

TEXTILE ENGINEERING

„Knitted technology and products“

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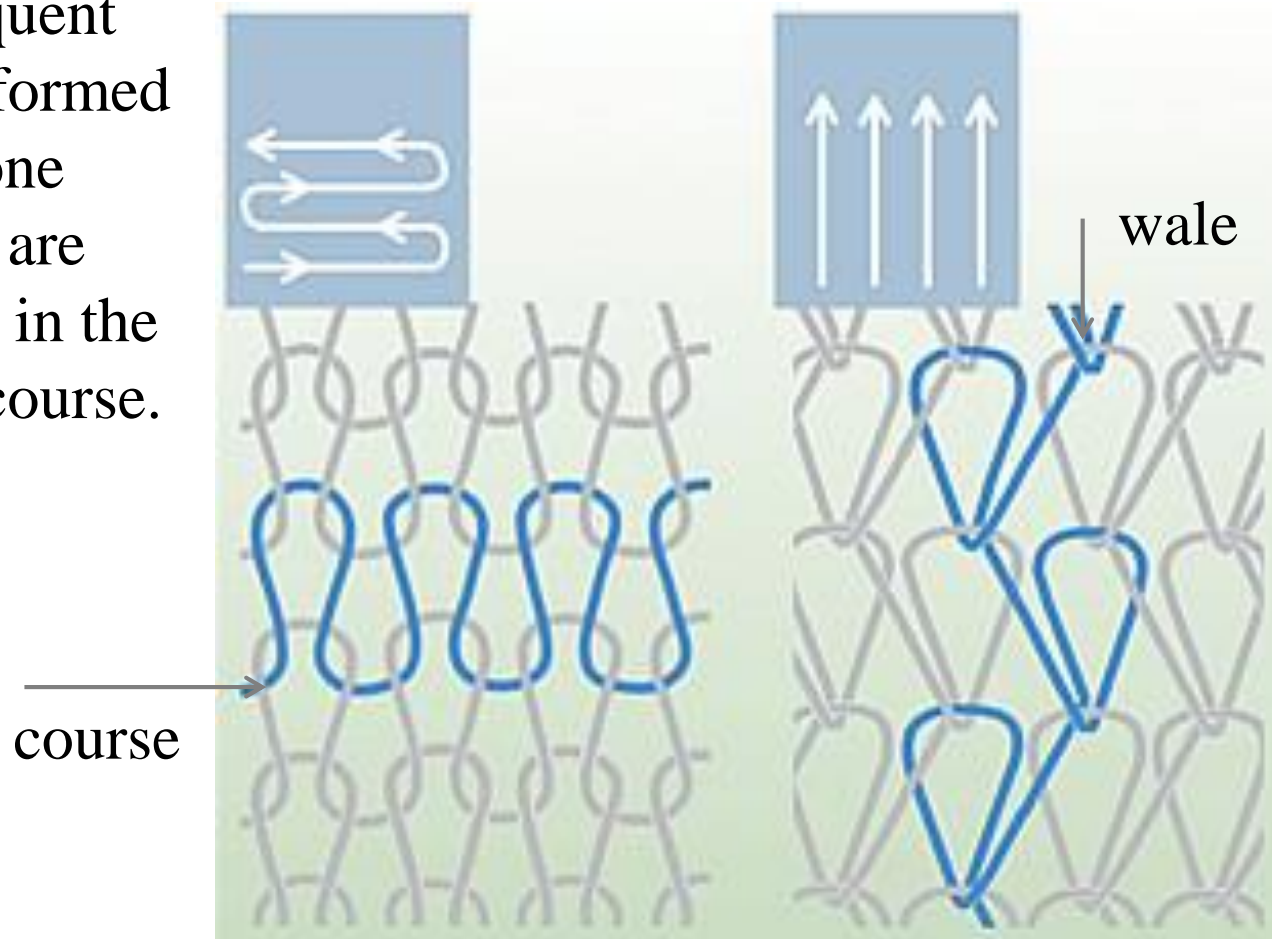
Ing. Irena Lenfeldová, Ph.D.

Department of Technologies and Structures

Faculty of Textile Engineering, 2021

Knitted technology

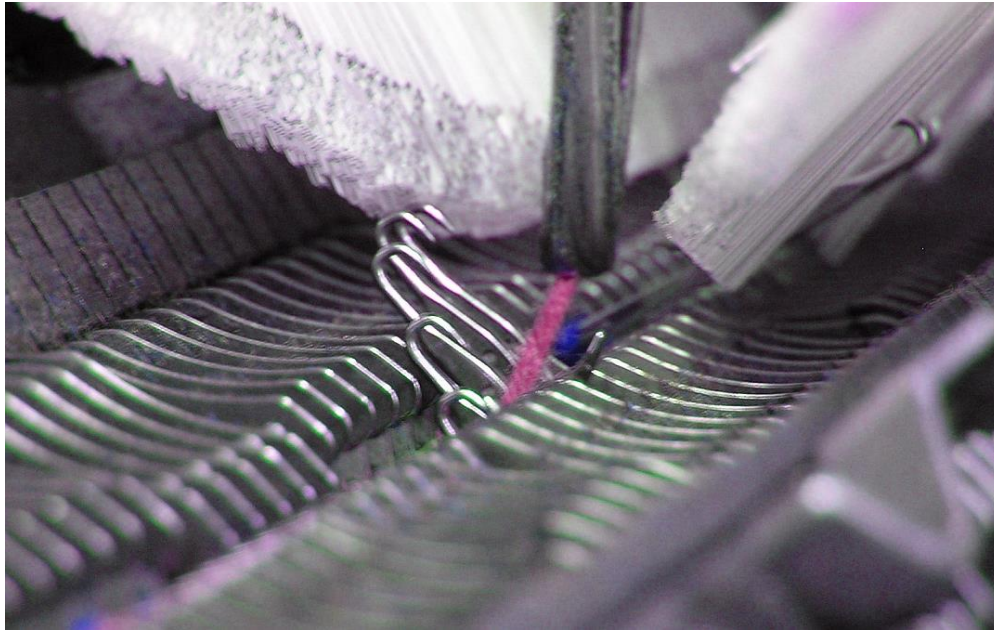
The subsequent loops formed from one thread are placed in the same course.



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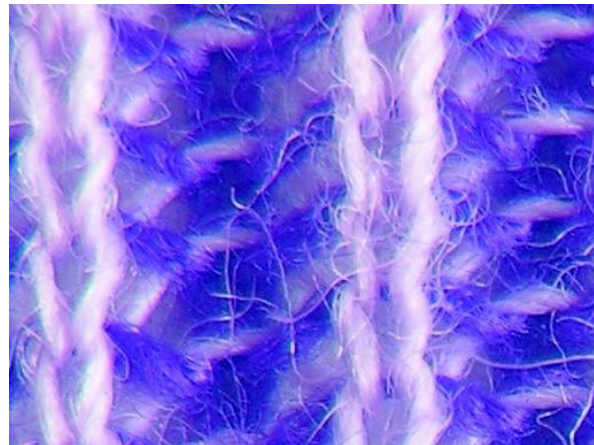
[1]

Knitted technology



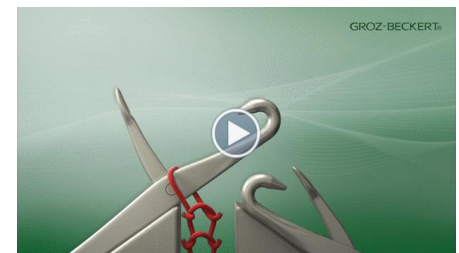
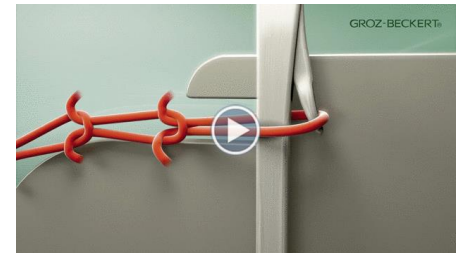
Weft knitted technology
Flat knitting machine
(V-bed type)

Weft knitted fabric -
rib structure with
tuck stitches

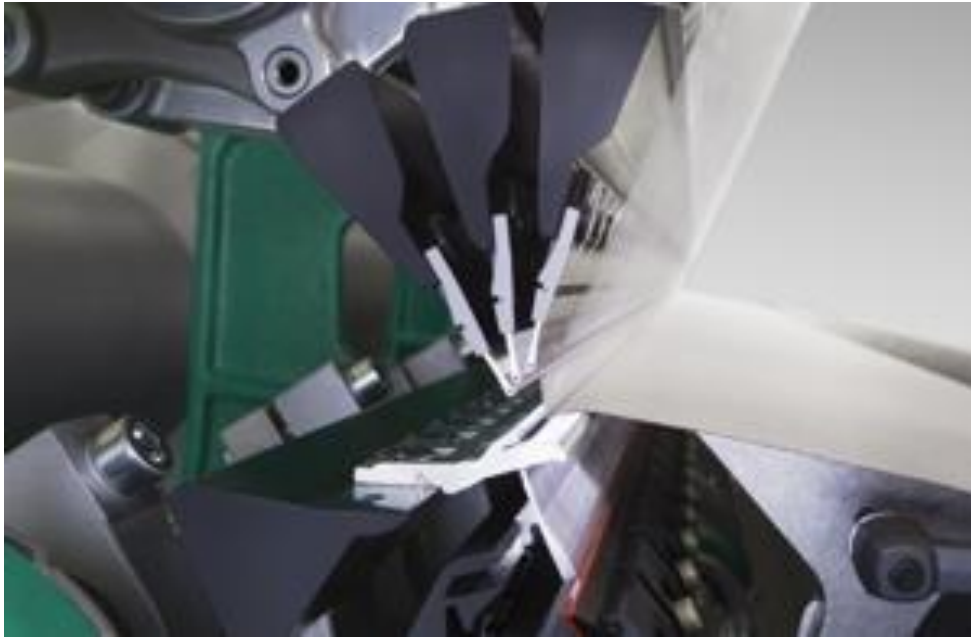


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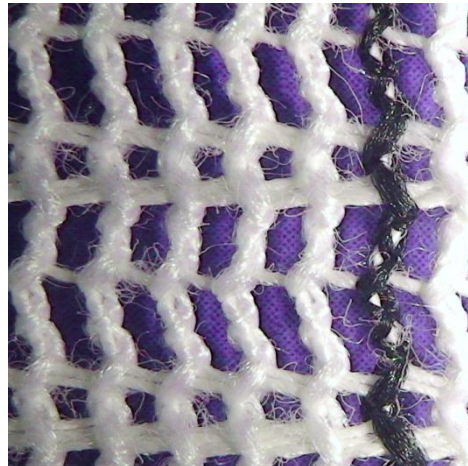
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Knitted technology

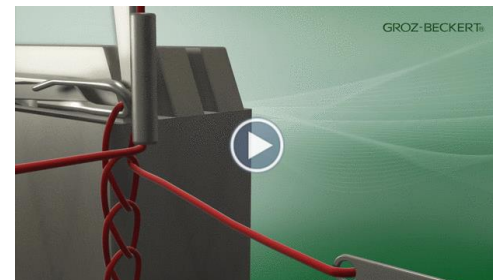
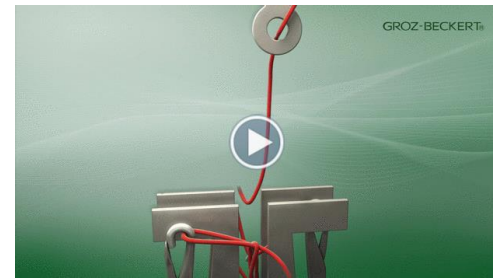
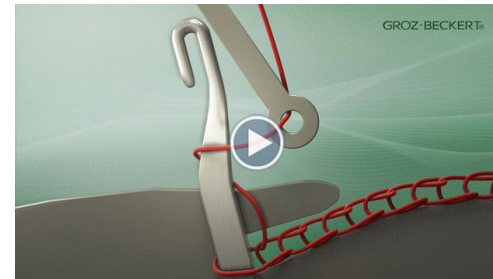


Warp knitted technology
Knitting machine [3]



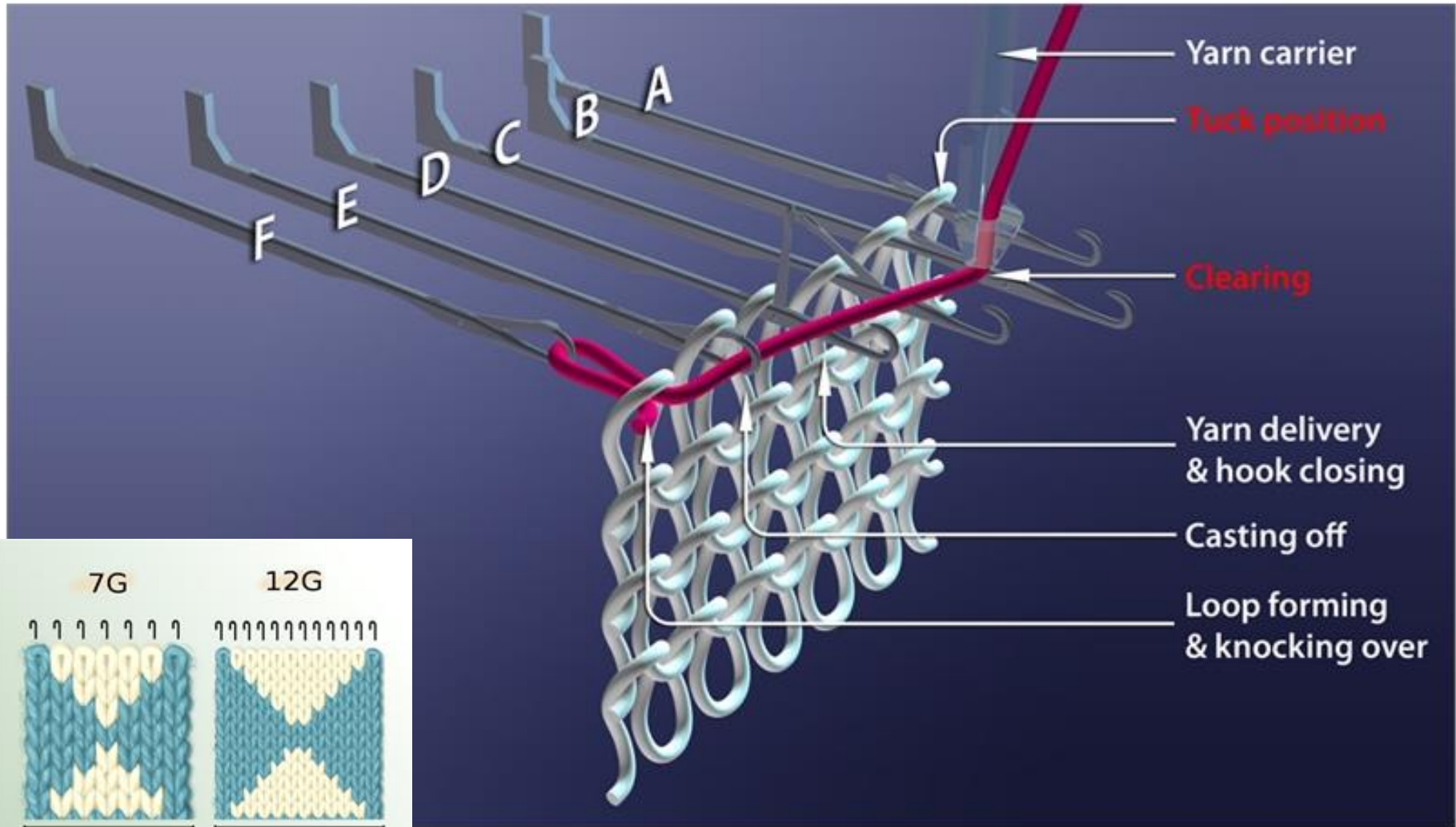
Warp knitted fabric

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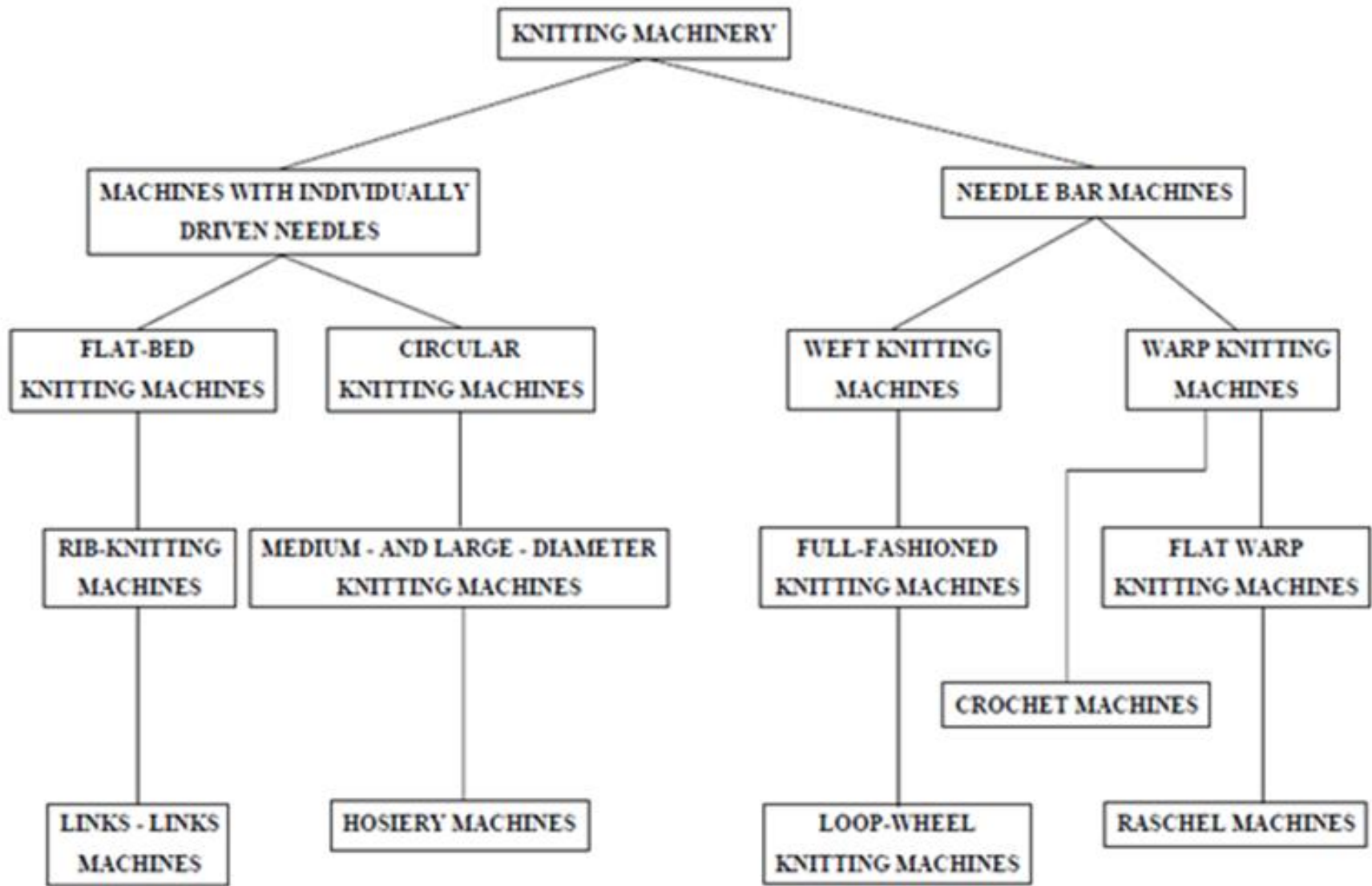


[2]

Weft knitting – loop formation [4]



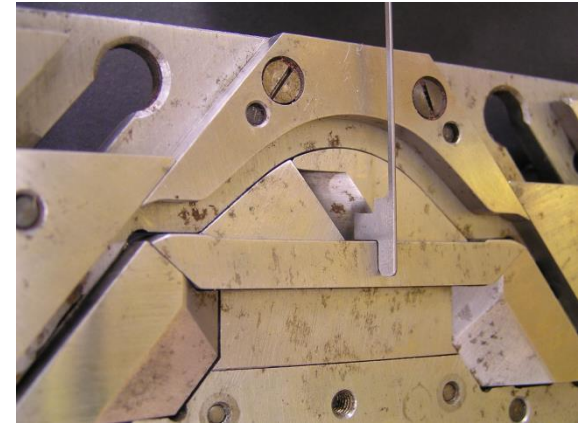
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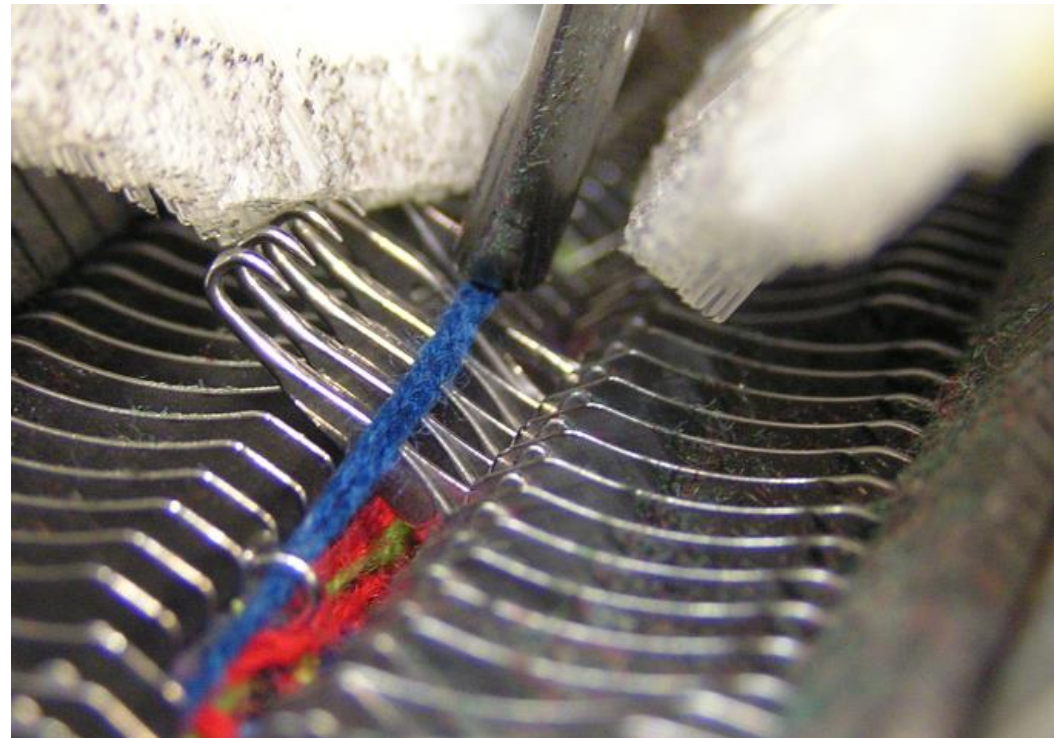
Sort of knitting machinery [6]

Flat knitting machines - needle beds arrangements:

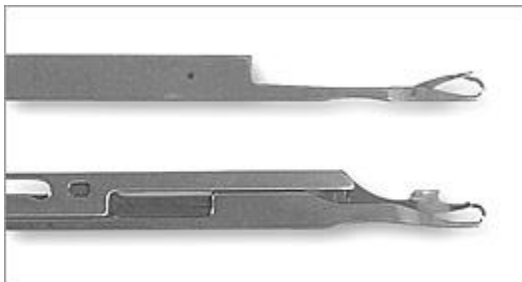
- One bed (single faced structures).
- Two beds – V bed (double faced - rib, purl).
- Two beds – double hooked needle (purl).



V- bed knitting machine - Stoll [7]

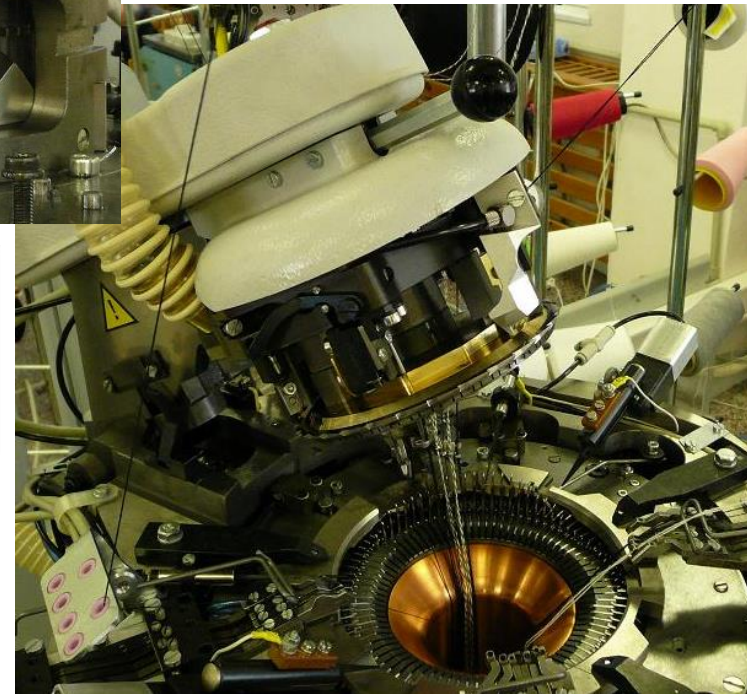
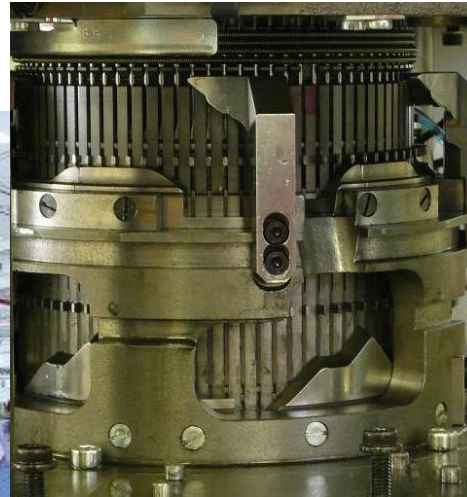
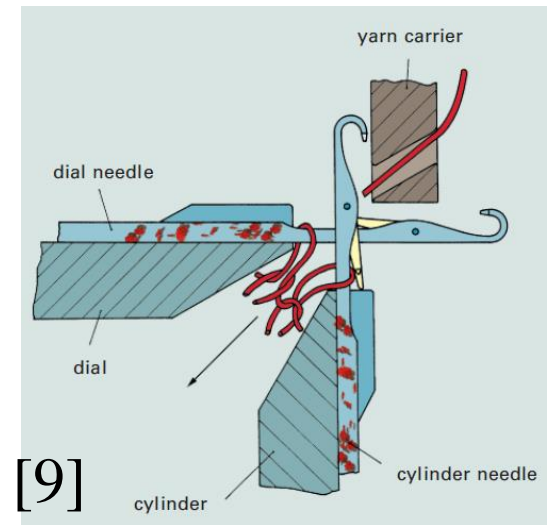


Latch needle (Left Top) and SlideNeedle (Left Bottom) [8]



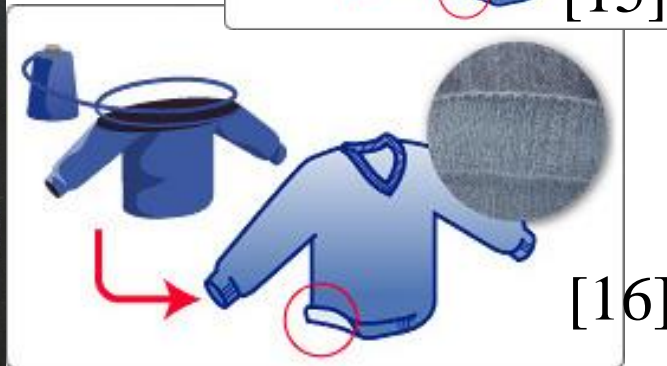
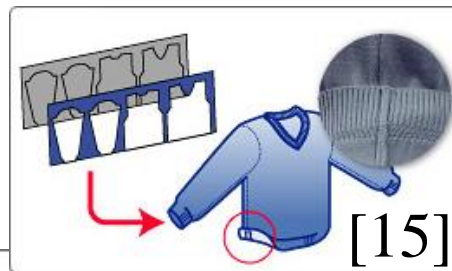
Circular machines - needle beds arrangements:

- One bed - cylinder (single faced structures).
- Cylinder and dial (double faced - rib, interlock).
- Two cylinders – double hooked needles (purl).



Large, body and [10]
small diameter
knitting
machine

Weft knitted technology – products D



[17]

Warp knitted technology - machines

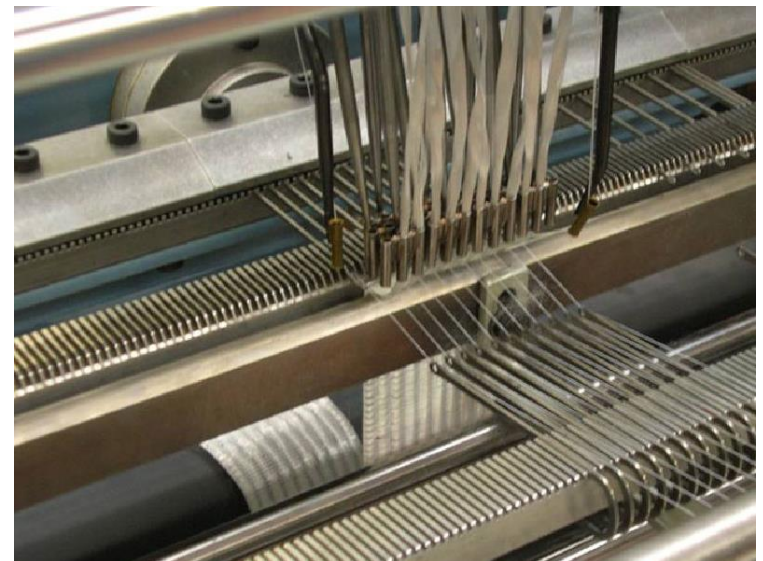
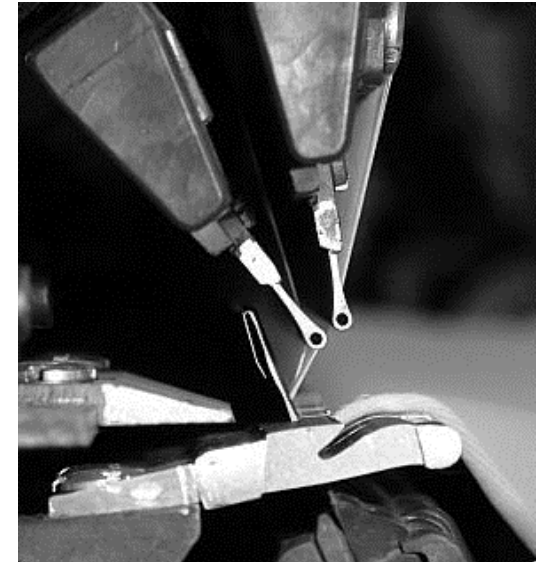


[18]

Raschel machine – single and double needle bar

Tricot machine – compound needle, bearded needle, single and double needle bar

Crochet machine – carabine needle [19], latch needle



Warp knitted technology - products

Applications of warp knitted fabrics:

- garments,
- underwear and hosiery products,
- medical and sanitary textiles,
- sport products,



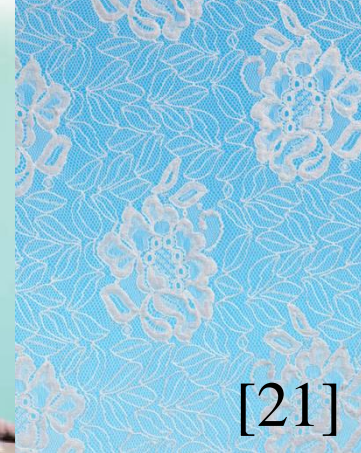
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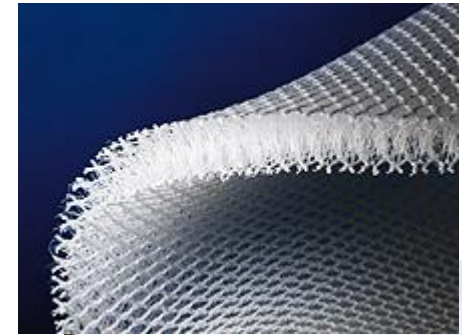
Warp knitted technology - products

Applications of warp knitted fabrics:

- furniture, upholstery and decoration,
- car industry,
- mechanical and technical products
- fishing and packaging industry,
- geotextiles, agri industry etc.



[26]



[27]

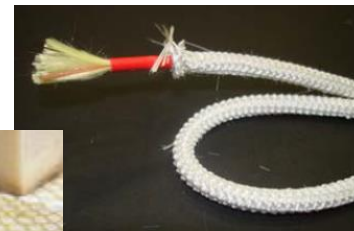
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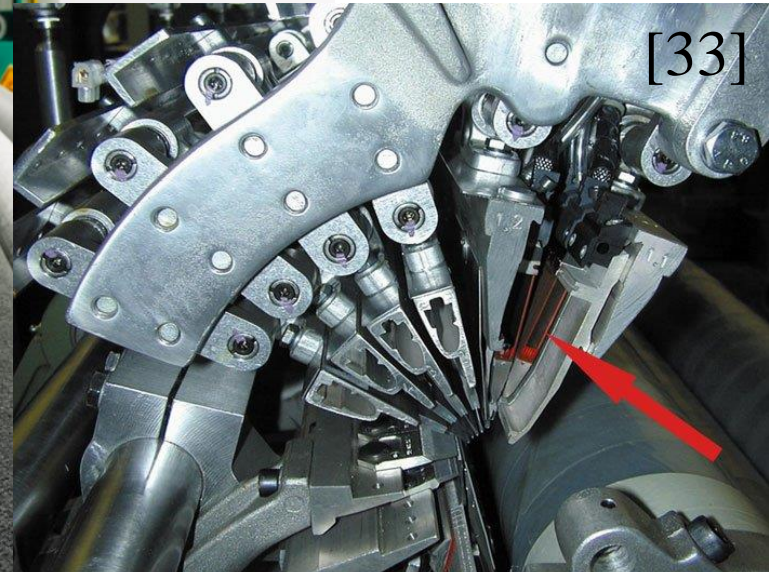
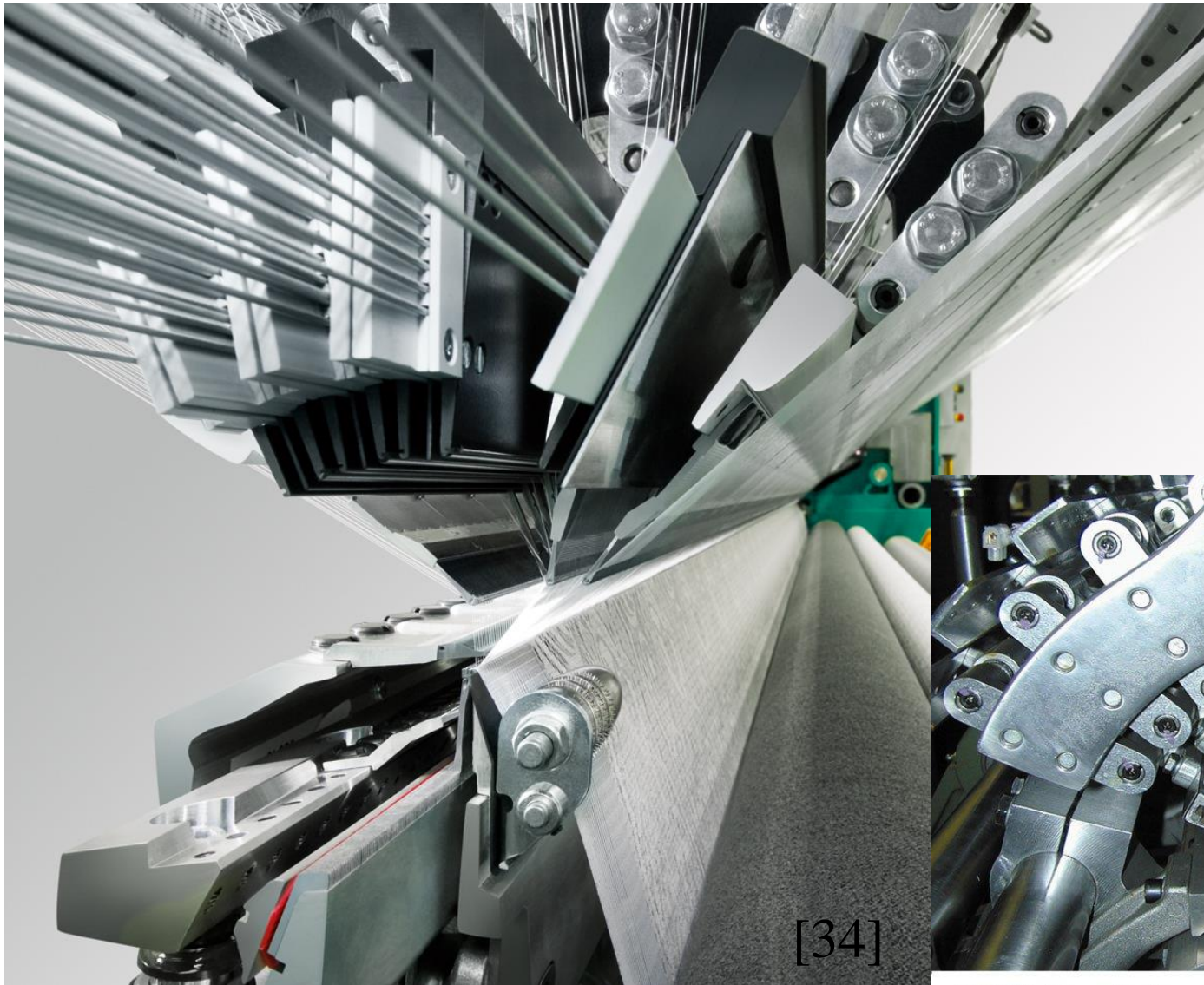


[29]



[32]

Warp knitted technology



RSJ 5/1 Warp Knitting Machine - Piezo Jacquard System

Advanced knitting technique

Transferring – weft knitting

- Flat , circular machine – weft knitted structure

Transferring – warp knitting

„Seamless“ knitted technology

- weft knitted structure
- warp knitted structure



Make-up operation of seamless product

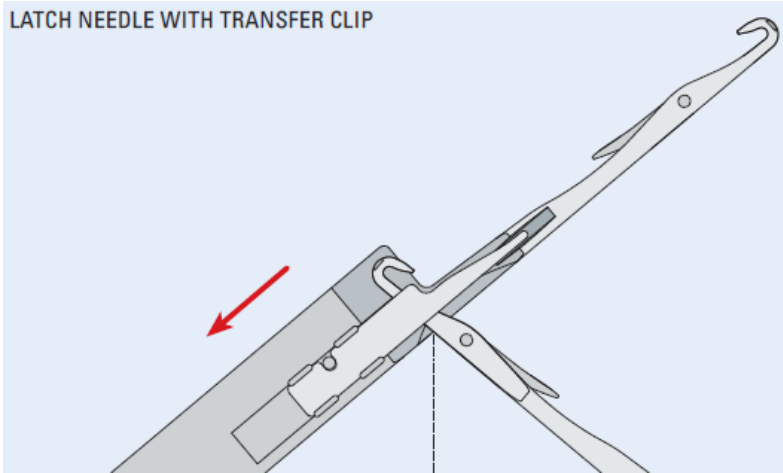
Comparison of seamless technology

Spacer knitted fabrics

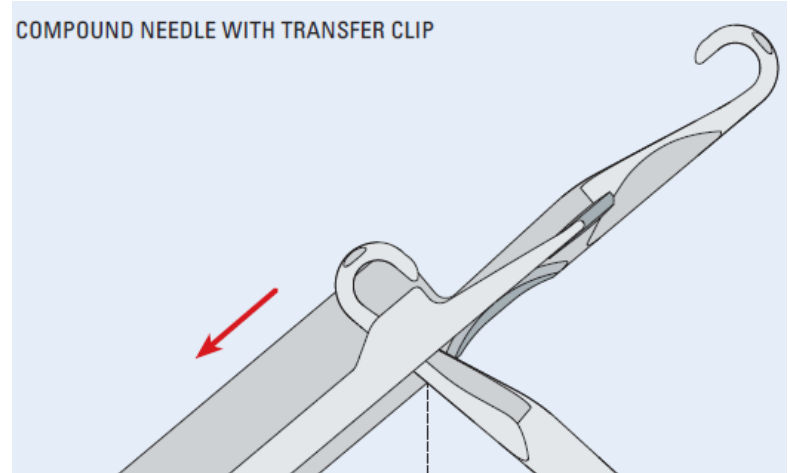
Transferring – weft knitting [35]

- V – bed machine (flat)

LATCH NEEDLE WITH TRANSFER CLIP



COMPOUND NEEDLE WITH TRANSFER CLIP



Transferring – weft knitting

There is another technique for transferring loops for circular machine.

transferring a loop from one needle directly into its adjacent needle, when both needles are in the same needle system.

Previously was only possible in straight bar weft knitting machines.

The building small holes in the fabric was by releasing the loop held in the needle's hook while at the same time the needle was fed with no yarn.

With the technique - small holes with no curl at all.

The limitation - to transfer up to three or four loops between adjacent needles in the same course, without breaking the yarn.



[36]

Transferring – weft knitting

Special needles a wing located in the needles stem. This wing allows:

- transferring the loop held in the needle into its neighbour.
- loop to enlarge it the sufficient length.

Difficulties: the synchronized movement of the needle transferring the loop going down, together with the movement of the needle that receives the loop.

Loop can be transferred from one needle to an adjacent needle on the same needle bed. Transfer in one direction can also be done without any problem.

*Transferring loops between needles
within the same needle system*



„Seamless technology - weft“

Santoni model SM8-TR1 is a single jersey machine available in gauges up to 24 gauge (110 – 160 rpm).

- Eight feeds on the same course, including knit-miss-tuck plus fishnet or anti-drop stitch structures (patented) or pattern with floated yarn.

- The set-up — a) knit and miss — plus fishnet, b) anti-drop structures with the possibility of inlaid knit work on all feeds. Machine with a new approach to seamless casual sportswear.

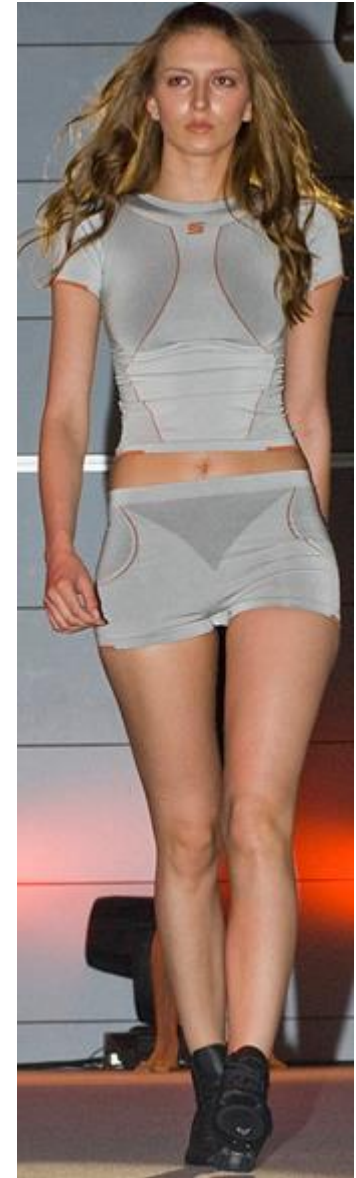
- Possibility to work with natural yarns like wool, cotton and linen as well as synthetic yarns. Advantages of this machine are production of double fabrics or plating of the finest hand touch, mesh, pointelle or eyelet areas wherever required [38].

SM-DJ2TS - complete double jersey circular machine.

ShanghaiTex - show an 18 gauge machine for seamless garments and a 15 gauge for sweater production.

SM-DJ2TS 18E can knit a wide range of both manmade fibres as well as all types of natural fibres.

(true ribs, links-links, jacquards, striping, pointelle, eyelet, body rib bands), i.e. luxurious woman underwear, man and woman underwear and nightwear.



[39]

„Seamless“ – warp knitting

Seamless, smart and extremely fine

Karl Mayer - DJ 4/2 EL - gauge of E 32, working width of just 44 " (and achieved a production rate of 750 courses/min).

finished articles in a single piece in the new, and the visitors were keen to learn as much as possible about this machine.

- The single tension fingers are used to equalise any tension differences in the jacquard yarns when using non-stretch yarns for the new gauge of E 32.
- If single tension fingers are not used, expensive two-component yarns (e.g. core yarns) have to be used when producing many articles – a restriction which makes the product more expensive and limits the lapping and patterning possibilities [40].

- For companies new to this sector, as well as those needing to produce a large number of patterns and sample.
- Small runs, large batches and intricate pattern samples (type of clothing, lingerie and sportswear).



„Seamless“ – warp knitting

Santoni - the pioneer in the circular knitting industry.

SWD 4/2J, a compact electronic double needle bar **warp** knitting machine for seamless items such as pantyhose, underwear and outerwear garments for specific Athletic and Active type of sport clothing

(breathability and non-run fabric structures, combination of mesh areas, body mapping with compression and support areas post-knitting finishing operations are not required).

- SWD 4/2J four- bar and SWD 6/2J six-bar 44-inch-wide machines in 24 gauge.
- Loop production rate is higher for a warp-knitting approach than for a weft-knitting approach [42, 43].

Warp Knitting Seamless – WKS [44]

The highly innovative seamless line, which ranges from t-shirts to lingerie wear, to gloves and tights then finishing with sportswear.

ADVANTAGES:

New technology has their unique advantages both commercial as well as economical, this seamless technology also not exception.

1. Freedom of body movement: the elasticity of seam, the difference in elasticity will affect the free body movement. Since the seamless garment doesn't have any seam in its structure this problem has been eliminated.
2. Wider range of fit for different range of body shapes.
3. Inherent softness: there are no bulky and annoying stitches at the underarm points, shoulders and neck lines, which may cause irritation to the wearer, since the garment having seam free structure it provides the soft feel only.
4. It reduces labour cost: due to the elimination cutting and sewing process it is obvious to reduce more labour involvement.

Make-up operation

Step 1: Warp knitting

The RDPJ and DJ machine series are perfect for producing seamless goods and items that require very little make-up [45].

The two-bar raschel machines:

- Tubular shapes having variable diameters (guaranteeing a perfect fit).
- Functional zones in specific locations (different stretch values)
- Seams that are worked directly into the garment.
- Open-work, jacquard designs (contours).
- Different patterns in the front and back..

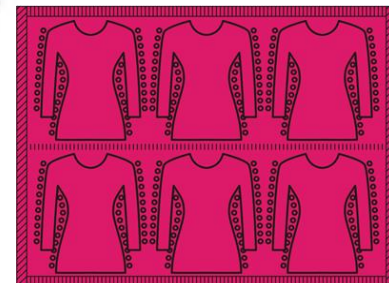
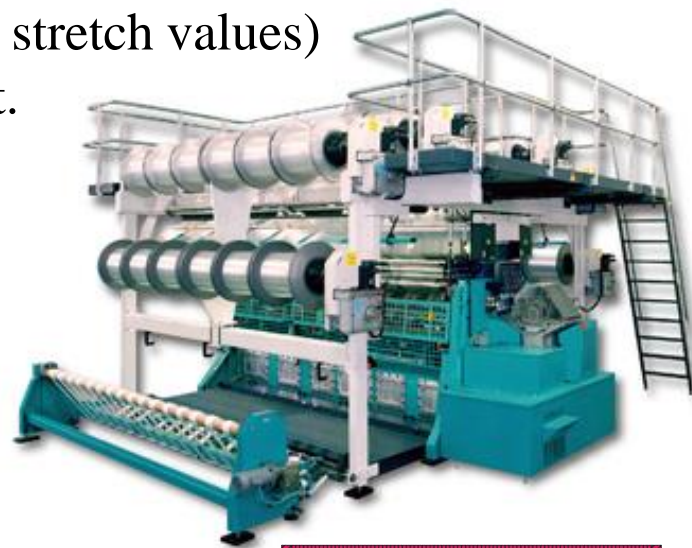
RDPJ 4/2 with a working width of 138" and a gauge of E 24, produced three long-sleeved shirts in a fabric panel. A core-spun yarn - in the jacquard bar and a standard yarn - in the ground guide bars (fabric - 81% PA 6.6 and 19% elastane).

The yarns for the long-sleeved shirts:

GB2, GB 5: PA6.6 dtex 40 f 34

PJB 3-1, 3-2, 4-1, 4-2: PUE dtex44 + PA6.6 dtex 38f34

[46]



Make-up operation

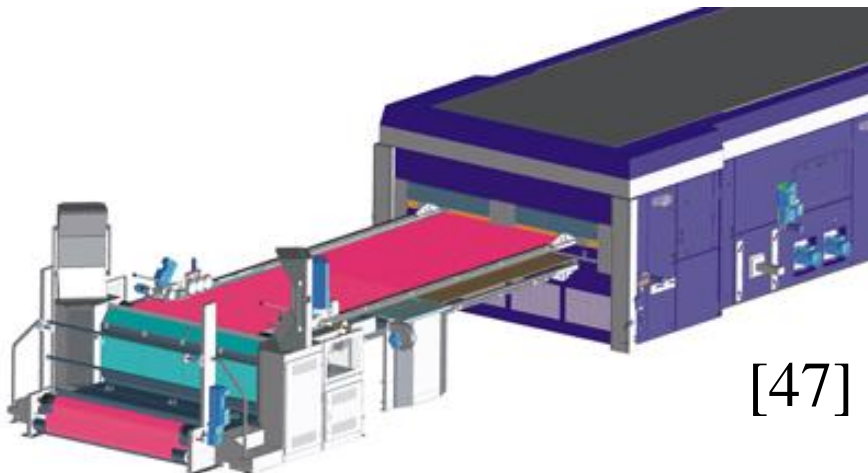
Step 2: Finishing

When relaxing and heat-setting conventional seamless articles, the tubes and stockings are normally finished individually.

Each separate piece is pulled onto a special frame.

These small units (dryer, a steam chamber and a tunnel for hot-air heat-setting).

Separate technical options are available for finishing straight-cut tubular items and stockings.



[47]

Tubular finishing is not ideal when processing elastane-containing knitted fabrics because of the size of the processing zones available, the achievable temperatures and the process reliability.

Comparison – Seamless technology

Loop production rate is higher for a warp-knitting approach than for a weft-knitting approach.

warp		weft	
-	Warp sheet on beams	+	Cones produced on winding machine.
+	Different diameter of the tubular product, max. according to the machine bars width (44").	-	Diameter of the tubular product - according to the machine diameter (16 – 20“). Several type of the machines - for the whole range of the product.
-	Set up (cut edges, small curling).	+	Set up with - inturned welt.
+	Closing the tubular product in the machine – in the needle bed.	-	No closing. Sewing is necessary.
+	No speed reduction in the case of the product closing.	+	No speed reduction in the case of the product set up.

Comparison – Seamless technology

warp		weft	
	Machine speed – approx. on the basis pattern (750 course/min).		Machine revolution depends on the pattern.
+	Simultaneously knitting pieces (sleeve – body (torso) – sleeve).	-	Cut edge fabrics. Knitting only the body – the other parts (sleeves) cut-and-sewn. Making-up operation.
+	Jacquard – unlimited patterning in whole product.	+	Jacquard – unlimited patterning in whole product.
+	Less disposition to the laddering.	-	Laddering.
-	Preparing of the bars after run-in of the warps.	-	Commencing knitting on empty needles.
+	Easily changing of the pattern, small batch production of various size product.	+	Easily changing of the pattern, small batch production.

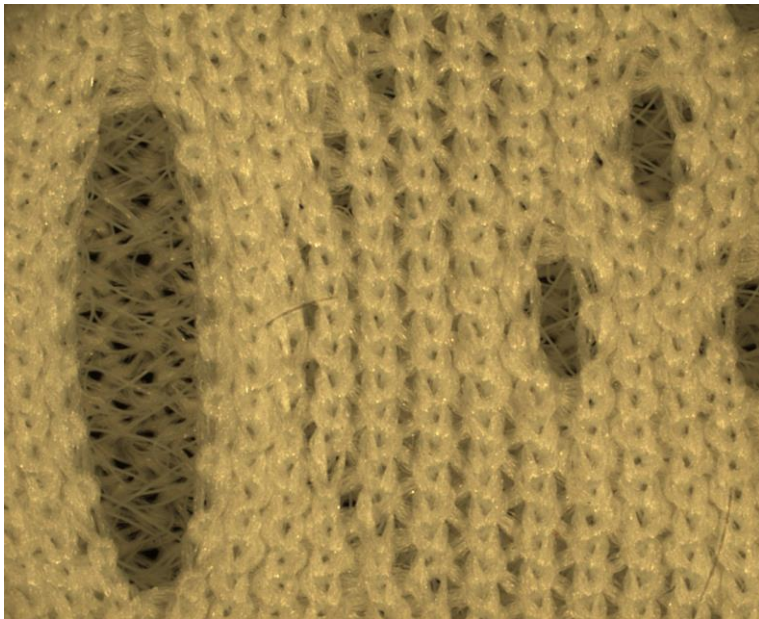
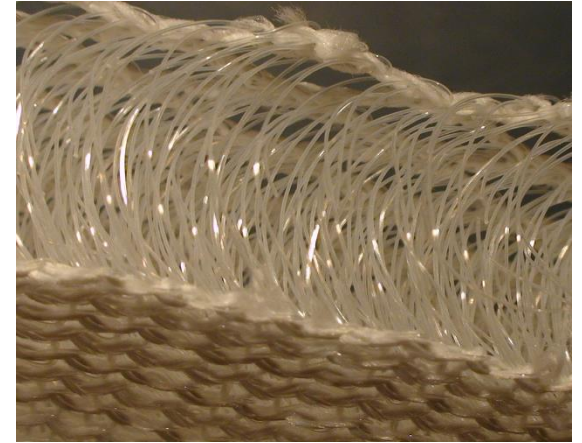
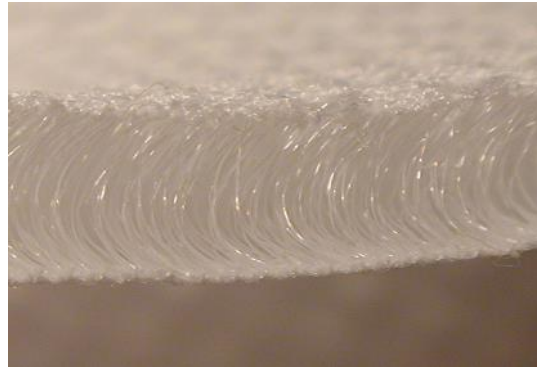
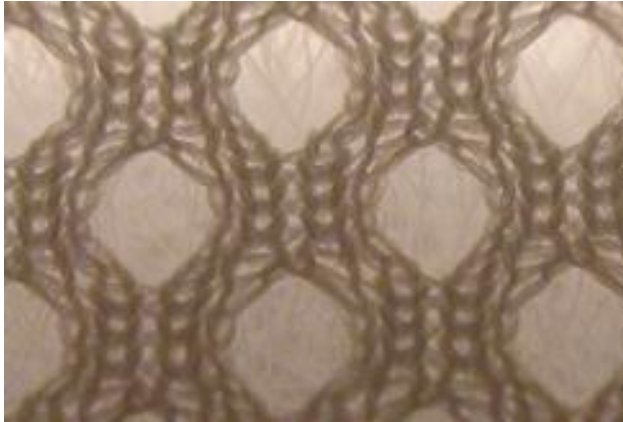
Warp knitted seamless

A potential for warp knitting is in market segment where garments are required to have sleeves.



[48, 49]

Spacer knitted fabrics - warp



Spacer knitted fabrics - generally

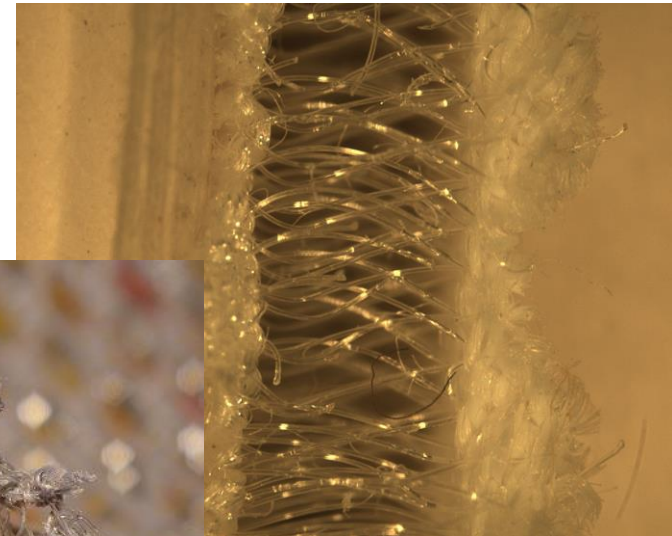
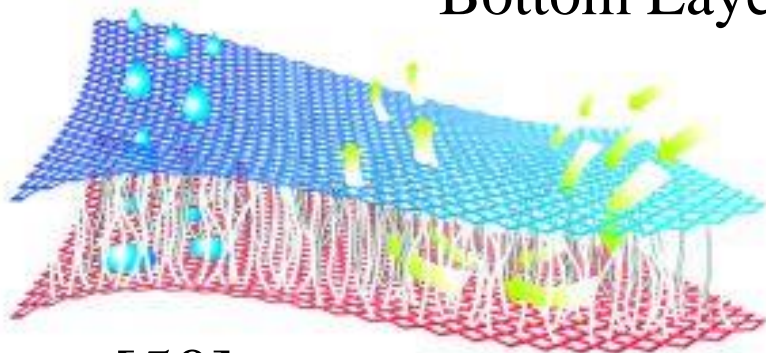
Three-Dimensionally Knit Spacer Fabrics

- According to Cass (2000), spacer fabrics are much like a sandwich and feature “two complementary slabs of fabric with a third layer tucked in between. The inner layer can take a variety of shapes, including tubes, pleat or other engineered forms, which give the entire three-layer fabric a wide and ever-expanding range of potential applications”.

Top Layer

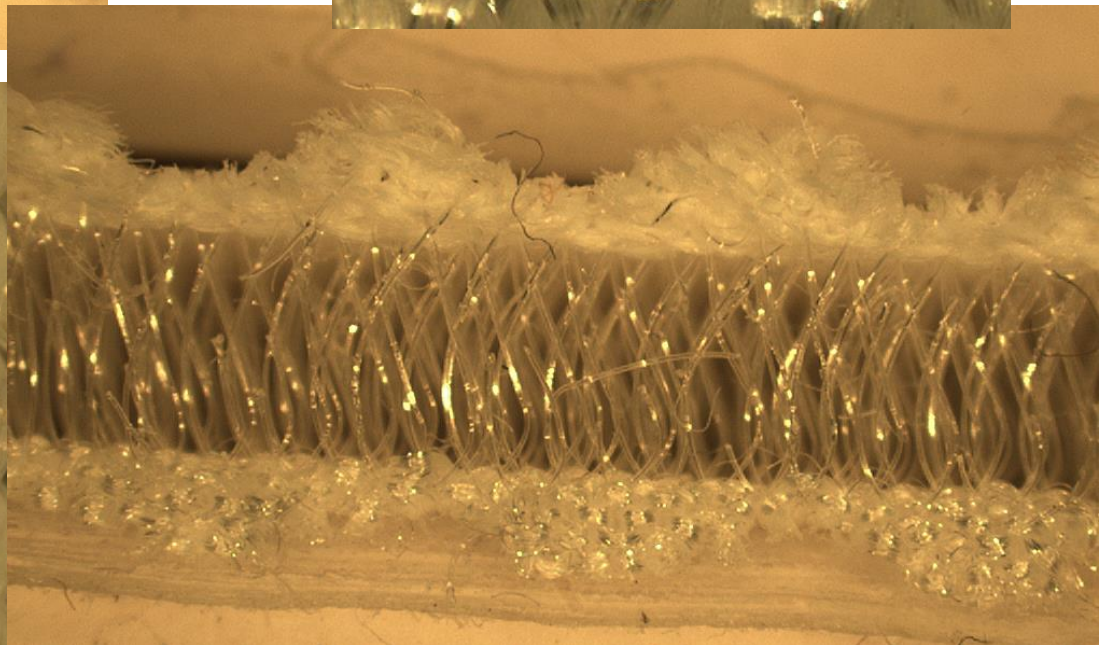
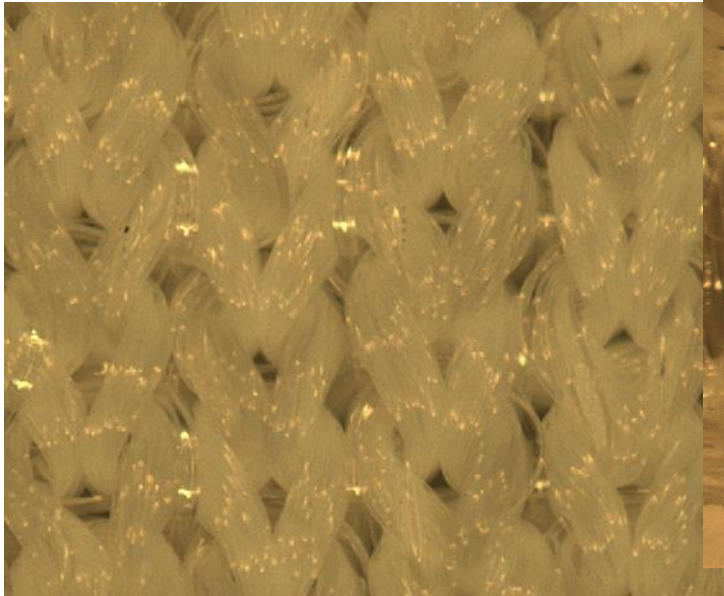
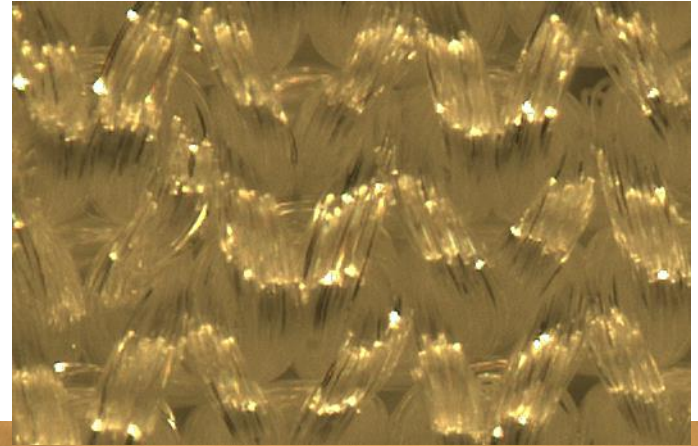
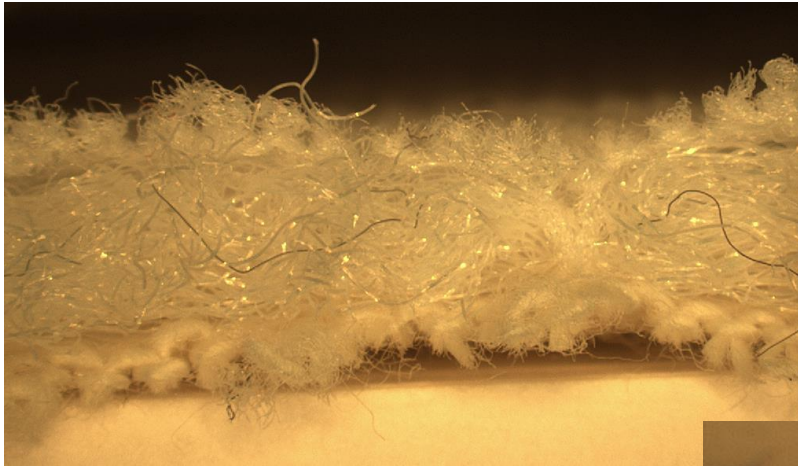
Connecting Layer

Bottom Layer



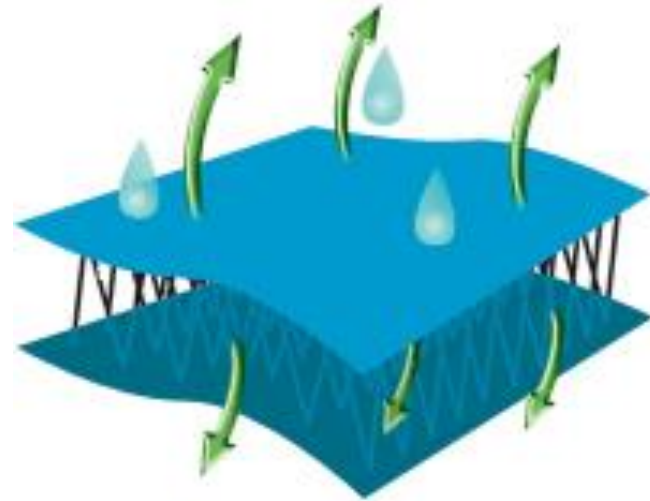
[50]

Spacer knitted fabrics - weft



Spacer fabric- Weft Knitting

- The innovation of spacer fabrics is not new, commercial developer Matthew Townsend of Leicester took out an initial patent for spacer fabrics in 1868. The patent was for knitting mattresses on a two needle-bed hand frame with interconnecting “threads” .
 1. Spacer Fabric Production on Weft Knitting Machines
 - Spacer fabrics are two distinctive layers of fabric joined together by a connecting layer.
 - Weft knitting machines with two sets of needles - to create two individual layers of fabric (to hold together by tucks).



[51]



[52]

Spacer fabric- weft

Dial and Cylinder Spacer Fabrics

- Producing knitted spacer fabrics can be done using a variety of combinations of stitches that connect two independent layers of fabric together.
- All techniques require the use of at least three different yarns:
 - 1) Yarn for the cylinder needles,
 - 2) Yarn for the dial needles, and
 - 3) A spacer yarn, normally monofilament yarn connecting the two layers. The distance can be manipulated by the dial height adjustment determining the amount of pile yarn.

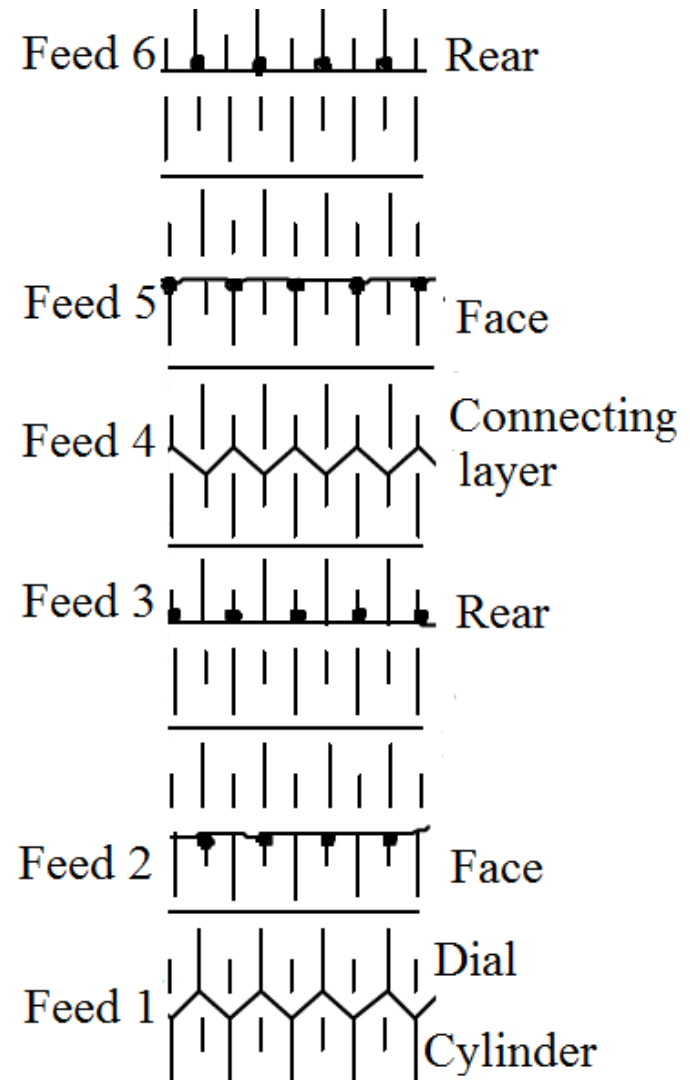
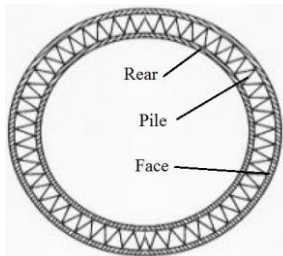
It should be noted that using high and low butt needles refers to the different types of needles in the cylinder and dial.

- In the notation, long lines represent high butt needles and short lines represent low butt needles.

Spacer fabric- weft

1. Tucking on dial and cylinder needles at the same feeder:

- a) tucking on the dial and cylinder needles on feeders 1 and 4 on high and low butt needles alternately (this connects the two layers together),
- b) knitting dial needles with dial yarn at feeders 3 and 6 on low and high butt needles alternately, and
- c) knitting cylinder needles with cylinder yarn at feeders 2 and 5 on low and high butt needles alternately.



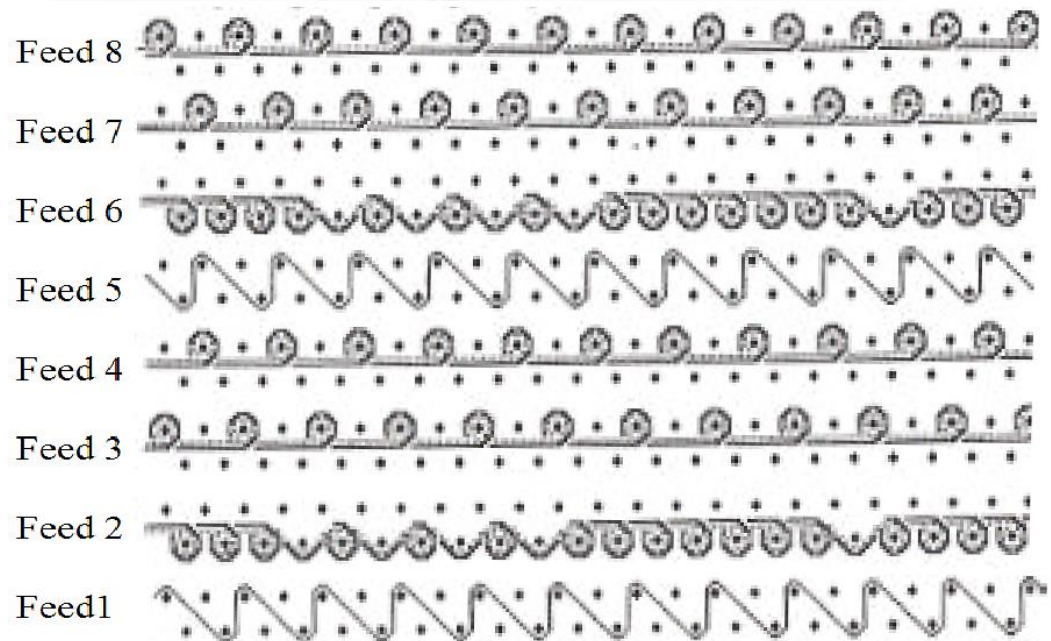
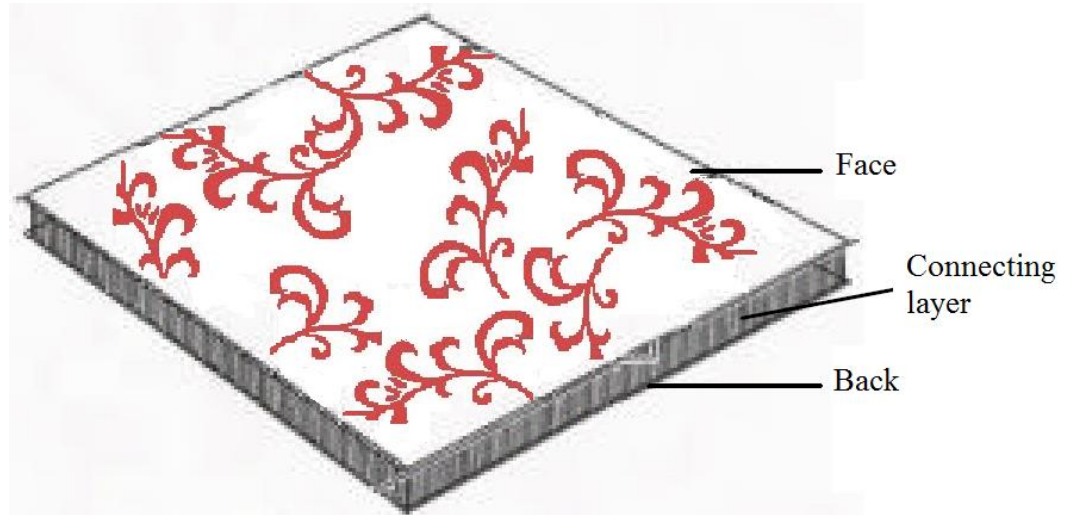
Spacer fabric- weft

V-Bed Spacer Fabrics

- Two types of products can be created:
 - 1) Two independent structures connected by cross threads, and
 - 2) Two independent fabric structures connected by fabric layers.
- The first technique: through the use of pile yarns to connect two independent layers of fabric on the front and back needle beds it is possible to form a double face fabric.
- This technique is extremely limited because the distance between the two needle beds dictates the space between the two fabric layers (the two needle bed are a fixed distance apart, the overall thickness of the spacer fabric is determined by the machine setting - between 2 – 10 mm).
- Much creative potential still exists - it is possible to use two different types of yarns and create two different structures on either side of the spacer fabric.

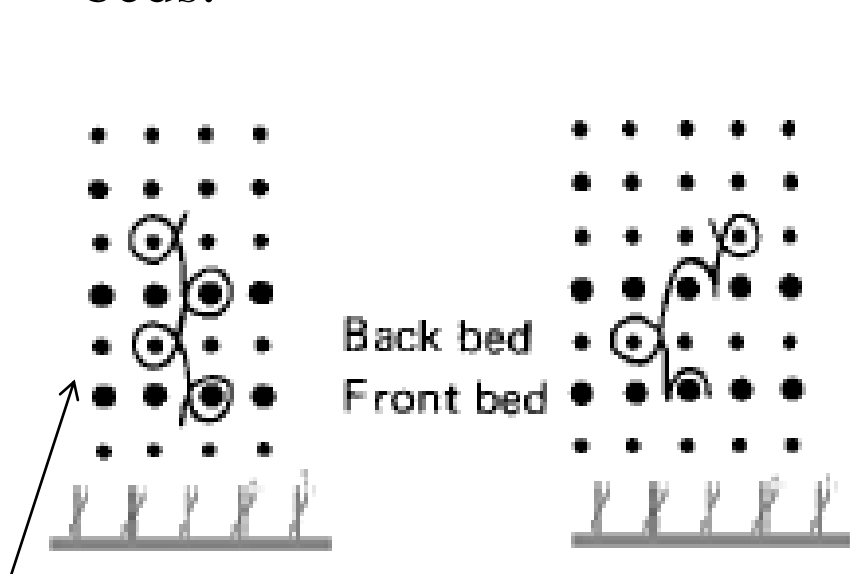
Spacer fabric- weft

- The ornamental multi-layered fabric used in the production of brassieres.
- Two fabric layers are connecting by tucks. (Feed 1 knitting and tucking the jacquard pattern seen on the front of the fabric, feed 2 and 3 are knitting on alternate needles on the back needle bed and feed 4 tucking on alternate needles of the back and front needle beds.)

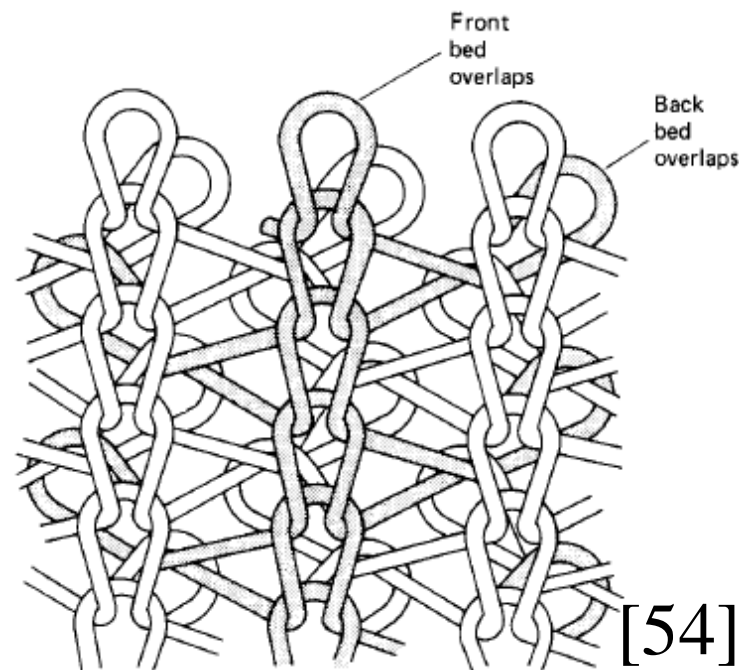


Warp Knitting - Double-faced fabric

- If the front guide bar overlap only the front needle bed and miss-laps on the back bed, and the back bar overlaps only the back bed and miss-laps on the front bed two separate single-faced fabrics will be knitted back-to-back.
- A fabric of double-faced loops, each composed of a warp thread from each guide bar, is produced if both guide bars overlap both beds.



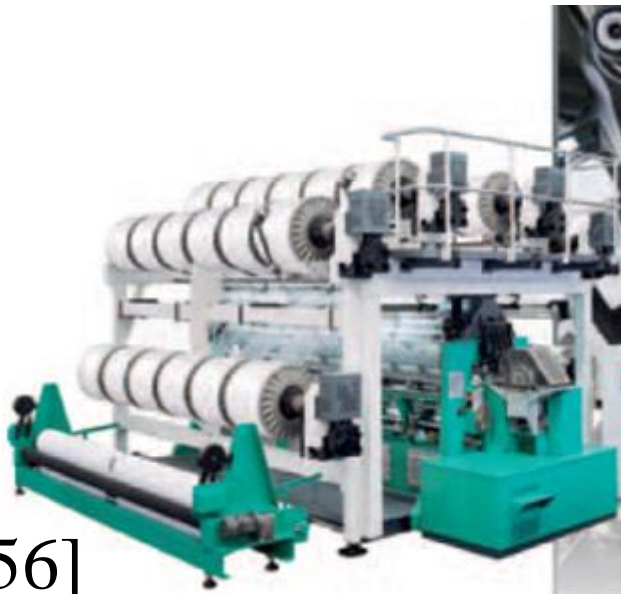
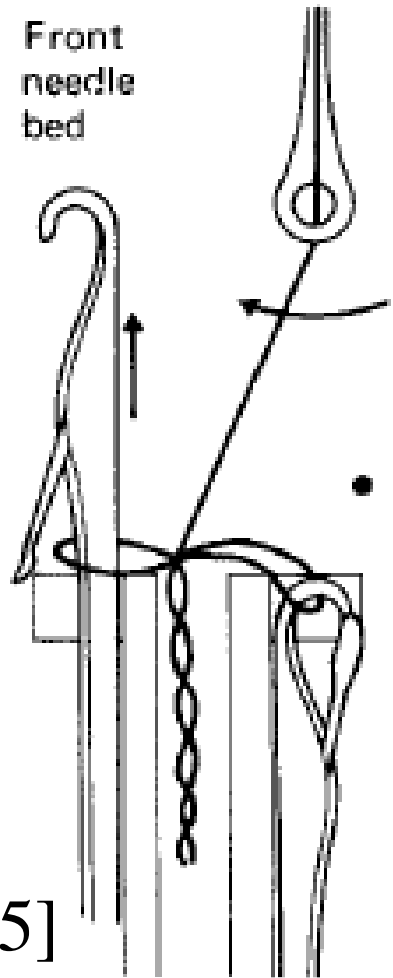
Unsatisfactory lapping movement [53]



[54]

Spacer fabric – warp

- Spacer fabrics are two distinctive layers of fabric joined together by a connecting layer.
- Production of spacer fabrics on a Raschel machine with two needle bars is possible (not on traditional tricot and Simplex machines). There is a front and back bed of needles being used to create distinct layers that are connected by spacer yarns. Raschel machines produce both outer layers simultaneously on different bars using their own sets of needles.



[56]

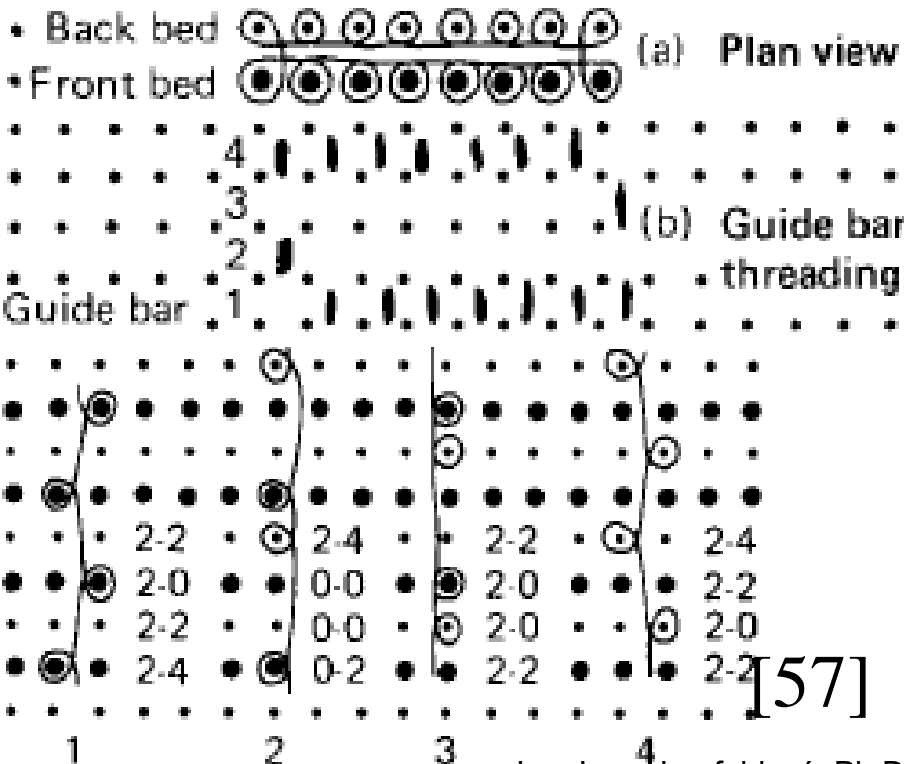
[55]

It is possible for the front and back to use different yarns and have completely different structures.

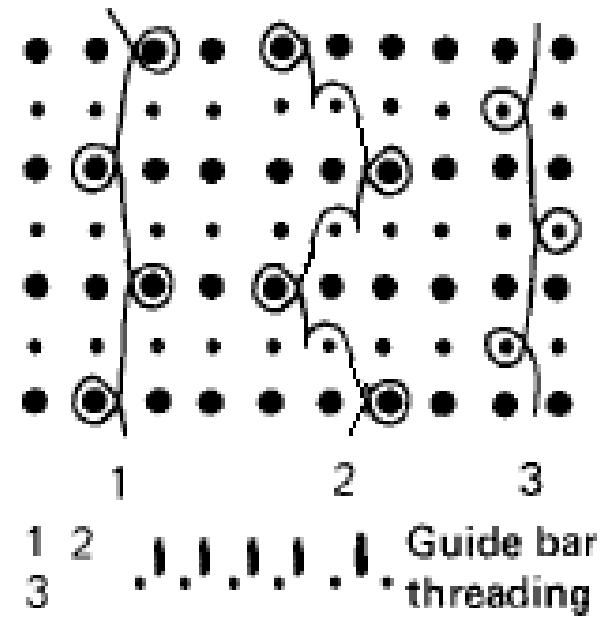
Spacer fabric – warp

Tubular product- Guide bar one is feeding yarns to the front needle bar, guide bar four feed yarns to the back needle bar and bars two and three alternate knitting on the front and back beds to join the two independent fabric structures.

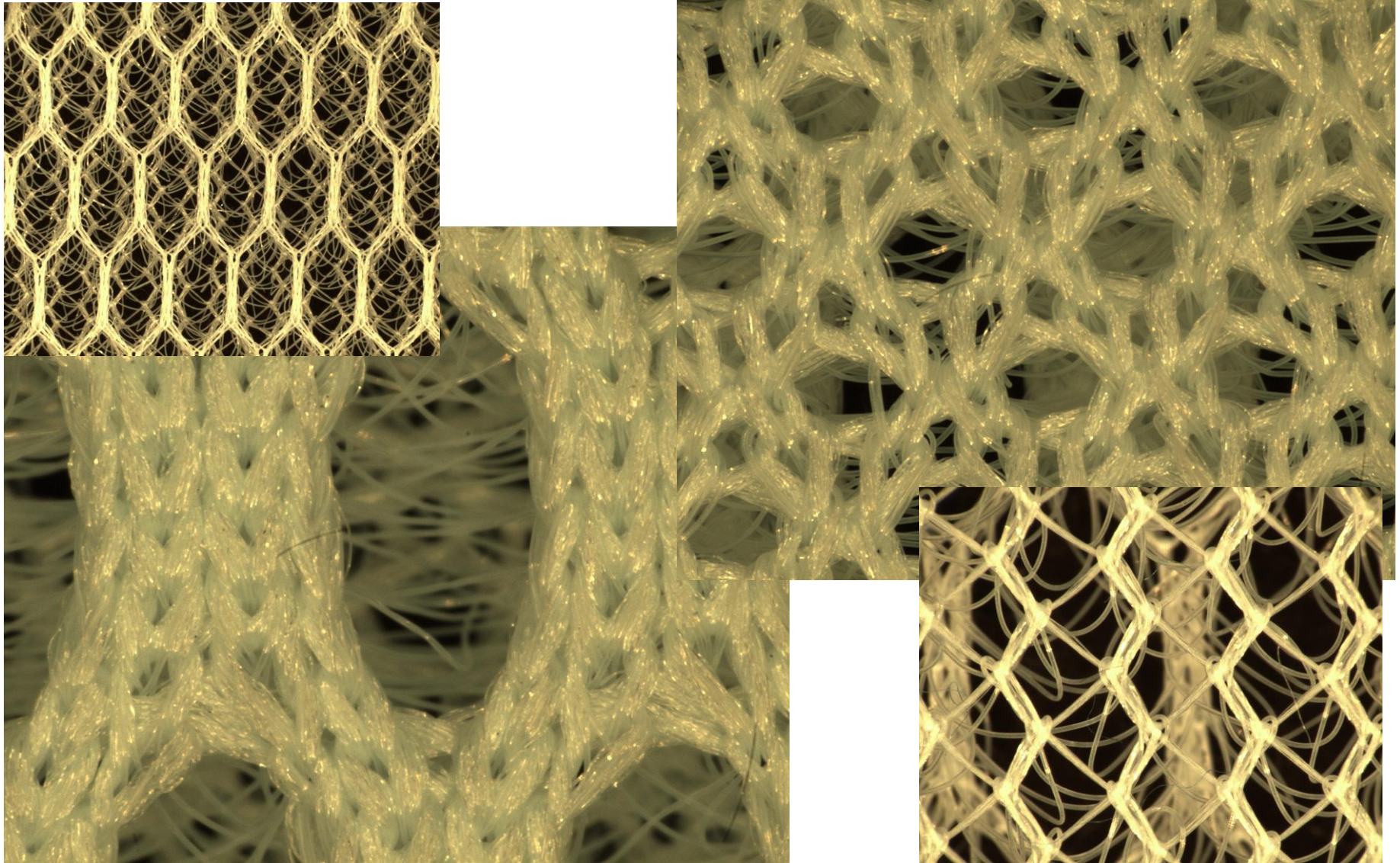
The pile yarns being fed on bars two alternate knitting on the front and back beds to join the two independent fabric structures 1 and 3.



[57]



Spacer fabric – warp



Resources

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