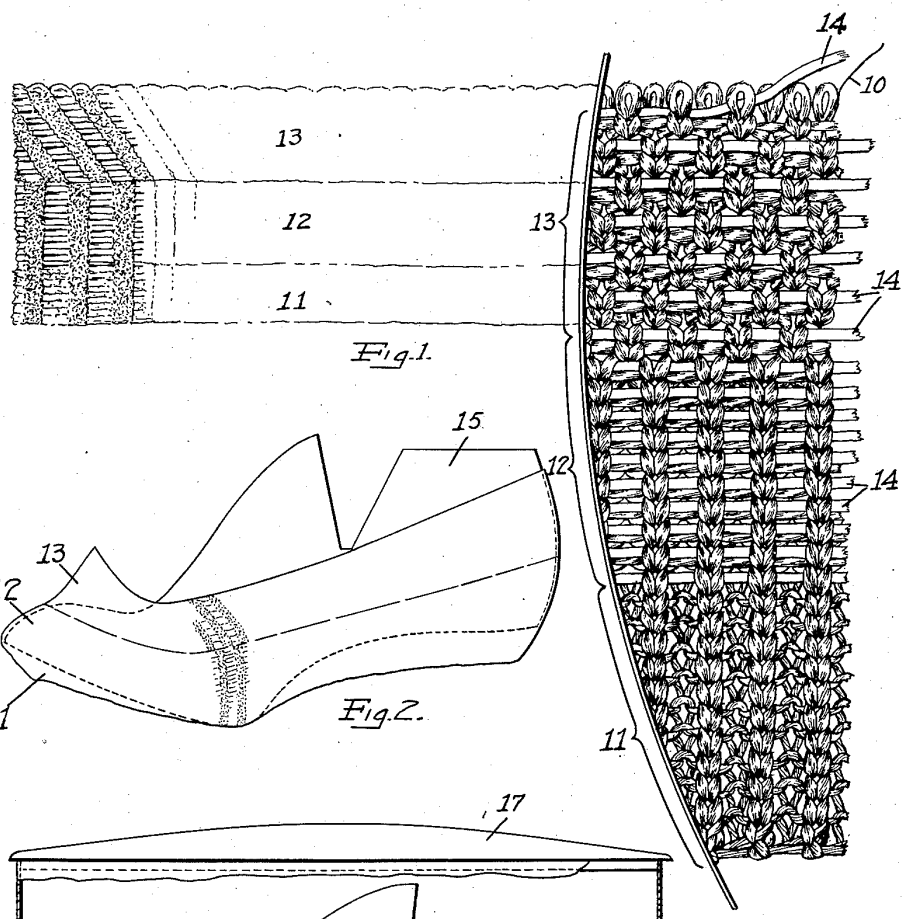


Fig. 1.

Fig. 2.

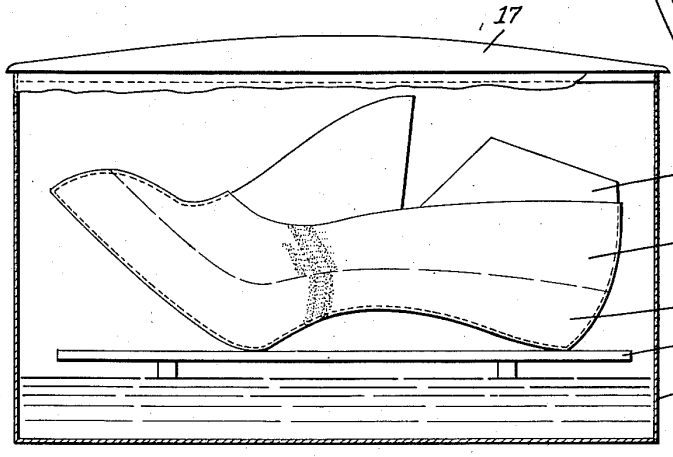


Fig. 3.

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Fig. 4.

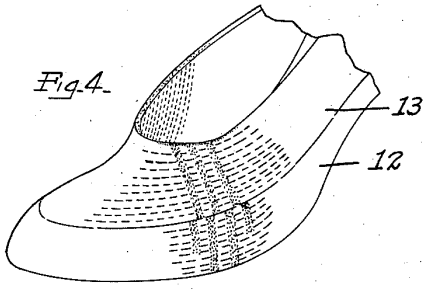


Fig. 5.

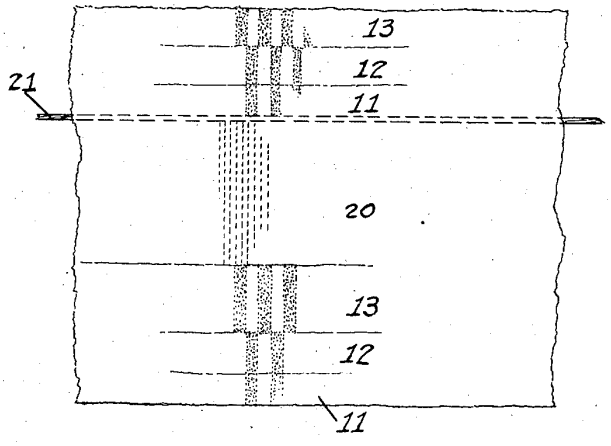


Fig. 6.

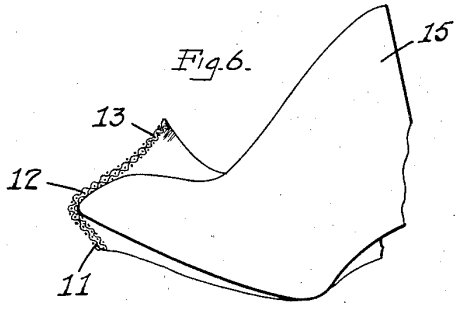
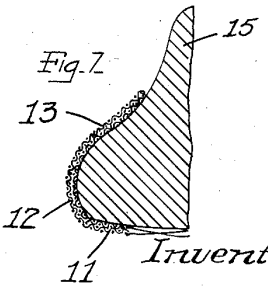


Fig. 7.



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PROCESS OF MAKING LAST-FITTING FABRIC UPPERS

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2 Claims. (Cl. 12—142)

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The present invention relates primarily to shoemaking and consists in a novel process of making of textile material a last-fitting upper which, as a resilient, self-sustaining article, exactly reproduces the contour of the last upon which it is fashioned and preserves or maintains that contour in wear.

A great many attempts have been made over a long period of years to produce a satisfactory shoe upper from knitted or woven textile material, particularly in recent years when there has been urgent demand in women's shoes for a great variety of ornamental and different color effects. None of such attempts has resulted in articles of commercial value, presumably because the uppers produced have retained the shape of the last only very temporarily.

I have discovered, however, that by properly distributing relatively coarse strands of certain thermoplastic material in a knitted fabric and then shrinking these strands in the fabric upon the last I am able to secure a stiff resilient self-sustaining upper in which the shape of the last is accurately reproduced and permanently retained. Vinyl yarn suitable for the purposes of my invention is available in the market as Vinyon HST. It is a thermoplastic resin, more specifically a polymeride of vinyl esters. In the original condition the vinyon yarn is exceedingly strong, tough and non-stretchable. It softens readily and completely when subjected to moist or dry heat, tends to contract as much as 50% in length when permitted to do so and then to thicken and stiffen into a hard, tough, resilient condition. Accordingly, a fabric having sufficient and properly distributed vinyon yarns in its composition may be worked in flexible condition over a last and then, by suitable heat treatment, converted into the desired resilient last-fitting form.

As herein shown the body of the upper may be knitted of any yarn suitable for machine knitting, for example, chenille yarn which is readily available in a great variety of colors and weights. From time to time during the knitting operation relatively coarse or heavy strands of vinyon yarn are laid in place so that they lie in parallel longitudinal courses in the knitted band or web and are substantially straight throughout their length. It will be understood that the knitting operation is carried out without any disturbance to the knitted structure of the fabric and that the vinyon strands are merely enmeshed and surrounded by the knitted structure of the fabric while maintaining their straight

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shape. This procedure permits placing the vinyon strands in any desired grouping; for example, they may be closely arranged in the lower courses of the upper and more widely spaced above that portion.

It is essential that the vinyon strands should extend completely around the upper in a longitudinal direction, that is, around the upper from toe to heel, and that the fabric should be provided in the form of an endless band of such dimensions that it may be worked with appreciable tension over the last with which it is to be employed. The fabric may be knitted as a strip in a flat bed knitting machine and formed into a continuous band by having its ends joined, or it may be knitted as a seamless band in a circular knitting machine.

As an optional and preferred feature of the invention I prefer to employ in the knitted yarn a strand of vinyon or other thermoplastic material. This strand may be intertwined or surrounded by the cotton or other material of the knitted strand and ordinarily will not show in the fabric. This latter plastic strand will, of course, extend in general transversely to the heavier longitudinally disposed vinyon strands. These transverse strands fuse or adhere to the longitudinal vinyon strands and tend to anchor them in the fabric. This insures that the fabric shall contract or shrink uniformly throughout its entire area when the vinyon strands are shrunk to the last. It also prevents raveling when the fabric is cut to any desired shoe shape.

These and other features of the invention will be best understood and appreciated from the following description of a preferred manner of practising the process of my invention, selected for purposes of illustration and shown in the accompanying drawings in which—

Fig. 1 is a plan view of the knitted strip, a portion thereof being shown as magnified approximately four times,

Fig. 2 is a view in elevation of the band stretched upon a last,

Fig. 3 is a view in elevation suggesting the step of steaming the band upon a last,

Fig. 4 is a fragmentary view in perspective of the complete upper,

Fig. 5 is a fragmentary plan view showing a fabric strip of modified structure.

Fig. 6 is a view in elevation, particularly in cross section, showing diagrammatically a position of the fabric band of Fig. 5 upon the last, and

Fig. 7 is a view in cross section showing a portion of the same band as shrunk to the last.

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The band shown in Fig. 1 is knit with a rib stitch upon a flat bed machine from chenille yarn having a plastic strand 10 twisted into it. A section 11 of the fabric is first woven from the chenille yarn alone or from a woolen yarn if preferred. As herein shown, the welt section 11 may comprise approximately nine courses but it may be knitted in any convenient width to cover the marginal portion of the last bottom and to be incorporated eventually in the shoe bottom.

The knitting operation then proceeds for the formation of the second or intermediate section 12, and in forming each course of this section a relatively thick heavy strand of vinyon 14 is laid or placed between the needles so that in the ensuing course the strand is enmeshed in the knitted fabric. As best shown in the magnified portion of Fig. 1, these strands 14 lie closely adjacent in longitudinal parallel relation. I prefer to use vinyon strands made up of thirty 250 denier threads twisted together and to cut the composite strands to the desired predetermined length before the knitting operation is begun. The section 12 is made of sufficient width to extend about the lower curved edge of the last and upwardly over the convex side curvature of the last. Any convenient knitting stitch can be employed in section 12, but as herein shown I have employed the same stitch as that used in the welt varied by the addition of the laid in vinyon strands. While I have referred specifically to vinyon it will be understood that any thermoplastic strand having substantially the same characteristics as vinyon may be employed within the scope of the invention.

The knitting operation then proceeds for the formation of the third or uppermost section 13 and in forming each course of this section the heavy vinyon strands 14 are laid between the needles in every alternate course, that is to say, with approximately twice the spacing of the vinyon strands 14 in the section 12. At the upper edge of the strip shown in the magnified section of Fig. 1, a strand 14 of vinyon is shown in process of being laid in the fabric, it being understood that the loops in the chenille yarn are maintained in two separated series by the needles of the knitting machine thereby affording convenient opportunity for the laying of the vinyon strand. In forming the section 13 any desired form of knitting stitch may be employed, although as shown in Fig. 1 I have employed the well-known popcorn stitch modified by laying in the vinyon strands 14.

The composite knitted strip above described is made of sufficient length to form an endless band which may be worked over the last so as to embrace it longitudinally when the two ends of the band are joined; or, as already suggested, the band may be knitted in a circular knitting machine in endless form so that the step of joining the ends of the flat band is made unnecessary. In the present instance it may be assumed, however, that the two ends of the strip 11—12—13 are united by stitching or binding corresponding to the back seam usually found in uppers. In Fig. 2 the endless band is represented as being worked over a last 15. In carrying out the process, the size of the last and of the band are such that the band embraces the last with substantial tension. The welt section 11 is brought in under the last bottom and the inner edges of this section may be lasted together across the bottom of the last. There is no necessity for closing these edges together beneath the last and ordinarily the welt will constitute merely a marginal band extending about the periphery of the last bottom.

The next step in the process consists in heat treating the upper while tensioned upon the last in order to first soften and then contract the thermoplastic elements of the upper. One convenient manner of effecting the desired results is to place the last, enclosed in the band as suggested in Fig. 2, in a steamer such as shown in Fig. 3. This comprises a cylindrical container 16 having a cover 17 and a support 18 for holding the last just above the water level of the container.

Steam at atmospheric pressure applied for one minute is completely effective for the desired purpose, although it will be understood that under some circumstances the application of dry heat may be preferred. The relation of the band to the last before the steaming operation is indicated in Fig. 6. At the conclusion of the steaming operation the vinyon strands have increased in diameter and have contracted with the fabric in which they are embodied so that the vinyon strands and the fabric fits skin tight upon the last conforming accurately to every curve in its contour. Moreover in cooling, the vinyon elements of the fabric have become stiff and extremely resilient, being set in the shape imparted to them by the last and tending resiliently to reassume that shape if temporarily distorted. The resilient last-fitting upper may now be removed from the last by the same procedure ordinarily followed in removing a lasted upper from the last. The resilient form-fitting upper resulting is suggested in Fig. 4 of the drawings.

In Fig. 1 is suggested the production of a composite band of suitable width for one single ply upper. It will be understood, however, that the knitting operation may proceed until a band is provided of sufficient width to supply bands for two or more uppers set off from each other in the fabric by a parting strand. It is contemplated further, however, that the knitting operation may be continued to produce a knitted lining section as suggested in Fig. 5. This section may be knitted with or without an added vinyon strand and may be set off in the fabric by a parting thread 21 from a similar composite strip. In employing a knitted band of the character shown in Fig. 5, the lining section 20 may be folded down inside the outer sections 11—12—13. The band may be stretched about the last as before and the shrinking operation carried out in the same manner. Fig. 7 of the drawings suggests the two ply or lined upper as it conforms to the last 15 after the shrinking operation.

By reason of the thermoplastic strand 10 which is incorporated in the fabric, a non-raveling characteristic is imparted to the upper. Accordingly, the exposed edge of the upper may be trimmed in any desired outline without in any way disturbing the body of the fabric and the trimmed edge may be bound or finished as desired.

The process above described results in the production of a resilient form-fitting upper such as has not been heretofore available in the shoemaking industry and which should be distinguished clearly from uppers in which thermoplastic strands have been inserted with the purpose of producing stiffened or ornamental areas in the upper but not at all for the purpose of producing a complete last-fitting upper which will

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maintain the shape of the last, yieldingly resist a distorting pressure, and immediately return to its normal last form when such pressure is removed.

Having thus disclosed my invention and described in detail a preferred manner of practising it for purposes of illustration, I claim and desire to secure by Letters Patent:

1. The process of making fabric shoe uppers, which consists in providing a band of chenille yarn having coarse strands of vinyon disposed longitudinally in closely spaced courses in one portion of the band and in more widely spaced courses in an adjacent portion of the band, stretching the band longitudinally about a last with the vinyon strands concentrated adjacent the lower portion of the last and passing about the toe and heel ends thereof, connecting one margin of the band across the bottom of the last, and then steaming the band thereby causing the vinyon strands to shrink and stiffen the band into a resilient, self-sustained last-fitting upper.

2. The process of making a resilient last-fitting upper, which comprises providing a textile knitted band having vinyon strands grouped in parallel adjacent longitudinal zones therein and having different spacings in the respective zones, stretching the band longitudinally upon a last

with the grouped vinyon strands connected in the form of closed loops in the band, the zone of largest concentration of vinyon strands being disposed at the lower side wall of the last and a zone of lesser concentration of vinyon strands being disposed above said first mentioned zone, and then steaming the band thereby causing the vinyon strands to contract, thicken and stiffen and to convert the band as a whole into a resilient self-sustained last-fitting form.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
388,042	Hillman	Aug. 21, 1888
625,331	Heaton	May 23, 1899
1,130,859	Thomas	Mar. 9, 1915
1,640,362	Mahler et al.	Aug. 30, 1927
2,144,689	Roberts	Jan. 24, 1939
2,262,861	Rugeley et al.	Nov. 18, 1941
2,266,631	Francis, Jr.	Dec. 16, 1941
2,312,089	Gobeille	Feb. 23, 1943
2,314,098	McDonald	Mar. 16, 1943
2,345,055	Lilley et al.	Mar. 28, 1944

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