Sept. 30, 1941. H. GRIMM ET AL 2,257,235

KNITTED FABRIC

Filed March 30, 1938 3 Sheets-Sheet 1

Fig. 1

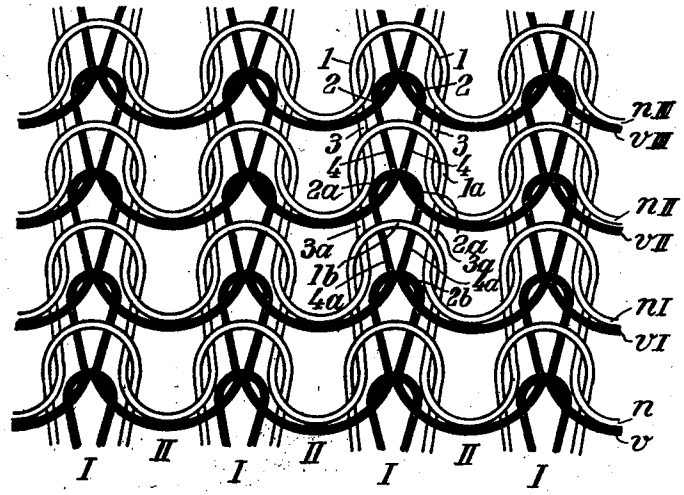


Fig. 3

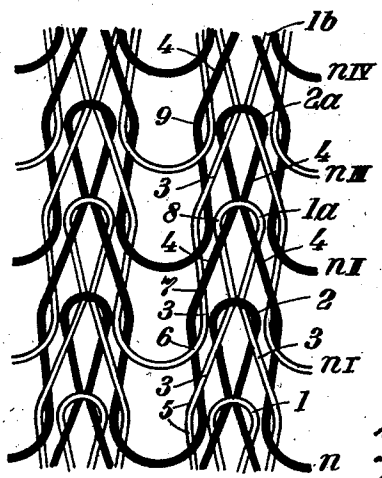
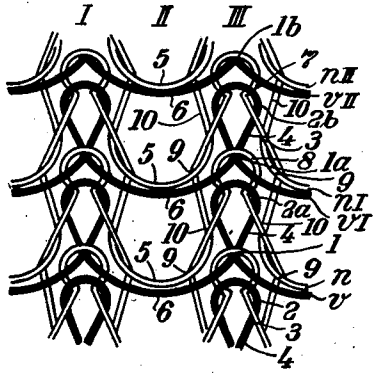


Fig. 2



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Sept. 30, 1941. H. GRIMM ET AL 2,257,235

KNITTED FABRIC

Filed March 30, 1938 3 Sheets-Sheet 2

Fig. 5

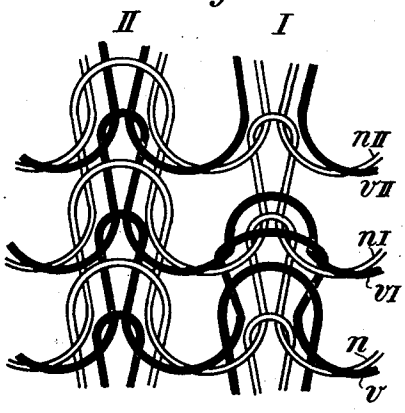
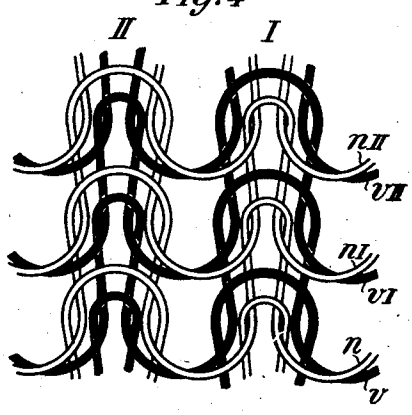


Fig. 4



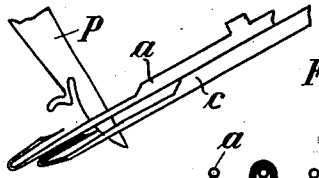


Fig. 7

Fig. 6

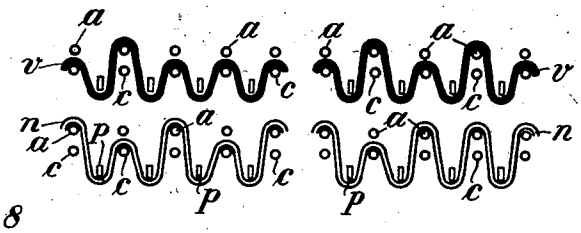


Fig. 8

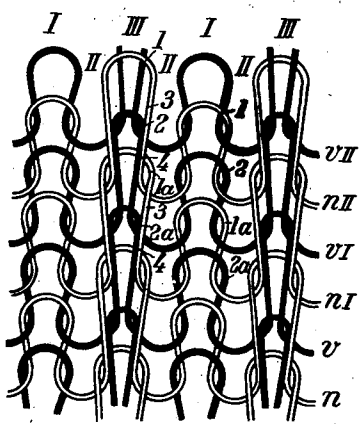
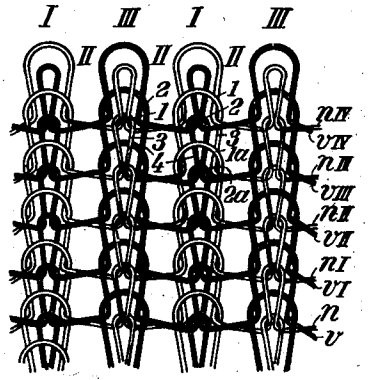


Fig. 9



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KNITTED FABRIC

Filed March 30, 1938 3 Sheets-Sheet 3

Fig. 10

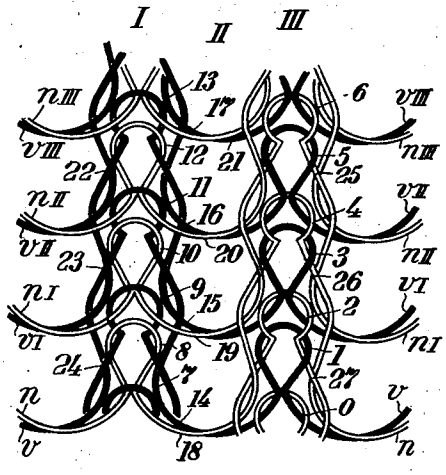
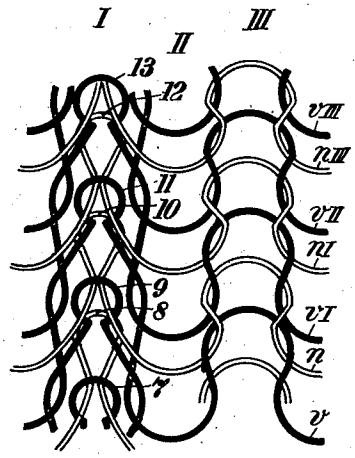


Fig. 11



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UNITED STATES PATENT OFFICE

2,257,235

KNITTED FABRIC

Hans Grimm and Oskar Kempf, Possneck, Thuringia, Germany

Application March 30, 1938, Serial No. 198,904
In Germany Februdary 11, 1938

2 Claims. (Cl. 66—169)

This invention relates to hosiery, or knitted goods and the manufacturing of the same.

The object of the invention is, to prevent the slipping of stitches in hosiery or knitted goods without influencing the natural elasticity of plain or ribbed fabric, and without considerably altering the appearance thereof as compared with the ordinary known plain or ribbed web. The transfer of stitches and also the picking up and presentation of stitches by auxiliary elements as preparatory work for the stitch locking is also avoided.

The above mentioned features are realised in a web:

(1) In which a stitch of a row of stitches and on a needle is looped in the same direction by a stitch of a row of stitches and on a needle situated thereunder, with the result that the web is secured against running of stitches,

(2) In which a stitch of a row of stitches and on a needle is looped in the same direction by a stitch of a row of stitches on a needle situated thereunder, the stitch of the upper row of stitches being knocked over on to the lower row of needles and formed into another stitch with the stitches of the lower row of needles,

(3) In which a stitch of a row of stitches on a needle is knocked over on to the lower needle and pulled out to form another stitch with the stitch on the shank of this needle with the result that the fabric is lock-stitched.

The invention further relates to a method for producing in a simpler manner a fabric with the above mentioned properties without hanging the stitches on auxiliary sinkers. For this purpose two needles are employed arranged one above the other or one sliding on the other, the lower needle looping the stitches of the row of stitches of the upper needles intermeshing as in a plain or ribbed knitted web with a stitch of a row of stitches which is produced by this lower needle as in a plain or ribbed knitted fabric and intermeshes in rows. Furthermore, the employment of two needles one above the other or one sliding on the other is provided for the operation described, and in addition thereto the stitch of the row of stitches hanging on the upper needle is knocked over on to the lower row of needles, when forming a following row of stitches, and is drawn out to another stitch with the passed through stitch of this needle. Finally the employment of two needles one above the other or one sliding on the other is provided for the production of fabric with open work and pattern effects with the above mentioned properties.

Furthermore the improvement relates to knitting and hosiery machines, on which goods with the above mentioned properties can be produced by needles sliding on each other.

Ladder-proof knitted webs plain on one side are known wherein—

(1) A stitch is drawn through the preceding caught and held stitch of the same wale and knocked off over this preceding stitch,

(2) Stitches formed of sinker loops are drawn through the needle stitches of the same row of stitches and hung over into the next following row of stitches,

(3) The stitches of alternate rows of stitches intermesh and these stitches engage in the stitches of the alternating intermediate rows in such a manner that the arms of all stitches be on the front side of the web and the heads of all stitches on the back,

(4) Stitches of a row of stitches are passed through by stitches of an intermediate row formed opposite thereto, whereupon these stitches of the intermediate row are in turn bound by the stitches of the second row of stitches following on the first row of stitches and so on.

Methods are also known for producing ladder-proof hosiery, according to which—

(1) The stitch hanging on the hosiery needle is taken up by an auxiliary needle mounted parallel in front thereof but not knocked over, and this auxiliary needle in conjunction with the hosiery needle holds the newly sunk loop so that the old stitch slides back from the shank of the auxiliary needle on to the shank of the knitting needle over the newly sunk loop, whereupon the first stitch formed in this manner is knocked over the old stitch returned into the needle hook so that the arms of the original stitch are embraced by the fresh stitch,

(2) Stitches formed by loopers and eyed needles are held by the former so that onto the second needle thus becoming free the loops of sinker stitches are transferred by a tickler device, formed into a stitch and can be knocked over the old stitch,

(3) The stitches of two neighbouring or successive rows of stitches are held against knocking over by a catching device, and a fresh row of stitches is threaded by the stitches of these two rows, only one of the two held stitches being then knocked over, whereupon the procedure is repeated with the freshly added stitch,

(4) Of two rows of needles situated exactly opposite each other, the one is brought into operative position when the other has knocked over its stitches, the stitches of this row of stitches being then pierced by the needles of the opposite side, catch the newly fed thread and in returning pull it as loop through the pierced stitch, whereupon the stitch on the shank is knocked over.

For producing ladder-proof fabric, it is known

(1) To employ auxiliary sinkers or transfer needles arranged in stationary bars, which sink-

ers or needles act as stitch holding elements, are situated in front of the working needle and adjustable individually or in the width of the whole machine. However, arrangements of this type can only be used on flat hosiery knitting machines,

(2) To employ additional auxiliary elements, which consist of a looper needle mounted above the ground needle proper, a stationary or movable tickling needle and web holder and knocking over sinker, with the aid of which two stitches are formed on the needle in a row of stitches from the needle stitch and its sinker loop by hanging around and hanging over the latter, and knotted together by the hanging around,

(3) To employ knitting machines with needle holders downwardly inclined at a predetermined angle, set with movable mutually opposite needles and producing a fabric with similar front and rear sides and formed of one or two oppositely directed knitted webs plain on one side, the stitch loops of which lie the one in the other.

Several embodiments of the invention are illustrated by way of example in the accompanying drawings, in which:

Fig. 1 shows a portion of the ladder-proof fabric in diagrammatic elevation.

Fig. 2 is a similar view of another ladder-proof fabric plain on one side.

Fig. 3 is a similar view showing a stitch connection produced with one thread for a fabric plain on one side.

Fig. 4 shows another crossed stitch connection changing as regards position of a fabric plain on one side.

Fig. 5 shows a stitch connection according to Fig. 4 with openwork effects in a fabric plain on one side.

Fig. 6 is a diagrammatic view showing the thread laying according to Fig. 4.

Fig. 7 is a similar view according to Fig. 5.

Fig. 8 is a diagrammatic view of a ribbed fabric according to the invention, one side of the fabric being ladder-proof.

Fig. 9 is a diagrammatic view of the thread lap of ribbed fabric with ladder-proof connections on both sides.

Fig. 10 shows a fabric with plain front side and ladder-proof knit rear side.

Fig. 11 shows a two-faced ribbed fabric, ladder proof knit.

As shown in Fig. 1 the new web is characterised by rows *n*, *n*I of stitches **1**, **1***a* interengaging like those of a plain fabric and caught from below by rows *v*, *v*I of stitches **2**, **2***a* which also interengage as in a plain fabric. The locking between the rows *n*, *n*I is due, on the one hand, to the catching from below of the stitch arms **3**, **3***a* and the stitch heads **1**, 1*a* of the rows *n*, *n*I by the stitch heads **2**, **2***a* of the rows *v*, *v*I, on the other hand, the slipping of the stitches **2**, **2***a* of the rows *v*, *v*I is rendered impossible as these stitches are looped longer than those of the rows *n*, *n*I and thus possess a greater extensibility than the stitches *n*, *n*I. The stitches **2**, **2***a* of the rows *v*, *v*I are encircled by stitches **1**, **1***a* of the rows *n*, *n*I, whereas the extension of the arms **4**, **4***a* of the stitches **2**, **2***a* intersect the arms **3**, **3***a* of the stitches **1**, 1a. Consequently, the arms **4**, **4***a* in the stitches **1**, **1***a* and the arms of all the stitches are on one side of the fabric whereas the stitch heads project on the other side. The fabric therefore has the appearance and the properties of plain two-thread fabric. Owing to the locking and the greater stitch length of the row of meshes catching from below, the fabric in the event of any of the stitches breaking is secured against the stitch further running down in the wale in which the fracture occurs. If it is supposed, that the stitch **1** of the row *n*II breaks it is evident that the stitch is liberated by the row *n*I located thereunder but is held by the stitch **2** of the row *v*II catching from below. If the stitch **2** of the row *v*II catching from below, whose stitch arms **4** are located in and are surrounded by the stitches of the row II, should break, the next following stitch **2***a* of the row *v*I would be held thereby that its arms are shorter than those of the *n* rows and are furthermore embraced by the stitches **1** of the *n* row. By pull or tension the stitch **1** closes and binds against slipping the arms **4** of the stitch catching from below.

The fabric illustrated in Fig. 2 is characterised by rows *n*, *n*I the meshes **1**, **1***a* of which interengage in the manner of a plain fabric and by rows *v*, *v*I of meshes **2**, **2***a* which also intermesh in the manner of a plain fabric and have been drawn through the stitches **1**, **1***a* and knocked over the stitch heads of the stitches **1**, **1***a*. The stitches **2**, **2***a*, catching from below the stitches **1**, **1***a*, encircle at **7** the arms **3** of the stitches **1**, **1***a*, whereas the arms **4** of the stitches **2**, **2***a* are bound at **8** by the heads of the stitches **1**, **1***a* of the *n* rows. The stitches **1**, **1***a* of the *n* rows hang the one in the other with the arms **3** and the sinker loops **5** and encircle at **9** the points of intersection **7** and **8** of the inner stitch **2**, **2***a* of the *v* rows formed from a second thread and of the inwardly drawn knocked over stitch **1**, **1***a* of the *n* row. The arms **4** of the stitches **2**, **2***a* lie in the head of the stitches **1**, **1***a* and cross as sinker loops the lower part **10** of the stitch arm **3** and the sinker loop **5** of the stitches **1**, **1***a* of the *n* rows. The arms **3** of the stitches **1**, **1***a* lie, on the one hand, in the head of the stitches **2**, **2***a*, cross over the arms **4** of the stitches **2**, **2***a* and the lower part **10** of the inwardly drawn arm **3** of the stitch **1**, **1***a* and, on the other hand, cross under the sinker stitches **5** and **6** and the inner arms **3** of the stitch **1**, **1***a*. Consequently, the stitch **1**, **1***a* is held in the head by the arms **4**, **4***a* or sinker stitches **6**, **6***a* of the *v* rows, by the arms **3**, **3***a*, or sinker stitches **5**, **5***a*, of the *n* rows and by the stitches **2**, **2***a* of the *v* rows, and the stitch **2**, **2***a* is locked by the long drawn out stitch **1**, **1***a* passing through it at the point of intersection **7** and encircling it at the knot point **9**. The arms of all the stitches lie on one side of the fabric, whereas the stitch heads project on the opposite side. The fabric therefore has the appearance and properties of plain fabrics. By the locking of the inner stitch **2**, **2***a* by the outer and repeated catching from below of the outer stitch **1**, **1***a*, by the arms of the inner stitch and the arms **3** of the previously formed stitch row *n*, the fabric, in the event of any of the stitches breaking, is secured against the stitches running downwards in the wale in which the breaking occurred. If it is supposed that the stitch **1***b* of the row *n* breaks at the point **10**, it is evident that the arms **3** or **10** will disengage from the previously formed stitch **1***a*, which however is held by the stitch **2***b* of the row *v*I engaging from below. If the stitch **2***b* of the row *v*I breaks, the next following stitch **2***a* of the inner stitch wale of the row *v* is held by the stitch head **1***a* engaging thereunder and en-

circling the arms 4 of the stitch 2b broken in this instance. If both stitches break, the stitch loop 1, 1a of the *n* rows drawn out to a second inner stitch, when the material is stretched, is drawn so tightly around the threaded mesh 2, 2a of the *v* rows at the point 8 that the arms are bound off and, on the other hand, the length of the stitches 1, 1a is greater than the lateral extensibility of the material, which is limited by the smaller stitch 2, 2a of the *v* rows. The stitch 1, 1a underlaps the knocked over smaller stitch 2, 2a and supports this stitch against dropping by the excess quantity of thread. Preventing of the slipping of the stitch 1, 1a is attained by several times catching from below and by the change of the double stitch formature from the outer to the inner stitch wale.

Fig. 3 represents a fabric that is plain on one side and which is made from one thread, but has the binding described in connection with Fig. 2. The fabric consists of interhanging rows of stitches *n*, *n*1, *n*2 and so forth, whose stitches 1, 1a and 2, 2b are drawn inwards and each formed into a second stitch. Every stitch is held twice by the next stitch. For example the arm 4 of the stitch 2a at the point 5 lies over the arm 3 of the stitch 1a, catches under the arm 3 of the stitch 1b at 6, crosses over this arm at 7 and is drawn through the stitch loop 1a at 8 and knocked over the stitch 1b at 9. The stitch 1a extends in a similar manner. If a stitch, for example the stitch 2a, breaks, it is evident that the dropping stitch will be held by the next following inwardly drawn stitch 1b in that the arms 4 of this stitch as outer stitch encircle or catch under the arms 3 of the broken stitch 2a and are pulled through the head of the inner stitch 2a.

Fig. 4 shows another stitch arrangement of a one-sided fabric, such as is produced by the employment of two superposed needles, two threads being necessary for the production of one row of stitches. In this binding the sinkers draw the thread *v* in a part row alternately over a lower and the next following upper needle, as shown in the diagram, Fig. 6. In the second part row the sinkers *p* draw the fed thread material alternately over an upper needle and the next following lower needle *c*, so that the stitches or the sinker loops of the part rows intersect. The binding shown in Fig. 2 can be built up with this lapping.

Another possibility of obtaining openwork effects on the basis of Fig. 5 is shown in the fabric diagrammatically illustrated in Fig. 6. The stitch loop of an upper needle *a* according to the desired pattern is transferred as catch loop on to the lower needle *c* and bound and knocked over by this needle.

Fig. 7 shows a looping of the thread which substantially corresponds to that of Fig. 6, with the difference that the stitches of any desired upper needles can be transferred on to the lower needles, for the purpose of producing openwork patterns or relief-like effects. The thread position of the *n* rows alternates from an upper needle *a* to the next following lower needle *c* and those of the *v* rows in analogous manner. The drawing depth of the sinkers, which must be different for every needle position to obtain a uniformly long stitch, is controlled by a separate device.

Fig. 8 shows a ribbed fabric, in which one side has the structure of the known ribbed fabric, whereas the other side is produced according to the looping described in relation with Fig. 1. The object is, to keep free one side of the fabric for relief-like pattern effects, which can then be bound ladder-proof in rearward direction. The fabric is composed of left stitch wales I and right stitch wales III which are interconnected by sinker loop wales II, and is characterized by rows *n*I, *n*II which interengage in the stitch wales III in a manner similar to a plain ribbed fabric and catch under the stitch 1, 1a, whereas the rows *n*I, *n*II and *v*I, *v*II interengage in the stitch wales I like in a plain fabric but in alternating sequence.

In Fig. 9 a double ladder-proof ribbed fabric is shown, which is produced according to the principle of the fabric illustrated in Fig. 1. This new fabric is characterised by rows *n*, stitches 1, 1a of which interengage as in a ribbed fabric and are locked with the rows *v* the stitches 2, 2a of which also interengage as in a ribbed fabric. The locking between the rows *n* and *v* is due, on the one hand, to the catching from below of the stitches 3 and 3a and, on the other hand, to the similar catching from below of the stitches 2, 2a and to an overlapping of the meshes which are catching from below.

A row of stitches extends in the following manner:

In the stitch wale I the stitch *n* forms the mesh which catches from below, crosses over the sinker stitch in the sinker stitch wale II and is drawn out in the stitch wale III as the stitch 2 to be caught from below. The stitch 1 of the row *n*III is caught from below in the stitch wale I by the stitch 2 of the row of stitches *v*III formed above and crosses under the sinker loops of the wale II of the sinker stitch of the row *v*III and is formed in the stitch wale III to the stitch 1 catching from below the stitch 2 of the row *v*III. The rows *n*, *n*I, *n*II and so on are directly hanging the one on the other, the stitches 1, 1a and so on formed from these rows catch from below, in the wale III, and overlap in the wale I the stitches 2, 2a and so on formed by the rows *v*, *v*I, *v*II and so on, which in turn in the wale I catch from below the stitches 1 and in the wale III overlap the stitches 1. The arms 3 of the stitches 1 of the *n* rows are, on the one hand, encircled as underlapping stitches in wales III by the arms 4 and the stitch heads 2 of the *v* rows and, on the other hand, the stitches 1 in the wale I encircle the underlapping stitch 2 and stitch arms 4 of the *v* rows. Consequently, the stitches 1 of one row of stitches *n* underlap the stitches 2 of the rows *v* in a stitch wale III and the stitches 2 of the rows *v* underlap in the other wale I the stitches 1 of the rows *n*, whereas the long-looped arms of these stitches are bound off against slipping by the stitch encircling and overlapping the same. The arms of all stitches are consequently drawn outwards, whereas the stitch heads are situated on the outer side. The fabric thus has the appearance and properties of a ribbed fabric which may be characterised in that two absolutely independent ribbed fabrics interengage for the purpose of ladder proofness in such a manner that their stitches lock each other, the structure and elasticity of ribbed fabric being preserved. Owing to the interlocking between the consecutive stitch rows by underlapping of a second row of stitches, the arms of which lie and are bound off in the stitch heads of the pulled through stitches, the fabric, in the case of breaking of any stitch, is secured against running off in the stitch wale in which the breakage has occurred.

In Fig. 10 a two-sided ribbed fabric is shown,

in which one side of the fabric has the appearance of the known ribbed fabric, whereas the other side has the looping described in connection with Fig. 1. The fabric consists of left wales I and right wales III which are interconnected by sinker mesh wales II, and is characterised by rows *v*, *v1*, *v2*, whose stitches hang the one in the other in the wale I and interengage intermediate the rows in the wale II and by rows *n*, *n1*, *n2*, whose stitches hang in the wale I intermediate the rows in the stitches of the inwardly drawn stitches of the *v* rows and cross over and underlap these and interengage in ordinary weave looping in alternate rows in the wale III. One side of the fabric has a ladder-proof binding according to this process, whereas the other side has the known structure of a ribbed fabric.

In Fig. 11 a double sided ladder-proof ribbed or circular ribbed fabric is shown, which has as basis the binding of the fabric shown in Fig. 1. The wale I has the appearance of rib stitches and corresponds in binding and lapping to the fabric shown in Fig. 1, whereas the wale III represents pearl stitches and the reversal of the stitch connection as compared with the wale I. This new fabric is characterised by rows *n*, whose stitches **2, 4, 6** interlock in rows in the wale III under the stitches **8, 10, 12** intermediate the rows in the wale I as in a ribbed fabric and are locked with the rows *v* whose meshes **1, 3, 5** interengage intermediate the rows in the wale III and in rows with the stitches **7, 9, 11** in the other wale I as in a ribbed fabric. The locking is due to the double underlapping of the inwardly drawn stitches and to the intermediate-row-connection of the inwardly drawn stitches with the inner stitches.

A row of stitches composed of two part rows *v* and *n* extends as follows:

In the wale I the row *v* for example forms the stitch **11** the arms **4** of which underlap the preceding stitch **9**, is knocked over the next following outer stitch **13** at the intersection point **23**, drawn through the inner stitch **11** and knocked over a second time but this time over the inner stitch **12** of the next following intermediate row *n2*. The extension of the arm of stitch **11** merges into the sinker stitch **14** of the wale II which underlaps the sinker stitch **18** and the arms of the stitch **2** and terminates in a stitch **1** in the wale III, which is drawn through the stitch head *o* and knocked over the stitch **2** of an *n* row. The second part row *n* develops in the wale **1** the stitch **8**, which is looped through the head **7** of a *v* row and knocked over the inwardly drawn stitch **9** and terminates in the sinker stitch **18**, which crosses over the sinker stitch **14**, underlaps the outer arm of the stitch **2** of an *n* row, is knocked over the outer stitch **6** at the point of intersection **26**, drawn through the stitch **3** of the intermediate row *v1* and knocked a second time over the stitch **5** of the intermediate row *v2*. In the wale I the stitches **7, 9, 11, 13** formed by the *v* rows interengage with their encircling arms, whereas their heads interengage between rows, i. e. through each head a stitch of an intermediate row is drawn and knocked over the next following stitch head of a *v* row. In the wale II the sinker stitches **14, 15, 16, 17** formed from the *v* rows cross over the sinker loops **18, 19, 20, 21** formed from the *n* rows and terminate into the inner stitches **1, 3, 5** of the wale III which stitches interengage mid-rows with the inwardly drawn stitches **0, 2, 4, 6, 8** formed from the *n* rows. The outer stitches **7, 9, 11, 13** of the *v* rows in the stitch wale I and the analogous stitches **2, 4, 6** in the wale III are knocked over the arms of the next following stitches at the points of intersection **22, 23, 24, 25, 26, 27**, pass through the stitch heads of the inner stitches **1, 3, 5, 8, 10, 12** and are thrown over the next following inner stitch. The inner stitches are not directly interconnected but engage in the stitch heads and arms of the inwardly drawn stitches. The object is, to secure the inner wale against running of the stitches in this rib, whereas the encircling outer stitches are protected against laddering by repeated underlapping. The arms of all the stitches are drawn outwards so that the stitch heads of the double sided fabric lie on the surface of the fabric. The fabric consequently has substantially the appearance and properties of a ribbed fabric, consisting of two interengaging interstitched fabrics in ribbed crossed over binding.

Contrary to Fig. 2 the fabric pictures show that a finished row of stitches is composed of two part rows. In the instance in question, two similar threads are employed for producing this fabric. The tightly drawn out rows of stitches *v* in the figures are only employed for characterising the structure of the fabric. However, threads of different materials may be employed to obtain pattern effects.

The method for producing the fabrics described is characterised by two needles sliding one on the other, and which may exist in one or several needle holders. The operation and cooperation of the needles for the stitch formation according to the illustrations is in principle the same; as in each case the stitch formed by the upper needle is threaded in the next following operation by a stitch formed by the lower needle, that is the lower needle, on whose shank a stitch is already hanging, passes through the presented stitch of the upper needle to form a fresh stitch, receives its thread and in returning draws the stitch loop through the stitch presented by the upper needle so that the arms rest in the stitch of the upper needle, whereas the old stitch on its shank is knocked over the stitch head. Furthermore the stitch of the upper needle is drawn out by the lower needle with the stitch of the lower needle to form a second wider stitch.

We claim:

1. A ladder-proof knitted web comprising wales and courses wherein in each wale each loop is drawn twice through the loop of the preceding course at walewise spaced points and intermediate said spaced points the loop of the following course is drawn through said first mentioned loop.

2. A ladder-proof knitted web comprising wales and courses wherein each loop of a course is intermeshed twice with each loop of the two adjacent courses in the same wale and between the two points of intermeshing engagement of a loop with the loop of the following course it has intermeshing engagement with the loop of the preceding course.

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