

July 5, 1966

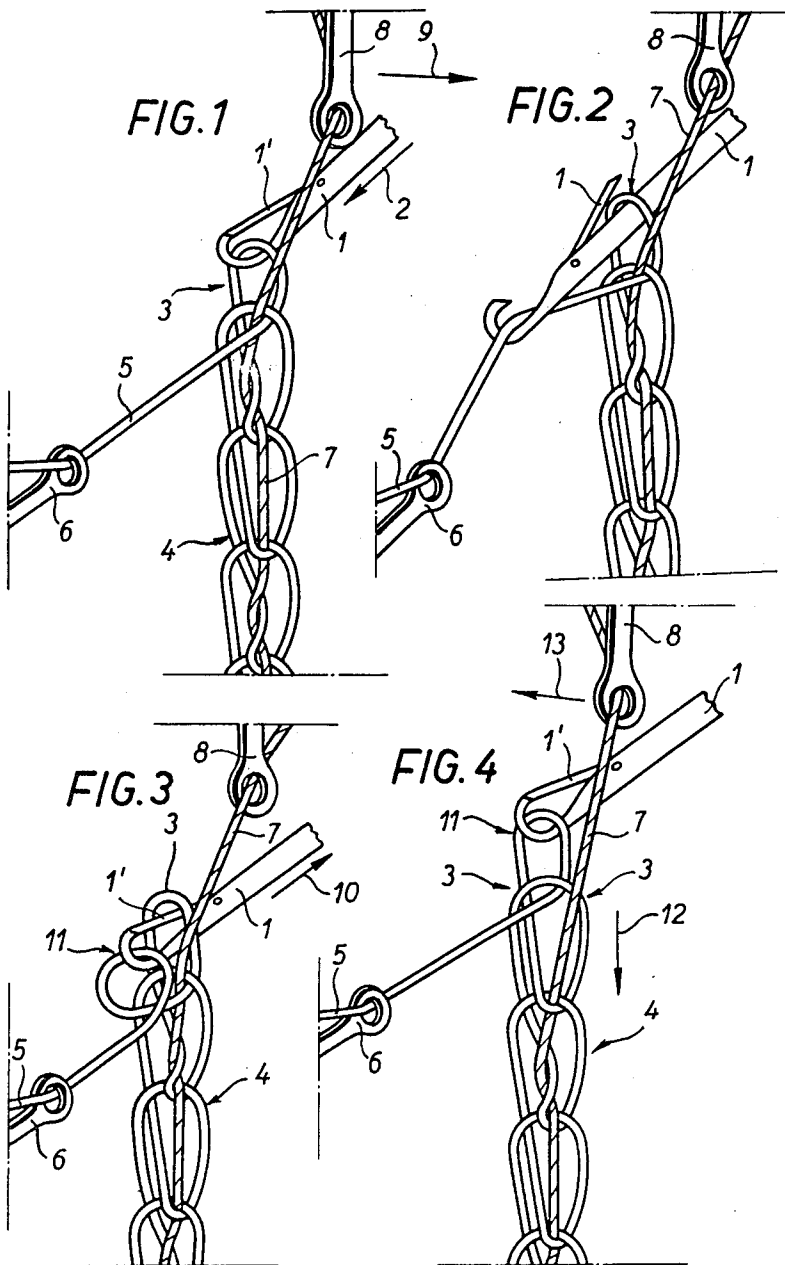
A. FORMENTI

3,258,941

RESILIENT KNITTED BAND

Filed May 21, 1963

6 Sheets-Sheet 1



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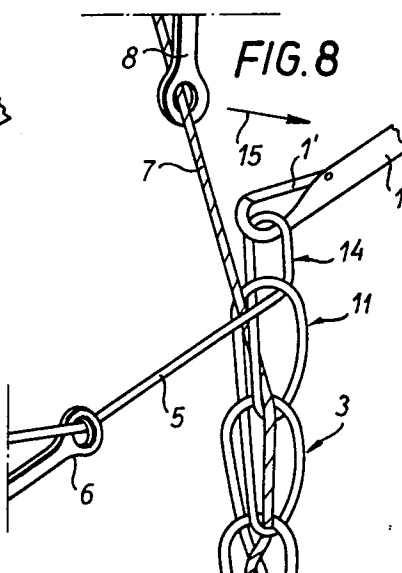
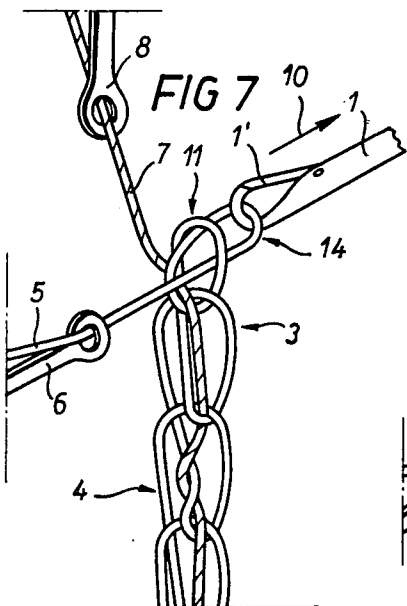
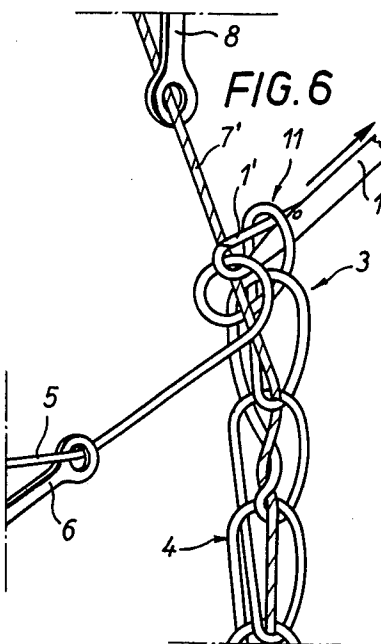
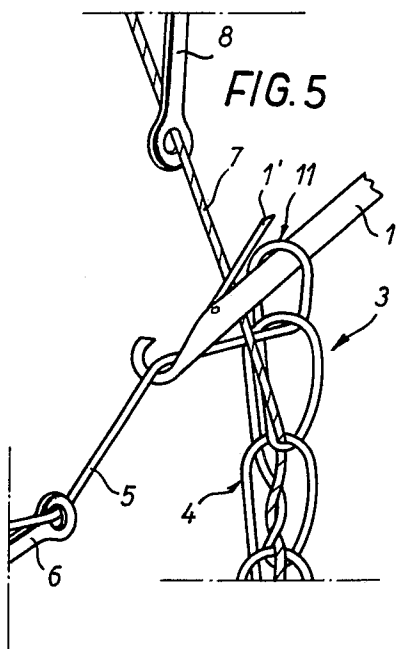
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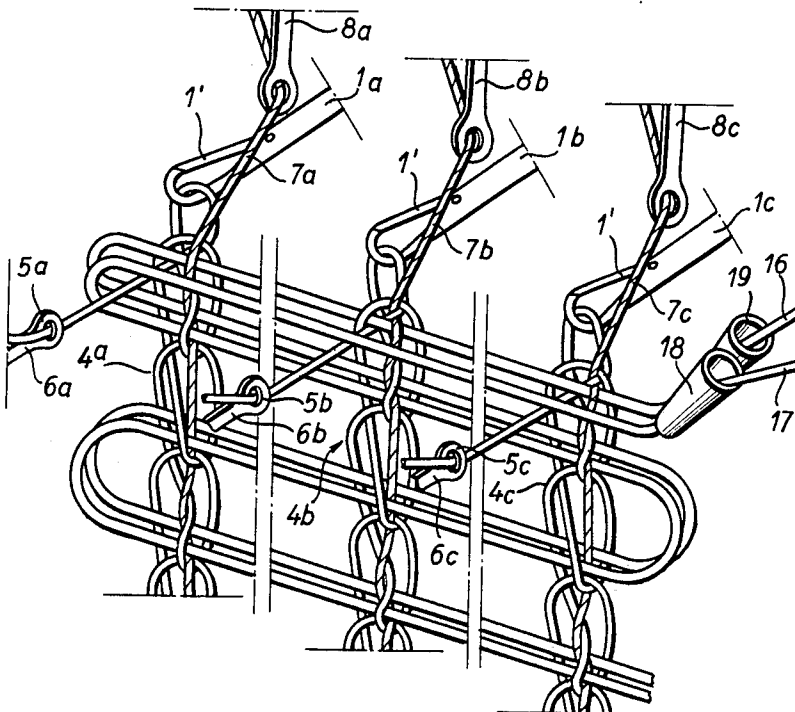
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FIG. 9



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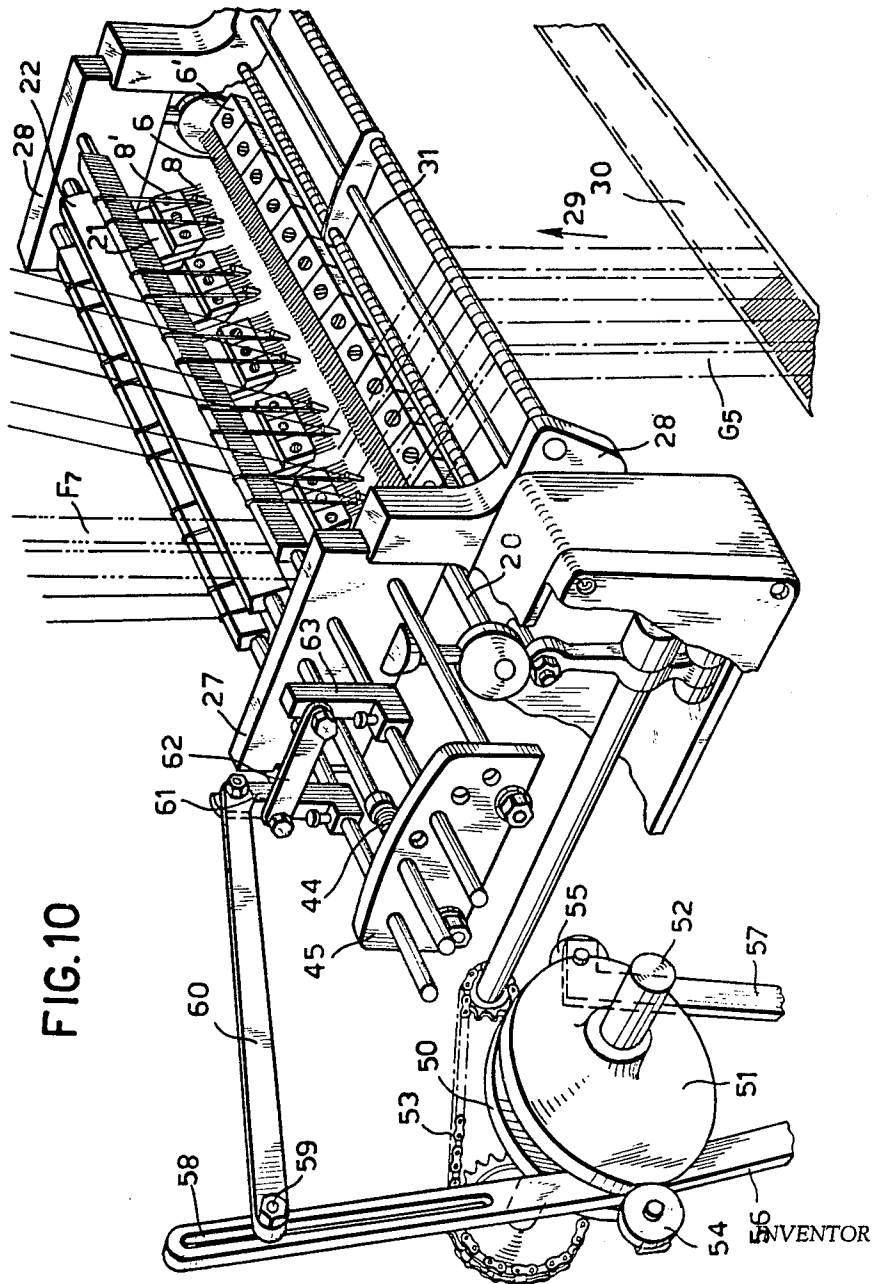
A. FORMENTI

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RESILIENT KNITTED BAND

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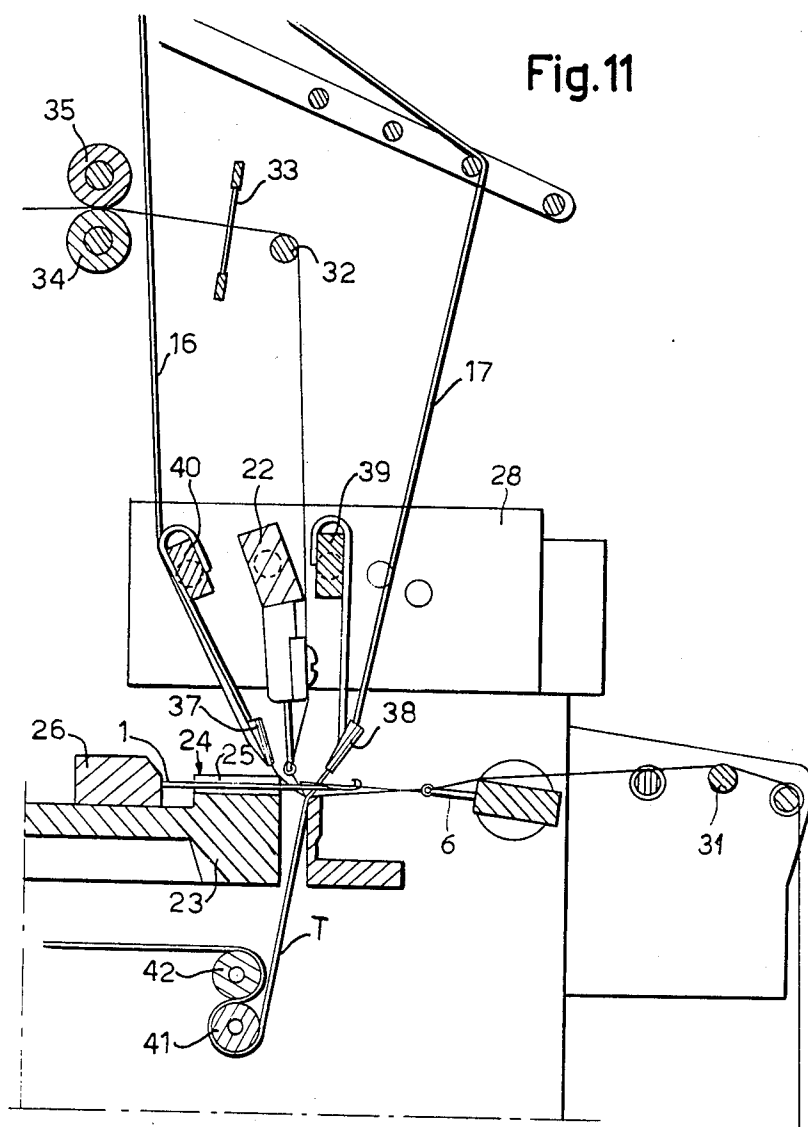
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A. FORMENTI
RESILIENT KNITTED BAND

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6 Sheets-Sheet 5



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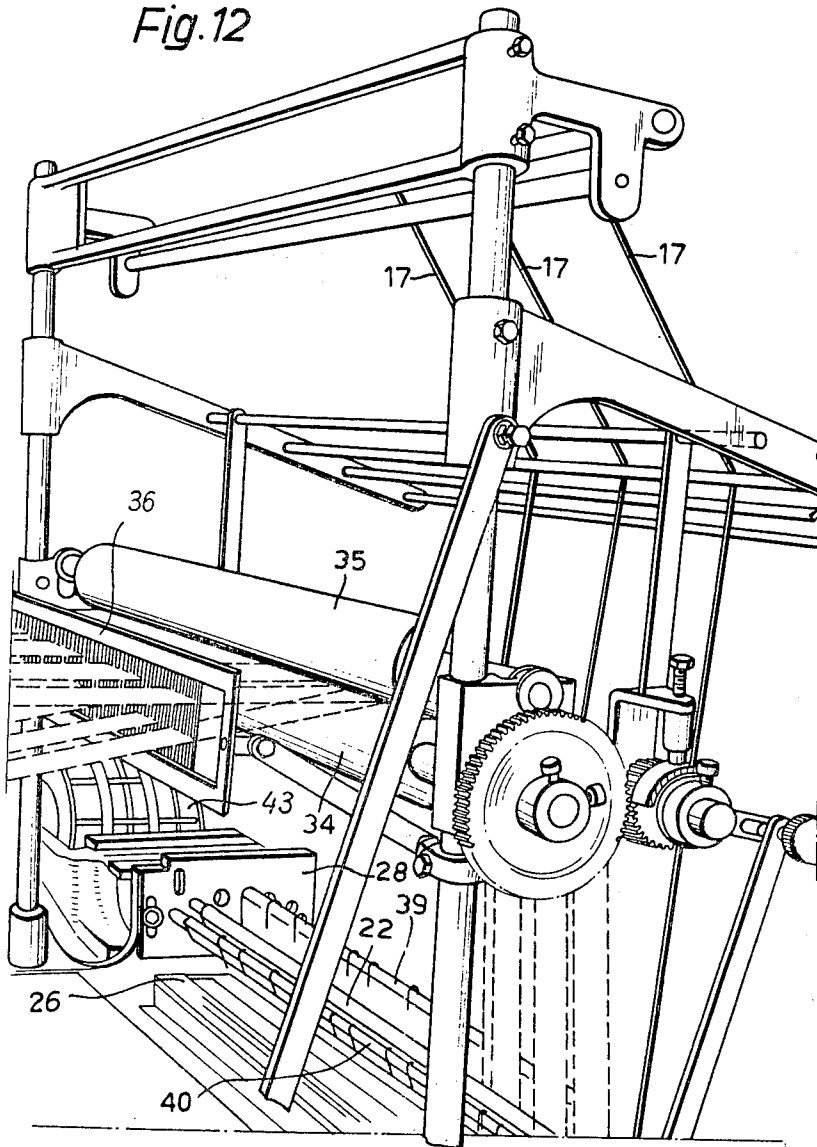
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Fig. 12



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RESILIENT KNITTED BAND

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2 Claims. (Cl. 66—193)

This invention relates to the structure and manufacture of resilient bands, more particularly bands which are resiliently extensible in the direction of their length and substantially non-extensible in the direction of their width, such as are currently employed in the manufacture of garments.

The invention further relates to a method of manufacturing such fabrics and the machine employed in carrying out the method.

Fabrics, more particularly bands of known type which are resiliently extensible in the direction of their length and substantially non-extensible in the direction of their width are usually manufactured by weaving. Consequently, they include a number of warp threads each comprising a resiliently extensible thread, such as a rubber thread wrapped by a plurality of relatively non-extensible textile warp threads. Such warp threads are interconnected by weft threads in the form of substantially non-extensible textile threads. A fabric or band of this type is practically non-extensible in the direction of its width owing to the low extensibility of the weft threads, and is resiliently extensible in the direction of its length by an extend admitted by the extensibility of the textile warp threads wrapping the rubber threads which on extension of the band straighten their path.

These known bands are subject to various drawbacks, including a deficient protection of the rubber threads by the weft and warp fabric threads against the action of detergents employed in washing garments which have been manufactured from resilient fabrics or bands. The result is quick deterioration of the rubber threads which easily slip off by becoming displaced with respect to the textile threads of the weft and warp to which they are deficiently anchored. A further drawback of known fabrics and bands resides in the necessity of manufacturing them by weaving, which is a slow process, and of employing, for providing the warp, rubber threads previously encased by wrapping them with textile threads. All this obviously increases the cost of manufacture of the fabrics and bands, which affects their sale price.

This invention provides a novel type of fabric, more particularly a band which is resiliently extensible in the direction of its length and substantially non-extensible in the direction of its width, is free from the above-mentioned drawbacks and can be manufactured by a process which is much simpler and quicker than weaving.

A further object of this invention is to provide resilient fabrics and bands of a structure such as to efficiently protect the resilient threads against the action of external agents, more particularly detergents used in washing garments by which such fabrics or bands are incorporated, and wherein the resilient threads are firmly anchored to the textile threads of the weft and warp so that the former cannot become displaced from the latter even on breaking.

A further object of this invention is to provide a simple and inexpensive method suitable for high speed inexpensive manufacture of the fabrics and bands involved.

A further object of this invention is to provide a machine suitable for carrying out the method, which can be obtained by adaptation of existing warp knitting machines provided for manufacturing warp knitted fabric.

According to this invention the above purposes are fulfilled by providing a fabric, more particularly a band,

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which is resiliently extensible in the direction of its length and substantially non-extensible in the direction of its width, the warp of which has inserted therein highly resilient threads, such as rubber threads, the weft being comprised of threads such as textile threads of low extensibility, having the characteristic feature that the warp comprises a plurality of adjacent warp chains and a plurality of highly resilient unknitted warp threads equalling in number the warp chains, each highly resilient warp thread being laid in the loops in one chain, the weft comprising two courses of continuous textile threads of low extensibility arranged along consecutive sections oriented transversely of the abovementioned warp chains, each section being laid in the consecutive loops of the same row of all the warp chains, said weft threads being so arranged as to extend on opposite sides of the extensible warp threads, each constantly on the same side of the latter throughout the width of the fabric or band.

The method of manufacturing the fabric or band described above is characterized in that it comprises the steps of simultaneously forming a plurality of adjacent warp chains in parallel relationship, leading into each chain as each consecutive loop in the latter is formed an extensible warp thread, such as a rubber thread, in such manner that the latter extends through all the loops in the warp chain, and causing at least two continuous weft threads of low extensibility to extend through all the loops in the same row of a warp chain set, causing said weft threads to extend in part on one and the other side of the set of extensible warp threads, respectively.

Further characteristic features and advantages of this invention will be understood from the appended description referring by way of a non-limiting example to embodiments of the invention, wherein:

FIGURES 1 to 8 are diagrammatical perspective views showing building of the warp chains of the improved fabric or band, and simultaneous insertion of a resiliently extensible warp thread, such as a rubber thread, through the loops in the warp chain.

FIGURE 9 is a diagrammatical perspective view showing the building of the fabric or band according to this invention,

FIGURE 10 is a perspective part front view of a straight bar warp knitting machine suitable for forming warp chain loops for the manufacture of a fabric or band according to this invention,

FIGURE 11 is a diagrammatical cross-sectional view of the machine,

FIGURE 12 is a perspective view of the rear machine portion.

The same reference numerals denote corresponding parts throughout the figures.

As will be seen from the diagrammatical representations in FIGURES 1 to 9 and from FIGURES 10 to 12 showing a machine for manufacturing bands or fabric according to this invention, the latter are preferably manufactured on a machine in which a plurality of needles having horizontal latches perform a reciprocating motion with respect to the yarn guides mounted on a bar arranged in front of the needles, further yarn guides being arranged substantially perpendicular to the needles, carried by a bar situated above the needles. The two bars each carrying the yarn guides perform suitable movements as required for building the warp chains.

FIGURES 1 to 8 show how the warp of the fabric or band according to this invention is formed, FIGURE 9 showing how the weft is connected with the warp as the former is being formed.

FIGURE 1 shows the parts cooperating in forming the warp in the position in which the latch needle 1, slidably mounted in a suitable seat in a needle bed (not shown in this figure) of the machine, starts advancing in the direc-

tion of the arrow 2. The hook on the needle 1 supports the loop 3, which is being built, in the warp chain 4 formed from a textile thread 5, such as a cotton or wool thread fed through the yarn guide 6. The loops in the warp chains underlying the loop 3 extend in a vertical direction and advance downwardly as new loops are being formed by sliding in a suitable vertical slot (not shown) in the forward portion of the needle bed, at the top of which needle guides are provided. As will be seen from the drawing, the loops in the chain 4 have laid therein a resilient thread 7, such as a rubber thread, which is fed through the yarn guide 8 which, at the time shown in FIG. 1, has completed its displacement in the direction of the arrow 9 (that is, to the right on the drawing). The advancing needle 1 leaves on its left the section of the resilient thread 7 interposed between the yarn guide 8 and chain.

FIGURE 2 shows a position of the above described members, wherein the needle 1 is at the end of its advance stroke and the loop 3 still incompletely formed has slid along the needle shank after having knocked over the latch 1' backwardly. The yarn guide 8 is still in the same position as shown in FIG. 1, while the yarn guide 6 has performed two swinging movements up and down, respectively, and therebetween a displacement to the right on the drawing in order to lead the thread over the hook on the needle 1.

FIGURE 3 shows the resetting needle moving in the direction of the arrow 10, which is about to insert the bight 11 in the thread 5 into the loop 3. In the meantime the latter has acted on the latch 1' to close the needle hook catching therein the bight 11 in the thread 5. The yarn guide 8 is still in the position shown in FIGS. 1 and 2.

FIGURE 4 shows the subsequent stage at which the loop 3 knocked over from the needle 1 is supported by the thread section interposed between the hook on the needle 1 and yarn guide 6. The chain 4 has sunk in the direction of the arrow 12, the yarn guide 8 starts its movement in the direction of the arrow 13 (to the left on the drawing).

FIGURE 5 shows the parts in a condition similar to that shown in FIGURE 2; however, the yarn guide 8 is shown at the end of its movement in the direction of the arrow 13 (FIG. 4). The section of the unknitted resilient thread 7 interposed between the chain 4 and yarn guide 8 is therefore on the right with respect to the needle (looking in the direction of the yarn guide 6).

FIGURE 6 shows an arrangement of the parts similar as shown in FIG. 3; however, the yarn guide 8 still occupies the same position as shown in FIG. 5.

FIGURE 7 shows the parts the moment the needle 1 completes its resetting motion in the direction of the arrow 10, and the bight 11 which, has now been converted to a new loop in the warp chain, is knocked over from the needle which engages by its hook a new bight 14.

FIGURE 8 shows a similar stage as shown in FIGS. 1 and 4; however, the yarn guide is on the right of the needle 1 and starts its movement to the right on the drawing, in the direction of the arrow 15 to resume its position shown in FIG. 1.

The consecutive steps of forming the warp chain having a resilient thread laid within its loops are then repeated in the order just described.

The manner of manufacturing a fabric or band, wherein the warp comprises a plurality of adjacent chains with a resilient thread, such as a rubber thread laid within their loops, will be easily understood from FIG. 9. This figure shows three needles and cooperating yarn guides 6a, 6b, 6c and 8a, 8b, 8c respectively, through which threads 5a, 5b and 5c of textile material of low extensibility and extensible threads, such as rubber threads 7a, 7b and 7c are fed parallel with one another and simultaneously in order to simultaneously form the warp chains 4a, 4b, 4c. Of course, under actual conditions spacing of the needles is as small as consistent with the nature of the fabric to

be manufactured. Before each simultaneous advance of the three needles 1a, 1b, 1c, two textile weft threads 16, 17, respectively, of low extensibility are simultaneously placed on the thread sections interposed between the hooks on the said needles and the yarn guides 6a, 6b, 6c. The weft threads are laid in such manner that they are situated on opposite sides of the extensible unknitted warp threads 7a, 7b, 7c. The weft threads 16, 17 are supplied through weft thread guides 18, 19, respectively, which move in a plane perpendicular to the direction of the simultaneous movement of the needles, on opposite sides of the plane in which the extensible warp threads 7a, 7b, 7c are situated. As mentioned above, movement of the weft thread guides 18, 19 ends before each advance stroke of the needles 1a, 1b, 1c starts. The weft thread guides are therefore arrested approximately in a position as shown in FIGURE 9, until the needles complete their resetting stroke towards their initial position. This results in a zig-zag direction of the weft threads 16, 17 which are transversely inserted into the loops in the same course of all the chains forming the warp of the fabric and, as mentioned above, are arranged on opposite sides of the extensible threads inserted into the warp chain loops.

As a result the fabric is extensible in the direction of the chain length or of the warp, and is substantially non-extensible in the direction of the weft. The extensible unknitted warp threads made of rubber are particularly well protected against any action from external agents, inasmuch as they are inserted into the consecutive loops in their respective warp chains and are additionally interposed between the adjacent sections of the weft threads 16, 17. Of course, the latter form on both sides of the extensible unknitted warp threads 7a, 7b, 7c two continuous layers instead of a succession of spaced transverse sections as diagrammatically shown in FIGURE 9, this representation being merely for the purpose of making the fundamental structure of the improved fabric understood.

The machine for manufacturing the fabric, more particularly for simultaneously manufacturing a plurality of bands according to this invention is fundamentally similar in structure to a warp knitting machine according to Italian Patent No. 611,123 of June 18, 1959. The machine shall therefore not be described in detail, its description being limited to its essential parts contributing to the formation of the fabric or bands according to this invention, more particularly with reference to the parts which have been modified or added for the purpose in view in the basic machine.

In the machine which is adapted for simultaneous manufacture of a plurality of extensible bands yarn, guides 6 are connected to sets by means of lead blocks 6', secured to the yarn guide needle bar 20 which is arranged in proximity to the forward machine portion. A distance from the guide needle 6, yarn guide needle sets 8 are arranged, the lead blocks 8' of which are secured to plates 21 extending from a further yarn guide bar 22. The latter is arranged at an elevation higher than the yarn guide bar 20 in such manner that the yarn guides 8 are adjacent the forward face of the needle bed 23 (FIG. 11). The needle bed is of conventional construction and is formed on its top face with projecting ribs 24 laterally confining horizontal guides 25 for the latch needles 1 secured to the bar 26. The ends of the bar 22 are supported by two side plates 27, 28 (FIG. 10) for longitudinal movement with respect to said plates. The plates 27, 28 are in turn slidably mounted in a vertical direction in guides ways fast with the machine frame 28. In order to simultaneously manufacture a plurality of bands, sets G5 of textile threads, such as cotton threads, corresponding to the thread 5 in FIGURES 1 to 8 are placed by full threading into the yarn guides 6.

The warp thread sets G5 are uniformly spaced in the direction of length of the machine. The warp threads advance in the direction of the arrow 29 after passing the dividing comb 30 and over a deflecting bar 31. Extensi-

ble warp threads corresponding in number to the yarn guide sets 8 arranged in front of the yarn guide sets 6 having the threads G5 threaded therethrough are threaded likewise by full threading, the said extensible warp threads, which may be of rubber, being formed to sets F7, equalling in number the sets of fabric warp threads G5 and bands to be simultaneously manufactured. Each set F7 includes a number of threads equalling the number of threads in the sets G5. The extensible warp thread sets are led before reaching the yarn guides 8 over a cylindrical deflecting bar 32, through a dividing comb 33, between two driven rubber coated feed rollers 34, 35, finally through a rear comb 36 (FIGURE 12).

A pair of weft thread guides 37, 38 are associated with each set of yarn guides 8 receiving the extensible warp threads, the weft thread guides being secured to two weft thread guide bars, one of which, 39, is arranged in front with respect to the yarn guide bar 22, the other weft thread guide bar 40 being arranged behind the said yarn guide bar. It will be seen from FIG. 10 that the bars 39 and 40 are slidably mounted in the plates 27 and 28 which also support the bar 22. The weft thread guides 37, 38 receive the weft threads of low extensibility 16, 17 so that, as explained above with reference to FIG. 9, at the same time as warp chains are formed from threads of the sets G5 and these chains have inserted, therethrough extensible unknitted warp threads from the sets F7, the weft threads 16, 17 are inserted into the loops in the warp chains and are laid on opposite sides of the extensible warp threads fed through the yarn guides 8. The weft thread guides 37, 38 are threaded one in, three out, and in alignment (FIG. 9). The formed bands T (FIG. 11) sink through the forward slot in the needle bed 23 and travel over driven rollers 41, 42 to the rear machine portion where they are wound to coils on a driven shaft (not shown).

The movements of the various machine parts, which are required to form the fabric, more particularly a plurality of bands, are derived from a motor (not shown) carried by the machine frame, which effects the advance and resetting motions of the bar 26 carrying needles 1 and swinging and longitudinal movements required to lead the warp threads from the sets G5 over cooperating needles 1 and, in a predetermined sequence, the movements of the further parts, which shall be described hereafter.

The bar 22 carrying the yarn guides 8 performs longitudinal movements under the action of cams provided on a rotatable drum 43 driven by the motor through a suitable drive (not shown). Displacement of the bar 22 takes place against the action of a spring 44 interposed between a bead on the bar and a plate 45 which is kept against displacement longitudinally of the machine. The spring 44 is adapted to restore the bar 22 to its end position towards the right on the drawing. The cams on the drum 43 adapted to effect movements of the bar 22 are such as to cause the bar and hence the yarn guide sets 8 to perform movements such that the yarn guides 8 are moved from a clearance between two adjacent needles to the next one only. The bar 20 for the yarn guides 6 is similarly displaced, so that the warp of the bands is made up of individual chains. Of course, the bar for the yarn guide 6 might be caused to perform other evolutions, whereby the threads G5 form a fabric such as of the semi-simple type having closed loops or of other known types.

The bars 39 and 40 carrying the weft thread guides 37 and 38 receive a simultaneous longitudinal movement, which exceeds in width the sets G5 and F7 threaded into the yarn guides 6, 8, respectively. The weft thread guides move between the consecutive clearances separating the last and first warp threads of adjacent sets, respectively. Movement of the bars 39 and 40 is derived from a pair of cams 50, 51 keyed to a shaft 52. The latter receives motion through a chain 53 from the transmis-

sion members (not shown) of the machine, which are driven from the motor. Rollers 54 and 55, respectively are rotatably supported in contact with the periphery of each cam on arms 56, 57, respectively, on a fork articulated at its lower end to the machine frame. The long arm 56 is formed with a slot 58 through which a bolt 59 extends which is retained by means of a nut and serves for attachment to the arm 56 of a rod 60 articulated to a metal lug 61. The lug 61 is secured to a cylindrical extension on the bar 40 as well as by means of a strap 62 to a further lug 63 secured to an extension on the bar 39.

The parts are of such configuration as to cause the bars 39, 40 to perform a stroke of a desired width which is selected depending upon the width of the bands being manufactured. The bars 22, 39 and 40 are supported, as mentioned above, for longitudinal displacement by plates 27, 28 which are in turn vertically slidable in suitable guides on the machine frame. The plates are periodically lifted and lowered, more particularly for the period of the stroke effected by the thread guides in order to place the weft threads 16, 17 on the warp threads of the sets G5. The movements of the machine parts are otherwise synchronized for operation in the manner described with reference to FIGURES 1 to 9.

The warp threads of the sets G5 and F7 and the weft threads 16, 17 are fed from sets of spools supported by two sets of creels (not shown) arranged behind the rear machine portion.

It will be understood that, within the principle of this invention, various constructional details of the machine as described can be widely varied without departing from the scope of this invention. For instance, by utilizing all the needles which can be mounted on the bar 26 and all the yarn guides 6 and 8 which can be carried by the bars 20 and 22, a single band equalling the frame in width, in other words a piece of fabric, resilient in a longitudinal direction can be manufactured.

What I claim is:

1. Fabric comprised of a warp and a weft, said fabric being resiliently extensible in the direction of the warp and substantially non-extensible in the direction of the weft, wherein the warp comprises a set of adjacent warp chains and a number of highly resilient unknitted warp threads equalling the number of warp chains, each of said warp threads extending within the loops in one of the warp chains, and the weft comprises two courses of continuous textile threads of low extensibility arranged in consecutive sections oriented transversely of the warp chains, each section extending through the consecutive loops in the same row in all the warp chains and, thus, interconnecting the warp chains, the weft threads being situated on opposite sides of the extensible unknitted warp threads, each weft thread being constantly on the same side of the extensible unknitted warp threads, the warp chains being interconnected solely by said weft sections.

2. The fabric of claim 1, in the configuration of a band, the length of the band being in the direction of the warp and the width of the band being in the direction of the weft.

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