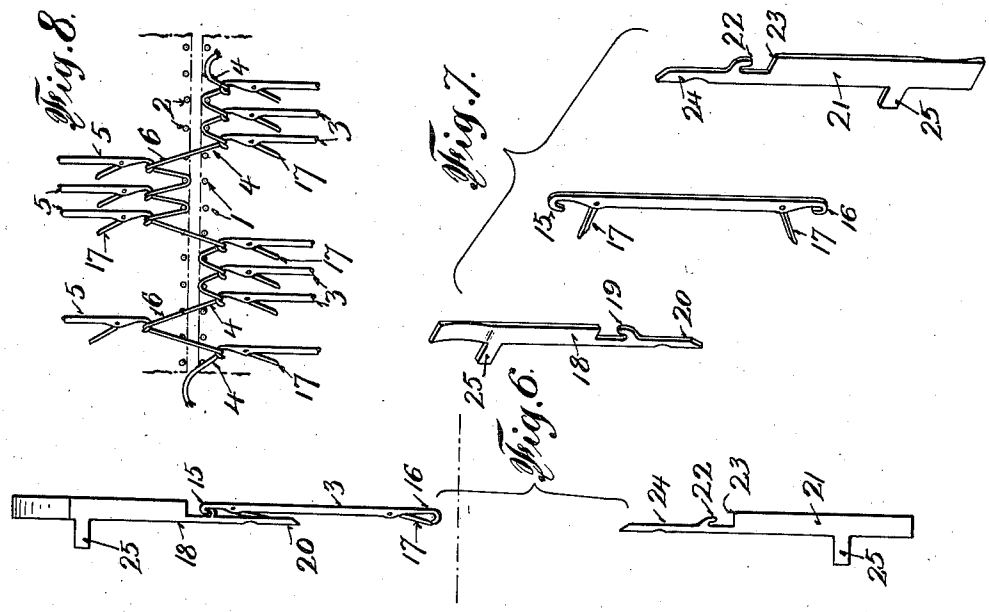
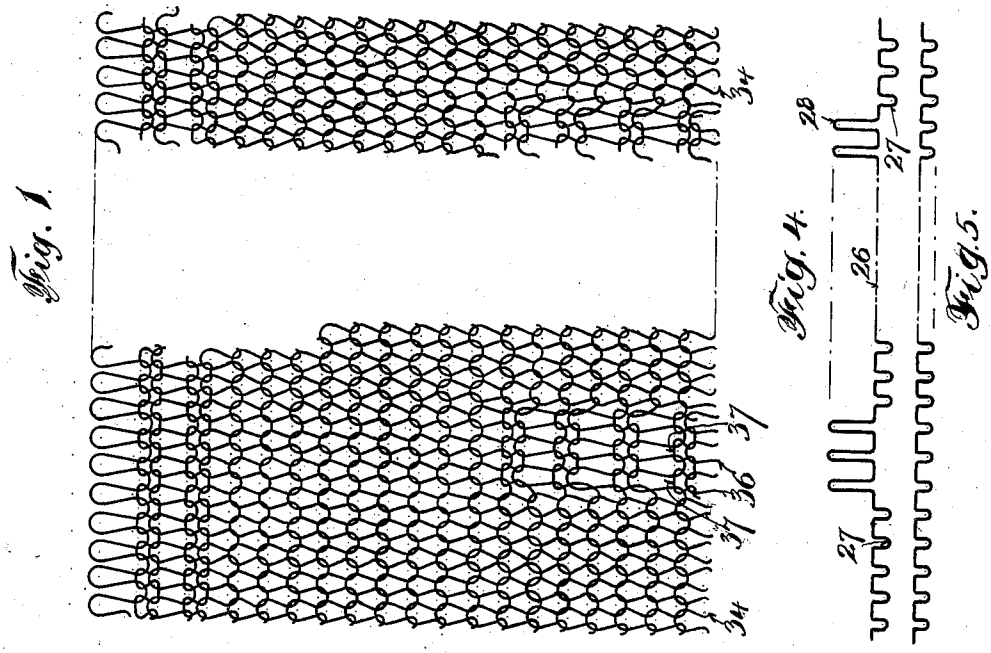
April 13, 1937. I. S. BLEENDES 2,077,033

KNITTED FABRIC

Filed July 5, 1934 2 Sheets-Sheet 1





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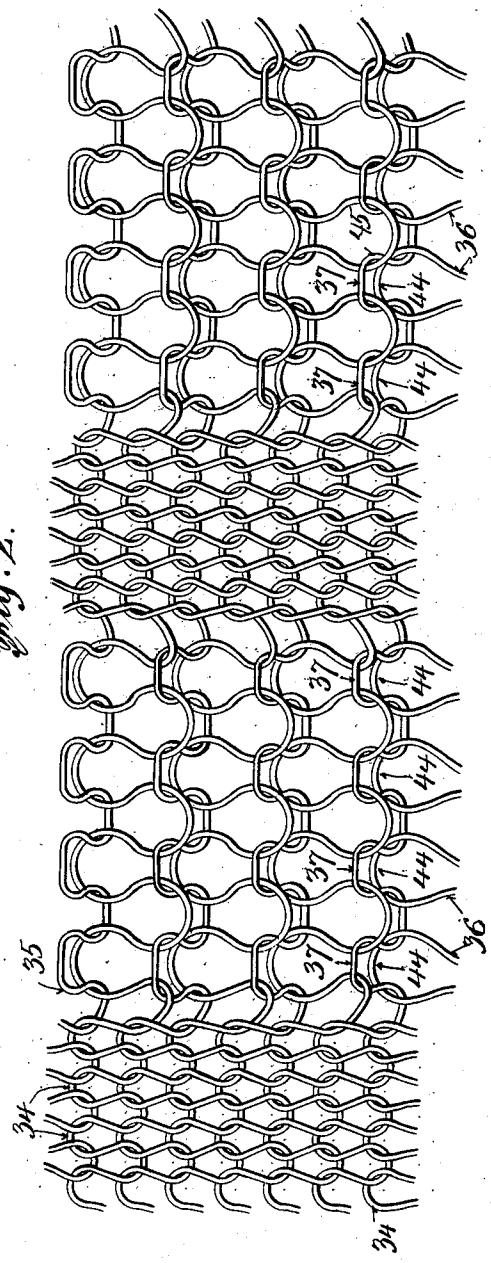


Fig. 2.

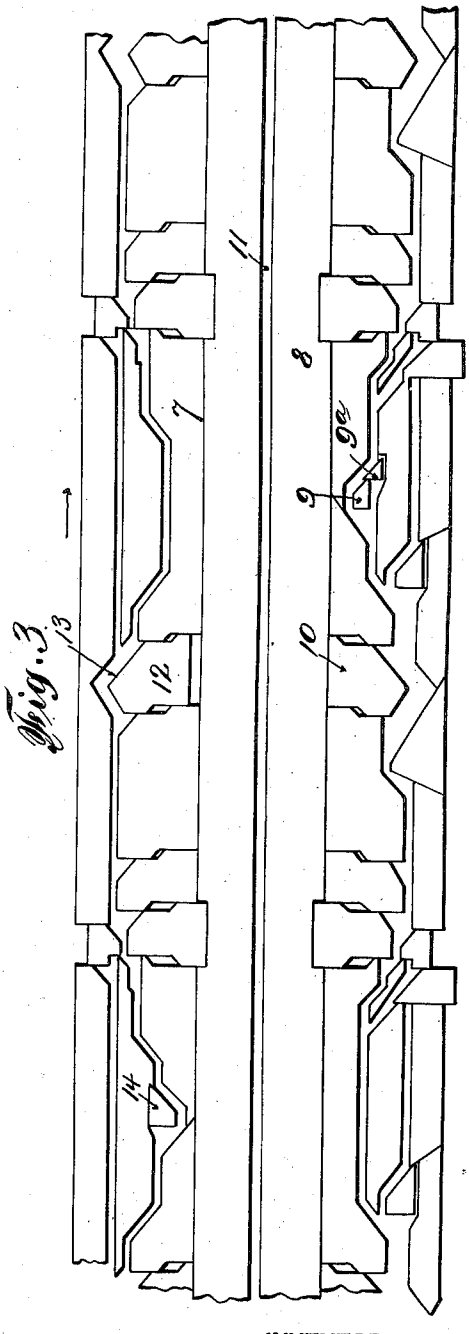


Fig. 3.

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KNITTED FABRIC

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Application July 5, 1934, Serial No. 733,853

1 Claim. (Cl. 66—169)

My present invention relates to a new knitted fabric. Heretofore it has been possible to produce what are called "lacing stitches" or "lacing effects" in knitted fabrics consisting of rather open work or stitches having large openings, interspersed with a ground fabric such as jersey knitting. One of these methods was carried out on the type of machine wherein sinkers of different heights caused certain stitches to be drawn out longer than others by the high portions of the sinkers, and it is possible to produce the lacing effect in different patterns on that type of machine.

The other method was to operate on machines having two rows of needles whether of the flat or circular type of machine, knitting one set of needles all the time and causing one or more selected needles on the opposite side to take the loop in one feed operation and drop it off immediately. This method makes the spaces longer between two stitches on the working side but it also required the machine to be operated with a fewer number of feeds, to wit, about half the normal number of feeds, thereby reducing the output of the machine.

The object of my present invention is to make lacing or lace stitches on what is known as a link and link knitting machine and I believe I am the first to produce lacing stitches on this type of machine.

One advantage of my present method over the first one described above is that one set of loops on the back of the fabric is partly hidden behind the short loop on the front of the fabric and in addition certain of the rear loops are made longer to increase the spacing or produce the open effect desired in lacing stitches. The present method is advantageous over the second one described above because the full number of feeds common to this type of machine may be operated.

The present method also makes it possible to knit rib stitches or selvage edge on the same piece of fabric which has lacing stitches, which is not possible in the first method described above. As to the second method, it is not possible to knit a rib, either with or without a selvage start, attached to the lacing portion of the fabric, except by a laborious hand method of transferring stitches from one set of needles to the other, or by costly machine construction if done automatically. In the present case no such hand operation or special machine construction is necessary.

The present method not only provides for the making of lacing effects on a link and link machine, thereby expanding the use of the machine without any change in its construction, but it also furnishes a type of lacing which is more open and more effective and more desirable as a lacing stitch than the lacing stitches made under the two methods described above.

Under the present method fabric may be made to produce any pattern, whether straight, horizontal, vertical, diagonal, and of any desired shape. The ground work of jersey stitches and the interspersed lacing stitches are all formed at the same time and no change is required in the machine to effect the simultaneous formation of both kinds of stitches, other than the adjustment of certain cams.

In addition to forming the ground fabric with interspersed lacing stitches, it is also possible to shift into the formation of rib stitches or selvage edge without changing the machine or, in other words, I utilize the characteristics of the link and link machine to shift from one type of stitch to another automatically.

Under the present method the machine operates as fast as the link and link machine operates in producing other types of fabrics.

The fabric forming this invention is composed of a ground work of jersey knit interspersed with lacing stitches formed in the manner described on a link and link machine. Other advantages will be set forth in the following detailed description of my invention.

In the drawings forming part of this application,

Figure 1 is a face view illustrating a piece of fabric embodying my invention. The view is more or less diagrammatic in order to show the construction, because in the actual fabric the stitches are brought up so close as to hide the actual construction of the fabric,

Figure 2 is a similar view of a small portion of the fabric enlarged many times to show the actual formation of the stitches,

Figure 3 is a face view of the cams controlling the jacks which effect the transfer of the needles in a link and link machine and the forming of stitches,

Figure 4 is a diagrammatic view illustrating the manner of forming lacing and jersey stitches under my present method,

Figure 5 is a similar view showing the formation of jersey stitches only,

Figure 6 is an elevation of a single knitting needle employed in a link and link machine, together with the opposite jacks for transferring the needle from one side to the other of the knitting line, and for forming stitches,

Figure 7 is a perspective view of the two jacks and a single knitting needle operated by it, and

Figure 8 is a detail view of some of the needles forming jersey stitches while others are forming the lacing stitches.

The present method is adapted to be carried out in connection with either a flat link and link machine or with a cylindrical link and link machine, the latter being a more recent development but embodying the main idea of the flat link and link machine. As is well known, the link and link machine is provided with jacks which transfer the needles back and forth from one side to the other of the line where the fabric is being formed. In the flat type of machine the needle beds on opposite sides of the knitting line are in a flat or horizontal plane, whereas in the cylindrical type of machine there is a lower needle cylinder and there is an upper needle cylinder, and jacks transfer the needles back and forth between the upper and lower cylinders.

In the drawings in the present case I have illustrated the construction as it will appear in a cylindrical type of link and link machine although it will be understood that the operation will be carried out in the same manner on a flat link and link machine.

In Figure 8, I have shown two rows of pins 1, 2 in co-operation with which the needles form the loops and produce the fabric in a line between the two rows of needles, which is common to knitting machines. In this view I have shown a number of needles 3 all on one side of the fabric line and in the lower cylinder, and in this view these needles are shown forming rather short loops 4 at the front of the fabric. I have shown other needles 5 which have been transferred to the upper cylinder of the machine and which are forming loops 6 at the back of the fabric in co-operation with the upper row of stationary pins 2.

These upper needles, which have been transferred for the purpose of making the lacing stitches, are drawn upwardly from the upper row of pins 2 a greater distance than the needles 3 are drawn down from the lower pins 1 in order that these upper needles will form longer loops than the loops formed by the needles on the lower cylinder.

The only change in the machine necessary to carry out the formation of these longer or lacing stitches is in the adjustment of the cams on the cam plates. In Figure 3, I have shown a portion of the upper cam plate 7 and the lower cam plate 8 of an ordinary cylindrical link and link knitting machine. These cams may be considered as travelling toward the right in Figure 3 as indicated by the arrow, in relation to the needle jacks.

When the transfer cams 9 and 14 are in action the transfer cam 9 will transfer all needles up and the cam 14 will return all transfer needles down again, thus forming alternate complete courses of left stitches on the first feed and right stitches on the second feed. This produces link and link fabric all over. With the upper stitch cam 12 advanced or raised, as indicated in Figure 3, it will make the course of left stitches looser than the intervening courses of right stitches, as will be apparent in the upper portion of Figure 1.

Underneath the transfer cam 9 and directly ahead of it is an auxiliary cam 9a. This latter cam 9a is thrown out of action when the machine is under the control of jacquard cards (not shown). Normally the butts of the jacks with the lower cylinder will pass underneath the cam 9 and no transfer will occur except that when there is a hole in one of the jacquard control cards a selected jack will rise high enough so that its butt may be engaged by the transfer cam 9 and thus finish the transfer of the selected needle associated with the particular jack.

Through suitable mechanism, not disclosed herein but known in the art, each needle in the machine is individually controlled from the jacquard cards at any particular feed. During the knitting of rib fabric the transfer cam 14 is out of action so that their intervening needles, once transferred to the upper cylinder, remain there, each knitting a continuous wale of left stitches just as those needles remaining in the lower cylinder each knit a continuous wale of right stitches. In a one-and-one rib vertical wales of right stitches alternate with similar wales of left stitches all tightly knit. The right wales at the front as well as the left wales at the back tend to draw toward each other, which function gives the fabric the elasticity characteristic of rib knitted fabric.

Following the transfer cam 9 there is a lower stitch cam 10 on the lower cam plate, and this causes the needles which remain in the lower cylinder to be reciprocated for the purpose of forming their loops 4 in co-operation with the lower row of pins 1 and these stitches will be on the front or face side of the fabric. This lower stitch cam, while being adjustable, is in the present method shown in its closest position to the space 11 between the cam plates where the fabric is being constructed, so that the needles in the lower cylinder will form the ordinary stitches. The upper stitch cam 12 disposed on the upper cam plate is adapted to reciprocate the upper jacks and thereby reciprocate the needles 5 in the upper cylinder, as indicated in Figure 8.

In the production of my new fabric the upper stitch cam 12 will be positioned with its top cam surface 13 spaced further from the fabric line than the lower stitch cam so that the needles which have been transferred to the upper cylinder, to wit, the needles 5 in Figure 8, will be given a longer thrust or reciprocation in relation to the upper row of pins 2 than that given to the lower needles 3 in Figure 8, in order to draw out longer loops which are to form the lacing stitches in the fabric.

As is well known in machines of this type, the upper stitch cam can be adjusted to the position shown in Figure 3 by the release of a set screw (not shown).

Passing further along on the upper cam plate, I have shown a down transfer cam 14 which operates in the reverse manner to the transfer cam 9; that is, it serves to operate the upper jacks in a manner to transfer needles from the upper cylinder back to the lower cylinder; in other words, any of the needles 5 which have been in the upper cylinder in Figure 8 may be retransferred back to the lower cylinder, so that after they have been serving for the purpose of forming loops at the back of the fabric while on the upper cylinder, they are retransferred back to the lower cylinder and after being so retransferred, they operate like the other needles 3 to produce the front stitches.

It will be observed from this that any needle which is in the lower cylinder will produce ordinary jersey or right side out stitches, and that any of these needles may be transferred to the upper cylinder, and while there they form re-

verse or left side out stitches, and these stitches formed by the upper needles are drawn out to form larger loops to constitute lacing stitches. On the other hand, when the upper needles are retransferred to the lower cylinder, they again return to the formation of front stitches.

The broad idea of my invention, therefore, resides in employing a link and link machine and in transferring certain needles from one cylinder to the other, and while transferred, forming larger loops for lacing effect, and retransferring the same needles back to their original position to form right or front side stitches.

It will be understood that in link and link machines the needles have hooks at each end, as indicated at **15** and **16** in Figures 6 and 7, and there is a pivoted latch **17** for each hook.

The purpose of the double hook and latch is to permit the needle to be operated on either the lower or upper cylinder to form the front or back loops of the fabric. At **18**, I have shown a known type of jack having a hook **19** to engage the upper hooks of the needles for the purpose of transferring them from the lower to the upper cylinder and for reciprocating the needles for the formation of the upper loops. There is a tang **20** on this jack for holding the upper latches in the open position as shown in the upper part of Figure 6. The lower jack **21** is shaped the same as the upper jack. It also has a hook **22** to engage the lower hooks **16** of the needles, together with a shoulder **23**, and these jacks also have tangs **24** to hold the lower latches in the open position. Both upper and lower jacks have projections **25** which travel respectively in the slots of the upper and lower cam plates.

In Figures 4 and 5, I have shown diagrammatically the manner in which the stitches are formed in the production of my novel fabric, Figure 4 showing one course and Figure 5 the next course thereto. The line **26** in Figure 4 represents the line on which the fabric is formed. The loops **27** below this line represent the loops **4** formed by the needles on the lower cylinder constituting the front or right side stitches. The loops **28** above the fabric line represent the longer stitches **6** formed by any of the needles which at this time are in the upper cylinder and obviously these loops are formed on the rear side of the fabric.

In Figure 5 which represents the course which follows that of Figure 4, all of the loops are formed by the needles in the lower cylinder, which loops are short ones. During this course the needles which had been transferred to the upper cylinder have been retransferred back to the lower cylinder so that in making this particular course all of the needles are in the lower cylinder and produce similar loops at the front of the fabric.

The loops in the course shown in Figure 5 interlock with the loops shown in Figure 4 and since in Figure 4 some of the loops of this course are formed by needles in the lower cylinder, jersey stitches will be formed by the two courses. On the other hand, where the needles have been transferred to the upper cylinder to form the longer loops in Figure 4 at the rear of the fabric, these will be interlocked with the shorter and front loops of Figure 5, thus producing lacing stitches.

The threads or yarns in Figure 2 show how they combine in the structure of the fabric and how the fabric passes from jersey stitch into lacing stitch and back again. It will be understood that in this figure all of the stitches are left very loose or open in order to see the construction. In the actual fabric the jersey stitches will be drawn up so that light will not be visible between the stitches, whereas the lacing stitches will be relatively open.

The formation of various types of stitches can be best explained by considering a vertical line of stitches or single wale in Figure 2. In this figure the needles engage the thread at the upper parts of the whorls or loops **34**, **35**. The inverted whorl is formed around the pins **1** and **2** of Figure 8. The fabric is knitted from the bottom upward. Beginning at the bottom of Figure 2 and that portion where jersey stitches only are formed, it will be observed that at any designated wale both sides of the first full stitch emerge from the back of the preceding upper whorl and lie close together over its center. This indicates that the stitch was formed by drawing the thread from the back towards the front of the fabric. By following the same line upward it will be seen that every successive stitch is formed in the same manner.

In referring to the lacing section which will be started at the bottom of the wale indicated by the numeral **36** it will be seen that the two sides of the first complete loop emerge from the back of the preceding upper whorl **37** and over its center exactly as in the description of the jersey portion but the second stitch is formed just the opposite way. Both sides enter from the front and emerge from the back of the first stitch. This is called a left stitch formed by a needle transferred to the upper cylinder while those previously mentioned are right stitches formed with the needles in the lower cylinder.

While in Figure 2 the lacing loop **44** and the jersey loop **45** are shown one below the other, in the actual fabric the lacing loop at the rear of the fabric is hidden by the jersey loop **45** because the angle of the thread is such as to cause the jersey loop **45** to lie over the upper portion of the lacing loop **44**, thus giving the appearance in proportions of a single line of thread at this point.

When the needles are in the lower cylinder during several courses they will make the jersey stitches which is the foundation portion of the fabric. If at any time it is desired to make a line or margin completely across the fabric of link and link stitches, all needles will be transferred to the upper cylinder to make loops at the back of the fabric during one course and will then be retransferred back to the lower cylinder for the next course, etc. so that the combined action of the needles will produce link and link fabric. No change in the machine is necessary to shift from one kind of stitch to the other, other than to provide the necessary holes in the jacquard card which controls the knitting machine. To change from any type of stitch to rib fabric all that is necessary is to transfer every other needle to the upper cylinder and leave them there until the desired length of rib fabric is produced. The needles may also be transferred two up and two down or in any other arrangement, depending on the type of rib desired.

I have described the formation of the left hand lacing stitches in Figure 2 and it will be understood that this may extend across any portion of the width of the fabric and be followed by other jersey stitches, and again by other lacing stitches,

all according to any preconceived pattern. It will also be apparent that considering the fabric from top to bottom in Figure 2, the lacing stitches may be terminated at any point and be followed by the formation of jersey stitches, and this may be followed again by lacing stitches.

From the above it will be apparent that I have provided a method of making knitted fabric having lacing in any form or design, by employing a link and link machine and without any change in the machine other than shifting the stitch cam which controls the thrust of the needles which form the back stitches of the fabric. Furthermore, the fabric itself is of a novel construction and the lacing stitches are more open and more lacelike than lacing performed on any other type of machine or by any of the previous methods.

Having described my invention, what I claim is:

A new knitted fabric having ground work of jersey stitches and lacing portions interspersed between the jersey stitch portions, said jersey stitch portions of the fabric consisting of interlocking plain stitches only and said lacing stitch portions consisting of tight plain stitches and loose purl stitches alternating in the several lacing portions of the fabric with the said purl and plain stitches interlocking with each other, said plain stitches which interlock with the loose purl stitches being disposed to lie in front of and to cover substantial portions of said loose purl stitches.

ISIDOR S. BLEENDES.