Dec. 20, 1938. H. P. LUHN 2,140,937

KNITTED FABRIC

Original Filed Aug. 6, 1935

Fig. 1

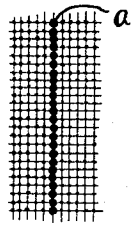


Fig. 2

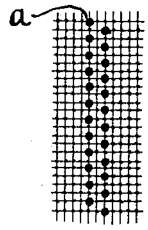


Fig. 3

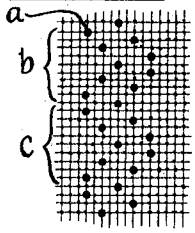


Fig. 4

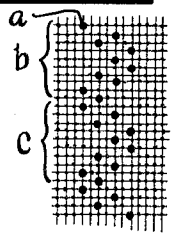


Fig. 8

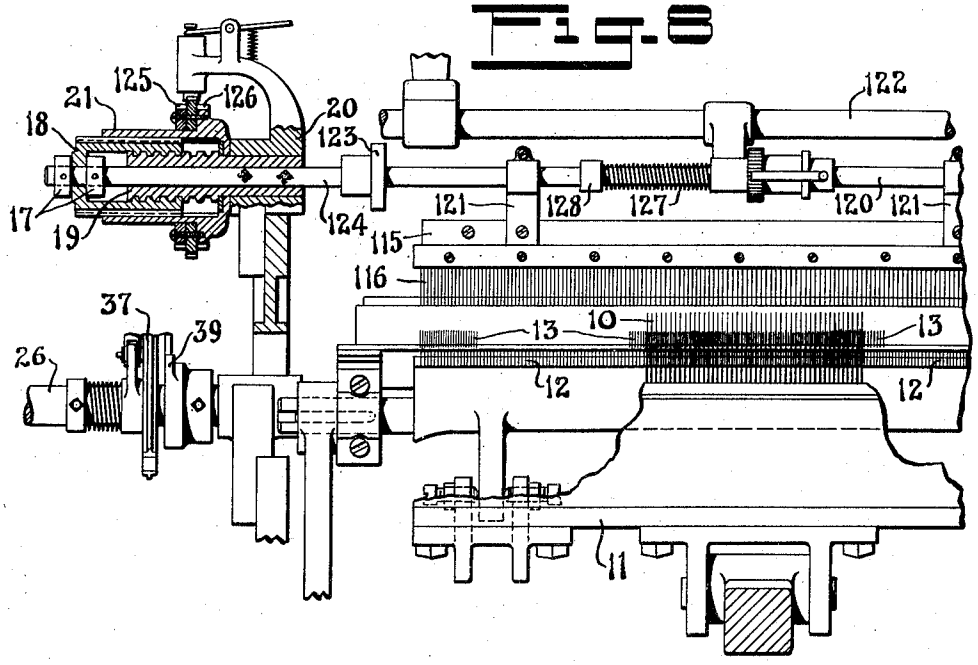


Fig. 5

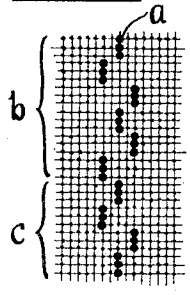


Fig. 6

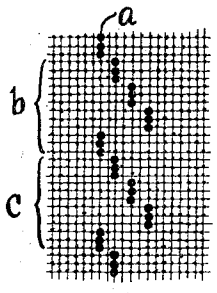
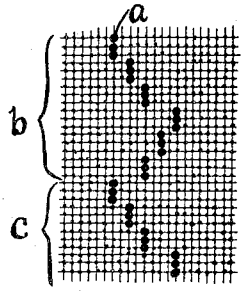


Fig. 7



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KNITTED FABRIC

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Original application August 6, 1935, Serial No. 34,885. Divided and this application July 8, 1938, Serial No. 218,078

11 Claims. (Cl. 66—169)

This invention relates to knitted fabrics and more particularly to sheer fabrics such as hosiery wherein so-called "sinker lines" or "needle lines" are effectively avoided.

This application is a division of my co-pending application Serial No. 34,885, filed August 6, 1935.

When knitted fabrics are produced on straight knitting machines of the Cotton type they are often found to have so-called "sinker lines" or "needle lines" which detract from their appearance. This is particularly true of sheer knitted fabrics of the hosiery type.

These lines are usually caused by the recurrence of imperfect loops in corresponding wales of successively knit courses. Usually such loops are imperfect because they are more tightly or loosely knitted than adjacent loops. The imperfections of particular loops may be minor in extent and not readily measurable nor particularly noticeable at the time they are formed. But as other courses are knit such loops afford contrasts in the fabric with more nearly perfect loops in adjacent wales and their repetition in corresponding wales course after course produces a visually apparent "line" or group of lines having the appearance of a band in the fabric.

Among the factors giving rise to the production of imperfect loops are the following: The sinkers or dividers, respectively, are not properly aligned either among themselves or with respect to each other; some sinkers or dividers have been worn down in use to a greater or lesser extent than adjacent sinkers or dividers; the needles may not all be properly aligned nor positioned at the same heights; a sinker, divider or needle may have its thread-engaging portion so worn as to catch and hold the thread at times when it should be permitting other parts to draw sufficient thread to form even loops. Any of these defects in the loop-forming and knitting elements may cause some loops to be more tightly or loosely knit than others because of being formed from and knitted with less or more thread than loops in adjacent wales.

Moreover, even if it were possible to readily locate the defective loop-forming and knitting elements which cause imperfect loops, the mere replacement of such defective elements would not necessarily result in eliminating the imperfect loops and the resulting sinker or needle lines. This is because the defects in such elements are purely relative. The defects in either needles, sinkers or dividers which have an effect in producing imperfections in the fabric are not necessarily related to the departure of the particular element from a new or perfect element but the defect in the condition of the particular element is relative to others adjacent thereto. For example, replacement of a suspected sinker by a new sinker would not eliminate the cause of the lines unless the adjacent sinkers and dividers were also new or practically unworn. In short, because of the fact that some parts are worn to a greater or lesser extent than others, the replacement of any part would require the substitution therefor of a part which is relatively as perfect or imperfect as the parts, adjacent which it is to be positioned, or with which it is to cooperate.

An object of the present invention is to provide a knitted fabric in which the so-called "sinker" or "needle" lines that result from the recurrence of relatively imperfect loops in the same wales of successively knitted courses are substantially eliminated.

Another object of the invention is to provide a knitted fabric having the corresponding loops of successively knitted courses distributed among a plurality of wales in a predetermined order so that the formation of vertical lines or bands visible to the naked eye, such as have heretofore been formed by vertical alignment of the corresponding loops of successively knitted courses, is effectively avoided.

My invention has particular application in the production of women's sheer hosiery and includes the sheer hosiery product.

In producing the improved fabric of the present invention the positions of the fabric loops relatively to the loop-forming and knitting mechanism are repeatedly varied during formation of the fabric so that imperfect loops which ordinarily would occur in the same wales in successive courses are dispersed over a plurality of wales. Where these imperfect loops result from elements which are defective because of wear or improper alignment, the resulting loops do not become aligned in such a manner as to form a line of imperfect loops contrasting with the loops in adjacent wales.

The improved fabric and means for producing the fabric are illustrated in the accompanying drawing, in which:

Figure 1 is a diagrammatic illustration of a portion of a knitted fabric showing, in exaggerated form, a sinker or needle line resulting from the recurrence of relatively imperfect loops in the same wale of successively knit courses:

Figures 2 to 7 are similar diagrams illustrating various embodiments of the invention in a sheer

fabric, and more particularly illustrating various ways in which the imperfect loops may be dispersed among a number of different wales in successively knit courses so as to prevent alignment of all the imperfect loops in a single wale, thereby eliminating formation of "sinker" or "needle lines"; and

Figure 8 is a fragmentary view with parts broken away of a machine for knitting full fashioned hosiery showing the mechanism for shifting the fabric transfer bar.

In Figures 1 to 7 the dots represent fabric loops, their horizontal and vertical alignments, respectively, representing the courses and wales of the fabric. The heavier dots *a* exaggeratedly represent imperfectly formed loops produced by improperly aligned, defective or imperfectly operating loop-forming and knitting elements. As is apparent from Figure 1, when imperfect loops recur in the same wale of successively knit courses, they align with each other and by contrast with more perfectly formed loops in adjacent wales afford the appearance of a line in the fabric.

Figures 2 to 7 illustrate dispersion of the imperfect loops over a number of wales, so that the contrasting line shown in Figure 1 is broken up.

As disclosed in my copending application noted above, the distribution of imperfect loops among a plurality of wales may be accomplished by varying the relative positions of the loops of the fabric and the elements of the machine which form and knit the loops. This may be accomplished in several ways as by changing the positions of the loop-forming and knitting elements relatively to the fabric or relatively to each other in the periods between the knitting of certain courses and the formation of the next or of certain succeeding courses. These variations may be effected either after the knitting of each course (Figs. 2 to 4) or at other intervals during knitting of the fabric (Figs. 5 to 7).

A machine and various methods for accomplishing the distribution of imperfect loops among a plurality of wales are disclosed in my copending application noted above. A fragmentary portion of the machine is shown in Fig. 8, for the purpose of illustrating a means and one of the methods by which my invention may be practiced. In order to simplify the present description, many of the mechanisms usually embodied in such machines will, if referred to at all, be described only briefly and generally with reference only to their function. The relation of conventional mechanisms to those especially provided for the purposes of producing the improved fabric of the present invention will be apparent to those skilled in the art from the following description.

Referring first to Figure 8, the needles **10** are mounted in a needle bar **11** and supported in the usual cooperative relation with the knock-over bits **12** and the sinkers and dividers (designated collectively by the numeral **13**). A transfer bar **115** is provided with a point **116** for each needle so that when dipped and raised to take the entire fabric from the aligned needles, it may be shifted a desired number of needle spaces in either direction and again dipped, and subsequently raised, to place the fabric on adjacent needles, thus changing the relationship of the fabric wales to the needles, sinkers, etc.

The dipping operations of the fabric transfer bar **115** to take the entire fabric from the needles and then re-engage it with other needles are effected by the usually provided "lace point" dipping mechanism, which being well understood is neither shown nor described herein. However, because this mechanism does not provide for the varied shifting movements of the fabric along the line of needles that are contemplated herein, the following special mechanism is utilized for shifting the fabric transfer bar **115** and a fabric engaged by the points **116** thereof. The bar **115** is supported by brackets **121** from the bar **120** forming part of the conventional dipping mechanism **122**. A spring **127** acts against a collar **128** on bar **120** to maintain the end thereof engaged with a stop **123** mounted on an axially movable stub shaft **124**.

Shaft **124** is also provided with fixed collars **17** for positioning an internally threaded sleeve **18** that is rotatably mounted thereon. The threads of sleeve **18** engage a similarly, but externally, threaded sleeve **19** fixedly mounted in the part **20** of the machine frame. A third sleeve **21** is rotatable on the fixed sleeve **19** and so mounted on the shaft sleeve **18** as to rotate the latter while permitting the sleeve **18** to move in opposite directions for displacing shaft **124** axially. Such rotative movements of sleeves **18**, **21** to shift the fabric transfer bar **115** take place when reversely cut ratchets **125** and **126** secured to sleeve **21** are selectively actuated by related pawls operated through a linkage **37** by an eccentric cam **39** fixed on the main cam shaft **26** of the knitting machine.

When the fabric transfer bar **115** has been dipped and raised to take the fabric from the needles and retain it temporarily on the points **116**, the bar may be shifted either to the right or left to a desired extent, whereupon bar **120** engages stop **123** during the second dipping operation, to align the points **116** with other needles (spaced from those engaging the respective loops during knitting of the previous course) for transferring the fabric thereto. Upon actuation of ratchet **125** the stop **123** is moved to the right pushing the bar **120** and hence points **116** in the same direction to the extent determined by the extent of ratchet operation. Upon operation of ratchet **126** the stop **123** is moved to the left and spring **127** causes bars **120**, **115** and hence the fabric transfer points **116** to follow its movement.

In order to maintain the carriers and narrowing points aligned with the fabric and thereby the lateral edges of the fabric even, appropriate means such as disclosed in my aforesaid copending application may be provided to shift the carrier-rod end-stops and narrowing stops in accordance with the shifting movement of the fabric transfer bar.

The mechanism described above provides for shifting the fabric in either direction to a desired extent after the knitting of a particular course. The successive shiftings may alternate in direction and vary in extent. Or, a number of successive shiftings may be in one direction and other subsequent shiftings in the opposite direction. As a result, the fabric loops are shifted the selected number of needle spaces relatively to the sinkers and dividers. The wale in which an imperfect loop was last formed is similarly displaced from the defective singer or divider or other element responsible for the imperfection, the defective element forming its next respective loop for the succeeding course in a different wale. Thus, the defective loops are dispersed among several wales.

Other means of distributing the imperfect loops among a plurality of wales of successively knitted courses may comprise the shifting of the sinkers and dividers longitudinally of the line of active needles or the periodic shifting of the needles in either direction the desired extent after the knitting of a particular course, so that in the formation of the succeeding courses the loops are formed and drawn by different needles, sinkers and dividers than those employed in the succeeding courses.

Certain of these methods may be combined and carried out at the same time in order to vary the relative positions of the loops of the fabric and the knitting elements. That is, the needles, sinkers and dividers may be shifted at the same time and the fabric may also be transferred. As a result, an infinite variation may be attained in the relative positions between the fabric loops and the knitting elements in forming successive courses.

As mentioned above, Figure 1 represents a sinker or needle line produced by recurrence of imperfect loops in the same wale course after course. The effect of variations of the relative positions of the loops and parts of the knitting mechanism is to disperse imperfect loops over a plurality of wales as the fabric is knit and in this way alignment of these loops to form such a line of loops contrasting with more perfect loops in adjacent wales is prevented.

In Figure 2 the staggered relation of the enlarged dots *a*, representing imperfect loops, illustrates the dispersion of these loops by effecting shiftings of the fabric or a shiftable part of the knitting mechanism to the extent of one step, or two needle spaces, first to the right and then to the left, alternating in successive courses.

Figure 3 illustrates another operating mode by effecting shifts of two steps to the left and three steps to the right in alternation while knitting a series of five courses. After formation of the fifth course shifts of two steps to the right and of three steps to the left are effected in alternation, the complete cycle of ten courses being designated by *b*. After knitting of the tenth course a two-step shift to the left begins the cycle over again, the second ten-course cycle being indicated at *c*.

Figure 4 represents a shifting cycle in which the fabric or a part of the knitting mechanism is shifted alternately one step to the left and two steps to the right for the first five courses. Through the sixth to the tenth courses the shiftings are alternately one step to the right and two steps to the left. After knitting of the tenth course, a one-step shift to the left is effected and the shifting cycle is thereby repeated.

In Figures 5 to 7 the fabric or knitting elements selected for shifting are shifted periodically after a desired number of courses, illustrated as three, have been knit. In Figure 5 after the third course the shift is one step to the left, with a two-step shift to the right after the sixth course. After knitting of the twelfth and eighteenth courses a one-step shift to the right is effected with an intermediate two-step shift to the left subsequent to knitting of the fifteenth course. The knitting cycle recommences with the nineteenth course with a one-step shift to the left occurring after the twenty-first course.

Figure 6 represents a fabric produced by a number of periodic shifts made successively in the same direction followed by a shift in the opposite direction to the starting point before beginning the next cycle. As represented, the shifts that take place are one step to the right after each of the third, sixth and ninth courses and a three-step shift to the left after knitting of the twelfth course.

Figure 7 represents a procedure in which a number of periodic shifts in one direction are followed by a number of periodic shifts in an opposite direction before repetition of the cycle. The diagram indicates a one-step shift to the right after the third and sixth courses, a two-step shift to the right after the ninth course, whereupon the direction of shifting is reversed and one-step shifts to the left are effected after the twelfth and fifteenth courses and a two-step shift to the left after the eighteenth course.

When the entire fabric is displaced from engagement with needles knitting a particular course to engagement with other needles prior to formation of the next course, the imperfect loop will not recur in the same wale when the next course is formed and knit, regardless of whether or not the imperfect loop is caused by a defect in a needle or a sinker or a divider.

When the fabric, needles and the sinkers and dividers are shifted relatively to each other (regardless of which of these is actually moved), their relative positions are so changed that when an imperfect loop is produced by a defective or improperly aligned needle, sinker or divider, a similar result is obtained. Here also the imperfect loop will appear in a different wale regardless of whether the needle or a sinker or a divider is the defective element.

It is to be understood that the fabric diagrams of Figures 2 to 7 are merely illustrative of a few of the many different degrees of shifting that may be effected to avoid recurrence of imperfect loops in the same wale in course after course of the knitted fabric. It will also be understood that the invention is not only applicable to sheer fabrics made of silk but also to fabrics made of rayon and other materials where it is desirable to avoid the appearance of the so-called "needle" or "sinker" lines.

I claim:

1. A knitted fabric devoid of contrasting lines or bands visible to the naked eye comprising a plurality of knitted courses of correspondingly knit loops, certain of said loops differing in appearance from other loops in the same course, the differing loops of said courses being distributed among a plurality of wales, whereby the contrasting lines or bands normally formed by alignment of said differing loops are broken up and rendered invisible.

2. A knitted fabric devoid of contrasting lines or bands visible to the naked eye comprising a plurality of knitted courses of similarly formed loops, certain of said loops differing in appearance from other loops in the same course, said differing loops being distributed among a plurality of wales, whereby the contrasting lines or bands normally formed by alignment of said differing loops are broken up and rendered invisible.

3. A knitted fabric devoid of contrasting lines or bands visible to the naked eye comprising a plurality of knitted courses of similarly formed loops, certain of said loops differing in shape from other loops in the same course, said differing loops being distributed among a plurality of wales, whereby the contrasting lines or bands normally formed by alignment of said differing loops are broken up and rendered invisible.

4. A knitted fabric devoid of contrasting lines or bands visible to the naked eye comprising a plurality of knitted courses of similarly formed loops, some of said loops differing in size from other loops in the same course, said differing loops being distributed among a plurality of wales, whereby the contrasting lines or bands normally formed by alignment of said differing loops are broken up and rendered invisible.

5. A knitted fabric comprising a plurality of knitted courses of similarly formed loops, certain of said loops differing in shape and size from other loops in the same course, said differing loops in adjacent courses being distributed among a plurality of wales in a predetermined order such that the alignment of said differing loops in associated groups of sufficient extent to create normally visible lines or bands is avoided.

6. A knitted fabric devoid of contrasting lines or bands visible to the naked eye comprising a plurality of knitted courses, the loops in the same wales of adjacent courses thereof being formed by different combinations of loop forming elements, whereby contrasting lines or bands normally formed by alignment of corresponding loops different in appearance from other loops in the same course are broken up and rendered invisible.

7. Hosiery fabric composed throughout a substantial portion thereof of threads of substantially the same character, said fabric being of a weight in which sinker or needle lines or bands can ordinarily be observed, as for example in substantially translucent hosiery, said portion of the fabric being formed of a plurality of courses, the loops in the same wales of adjacent courses thereof being formed by different combinations of loop forming elements, whereby sinker or needle lines or bands normally formed by alignment of corresponding loops different in appearance from other loops in the same course are effectively avoided.

8. Hosiery fabric composed throughout a substantial portion thereof of threads of substantially the same character, said fabric being of a weight in which sinker or needle lines or bands can ordinarily be observed, as for example in substantially translucent hosiery, said portion of the fabric being formed of a plurality of courses of similarly formed loops with some of the loops in each course differing in appearance from adjacent loops, the differently appearing loops of adjacent courses being staggered among a plurality of wales, whereby sinker or needle lines or bands normally formed by alignment of said differently appearing loops are effctively avoided.

9. Hosiery fabric composed throughout a substantial portion thereof of threads of substantially the same character, said fabric being of a weight in which sinker or needle lines or bands can ordinarily be observed, as for example in substantially translucent hosiery, said portion of the fabric being formed of a plurality of courses of similarly formed loops with some of the loops in each course different in shape from adjacent loops, said differently shaped loops of one course being distributed in different positions in said course as compared with the distribution of said loops in certain of the adjacent courses, whereby said differently shaped loops are diffused and distributed so that sinker or needle lines or bands are effectively avoided.

10. Hosiery fabric composed throughout a substantial portion thereof of threads of substantially the same character, said fabric being of a weight in which sinker or needle lines or bands can ordinarily be observed, as for example in substantially translucent hosiery, said portion of the fabric being formed of a plurality of courses of similarly formed loops with some of the loops in each course differing in size from adjacent loops, said differently sized loops of one course being distributed in different positions in said course as compared with the distribution of said loops in certain of the adjacent courses, whereby said differently sized loops are diffused and distributed so that sinker or needle lines or bands are effectively avoided.

11. Hosiery fabric composed throughout a substantial portion thereof of threads of substantially the same character, said fabric being of a weight in which sinker or needle lines or bands can ordinarily be observed, as for example in substantially translucent hosiery, said portion of the fabric being formed of a plurality of courses of similarly formed loops with some of the loops in each course differing in shape and size from adjacent loops, said differing loops of one course being distributed in different positions in said course as compared with the distribution of said loops in certain of the adjacent courses, whereby said differing loops are diffused and distributed so that sinker or needle lines or bands are effectively avoided.

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