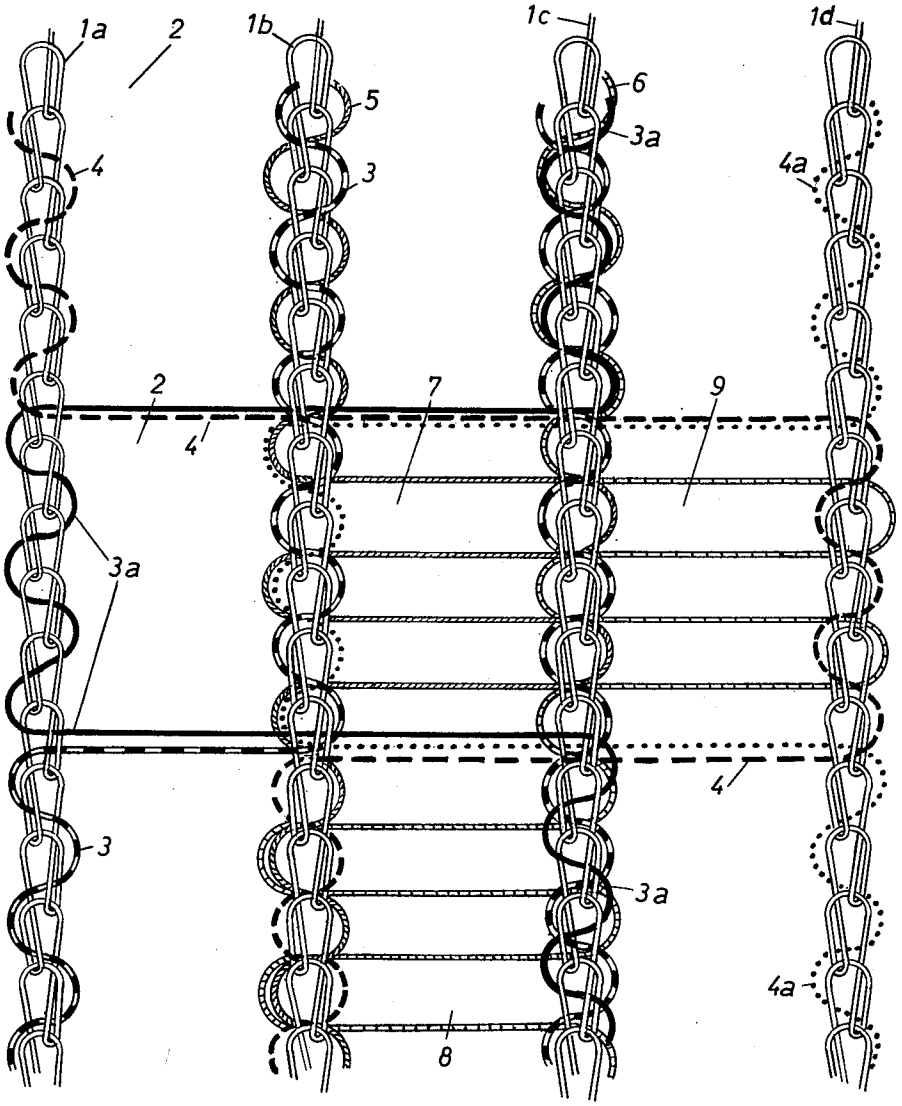
April 9, 1963 W. H. SCHEIBE 3,084,529

OPEN MESH WARP KNITTED FABRIC

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Fig.1.



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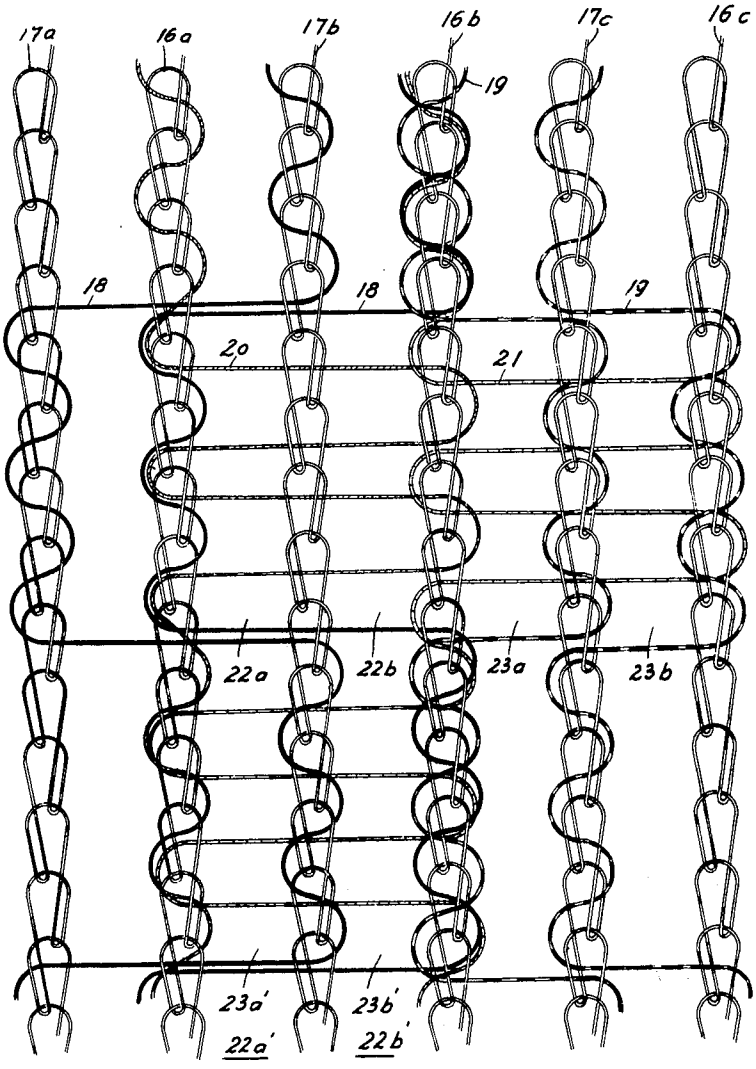
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Fig. 2



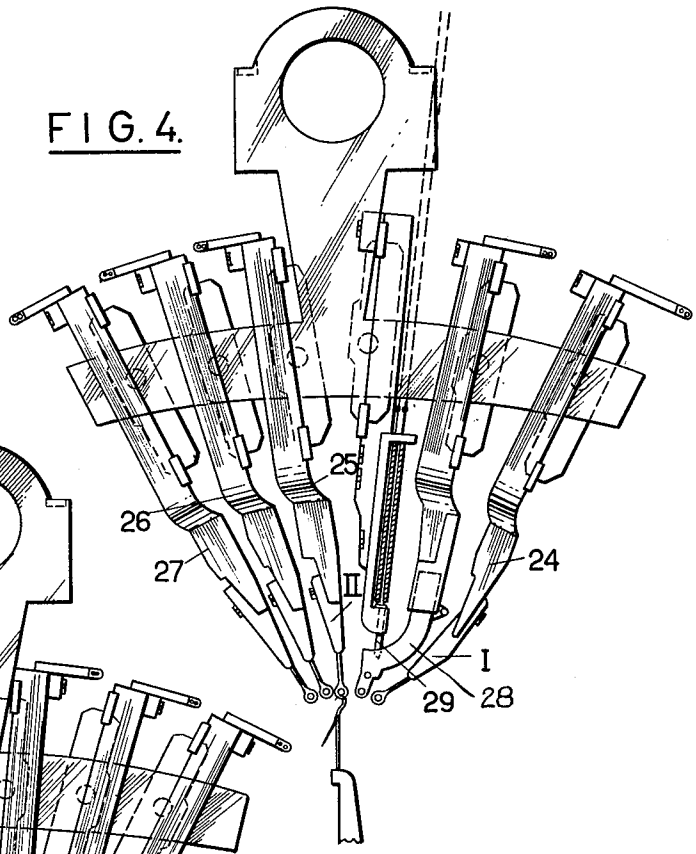
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OPEN MESH WARP KNITTED FABRIC

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FIG. 4.



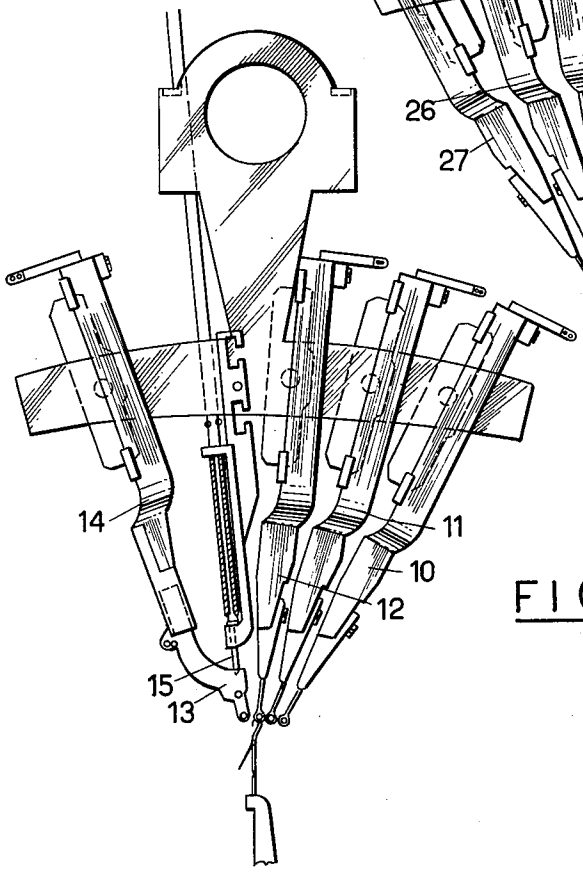


FIG. 3.

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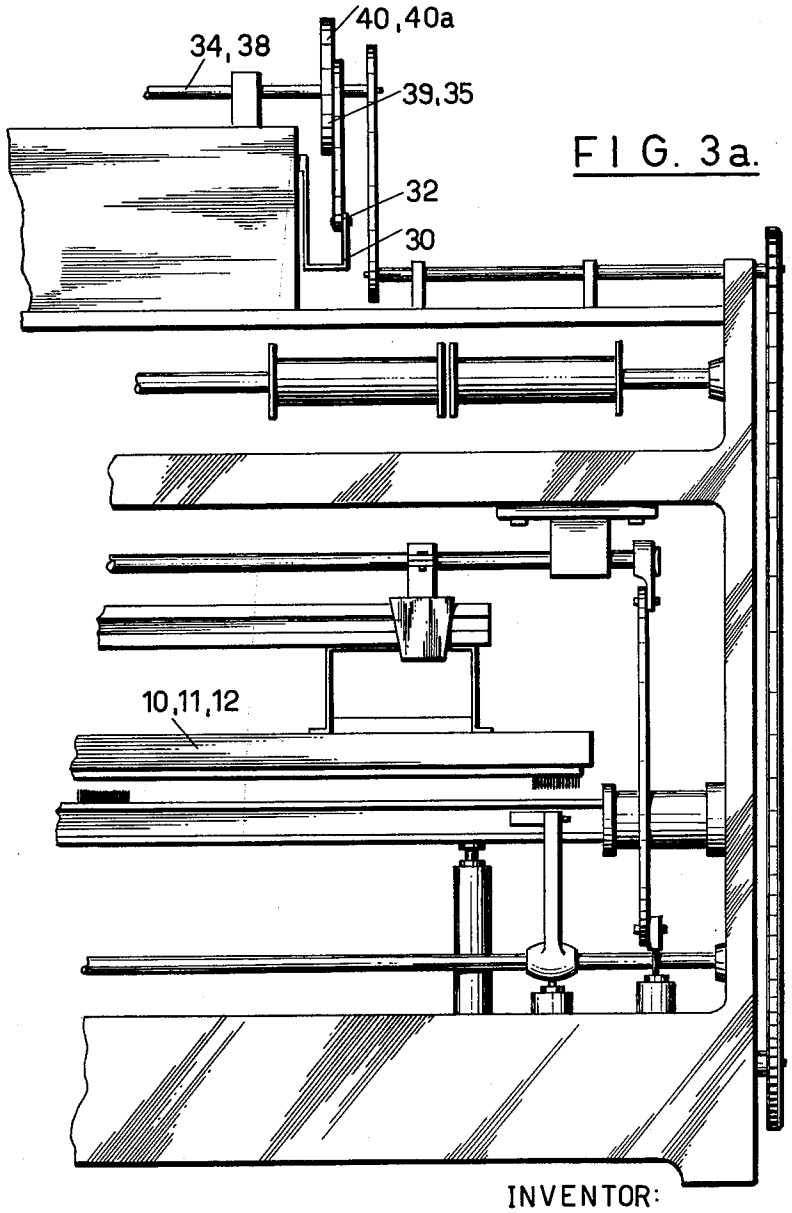


FIG. 3a.

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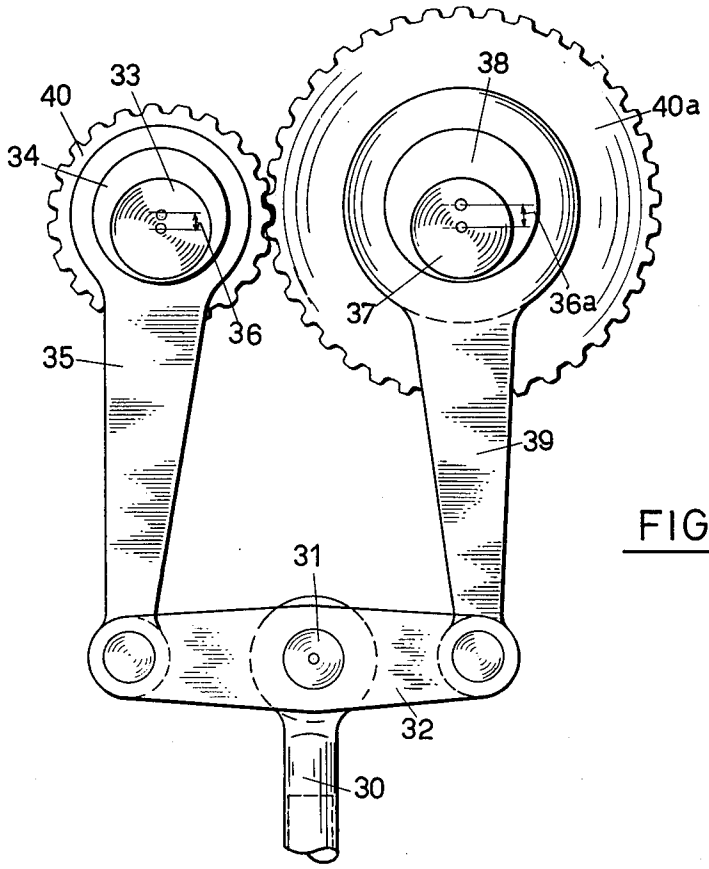


FIG. 5.

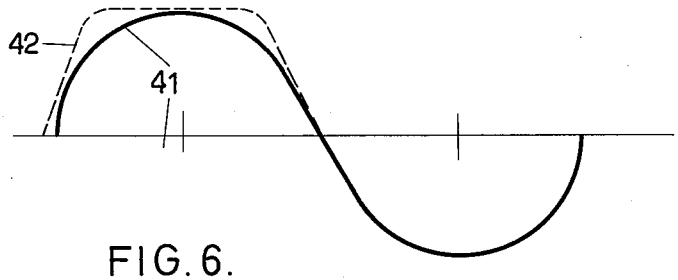


FIG. 6.

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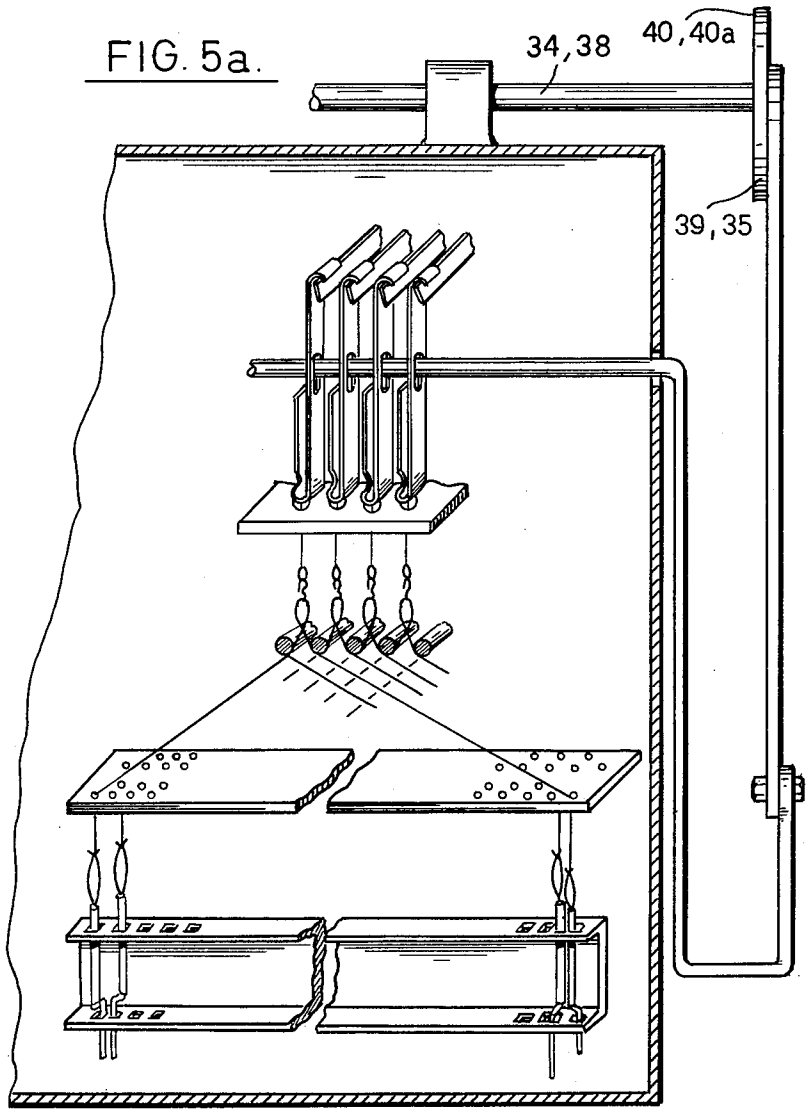
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FIG. 5a.



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OPEN MESH WARP KNITTED FABRIC

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Filed Jan. 30, 1959, Ser. No. 790,228
Claims priority, application Germany Feb. 6, 1958
3 Claims. (Cl. 66—193)

The present invention relates to knitted fabrics of the type known as filet, tulle, raschel, etc., which may be used as curtains, laces and for many other purposes. The invention also relates to improved warp knitting machines for the manufacture of such fabrics.

The novel fabric belongs basically to the group of knit goods comprising a foundation formed by warp chain threads which are interconneted by cross- or weft threads to form a number of squares, certain squares being filled in by design forming or darning threads which run cross-wise of the fabric and form a large number of different patterns in the basic design.

When such fabrics are formed on known knitting machines, for example on those known as raschel machines, it is considered as necessary that the darning or design forming threads be connected to warp chain threads at both sides of a square which is filled in to constitute part of a certain pattern. This greatly reduces the number and attractiveness of possible fabric patterns and, in addition, the desirable three-dimensional effect cannot be attained in such types of fabrics.

Also, a satisfactory patterning without disturbing cross threads was considered possible only in the manufacture of open mesh fabrics known as bobbinet lace. The disadvantage of such fabrics is in that the machinery for their manufacture operates at comparatively low speeds and, consequently, the product is a rather expensive one. In addition, it was held that the "sculptured" effect which is produced by connecting the cross threads only to certain warp chain threads of the basic pattern was possible only in the bobbinet lace. All simpler and cheaper types of filet goods, tulle and similar knitted fabrics were manufactured with patterns lacking such "sculptured" effect.

An important object of the present invention is to provide an improved warp knitting machine and a novel open mesh fabric manufactured in such a machine, the fabric being characterized in that the squares formed by its foundation are filled in with cross- or weft threads to form a great variety of patterns which may produce a three-dimensional effect, if desired.

Another object of the invention is to provide an improved warp knitting machine which is so combined with a Jacquard mechanism that it may produce filet lace and like fabrics with a great variety of designs such as were heretofore possible only by the use of apparatus for the manufacture of bobbinet lace.

A further object of the instant invention is to provide a novel attachment for a Jacquard mechanism which enables the warp knitting machine to operate at speeds presently attainable only with certain isolated types of high-speed knitting machinery.

The above and certain other objects of the invention are attained by the provision of a knitting machine certain eye-needles of which are controlled by a Jacquard mechanism preferably combined with a novel attachment capable of bringing about controlled delays in the movements of the hook from either or both of its dead center positions. The novel attachment enables the hook to remain in its dead center position or positions for controlled periods of time. Due to the provision of such attachment, the machine may operate at very high speeds and may produce patterns with pleasing "sculptured" effects. Undesirable variations in the thickness of warp threads of the finished product may be avoided by selecting relatively thin material for the darning threads and/or by using warp chain threads of different thicknesses.

The invention will be described in greater detail with reference to the accompanying drawings, in which:

FIG. 1 is an enlarged, fragmentary diagrammatic view of one form of the novel fabric;

FIG. 2 is a similar fragmentary view of a different form of fabric;

FIGS. 3 and 3*a* illustrate portions of a raschel machine for the manufacture of the fabric shown in FIG. 1;

FIG. 4 is a fragmentary view of a different raschel machine for the manufacture of the fabric shown in FIG. 2;

FIG. 5 is a schematic view of an improved control and guide mechanism attached to a Jacquard hook;

FIG. 5*a* is a schematic fragmentary view of a Jacquard hook; and

FIG. 6 is a diagram of two curves, one of which is illustrative of the movements of the hook in prior Jacquards, and the other of which represents the movements of a hook when controlled by the attachment shown in FIG. 5.

The foundation or basic pattern of the texture shown in FIG. 1 consists of spacedly juxtaposed warp chain threads 1*a*, 1*b*, 1*c* and 1*d* which are wrapped by eye-needles to be described hereinafter in connection with FIG. 3. The squares 2 in the foundation of the fabric are formed by the aforementioned warp chains 1*a*–1*d* and by cross- or weft threads 3, 3*a* and 4, 4*a* which latter are interlaced with the chain threads whenever they run in directions parallel with the latter. Thus, weft thread 3*a* is interlaced with chain threads 1*a* and 1*c*, and forms a pair of squares 2, 7 at both sides of chain thread 1*b*. Each square extends over four courses of warp stitches. Weft thread 4 is interlaced with chain threads 1*a*, 1*d* and 1*b*, and forms squares 7 and 9 at both sides of the chain thread 1*c*. Each of chain threads 1*a*–1*d* also intermeshes with a darning or design forming thread, there being shown in FIG. 1 a darning thread 5 for chain thread 1*b* and a darning thread 6 for the chain thread 1*c*. Thread 5 is interlaced with chain thread 1*b* above the upper cross runs of weft threads 3, 4 and thereupon fills the square 7 by running back and forth in crosswise direction to be thereupon again interlaced with thread 1*b* beneath the lower transverse runs of weft threads 3 and 4. The other darning thread 6 is interlaced with chain thread 1*c*, thereupon fills the squares 9 and 8, and is again interlaced with the chain thread 1*c* below the square 8. For the sake of clarity and simplicity of illustration, only the two median chain threads 1*b*, 1*c* are shown with darning threads 5, 6, respectively, but it will be readily understood that the outer chain threads 1*a*, 1*d*, too, may be interlaced with additional darning threads which latter then fill in certain other squares in the foundation of the fabric to produce a desired design.

The eye-needle which wraps darning threads 5 and 6 is actuated by a Jacquard mechanism. Depending upon the design or pattern of the fabric shown in FIG. 1, squares at only one or both sides of a chain thread may be filled in with darning threads. Thus, darning thread 5 fills in the square 7 at one side but leaves empty the squares at the other side of its chain thread 1*b*. On the other hand, darning thread 6 alternately fills in a square 9 at one side and a square 8 at the other side of its chain thread 1*c*. For so wrapping the darning threads, the eye-needles of the knitting machine are moved laterally by the hooks of the Jacquard mechanism. In the manufacture of the fabric shown in FIG. 1, the hooks which control the eye-needles of darning thread 5 are actuated only at the second and fourth mesh so as to fill in the square 7 at one side of chain thread 1*b*. On the other hand, the hooks which control the eye-needles of thread 6 are actuated at the second, fourth, seventh, ninth, etc. mesh whereby the square 8 and 9 are filled in at the opposing sides of chain thread 1*c*.

The raschel machine for the manufacture of the fabric pattern shown in FIG. 1 is illustrated in FIG. 3. It comprises an eye-needle 10 which wraps the chain threads 1*a*–1*d*, and the eye-needles 11, 12 for cross threads 3, 4, respectively, these threads forming the foundation of the fabric. The lower end 13 of additional eye-needle 14 is moved laterally by the hook 15 which latter is controlled by a Jacquard mechanism. The construction of hook 15 is such that it can bring about lateral displacements of the lower end 13 in two opposing directions, i.e. the hook may reciprocate in two opposing directions.

In the fabric which is shown in FIG. 2, the foundation consists of alternately arranged warp chain threads 17*a*–17*c* and 16*a*–16*c*. Chain threads 17*a*–17*c* and 16*a*–16*c* are wrapped by independent eye-needles. The squares in the foundation or basic pattern are formed by aforementioned chain threads 16*a*–16*c*, 17*a*–17*c* and by cross- or weft threads 18, 19 which latter are laid by eye-needles to be described in greater detail in connection with FIG. 4. Only the chain threads 16*a*–16*c* are interlaced with darning or design forming threads, such as thread 20 for chain thread 16*a*, thread 21 for chain thread 16*b*, and a non-represented thread for the chain thread 16*c*. Thus, when the darning threads 20, 21, etc. are led in crosswise directions, they merely pass over the alternate chain threads 17*a*–17*c* without being connected thereto. In this manner, each darning thread fills in two squares of the foundation which produces in the finished fabric a highly desirable plastic effect. Thread 20 fills in the squares 22*a*, 22*b* and 22*a'*, 22*b'* between chain threads 16*a*, 16*b*, while the other darning thread 21 fills in a pair of squares 23*a*, 23*b* between chain threads 16*b*, 16*c* and thereupon a pair of squares 23*a'*, 23*b'* at the opposing side of its chain thread 16*b*. Thus, it will be seen that a chain thread 20 may fill in certain squares (22*a*, 22*b*, and 22*a'*, 22*b'*) only at one side of its associated chain thread 16*a*, or that a darning thread 21 may fill in squares (23*a*, 23*b* and 23*a'*, 23*b'*) at the opposing sides of its chain thread (16*b*).

It will be readily understood that the threads 20, 21 may be led crosswise relative to chain threads 16*a*, 16*b*, respectively, in such manner as to pass over more than a single intermediate chain thread, i.e. in such manner as to fill in three or more squares at one or both sides of their respective chain threads. For example, the design forming thread 20 could be led over chain threads 17*b*, 16*b*, and 17*c* to be interlaced with chain thread 16*c*, if a different type of pattern is desired. Between each pair of consecutively filled-in squares (e.g. 22*a*, 22*a'* in FIG. 2), the design forming threads 20 are always interlaced with the respective chain threads 16*a*. This causes slight increases in the thickness of the chain thread which, however, can be corrected by suitable selection of the thread thicknesses, i.e. of the thicknesses of darning threads 20, 21 and of chain threads 16*a*–16*c*, or compensated for by increasing the thicknesses of intermediate chain threads 17*a*–17*c*. In this manner, the presence of darning threads in the chain threads between the filled-in squares of the foundation need not be noticed, i.e. the thickness of composite chain threads is only slightly increased.

The raschel machine for the manufacture of the fabric shown in FIG. 2 is represented in FIG. 4. The machine comprises two eye-needles 24, 25 for warp chain threads 16*a*–16*c* and 17*a*–17*c*, respectively. The weft threads 18, 19 are laid by eye-needles 26, 27, respectively. The design forming or darning threads 20, 21 are laid by the lower end 28 of a further eye-needle, the part 28 being controlled by the hook 29 of a Jacquard mechanism in a manner depending upon the desired design in the fabric pattern, i.e. the part 28 is selectively moved in the one or the other lateral direction by the hook 29. The direction in which the end member 28 is moved by hook 29 is the same as the direction in which the darning threads 20, 21 are led crosswise with respect to chain threads 16*a*, 16*b*, respectively. It can be said that, in addition

to the eye-needles for threads which constitute the foundation of the fabric, there is provided at least one Jacquard-controlled eye-needle for the design forming threads. By the provision of a Jacquard to control at least one eye-needle, and by the provision of a special attachment for the Jacquard mechanism, the knitting machine of FIG. 3 or 4 is capable of operating at speeds considerably higher than those at which the known machines for the manufacture of bobbinet lace operate.

Eye-needles 24, 25 operate independently of each other to wrap alternating chains 17*a*, 16*a*, 17*b*, 16*b*, etc. Thus, the operation of the machine shown in FIG. 4 is such that the chain threads 17*a*–17*c* are wrapped by eye-needle 25 between the chain threads 16*a*–16*c* which latter are wrapped by eye-needle 24.

If the eye-needle which wraps the design forming threads 5, 6 or 20, 21 were actuated by a conventional Jacquard mechanism, the raschel machine of FIG. 3 or 4, could operate only at relatively low speeds because of relatively long periods of time required for filling in certain squares of the foundation. Accordingly, such a machine would constitute no improvement over the known apparatus for the manufacture of bobbinet lace. To speed up the operation of raschel machines shown in FIGS. 3 and 4, there is provided a novel attachment for the Jacquard mechanism which is illustrated in greater detail in FIG. 5. The purpose of this attachment is to guide the hook in such manner that the latter performs a longer-lasting movement in its upper and/or lower dead center position. This enables the raschel machine to operate at speeds such as are attainable only with latest models of high-speed knitting machines.

Referring now in greater detail to FIG. 5, there is shown a hook or Jacquard ram 30 which, at its upper end, carries a pivot axle 31 connected with a crossbar 32 which latter is formed as a two-armed lever. The ends of crossbar 32 are connected to lower ends of respective driven control levers 35, 39. A Jacquard shaft 33 carries an eccentric element 34 which is received in the eye at the upper end of lever 35, shaft 33 also carrying a small gear 40 which meshes with a second gear 40*a* mounted on a shaft 37. Due to the eccentricity 36 of eccentric 34 the lever 35 performs a crank motion. Lever 39 receives a similar motion from shaft 37 over a second eccentric element 38 whose eccentricity is indicated by reference numeral 36*a*. The gear drive 40, 40*a* operatively connects shaft 37 with Jacquard shaft 33. In this manner, the cross-bar 32 constitutes a component part of two coupled four-joint articulate connections whose cranks 35, 39, respectively, are controlled in motion by eccentricities 36, 36*a*, respectively.

Depending upon the transmission ratio of gear drive 40, 40*a* and also upon the position of eccentric elements 34, 38 with respect to each other, a longer or shorter dead-center motion of hook 30 may be brought about by the just described assembly. Alternately, it will be readily understood that a suitable change in the position of eccentric elements 34, 38 with respect to each other and/or in the transmission ratio of gear drive 40, 40*a* will bring about a longer-lasting movement of hook 30 in only one of its dead center positions, i.e. either in its upper or in its lower dead center.

The curve 41 in FIG. 6 illustrates the movements of a hook in conventional Jacquard mechanisms. The broken-line curve 42, on the other hand, illustrates the path of the hook guided by the device shown in FIG. 5. It will be noted that the broken-line curve has a flat portion corresponding to movements of hook 30 in its upper dead center position.

My invention is, of course, not limited to the specific embodiments described and illustrated but may be realized in various modifications and adaptations without departing from the spirit and scope of the appended claims.

What I claim is:

1. An open mesh warp knitted fabric comprising a

foundation consisting of warp chain threads and weft threads, each warp chain thread constituting an elongated chain of warp stitches, said chains being spacedly juxtaposed, and the stitches thereof being arranged in weftwise courses, said weft threads being spaced from each other and defining a plurality of openings therebetween, each opening extending warpwise over a plurality of said courses; and a design forming thread interlaced with a pair of chain threads separated by at least one intermediate chain thread, said design forming threads extending weftwise to fill in the openings between said pair of chain threads and passing over said intermediate chain thread without being interlaced therewith.

2. A fabric as set forth in claim 1, wherein said pair of chain threads is separated by a single intermediate chain thread.

3. A fabric as set forth in claim 1, wherein said intermediate chain thread is thicker than the chain thread interlaced with said design forming threads.

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