25

Plain tricot structures knitted with two full set guide bars

Plain tricot structures knitted with two full set guide bars are by far the most popular of all warp knitted structures and are mainly based on a two-course repeat cycle with a change of direction lap at each course. Although the majority have been made on 28-gauge tricot machines using 40 denier nylon, other gauges, yarn types and counts, and also raschel machines, are used.

The two bars make different lapping movements because, if they were both to make the same lapping movement a structure having single needle bar characteristics would be produced. Each guide bar contributes a thread to every overlap and the two underlaps can be clearly distinguished as they lap to a different angle, extent or direction. Under normal conditions, the threads of the front guide bar tend to dominate the face as well as the back of the fabric (Fig. 25.1).

25.1 Rules governing two guide bar structures

1 As the guides swing through the needles to start their next overlap, the back guide bar is first to lay its underlap on the technical back (Fig. 25.2) and the front bar is the last, so its underlaps lie on top on the back of the fabric (Fig. 25.3).

2 The front bar thread is the first to strike the needle on the return swing after the overlap (Fig. 25.4) and as its bar swings furthest to the front of the machine, it tends to occupy a lower position on the needle. If this position is retained it will show prominently on the under surface, which is the technical face (Fig. 25.2).

3 A low setting of a guide, a longer run-in, an open instead of a closed lap, or a short underlap movement, will all tend to cause a warp thread to occupy a low position on the needle, either reinforcing or reversing the normal front guide bar/ back guide bar plating relationship.

Carefully arranged lapping movement can thus overcome the normal plating dominance of the front guide bar threads on both surfaces of the structure. A structure showing the underlaps of the front guide bar on the surface of the

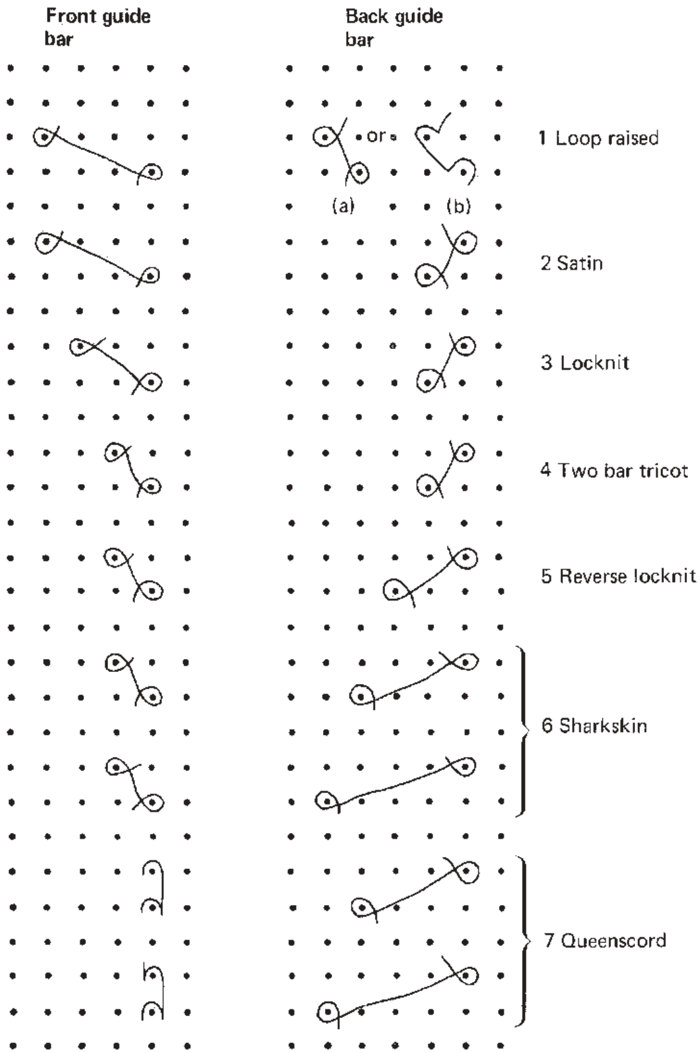

Fig. 25.1 Notations of two guide bar warp knitted fabrics.

technical back, but the overlaps of the back guide bar on the surface of the technical face, is produced if the front bar makes a 2 × 1 closed lap and the back bar makes a 1 × 1 open lap in opposition to it.

4 If the two bars overlap in opposition, the yarns tend to twist over each other in the overlap so that the back bar thread tends to partly show on top of one side limb.

5 If the two bars underlap in opposition they tend to balance the tension at the needle head, producing a more rigid upright overlap stitch. On the technical back, the underlaps will cross over each other in the middle between wales and this improves the strength of the structure.

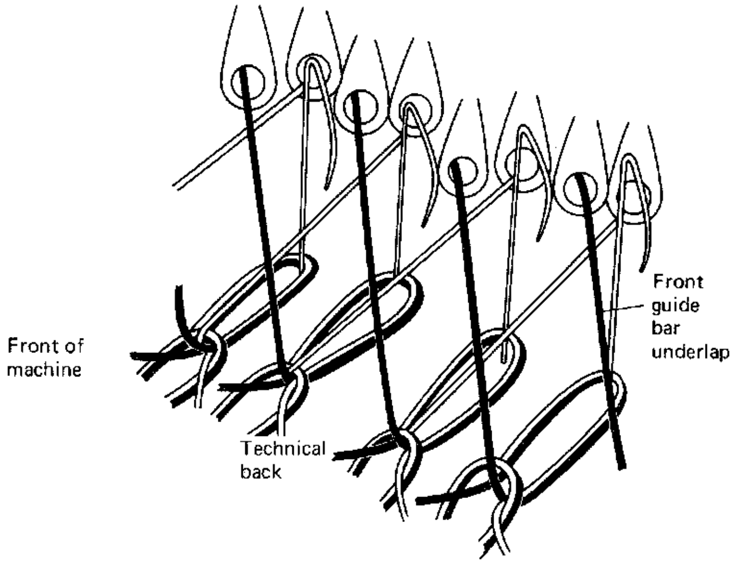

Fig. 25.2 Plating position of the front guide bar underlap.

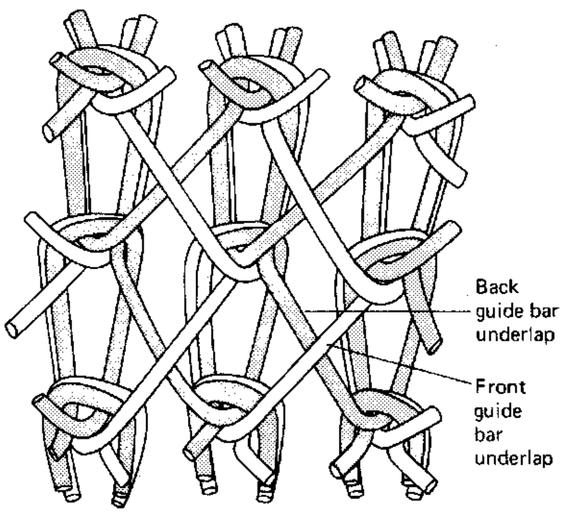

Fig. 25.3 Plating appearance on the technical back of a two guide bar fabric.

6 A short movement will cause the underlap to lie at an angle and its laps will be under the greatest tension. If the front guide bar makes the shortest underlap, it will tie the longer underlaps of the back bar securely into the rigid structure. If the front bar makes the longer underlap, this floats freely across the back and allows more movement of the yarn within the structure giving it more elasticity and a greater tendency to curl towards the technical face at the top and bottom.

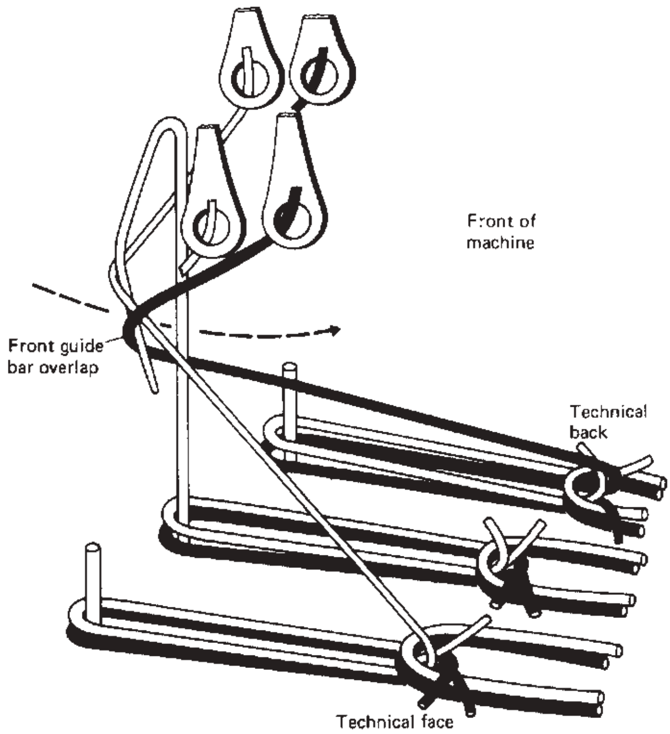

Fig. 25.4 Plating position of the front guide bar overlap.

25.2 Two bar tricot

Two bar tricot (*half jersey* in the USA) is the simplest two-bar structure and uses a minimum amount of yarn (Figures 25.3 and 25.5). The two laps balance each other exactly as they cross diagonally in-between each wale, producing upright overlaps.

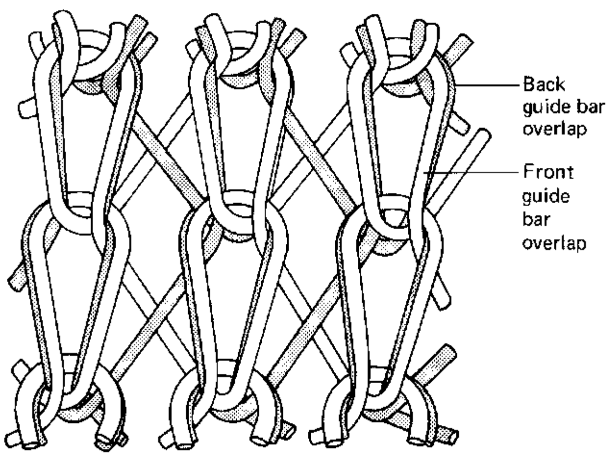

Fig. 25.5 Plating appearance on the technical face of a two guide bar fabric.

It tends to have poor cover and, in fine denier and in continuous filament yarn, it tends to split between the wales either during tentering or button-holing, especially if acetate or triacetate yarn is used.

25.3 Locknit

Locknit (*jersey* in the USA) or *charmeuse* (France and Germany) is the most popular of all warp knitted structures and accounts for 70–80 per cent of total output. The longer underlaps of the front bar on the back of the fabric improve extensibility, cover, opacity, and give a smooth, soft handle and good drapability. Its greater cohesion reduces snagging and splitting. Its tendency to curl towards the face at the top and bottom, and towards the back at the sides, can be reduced by heat setting.

On a 28-gauge tricot machine, a fabric might be produced from nylon yarn weighing about 30 g/m^2 for 20 denier, 82 g/m^2 for 40 denier. and 152 g/m^2 for 70 denier. In each case the finished wales per inch are more than 37. Shrinkage is generally between 20 and 30 per cent, but it can be less. An elasticated fabric for lingerie may be produced on the same gauge, using 40 denier nylon on the front bar and 40 denier spandex on the back, with a weight of 158 g/m^2.

The finest lingerie can be knitted in E 44 gauge from 22 dtex polyester with a weight of 46.1 g/m^2. Stretch lingerie can be knitted in the same gauge using 44 dtex Elastane in the back bar and 44 dtex nylon in the front guide bar.

The elasticity of locknit makes it particularly suitable for lingerie and intimate apparel. A knitting width of 168 inches (427 cm) can be finished between 92 and 100 inches (234–254 cm), which is a satisfactory width for handling these structures.

25.4 Reverse locknit

Reverse locknit (or *reverse jersey* in the USA) has a reduced extensibility and no curling, and because of the short front guide bar underlaps it has a lower shrinkage in finished width, this being often less than 10 per cent. It is used to a lesser extent than *Locknit*.

25.5 Sharkskin

Sharkskin is produced by increasing the back guide bar underlap to three or four needle spaces, making an even more rigid and heavier fabric whose stability renders it useful as a print base (Fig. 25.6).

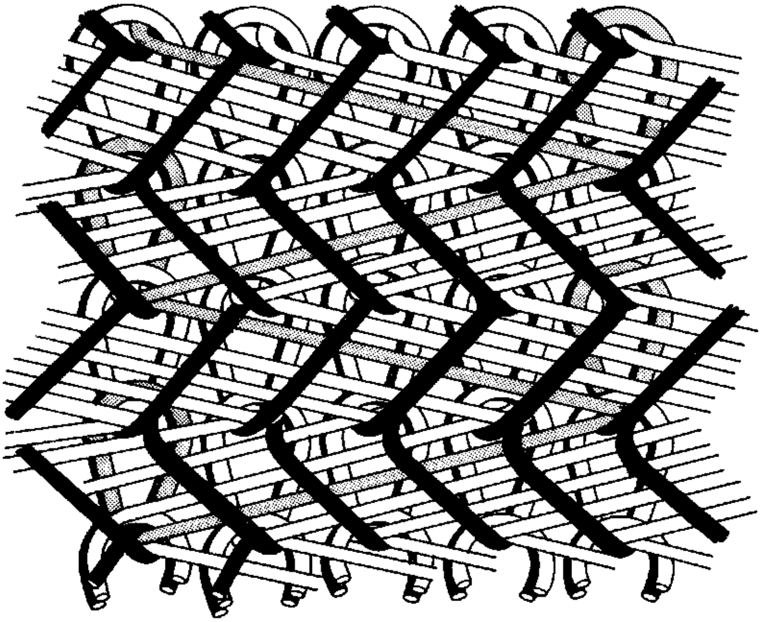

Fig. 25.6 Technical back of sharkskin fabric.

25.6 Queenscord

Queenscord has even greater rigidity than sharkskin. Because the front guide bar makes the shortest possible underlap, the pillar stitch tightly ties-in the back bar underlaps giving the fabric a shrinkage of only 1–6 per cent. The pillar stitch yarn as it passes up the wale tends to give a slight cord effect and the underlaps of the pillar are unable to balance the underlaps of the back bar so they show inclined overlap stitches (Fig. 25.7).

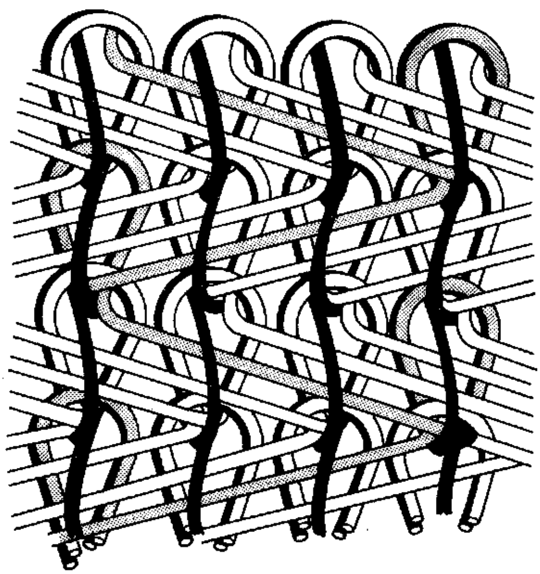

Fig. 25.7 Technical back of queenscord fabric.

25.7 Double atlas

In this structure, two guide bars *atlas lap* in opposition with identically balanced lapping movements, often similarly threaded with colours, in order to produce balanced symmetrical designs including checks, plaids, diamonds and circles. Areas of intense colour are obtained where both overlaps on the same needle are of the same colour, and paler areas are produced by overlaps having two threads of different colours. Repeats of 24 or 48 courses can be made but additional selvedge threads may be required to cover empty needles at the fabric edges.

In the past, special circular and rectilinear machines have been built, termed *Milanese* machines, that cause two sets of threads to make open lap atlas traverses across the needle bed without return traverses. As they reach the selvedge, the threads move into the other set (in rectilinear machines). Either single-needle (*cotton lap*) or two-needle traverse (*silk lap*) fabrics can be produced. Despite the balanced rounded loops, attractive appearances, multi-colour possibilities, handle, drapability and elastic recovery properties of Milanese fabrics, their slow rate of production has rendered them uncompetitive.

25.8 Satin

Satin has an increased front guide bar underlap (3 × 1 or 4 × 1 lapping movement) compared to locknit, giving even greater elasticity, but when threaded with continuous filament yarn, the long floats produce a lustrous light reflective surface.

25.9 Velour and velvet

Velour and *velvet* structures are based on producing long underlaps on the front guide bar that are formed into a pile surface on the technical back during finishing.

Brushed velour normally has the same lapping movement as satin, with 40–60 denier nylon or polyester yarn in the back guide bar for strength and possibly 55–100 denier viscose or acetate threaded in the front guide bar, which is broken into a pile by brushing during finishing. Velvet is produced with a longer underlap on the front guide bar, such as a 6 × 1 or even an 8 × 1 lap.

These underlaps are cropped or sheared during finishing, producing a more regular and prominent pile surface and a width shrinkage of approximately 35 per cent, compared with 50 per cent or more for velours. An open tricot lap may be made on the back guide bar to bury the pile yarn on the face and thus produce a more stable structure. On a 28-gauge tricot machine, 40 denier nylon might be used for the face yarn and 100 denier rayon for the pile, producing a structure with a finished weight of approximately 150 g/m^2.

In *raised loop velours* (Fig. 25.8), both guide bars lap in unison, producing an unstable construction with inclined loops similar to those of a single guide bar structure. Stability is achieved later during finishing when double-action pile and counter-pile rollers contact the individual filaments, raising them into a mass of fine loops and at the same time consolidating the structure. On 28-gauge tricot machines, either nylon or polyester yarn in 40 denier is used for apparel and 90 denier for furnishings.

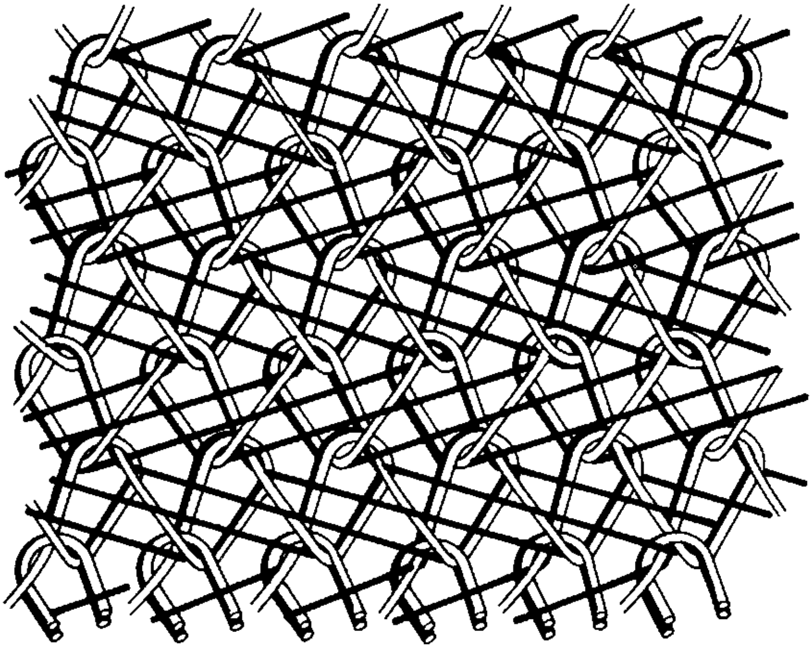

Fig. 25.8 Technical back of raised loop velour.

25.10 Overfed pile structures

Overfed pile structures are achieved usually by supplying warp at a faster rate to the back guide bar than is required for the conventional structure, so that the surplus warp forces its way through to the surface on the technical face as a pile. One example is *airloop*, which is reverse locknit having a front-to-back guide bar run-in ratio of approximately 1 to 2.3 instead of 1 to 1.2. The structure has a less definite pile and a soft hand. A crepe effect is achieved but the pile height and density tends to vary from centre to edge and the fabric is unstable and stretchy, like a single bar structure. Another structure is made with locknit if the run-in of the two bars is the same instead of having a front-to-back ratio of 4:3. Mechanisms have also been used to produce similar effects; these include a tension bar that dips to feed more yarn for either the overlap or the underlap, and patterning by selecting the tension on the warp threads to reduce the pile yarn then later releasing it to overfeed. Variation in shade is achieved by using two different coloured warps, one in each guide bar.

25.11 Typical run-in ratios for nylon yarns

The table below gives examples of typical run-in ratios for *standard flat nylon yarns*:

Yarn	B-B	F-B	Run-in ratio
Locknit	1-0/1-2	2-3/1-0	3:4
Reverse Locknit	2-3/1-0	1-0/1-2	4:3
Sharkskin	3-4/1-0	1-0/1-2	5:3
Queenscord	4-5/1-0	1-0/0-1	9:4
Queenscord	3-4/1-0	1-0/0-1	9:5
Raised loop	1-0/1-2	1-0/3-4	5:9
Tricot	1-2/1-0	1-0/1-2	1:1
Satin	1-0/1-2	3-4/1-0	5:9

Further information

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WHEATLEY, B., Production of cut velvet on Karl Mayer tricot machines, *Knit. Times*, (1972), 23 Oct., 78–82.
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26

Surface interest, relief and open-work structures

26.1 Basic principles

A warp knitted fabric with a regular surface and uniform appearance is generally produced when all of the following conditions exist:

- Each bar is fully-threaded, with every guide in the same bar carrying a similar yarn.
- Each bar makes a regular lapping movement of similar extent at each course.
- When weft is inserted it occurs with a similar yarn at regular intervals.
- Warp is supplied to each bar at a constant tension and uniform rate from course to course.

Carefully arranged variation of one or more of the above conditions enables patterns, surface interest, relief and open-work structures to be knitted, as the guide lines below indicate:

- *Variation in the threading* of one or more guide bars (guides threaded with different types of yarn or empty guides without yarn) will alter the appearance of the particular wales lapped by these guides. The effect will run the length of the fabric.
- *Variation in the extent of underlaps* produced by a guide bar will affect the appearance of those courses where the variation occurs and if the guide bar is fully-threaded the effect will run across the width of the fabric. Similar effects are obtained using weft insertion with different types of yarn, or by varying the frequency of the insertion.
- The appearance of the fabric may also be changed at certain courses by *varying the rate of warp supply* or selectively tensioning the warp threads and thus influencing the length of yarn in the underlaps.

26.2 Miss-lapping

Miss-lapping occurs when a guide bar (which has usually been knitting) makes neither overlaps nor underlaps for one or more courses, so that if it is a front bar, its threads will float vertically at the technical back. A simple use of this technique is in two fully-threaded 'window pane' effects. The front bar knits a pillar stitch with a striped warp, but at the courses where it miss-laps a single bar semi-openwork effect is produced by the inclined laps of the back bar which continues its 2 × 1 closed lap movement (Fig. 26.1).

Blind-lapping involves interrupting the warp let-off supply to a miss-lapping guide bar. As the other bars continue to knit, the courses of fabric which they produce will be forced outwards by the yarn tension to produce a raised pleat on the technical face. Blind-lapping with partly-threaded guide bars will vary the appearance across the fabric width.

The *casting-off of overlaps* can be used in the production of terry fabrics. The ground structure is knitted on alternate needles, with the remaining needles being overlapped by the back guide bar at odd courses to form the terry loops. These are cast off at even courses when this bar inlays to ensure that the pile is held in the structure.

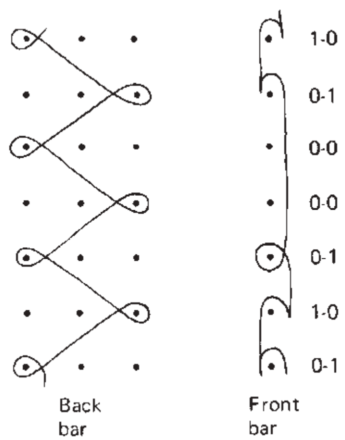


Fig. 26.1 Miss-lapping.

26.3 Part-threaded guide bars

The following are the basic rules when employing *part-threaded* guide bars for the production of nets, cords and relief designs:

- During a normal knitting cycle, *every needle must receive at least one overlapped thread* but it is not necessary for the same guide bar to supply every needle or for every needle to be overlapped by the same number of threaded guides.
- The guide bar threading for one width repeat is usually shown in its correct relative position between the needle spaces at the first link of the design, with **I** representing a threaded guide and • representing an empty guide.
- Overlaps composed of only a single thread will be inclined, whereas loops produced by the overlaps of two bars lapping in opposition will be smaller and upright.

- Wales will be drawn together where underlaps pass across between them and will separate at points where no underlaps cross, producing net pillars in the former and net openings in the latter (Fig. 26.2, P and O). If a full-threaded guide bar that knits at every course is also used, the effect will occur in the form of a *cord* or *relief* instead of a net.
- Symmetrical nets are produced when two identically-threaded guide bars overlap in balanced lapping movements in opposition. The threaded guides of a **I • I •** arrangement in each bar should pass through the same needle space at the first link in order to overlap adjacent needles, otherwise both may overlap the same needle and leave the other without a thread.
- In the production of nets, a guide bar should traverse *one more needle than the number of threaded guides in a guide bar* in order to cross over the threads of the other bar (Figures 26.2 and 26.3).
- In balanced nets, the width of the net pillar in wales will be equal to the threading repeat of one bar, and half the width will be equal to the number of adjacent threaded guides in one bar.
- In balanced nets, a thread of one guide bar normally laps across the threads of two repeats in the other guide bar during its complete sequence (Fig. 26.2).

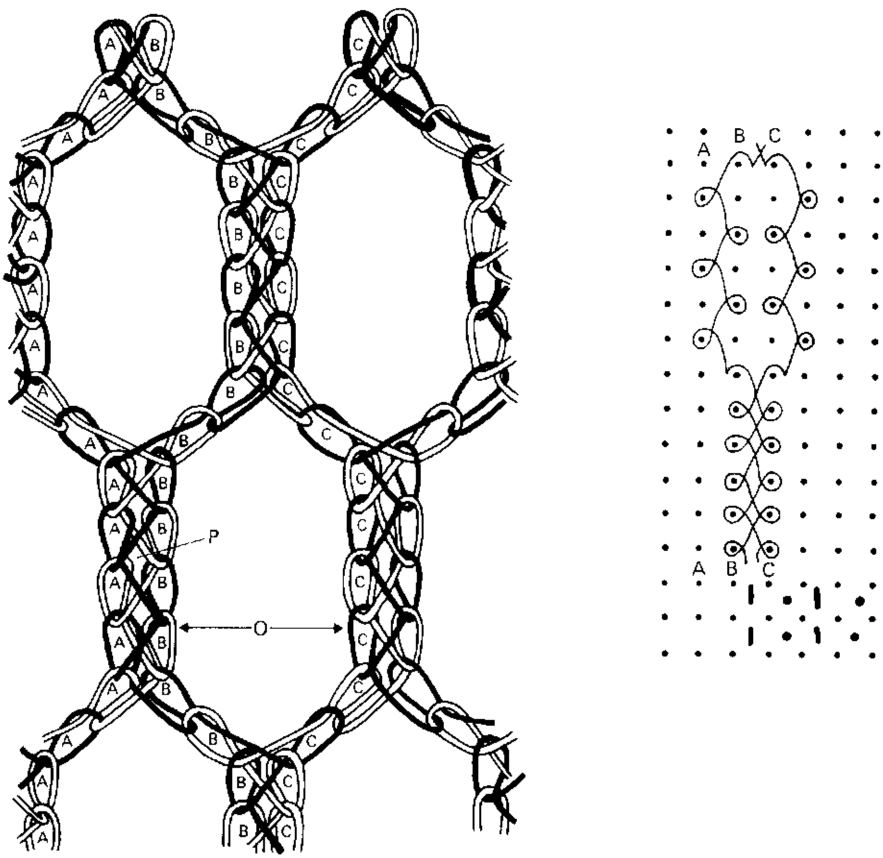


Fig. 26.2 Structure of a balanced net.

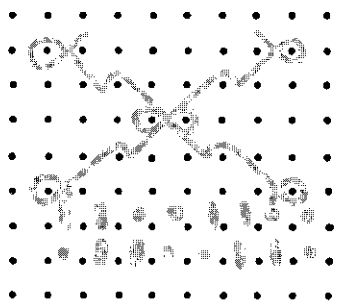


Fig. 26.3 Notation of 2 × 2 sandfly net.

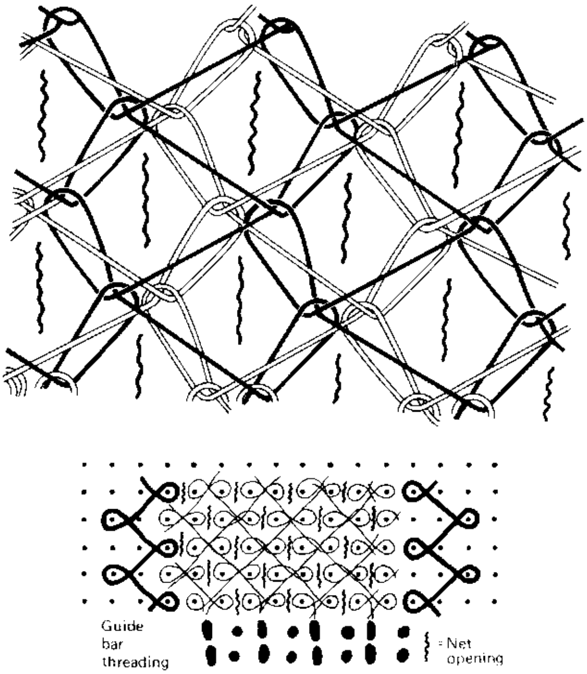


Fig. 26.4 Pin net loop structure and lapping diagram.

- A vertical net pillar extends in length as long as the threading repeat of one bar continuously re-crosses the same threading repeat in the other bar. A net opening is terminated as soon as the guides of one bar progress across towards another set of threads in the second bar. An open lap is often used for this progressive traverse (Fig. 26.2).
- In order to traverse across from one pillar to another and return by means of open laps, there must be an odd number of closed laps in the guide bar pillar lapping movement.

Pin net is the simplest net produced with alternately threaded guide bars. It uses a 2 × 1 closed lap and produces openings at every other wale and course. Its disadvantage is its lack of strength because of the small number of wales and courses involved in the repeat (Fig. 26.4).

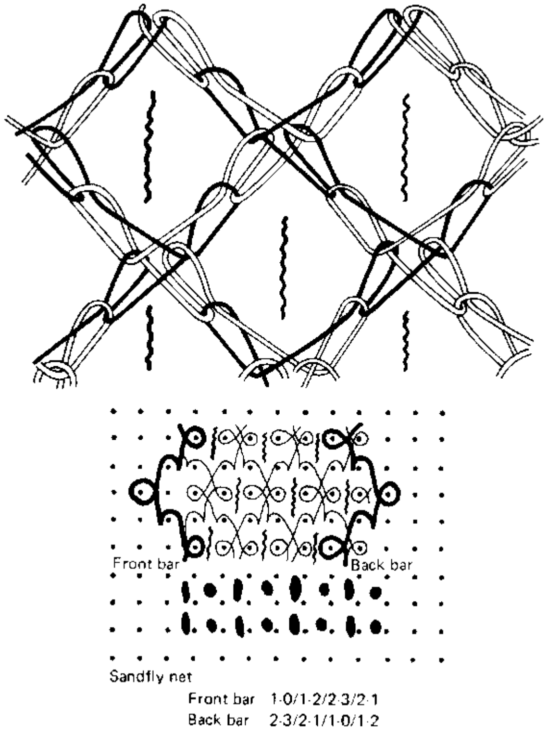


Fig. 26.5 Loop structure and notation of sandfly net.

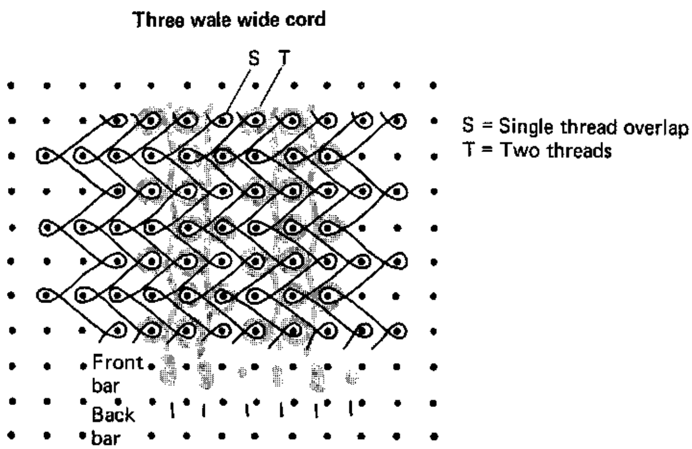


Fig. 26.6 Three wale wide cord.

Sandfly net is more popular. It is diamond-shaped, with staggered rows of openings occurring at every other course. The closed laps pull tight and move in the direction of the underlaps to form an opening, whilst the open laps help to form the diamond point closure of the hole (Fig. 26.5).

In *cord fabrics*, the width of the cord will be determined by the number of adjacent threads in the partly-threaded guide bar and the extent of its underlap movement (Fig. 26.6).

27

'Laying-in' and fall-plate

27.1 Laying-in and weft insertion

Laying-in is achieved in warp knitting by causing a guide bar to only underlap; its threads will be held in the technical back of the structure only if a guide bar in front of it is overlapping. The yarn will inlay on top of the overlaps during knitting so that, as the guides of the knitting bar swing through the needles for the next overlap, their underlaps will be laid on top of the inlay yarn, trapping it into the back of the fabric (Fig. 27.1).

An inlaid yarn may pass across part or all of the knitting width or it may be introduced in a warp direction. Using a *weft insertion device*, a *full-width weft* may be

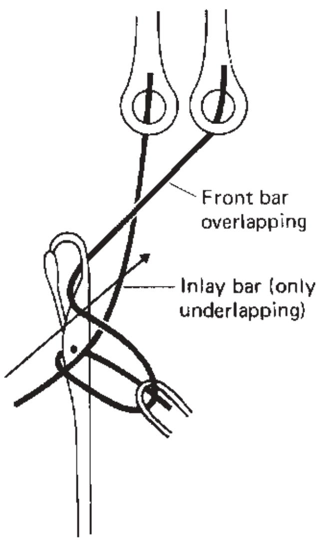


Fig. 27.1 The action of inlay in warp knitting.

introduced. The laying-in guide may be specially designed to take coarse or unconventional yarns or to achieve a longer than normal underlap, and a pattern mechanism designed only for laying-in may be used as in the case of weft insertion.

The raschel is particularly suitable for laying-in and sometimes the machine is designed to eliminate the swinging movement for the laying-in bars. On the crochet machine, the action of the knitting bar and the inlay bars is separately arranged and derived.

27.2 General rules governing laying-in in warp knitting

- *An inlaid yarn will pass across one less wale than a knitted yarn that has the same extent of underlap*. This is because the latter's overlap will add one further needle space traverse onto the underlap movement; thus a one-needle underlap will cause a yarn to inlay in the same wale and it will take a two-needle space underlap to cross from one wale to another. If a guide bar is fully threaded, it will put one less thread between a wale than the number of needles it underlaps.
- To eliminate the overlap movement (when using a two-link-per-course chain) it is necessary to put two links of the same height at the point where this should take place. Sometimes the pattern mechanism is arranged to run at one link per course to cater for the underlap and thus to save links.
- *The inlaid yarn will be tied in at every wale it crosses* (if the overlapping guide bar is in front of it). If the knitting guide bar is making a pillar stitch, it will be tied in by the same number of threads as the number of needles it underlaps.
- If the knitting bar *underlaps in opposition to the inlay*, it will add an extra thread for tying it into the structure. The inlay will thus be tied-in by one more thread than the number of needles the inlay underlaps.
- When the laying-in and knitting bars lap in unison, there will be one less thread available for tying in the inlay so that the inlay will be tied-in by one less thread than the number of needles it underlaps.
- If the knitting and laying-in bars underlap in the same direction and to the same extent as each other, the inlay will '*evade*' the knitting bar underlaps and will slip through onto the technical back of the structure where (under tension) it will form a straight vertical configuration.
- If a guide bar makes neither overlaps nor underlaps, it will '*miss-lap*' and its thread will form a straight vertical configuration between two wales on the technical face, as the underlaps of the knitting bar will prevent it coming through onto the technical back.
- In order to '*interweave*' an inlaid yarn vertically with a knitted yarn, it is necessary to cause it to evade for three courses and to miss-lap for one course during the repeat. This is because, with a normal two-course repeat of the knitting guide bar, the underlaps will only cross that particular wale once. In a four-course repeat there will only be two courses where the underlaps cross the wales. At one of these there is miss-lapping and at the other there is evasion.

  A vertically inlaid yarn that is positioned between two wales is termed a '*filler*' *thread*.
- If only two guide bars are employed, one knitting and one laying-in, the laying-in bar cannot produce a structure by only miss-lapping or only evading. In the first case, its yarn will fall out between the wales on the technical face and in the

second case it will fall out from the back of the structure. Threads making these movements can, however, be trapped if other laying-in bars are carefully arranged as to their positions and lapping movements.

- If two inlay threads cross over each other in a structure, the thread from the bar nearest to the front of the machine will show nearest to the technical back of the fabric.

27.3 Mesh structures

Mesh structures can be produced by *pillar stitch/inlay*, which may be used alone or as the ground for designs produced by pattern bars. The overlaps and underlaps of the front guide bar knitting the mesh will hold (on the technical back of the fabric) the inlay pattern threads of guide bars behind it at each course. That is the effect side of the fabric. Mesh is usually made by a single, fully-threaded guide bar knitting an open lap pillar stitch or its variant whose wales are reinforced and joined together by one or more inlay guide bars (often fully threaded).

Hexagonal mesh is achieved by wale distortion (because there are fewer underlaps joining the wales together) and by knitting tight loops in a fine yarn for the gauge of the machine. This mesh is produced by open laps followed by a closed lap which causes the lapping to alternate between two adjacent wales and forms the underlaps and inclined overlaps which close the top and bottom of the staggered mesh holes (Fig. 28.7).

Three-course tulle is the standard mesh for raschel lace.

27.4 Fall-plate patterning

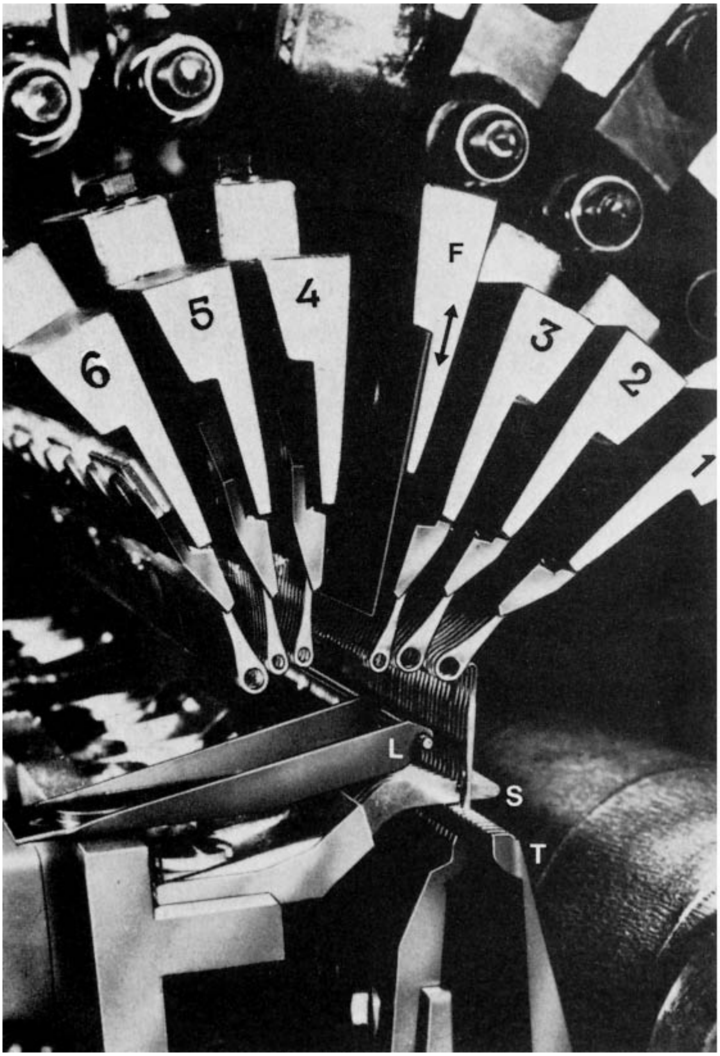
The fall-plate loop is achieved by a mechanism (Fig. 27.2) exclusive to latch needle raschel machines, although a similar effect to fall-plate loop structure, termed *plaiting*, can be achieved on crochet machines by wrapping a loop below the chain loop on the latch of the needle as it is moving out to clear.

In both arrangements, the fall-plate loop slips from the open lap immediately after formation and joins the technical back of the old loop from the previous course without being pulled through it.

The fall-plate is a thin metal blade attached to a bar and extending the full width of the machine. It is mounted between the guide bars and is attached to the guide bar brackets so that it makes the same swinging movement but it also achieves a vertical upwards and downwards movement described by the American term '*chopper bar*'. The vertical movement of the fall-plate can be obtained from a pot cam on the main cam-shaft and is adapted through linkages.

Figures 27.3 and 27.4 illustrate the action of the fall-plate. The raschel knitting action is normal; the guide bars swing through the needles as they rise, then shog for the overlap and return to the front of the machine. The fall-plate descends, contacting the threads from guide bars in front of it as they pass onto the latch of the needle.

As the fall-plate descends, it causes the overlaps formed by those threads to be pushed downwards and off the latches, to join the loops of the previous course. They are knocked-over with them whilst the overlaps of the guide bars behind the fall-plate remain unaffected in the hooks of the needles, ready to form the next course.



Front of machine

Fig. 27.2 Multi-purpose fall-plate raschel machine [Karl Mayer]. Bars 1, 2, 3 – fall-plate guide bars; bar 4 – knitting guide bar; bars 5, 6 – inlay guide bars. L = latch opening wire; S = holding-down sinker; T = trick plate; F = fall-plate.

As the needles rise after knocking-over, the fall-plate is lifted to its high, inoperative position where it remains until the next knitting cycle.

It is necessary to knit the ground structure overlaps on the guide bars behind the fall-plate because these are unaffected by its descent. Every needle must receive at least one ground structure overlap. It is preferable to overlap the fall-plate yarn in the opposite direction to the ground overlaps as this is less likely to cause the ground overlaps to be lower on the needle stems and thus to be pushed off the latches as the fall-plate threads are pushed down.

As fall-plate yarn is not knitted by the needle hook, fancy or heavy yarns may be used in partly- or fully-threaded guide bars. Fall-plate designs use either open or closed lap movements to produce attractive relief designs whose overlaps as well as underlaps show clearly on the technical back, often as 'cup handle' shapes (Fig. 27.5).

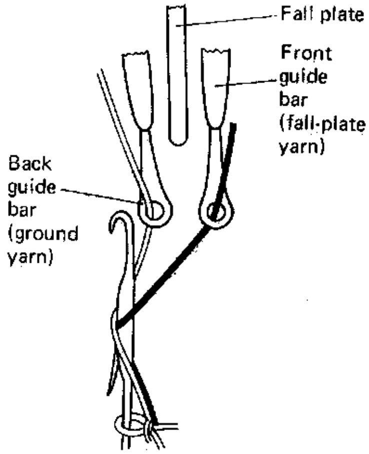


Fig. 27.3 Fall-plate raised out of action.

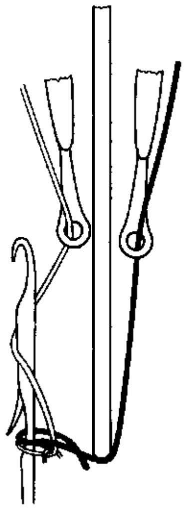


Fig. 27.4 Fall-plate lowered into action.

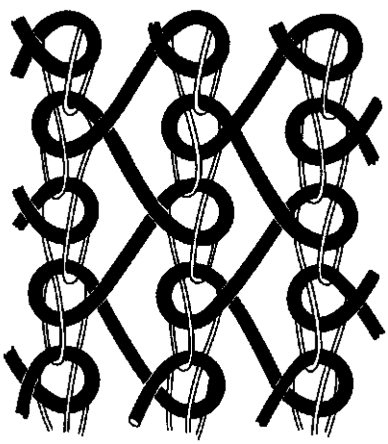


Fig. 27.5 Simple fall-plate loop structure.

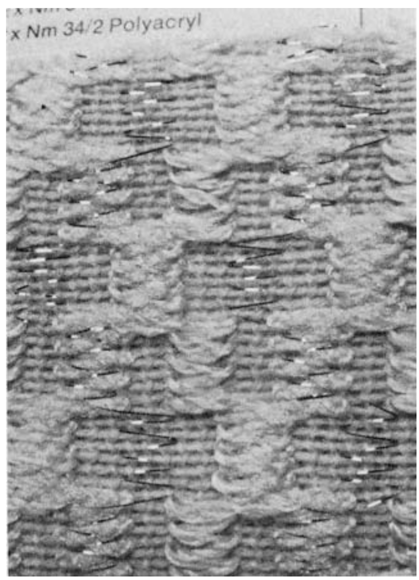


Fig. 27.6 Raschel fall-plate fabric showing on the technical back of a pillar inlay structure.

The connection of the fall-plate pattern yarns to the ground structure is peculiar to its design (Fig. 27.6). The loop is held down at the technical back of the ground underlap of the course above, as well as by the underlap of the course at which it appears.

The fall-plate underlap floats loosely across the fabric up to its next overlap. The overlaps appear at the course previous to that at which they were formed.

Multi guide bar machines having fall-plate pattern bars controlled by an automatic overlap are used to produce three-dimensional '*embroidery*' or '*broche*' relief designs in lace, particularly for curtains. These pattern bars will be positioned at the front of the machine whereas the ground guide bars will be placed behind the fall-plate, and any inlay pattern bars will be placed behind these bars.

A fall-plate raschel termed the *Co-we-nit* was introduced by *Karl Mayer* in 1967. It was designed specifically to knit a woven-like structure. Despite arousing considerable interest, it was commercially unsuccessful for the following reasons:

- Its design scope was limited.
- Co-we-nit structures were difficult to mend.
- Productivity was low.
- It required better quality yarns than a weaving loom in order to produce an equivalent fabric.

The machine produced two separately-timed overlap actions, one for knitting the pillar stitch of the front bar, the second for the weft bar behind it that open laps in the same direction. The weft bar open laps are then pushed from the needle hooks by the fall-plate so that they appear to be an inlay. The two back guide bars, gauged twice as fine as the needle bar, provide vertical warp threads that 'interweave' with the fall-plate weft yarns, using carefully arranged evasion and miss-lapping movements. A half-needle space evasion movement can cause only one of the two threads of the warp bar to cross over the weft on the technical back of the structure, which is the effect side.

27.5 Full-width weft insertion

When the needles are in the lowered position during the warp knitting cycle, a so-called *'open shed'* effect is created at the back of the machine. It is then possible for a weft yarn, laid across the full width of the machine, to be carried forward by special weft insertion bits over the needle heads and deposited on top of the overlaps on the needles and against the yarn passing down to them from the guide bars. In this way, the inserted weft will become trapped between the overlaps and underlaps in the same manner as an inlay yarn when the needles rise but, unlike the latter, the weft will run horizontally across the complete course of loops.

This technique is less restrictive for fancy and irregular yarns than for inlay and, as a weft covers the full fabric width, yarn can be supplied from individual packages. It has the major advantage that weft can be prepared and laid in advance of the timing of the insertion so that it has less effect on the knitting machine speed.

By 1938, a prototype FNF compound needle tricot machine could insert weft whilst knitting at 800 courses per minute. It was, however, *Liba* who pioneered the modern principles of single reversing weft insertion for coarse-gauge raschels and magazine weft insertion from a stationary package creel for fine-gauge compound needle tricot machines, with their *Shussomat* [1] and *Weftloc* models introduced in 1967 and 1970 respectively.

The single traversing weft is laid across the back of the machine by a cable-driven carrier that reciprocates on two parallel rods. At the end of the traverse, the selvedge return loop passes around a vertical pin that holds the weft in place until required, whilst the carrier continues its traverse. The weft pins are attached to the needle bar so that the two descend together, releasing the full-width weft at the moment when

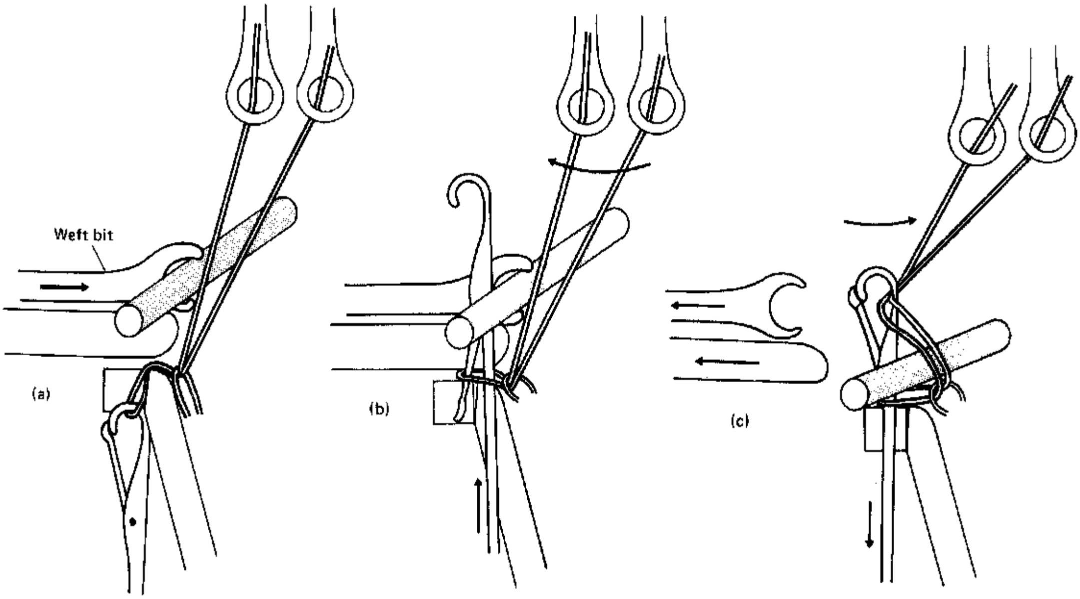


Fig. 27.7 Weft insertion principles.

the weft bits, one above every alternate sinker, advance over the lowered needle heads to insert the weft (Fig. 27.7).

This method of weft insertion produces a selvedged effect with the weft rising at the selvedge from one course of insertion to the next. The knitting width is sometimes divided into a number of knitting widths, each having a reciprocating weft carrier. In this way, narrow-width fabrics suitable for dish-cloths can be produced. Insertion of the cotton weft may be interrupted between each piece, triggering a scanning electronic eye that operates a hot wire to melt the empty nylon pillar stitches across the course. Thus, each piece is automatically separated and heat-sealed.

Machines with inlay and knitting bars are used in the production of sun filter curtaining. These employ a pattern chain control of the weft insertion from one end of the machine so that insertion can occur as required from a choice of a number of different wefts. Speeds of about 500 courses per minute are possible with this type of machine.

27.6 Magazine weft insertion

The principle of magazine weft insertion (Fig. 27.8) is to supply, for example, 18 or 24 ends of yarn from a stationary creel to an insertion carriage. With a weft insertion speed of 6500 m/min, the speed of the weft yarn will be only 320 m/min because multiple wefts are simultaneously being laid onto the conveyor to be fed individually to the knitting machine. The carriage traverses across the back of the machine, laying the weft yarns in parallel form onto the receiving pins of two magazine chains, one at each side of the machine.

The chains convey the weft to the weft insertion bits at the rate of one weft per

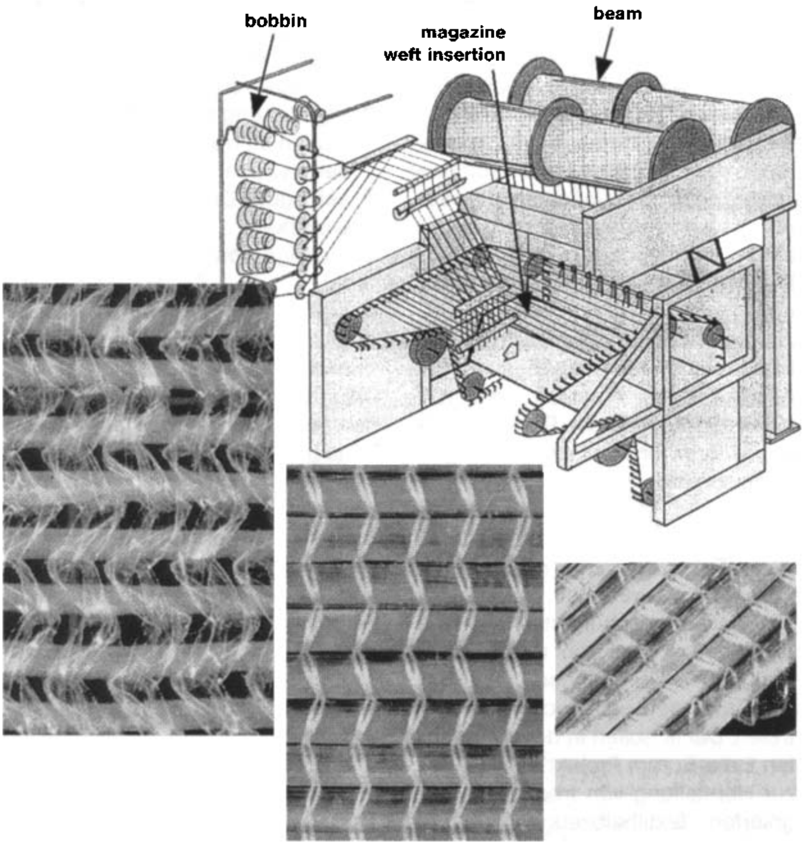


Fig. 27.8 Magazine weft insertion [Karl Mayer].

knitting cycle. As the carriage reverses its traverse, each return weft is placed around a receiving pin 18 or 24 positions further along the chain than the pin that first received it, in order to accommodate all the parallel weft yarns. Once the weft has been inserted into the fabric, the selvedged edges must be trimmed free of the receiving pins as the chains continue their rotation. It is essential in these cut selvedged fabrics to tightly grip the weft within the structure, otherwise wefts may slip or be pulled out; closed rather than open laps tend to be better for this purpose. Patterned effects are achieved by the package arrangement on the creel. Speeds of about 700–800 courses per minute are obtained [2].

Other methods, such as the use of a propeller for rotating the weft packages on a carousel, have been employed but have been found to be too restrictive.

27.7 Cut presser and miss-press structures

On certain bearded needle tricot machines, the possibility exists of pressing only selected needle beards (*cut presser work*) or only pressing beards at selected knitting cycles (*miss-press work*).

Cut presser machines are generally in tricot gauges from 12–24 and knit either staple spun yarns or textured yarns for blouses, dress-wear, baby-wear and shawls.

The fibre presser blade has sections which are cut away so that needle beards that correspond to these sections are not pressed at that cycle. Although needles can by this means hold their loops for a number of knitting cycles, their beards must be pressed at least once during the pattern repeat. All needle beards in the knitting width are eventually pressed by contact with the solid portions of the presser, as a result of the presser being shogged sideways by means of a push-rod and chain links in a similar manner to a guide bar.

For the production of simple *shell-stitch* fabrics, the presser is cut to the threading of the single guide bar whose total of adjacent threaded guides is the same as the total of adjacent empty guides.

For example, a 4×4 cut presser (Fig. 27.9) will press the four beards of the needles overlapped by the guide bar and will not press the four beards corresponding to the empty guides, so that these needles will hold their loops from a previous course or courses. If overlapped needles are not pressed, 'tuck stitches' will be produced, whereas drop stitches would occur if non-overlapped needle beards were pressed. It is thus necessary for the presser bar to be shogged sideways in unison with the guide bar.

In order to connect the sections of wales together, an atlas traverse lapping movement must be made across at least two more needle spaces than the number of adjacent empty guides, so that in the above example at least six needle spaces must be covered.

As held stitches are produced, the wales will contain different numbers of loops and some wales will contain successive loops that were actually knitted many cycles

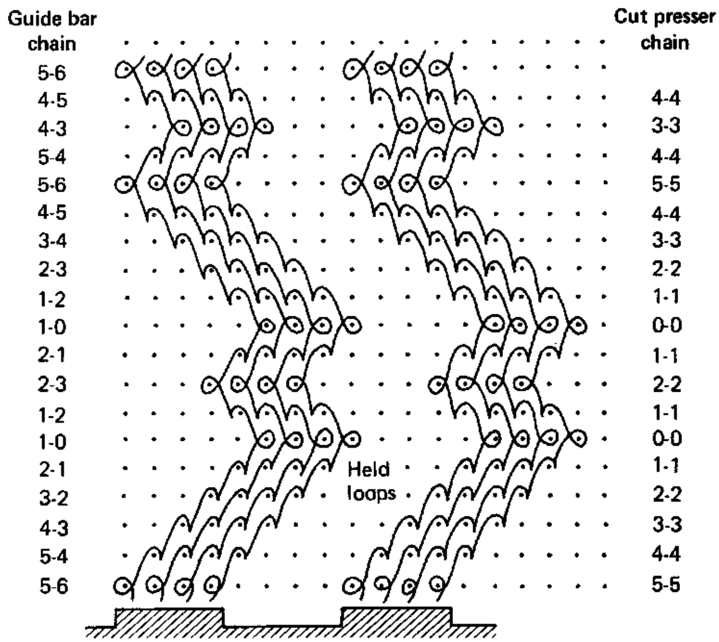


Fig. 27.9 Cut presser lapping movement.

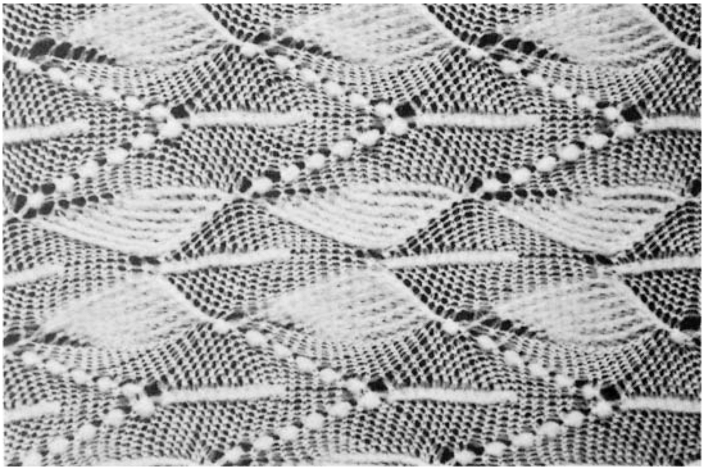


Fig. 27.10 Shell stitch cut presser fabric.

apart in the sequence. Tension within the fabric produces distortion so that the wales lose their parallel alignment and a three-dimensional surface appearance is created (Fig. 27.10).

At the point where the atlas traverse changes direction, the absence of connecting underlaps on the far side of the traverse change produces unbalanced fabric tension that draws the two adjacent wales apart.

More complex effects may be achieved by employing one or more of the following techniques:

- A more complex lapping movement;
- Using more than one partly-threaded guide bar;
- Accumulation of overlaps without pressing;
- Double needle overlaps.

Most cut presser machines also have a plain presser bar that, when brought into action by means of a pattern chain, cancels out the effect of the cut presser, but this necessitates the use of an additional full-threaded guide bar.

27.8 Spot or knop effects

Spot or *knop* effects require the use of both a plain presser and a cut presser (Fig. 27.11). The front and back guide bars might be full-threaded and knit a locknit or reverse locknit in co-operation with the plain presser. At various selected points in the production of the fabric, these two bars stop overlapping and the plain presser is withdrawn so that the cut presser operates in conjunction with a partly-threaded middle guide bar to make the knop overlaps.

Adjacent needles hold their ground loops until fabric knitting recommences, when the excess knop loops will be thrown upwards in a relief effect on the technical face. When not knitting, the back bar must evade the middle bar and the middle bar must evade the front bar, otherwise their vertically-floating miss-laps will protrude between the wales on the technical face.

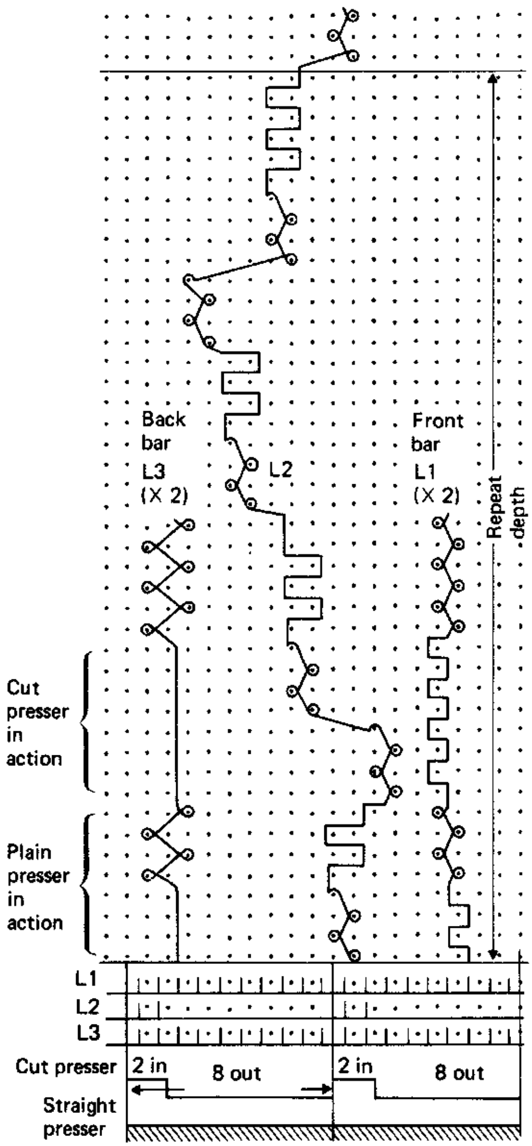


Fig. 27.11 Cut presser knop fabric.

Selective miss-pressing of all needle beards is achieved on modern machines by turning an eccentric disc through 180 degrees inside the circular opening of the presser bar. In one position of the disc, the presser advances sufficiently to close the beards. In the other position, the presser does not advance to contact the beards.

27.9 Terry by the press-off method

The press-off method has proved particularly suitable for knitting terry fabrics for towelling and fitted bed linen. A compound needle tricot machine has been specially developed for the technique. In the needle bar, which is in the gauge range E 20 to E 24, normal compound needles alternate with large-head needles. The guide bars are threaded **I • I •** with the ground guide bar overlapping only the normal compound needles and the terry guide bar overlapping only the large-head needles. In the latter case, this occurs only at alternate courses so that at the next knitting cycle the large-head needles knock over the terry pile loops without receiving a new overlap, thus pressing-off their loops.

Single-sided terry can be knitted with three guide bars. The front bar produces the ground chain stitch, the second bar inlays the ground, and the third bar alternately overlaps and inlays the terry. After the overlaps of the odd courses have been pressed-off, the inlays of the even courses are held in the structure by the ground bars. Terry loops 3 to 4 mm high are produced from plied cotton yarn of Nm 85/2 in a weight range of 135 to 300 g/m^2.

Double-sided terry requires a fourth guide bar, in front of the chain stitch ground bar. This overlaps at odd courses over the normal needles and overlaps at even courses over the large-head needles, and is pressed-off the latter. The machine has special brushes to draw these pressed-off loops from the centre of the fabric so that they appear on the technical face, whereas the inlaying terry guide bar shows its terry loops on the technical back. Double-sided terry fabrics are in the weight range of 220 to 450 g/m^2 [3].

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