

Speciality fabrics and machines

14.1 The range of speciality fabrics

Speciality fabrics include fleecy, plush, high pile and wrap fabrics. Although some constructions are unique to a single type of circular machine, others may be knitted on a range of machinery.

The surface effects of fleecy, plush or pile are developed during the finishing process usually on the technical back of single faced fabric.

In *fleecy fabrics*, the fleece yarn fibres (usually in the form of inlaid yarn) become entangled and indistinguishable from the base yarn on the effect side, despite having been separately supplied during knitting.

In *pile* and *plush* structures the pile and plush is clearly distinguishable from the base. Pile is considered to stand out at right-angles to the base, whereas plush lies at less of an angle from the base surface. High-quality three-thread *invisible fleecy* and *sinker loop terry (plush plating)* are still produced on a rapidly declining number of old loopwheel and sinkerwheel frames respectively [1], but they are facing intense competition from modern, high-speed, more productive, single-jersey, latch needle machines.

Invisible fleecy (Fig. 14.1) is a plain plated structure composed of a face and binding yarn with a fleecy backing yarn tucked into the technical back at every fourth wale to mesh only with the binding yarn. The face yarn prevents the arms of the fleecy tucks being visible between the wales on the face, which would spoil its clean appearance. The fleecy inlay is spread across the technical back by centring the fleecy tucks of the next three-feed sequence on the middle of the three needles that missed the fleecy yarn in the previous sequence.

A popular gauge for sweat shirts and track suits is E 20, using 1/28's to 1/30's (NeB) cotton or acrylic yarn or 1/70's (Td) nylon and 1/9's to 1/12's (NeB) cotton or acrylic fleece yarn. A 30-inch diameter machine will give a finished width of 54–60 inches (1.37 m–1.52 m). The loosely-twisted fibres of the fleece yarn respond easily to napping during finishing.

The standard sweatshirt weight is 250 to 300 g/m².

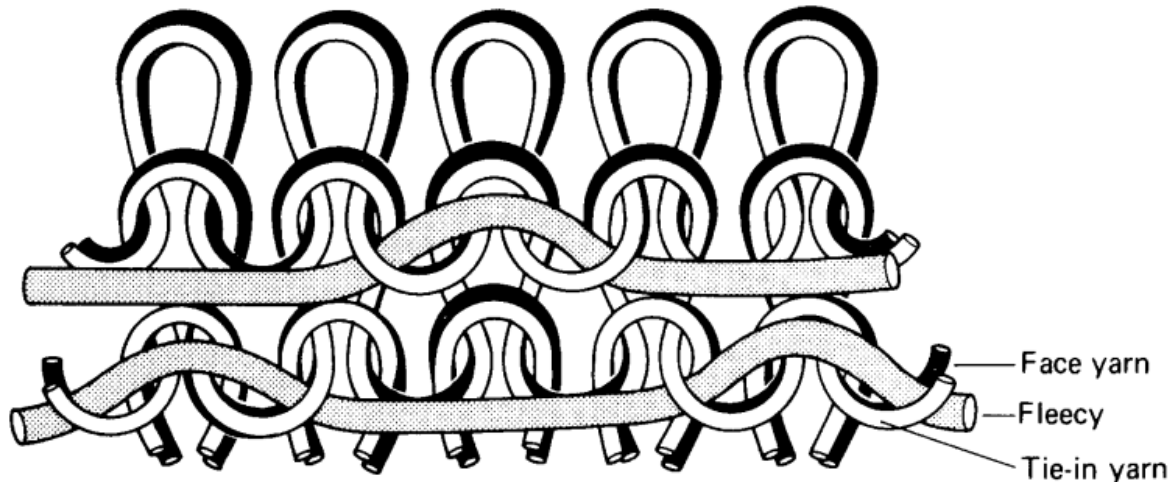


Fig. 14.1 Three-thread fleecy loop structure.

14.2 The production of fleecy on sinker-top machines

Three-thread fleecy was at first knitted as a quality fabric on the (no longer viable) loopwheel frame. (The loopwheel frame was described in detail in the first and second editions of this book, Sections 14.1 and 14.2). Three-thread fleecy is now produced mainly on single-jersey latch needle machines in the manner first patented by *Lestor Mishcon* in the USA in 1937. Pattern wheel selection was used for fleece yarn tucking. The preferred method today is to use a top needle butt and cam-track for knitting the ground (face) and tie-in (binding) yarns, and four tracks and corresponding butt positions (which can be rearranged) for the fleecy tucking sequence.

Figure 14.2 shows a typical knitting sequence for producing three-thread fleecy:

- 1 Selected needles are raised to tuck height to receive the fleecy yarn (F) (usually one out of four). The sinkers then move forward so that the top throat controls the fleecy tuck (F) whilst the lower throat controls the previous course.
- 2 All needles are raised to clear the previous course and receive the tie-in yarn (T).
- 3 The needles descend to the normal 'tucking-on-the-latch' position so that the previous course remains on the outside of the closed latch. The fleecy tuck, which is higher on the closed latch, slips off the needle head. As the fleecy tuck rests on the upper sinker belly, with the sinker withdrawing, the tie-in yarn (inside the closed hook) is drawn downwards through it.
- 4 The upper sinker throat holds the tie-in loop on the open latch whilst all needles rise to receive the ground yarn (G).
- 5 The needles again descend to the 'tucking-on-the-latch' position, to form loops from the tie-in yarn over the sinker crowns.
- 6 The sinkers finally withdraw and, as the needles descend, the new plated course slips onto their lower sinker bellies and the old course is knocked-over. Very carefully adjusted cam settings encourage the ground yarn to plate on the technical face (the underside) of the structure.

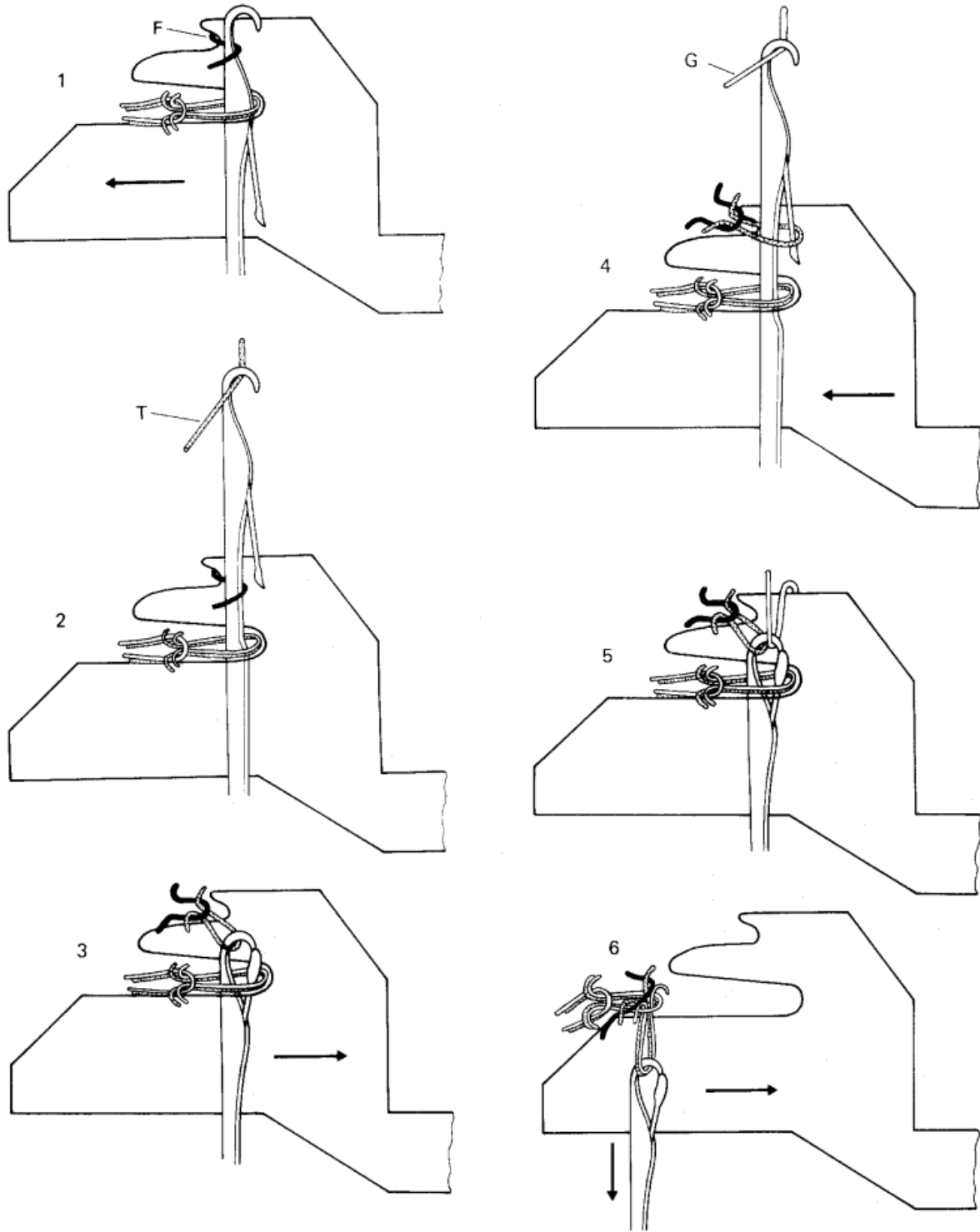


Fig. 14.2 Three-thread fleecy knitting cycle.

14.3 Fleecy interlock

Fleecy interlock is a plated fleecy fabric consisting of a main yarn, which is fed to knit on both needle beds and a fleecy yarn, which is fed first, and at a lower level, below the latches of the dial needles whilst they are at clearing height. It does not enter their hooks or show on the dial side of the fabric (Fig. 14.3).

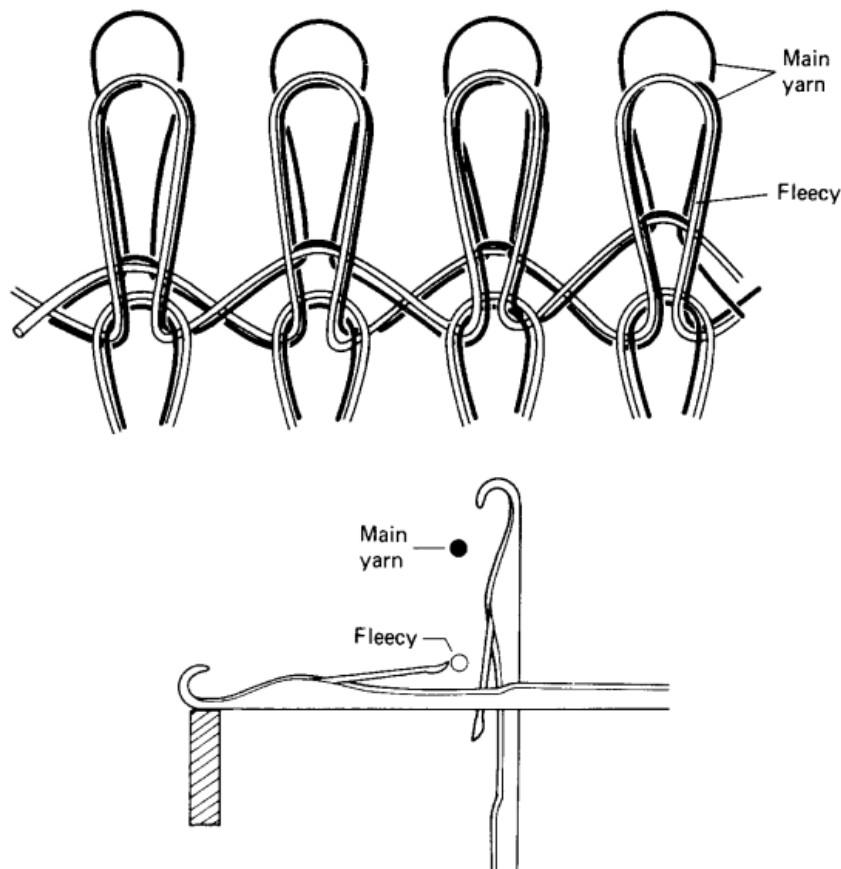


Fig. 14.3 Fleecy interlock.

14.4 Plush

Single-sided plated plush or *terry* is a popular leisurewear and sportswear structure that has the form-fitting properties of single jersey and is used in both fabric and sock form. The elongated plush sinker loops are formed over a higher knock-over surface than the normal-length ground sinker loops with which they are plated (Fig. 14.4). The plush sinker loops show as a pile between the wales on the technical back of the fabric.

Henkel plush or *velour* is achieved during finishing, by cropping or shearing the plush sinker loops in both directions. This leaves the individual fibres exposed as a soft velvety surface whilst the ground loops remain intact. It requires a fine gauge structure and involves a considerable loss of cropped fibre.

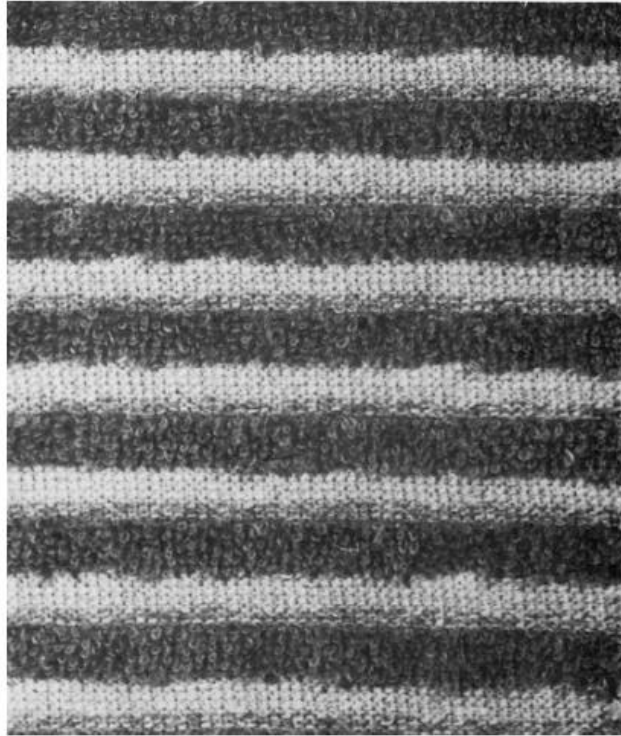


Fig. 14.4 Horizontal ribs with an ottoman effect on two-tone towelling [Alwin Wild, Switzerland].

14.5 The bearded needle sinkerwheel machine

In the past, this machine was renowned for the production of high-quality plush fabric but its productivity was low, with a speed factor of 500 and only 4 to 12 feeds in a diameter range of 10–44 inches. With the demand for increased production, knitters turned to the more productive latch needle sinker top machines, which were progressively refined to meet the needs for high-quality plush.

(The sinkerwheel machine was described in detail in the first and second editions of this book, Sections 14.6 and 14.7.)

14.6 Sinker plush knitted on single-jersey latch needle machines

On the sinker top latch needle machine, the ground yarn is fed into the sinker throat and the sinker is then advanced so that the plush yarn fed at a higher level (Fig. 14.5) is drawn over the sinker nib. If the sinker is not advanced, the two sinker loops will be of equal size as they will both be drawn over the same knock-over surface.

The numerals 1–6 illustrate the production of one course of standard plush:

- 1 The ground yarn is fed onto the open latch and into the throat of the sinker which is fully withdrawn.
- 2 As the needle descends the stitch cam, the plush yarn is fed into its open hook. The sinker advances and its nib re-engages the plush loop of the previous course so that it stands up as a pile loop whilst the new plush loop is drawn over the

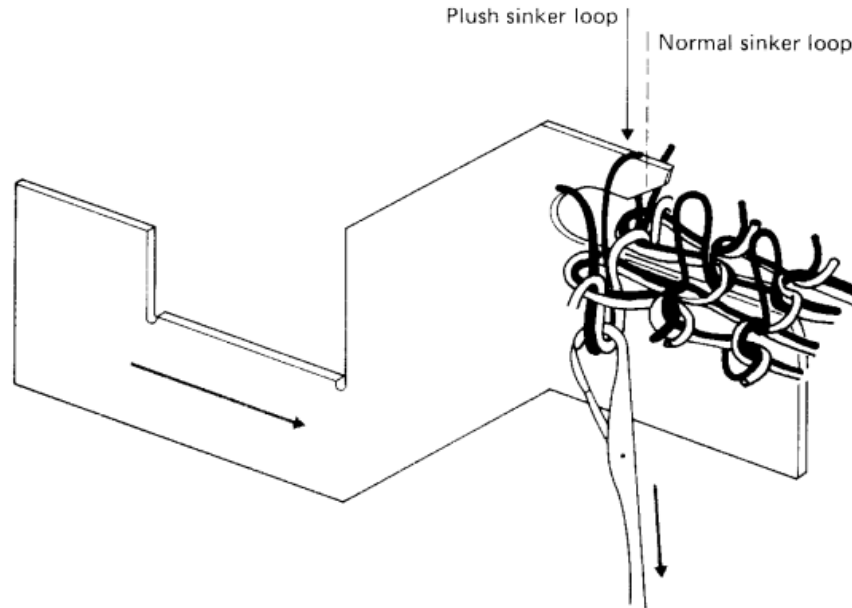


Fig. 14.5 Action of the plush sinker.

top of the nib. The back of the throat of the advancing sinker engages with the ground yarn loop, holding it against the inside of the needle hook in a lower position than the plush loop.

- 3 The sinker is advanced fully forward to retain the plating relationship and tighten the plush loop on the sinker step whilst the needle descends to knock-over.
- 4 The loops are relaxed as the needle rises to clear.
- 5 The new plush loop is retained on the sinker step as the needle rises.
- 6 When the needle is at maximum clearing height, the sinker advances to retighten the plush loop.

Mechanical or electronic selection may operate onto the backs of sinkers and thus produce designs in plain and plush stitches. A range of plush heights from 2 to 4 mm is possible, using different heights of sinkers. Precise camming of needles and sinkers, sharper angles of stitch cams, and control of loops (such as by sinker nib penetration methods after formation) are all being employed to improve accuracy of plating and reduce plush loop robbing.

On a 20npi machine 1/30's (NeB) cotton might be used for the plush with a ground of 2/70's (Td) S- and Z-twist nylon alternating at each feeder in a weight of approximately 285 g/m, whereas for 24npi the more expensive 1/30's cotton and 100 denier nylon is required. The speed factor is about 500–600, with between 1.3 and a maximum of 2 feeders per diametral inch.

Polar fleece is not a fleece fabric, it is actually a reverse plated plush fabric. The micro fibre plush yarn face loop is pushed towards the back of the needle hook, causing the two yarns to change positions so that the plush yarn is below the ground yarn loop. It therefore plates on top on the technical face, in addition to being on top on the sinker loop side of the technical back. Both sides of the fabric are lightly raised during finishing.

14.7 Full-density patterned plush

The durability of plush fabrics is strongly influenced by the density of the pile. In plain, single-colour pile there is an optimum pile density of one pile loop to each ground loop.

When knitting patterned plush (either in colour or self-colour with different plush heights), optimum pile density cannot be achieved. The reason is that, although the plush yarn plates with a complete ground course on the technical face side, it only produces a part course in pile on the effect side.

Mayer and Cie have developed the model MCPE to knit high-density jacquard plush fabrics, using electronic selection. Two independently-controlled sinkers operate in each trick to separately form the ground yarn and the pile yarns into loops. All the loops are then knocked-over together. On the technical face side, the ground yarn is required to perfectly plate over the pile yarn. One of the sinkers holds down the fabric and the pre-formed ground yarn loop; the other knocks-over and holds-down the pile loops.

At preliminary loop forming, all needles are taken down to 'tucking-on-the-latch' height so the old loops remain on the closed latches. For two-colour plush, at pile feeder for colour A, selected needles rise to receive pile yarn A. At pile feeder for colour B, the remaining needles are selected to receive pile yarn B. At knock over, all the ground and pile loops are knocked over together.

When a needle is not selected to knit the pile yarn, it floats on the pile surface and is clipped out in finishing. It is only knitted into the ground when selected, so there is less wasted yarn.

The 30-inch diameter machine has 48 cam segments. In three-colour plush there will be 12 knock-over/ground segments and 36 pile loop segments, in a sequence of 1:3.

14.8 Cut loop

Pai Lung have developed a cut loop cylinder and dial jacquard terry machine. The dial needles knit single jersey. The cylinder contains the pile elements, which are actuated by electronic selectors. The cutting elements are in a separate sinker ring and co-operate with the cutting edges of the pile elements in a shearing action.

14.9 Double-sided plush

Double-sided plush can be obtained using a machine with two sinkers per needle, the face plush yarn being drawn by the throat of a second, specially-shaped sinker placed alongside the plush sinker in each dial trick.

Babygro, a special two-way stretch babywear fabric, has been knitted on loop-wheel frames using bearded needles. The plated cotton yarn is pressed-off odd needles at odd feeds and even needles at even feeds to obtain float pile loops.

A wide range of plush fabrics in single-jersey construction can also be knitted on modified rib machines by drawing loops with the second set of needles and then pressing them off to form the plush loops. Sometimes plush points are employed.

Uneconomic rates of production make these techniques non-viable.

14.10 Sliver or high-pile knitting

Sliver or high-pile knitting is single-jersey made on a circular machine having sliver feeds where the stock- or dope-dyed slivers are drawn from cans at ground level. They are then prepared by mini three-roller drafting card units followed by two wire-covered rollers that draw and transfer the thin film of fibres to the needles (Fig. 14.6). At each sliver feed, the needles are lifted to an extra high level where they rise through the wires of the doffer roller to collect a tuft of staple fibres in their hooks.

Air-jet nozzles over the knitting points ensure that the tufts are retained in the needle hooks and that the free fibre ends are orientated through to the inside of the fabric tube (the technical back), which is the pile side.

As the needles start to descend, the ground yarn is fed to them, so that each has a ground loop and a tuft of fibres that are drawn through the previous loop. A range of facilities are available from different machines including up to 16 roller speed settings, the use of two different fibre lengths, and mechanical or electronic needle selection and sliver selection. Electronic selection can select needles to take fibres from one of four different coloured slivers.

Borg Textiles pioneered specialised sliver knitting in the 1950s in co-operation with *Wildman Jacquard* although *J. C. Tauber* obtained US patents as early as 1914. A typical machine now has a diameter of 24 inches in a gauge of 10npi and runs at 45 rpm with 12–18 sliver feeds.

The fabric finishes 54–58 inches wide (137–147 cm) in a weight of about 450 g/m when knitting 360 denier fibrillated polypropylene ground yarn and a modacrylic sliver having a 3 denier $1\frac{1}{2}$ inch staple.

Fibre staple lengths can range from 20 to 120 mm, in sliver weights from 8 to 25 g/m², giving greige (unfinished) weights of 200–2000 g/m², for end-uses such as fun furs, linings, gloves, cushions, industrial polishers and paint rollers.

A typical high-pile finishing route is: rough shearing, heat setting and back-coating, pile cropping, electrifying or polishing (to develop the lustre and remove

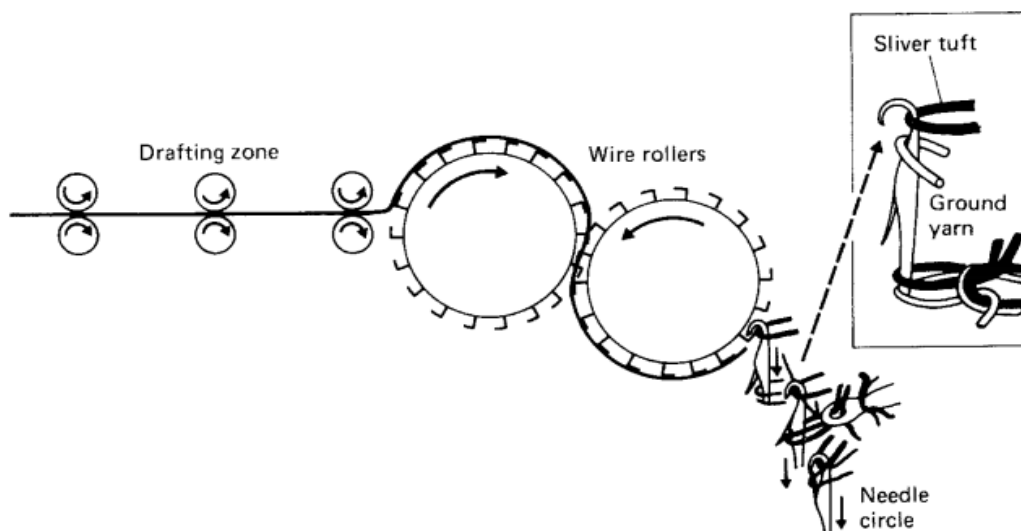


Fig. 14.6 Sliver high pile machine.

crimp from the fibre ends), tiger framing (to distribute the pile effect), and controlled torque winding (to further develop the pile uniformity).

14.11 Wrap patterning

Wrap patterning was popular in single jersey, especially in underwear, for producing vertical stripe effects, often in conjunction with horizontal patterning (Fig. 14.7). The fingers or wrapping jacks, with their warp yarn pins, must rotate in unison with the cylinder in order for each to remain with its section of needles.

Solid-colour warp insertion can be achieved with the *Camber* wrapping method, which may be used on any of their needle selection machines. The first selection system of the sequence selects needles to receive the wrap yarn, and the second selects the remaining needles to receive the weft ground yarn. According to machine model, diameter, and gauge (E 5–32), up to 100 or more fingers will successively pass through each section and be capable of wrapping across up to eight or more selected adjacent needles.

As each finger in turn contacts a stationary cam at the wrapping section, it pivots out of the cylinder and rises up its clockwise moving post, wrapping its warp yarn into the passing hooks of those needles selected to rise to take it. It is then cammed to return to its inactive position inside the cylinder whilst the needles pass to the next system, where those previously unselected rise to take the ground yarn. On a 28-gauge machine, 70–200 denier yarn might be used for the warp and 1/30–1/50 (NeB) for the ground.

On the *Mayer Vilonit* machine, wrapping and striping are incorporated into fabrics in the form of tuck-miss inlay patterns, thus providing an opportunity to use a wide range of yarn counts. A 26-inch diameter machine has twenty-four feeders, six with four-colour striping and six using the 46 wrapping fingers. Needle selection is by punched-tape controlled peg drums. Cam sections are in sequences of eight. At feeders 1 and 5, needles are selected to tuck the striping yarn, at 3 and 7 they

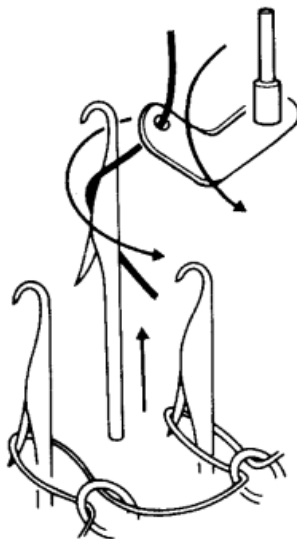


Fig. 14.7 Wrap patterning.

are selected to tuck the wrap yarns, whilst at feeds 2, 4, 6 and 8 needles are selected to knit the ground yarn.

Wrap patterning produces small, vertically-arranged designs without restrictive horizontal floating threads, but it requires a more expensive machine, it is time-consuming to set-up patterns, and productivity in numbers of feeds and speed of production is slow.