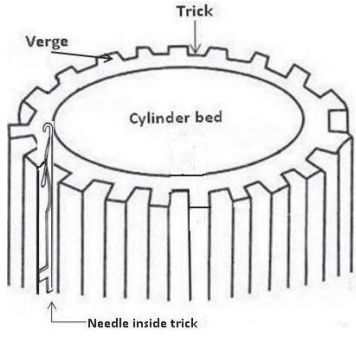
Knitting Chapter-02

Glimpses of knitting

For knitting a fabric, only one or one set of yarns is to be supplied to the knitting machine. Depending upon the direction of movement of yarn during loop formation with relation to the direction of fabric formation, knitting technique is classified as warp knitting and weft knitting.

Weft knitting machines produce four basic knitted structures such as plain, rib, interlock and purl. Plain structure is produced in single jersey machine whereas the other three are produced in double jersey machines.



These basic structures are composed of face loops and back loops.

The main element required in loop formation is needle. Latch needles are used in weft knitting and bearded needles are mainly used in warpknitting. The other important element required in loop formation is sinker. Theneedles are given upward and downward movement along its axis for loop formation by means of a cam system. For proper axial movement of the

Advantages of knitting

The technique of inter-looping for making fabrics has the following advantages:

- Fabric can be produced from minimum number of yarns, even only one yarn.
- The extensibility and stability of the knitted fabric can be engineered.
- The desired porosity or compactness of the fabric can be achieved easily.
- Loop structures are easily distorted under tension in application, which imparts more freedom of movement and comfort of the wearer.
- Yarn can easily flow from one loop to another under tension.
- Wastage of yarn during conversion of yarn in to fabric by knitting is negligible.
- Knitting can produce fabrics which are very much suitable for intimate wears as well as for technical applications.

Reasons for the growth of knitting

- Capital investment for starting a new knitting unit is less than that required for other fabric-producing industries.
- No yarn preparatory machinery is required in weft knitting and only warping is needed in warp knitting.
- Machine productivity is high.
- Time required to get an order executed is less than weaving.
- Knitting is more flexible than weaving, i.e. styles and designs can be changed rapidly.
- Modern knitting machines, particularly warp knitting machines can produce various types of technical textiles (medical textiles, automobile textiles, geo-textiles, etc.).
- Seamless garments can directly be made in knitting.
- Knitted garments have very good demand in export market.
- Computer-aided designing and manufacturing in knitting have made it possible to manufacture any desired structure within a short time at reasonable price.

Comparison between weaving and knitting

The comparison of the features of the techniques, machines and products of weaving and knitting is given in Table

	Weaving	Knitting
1.	Fabric is made by interlacement of threads	Fabric is made by inter-looping of threads
2.	Two sets of threads – warp and weft – are used in making the fabrics	One or one set of thread(s) – either warp or weft – is use d in making the fabric
3.	Weaving requires more number of preparatory processes	Knitting requires less number of preparatory processes
4.	Fabric is less stretchable	Fabric is more stretchable
5.	Fabric does not bend easily and results less comfort and form fitting property	Fabric bends easily and results good comfort and form fitting property
6.	Fabric has low wrinkle (crease) resistance	Fabric has high wrinkle (crease) resistance
7.	Fabric is less porous and air permeable	Fabric is more porous and air permeable
8.	Fabric is stronger and durable	Fabric is comparatively weaker and less durable
9.	Lesser inherent tensions cause minimum shrinkage and loss of size	During conversion of yarn into loop, tension development is high which results higher shrinkage
10.	Fabrics are more dimensional stable due to tighter construction and intersecting of warp and weft in right angle	Because of loop structure and inability of yarn to return to original position, the dimensional stability is poor

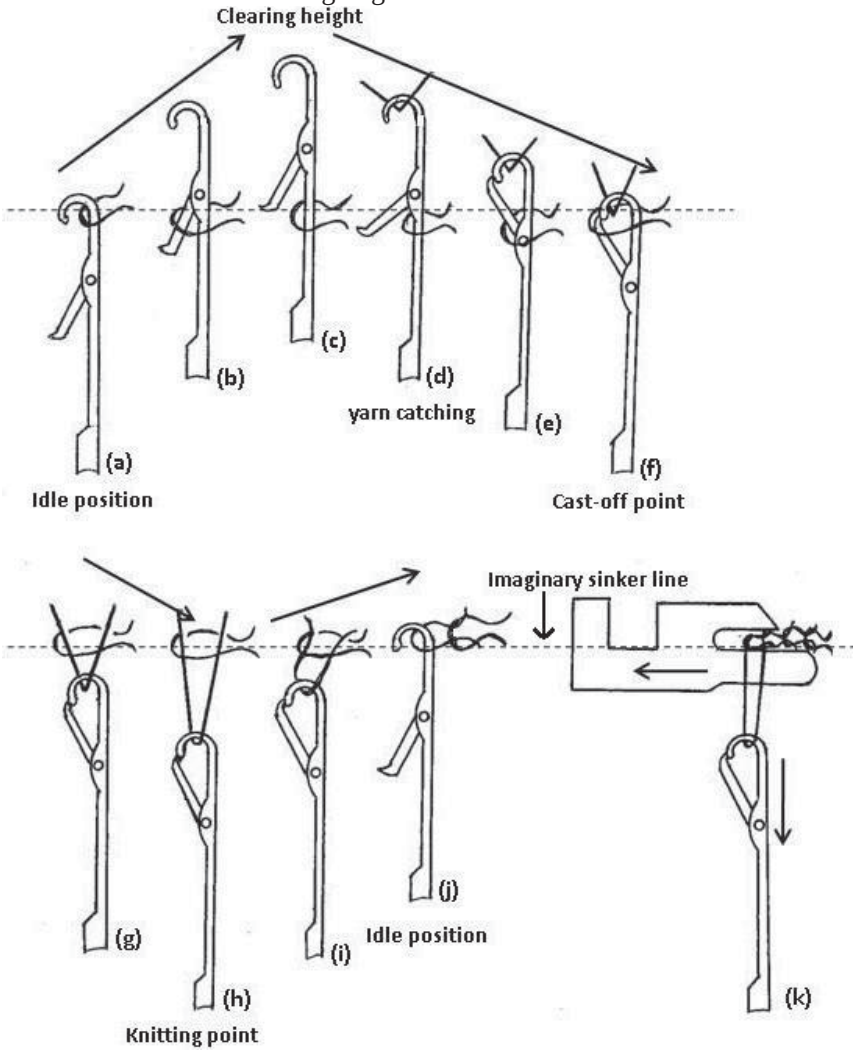
Comparison between weft knitting and warp knitting

The relative comparison between weft knitting and warp knitting (process, machine and structure) is shown in Table

	Weft knitting	Warp knitting
1.	Loop formation takes place course wise in horizontal direction	Loop formation takes place wale wise in vertical direction
2.	Yarn runs in horizontal or course direction during knitting	Yarn runs in vertical or wale direction during knitting
3.	Yarn is supplied generally in the form of cone hold in a creel	Yarn is supplied generally in the form of warp beam (number of beams may be 2 or more)
4.	Only one or a few yarn(s) (152 maximum) is/are needed during knitting a fabric	Large number of yarns are needed for knitting a fabric
5.	Staple yarns are preferably used but filament yarns are more suitable	Filament yarns are mostly used but staple yarns are nowadays used in some cases
6.	Less preparatory processes are required before knitting	More preparatory processes are required before knitting
7.	Latch needles are used in all machines material	Bearded needles are mostly used but latch needles can also be used in some cases
8.	Fabrics have good stretchability in both direction, comparatively higher width direction	Fabrics have low stretchability in both direction, comparatively higher in width direction
9.	Machine may be flat or circular	Machines are generally flat
10.	Circular machine produces circular fabrics but both flat or tubular fabric may be produced in flat machine	Mainly flat fabrics are produced but limited range of circular fabrics can also be produced.

Knitting action of the latch needle

The knitting action of the latch needle, i.e., the position of a latch needle as it passes through the cam system and moves up and down in its trick with reference to the sinker level for completing one knitting cycle, is shown in Fig. 3.8. The knitting cycle passes through a large number of stages as described in the undergoing.



i. *Rest position of the needle* (a). The head or crown of the needle is at a slightly higher level of the top of the verge or sinker. The loop formed at the previous feeder or knitting cycle is in the closed hook.

ii. *Latch opening* (b). As the needle follows the cam profile, needle is forced to gradually move up by the clearing cam. The old loop which is held down by the sinker as well as pulled by the take-down load, slides inside the hook, comes in contact with the latch and opens the latch.

iii. *Clearing height* (c). As the needle reaches the top of the clearing cam,

the old loop is cleared from the latch and the latch is hanging down.

iv. *Yarn feeding and latch closing* (d and e). The needle starts to descend under the control of the stitch cam. The old loop which slides on the needle stem comes under the latch. At this height new yarn is fed to the needle and the needle continues downward movement. The loop closes the latch on the hook and rides over the latch. The sinker starts to move outward

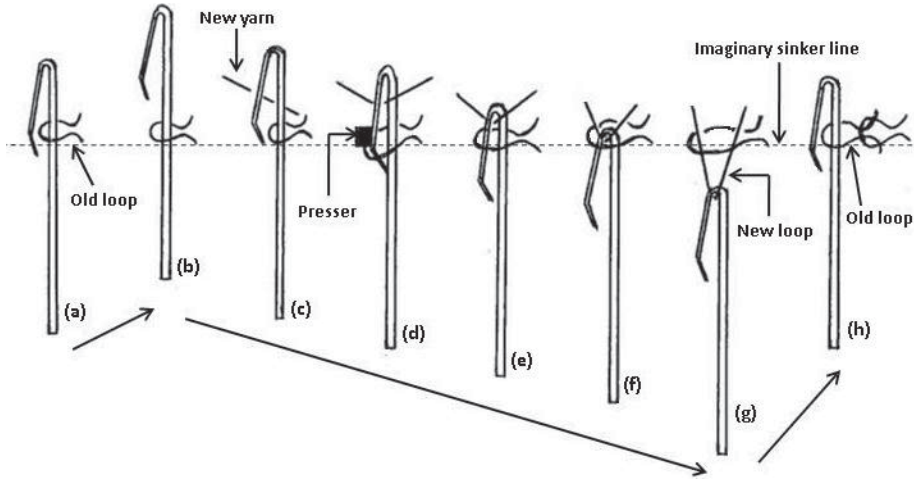
v. *Casting-off* (f). As the needle head approaches the verge or sinker level, the old loop slides off the needle and the new loop is drawn through it. The sliding off of the old loop from the needle is called casting-off and the old loop is called cast-off loop. The sinker continues outward movement and allows the old loop to lie on the throat.

vi. *Loop formation* (g and h). The needle with the new loop in its hook descends further inside the trick and the loop size gradually increases. The needle ultimately reaches the bottom of the stitch cam, i.e., the down most position and maximum length of yarn is drawn mainly from the package and partly from the previous loop to complete the formation of the new loop. The down most point is termed as knitting point. The sinker starts inward movement.

vii. *Attaining idle position* (i and j). The needle with the new loop insidethe hook moves up. The Sinker completes the inward movement and pushes the old loops or fabric to assist take-down. The needle reaches the idle position again During loop formation the sinkers also move to and for maintaining same height or level. However, for the sake of simplicity, the different positions of the sinker with respect to the needle are not shown in the figures. Only to have an idea of the same the position of the sinker at knitting point been shown in Fig.

Knitting action of the bearded needle

Like latch needle bearded needle also passes through different stages during a knitting cycle. The different stages of loop formation are shown in Fig.



i. *Idle position of the needle* (a). The head or tip of the needle is at a slightly higher level of the top of the verge or sinker. The loop formed at the previousfeeder or knitting cycle is inside the hook.

ii. *Clearing height* (b). As the needle follows the cam profile, needle is forced to gradually move up by the clearing cam. The old loop whichis held down by the sinker as well as pulled by the take-down load slidesinside the hook. As the needle reaches the top of the clearing cam, the old loop is cleared from the hook, i.e., it reaches beyond the control of the beard.

iii. *Yarn feeding* (c). The needle starts to descend under the control of the stitch cam. The old loop slides on the needle in upward direction. At this height new yarn is fed to the needle and the needle continues downward movement.

iv. *Hook closing* (d and e). The pusher or presser bar comes in contact withthe beard and closes the hook so that the old loop sliding on the needle stem now can ride over the beard.

v. *Casting-off* (f). As the needle head approaches the sinker or verge level,the old loop slides off the needle and the new loop is drawn through it. The pressure bar is withdrawn. The sliding off of the old loop from the needle is called casting-off and the old loop is called cast-off loop.

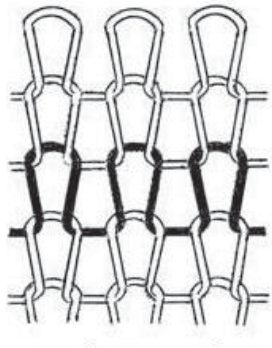
vi. *Loop formation* (g). The needle with the new loop in its hook descends further inside the trick and the loop size gradually increases. The needleultimately reaches the bottom of the stitch cam, i.e., the down most position and maximum length of yarn is drawn to form the loop. This istermed as knitting point.

vii. *Idle position* (h). The needle with the new loop inside the hook moves up. Sinker pushes the old loops or fabric to assist take-down. The needleattains the idle position again.

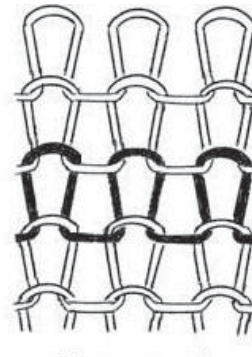
Features of plain (single jersey) knitting (machine, process and structure)

(a) Machine has only one bed which may be flat or circular.
(b) There is only one set of needles and one cam system in the machine.
(c) Minimum one yarn is needed to produce a fabric.
(d) Single-faced structure, i.e., only one type of loops – Face or Back – are visible on the surface.
(e) Fabric has good extensibility in both length and width direction but width-wise extensibility is generally much higher than length-wise extensibility.
(f) Yarn /course can be unroved from starting and ending end of knitting.
(g) Fabric curls at the free edges on flat surface – toward the front at the upper and lower edges and toward the back at left and right edges. This curling is mainly due to the unbalanced yarn bending moment existing in the three-dimensional nature of the structure. Yarn bending rigidity property is responsible for curling.
(h) Because of stitch simplicity, production rate is high and machine is simple and cheap.
(i) Properties like rigidity, air permeability, bursting strength, etc. and GSM of the fabric change with change in loop length.
(j) Fabric thickness is approximately two times the diameter of the yarn used.

(k) Sinker top machine is very common.
(l) Common gauge is 16–28 for circular machines and 5–12 for flat machines.



Face loop on surface

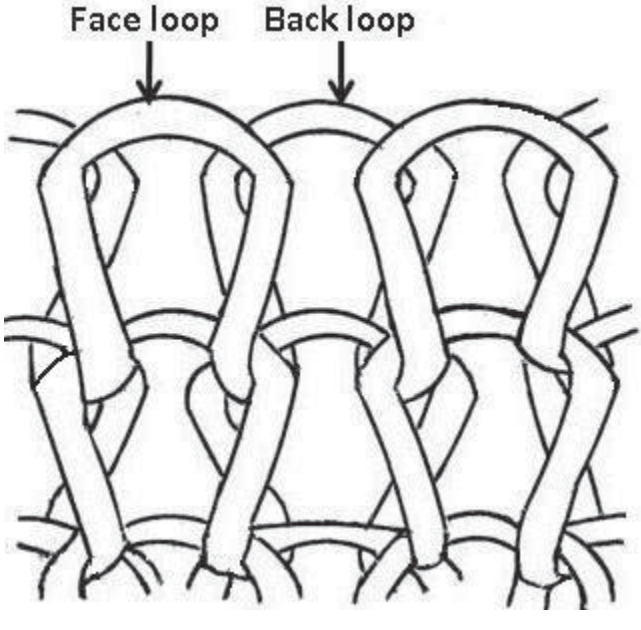


Back loop on surface

Features of rib knitting (machine, process and structure)

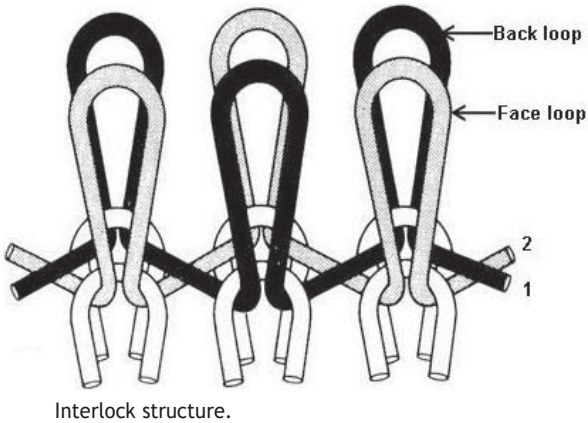
(a) Machine has two beds – may be flat or circular.
(b) There are two sets of needles – one in each bed.
(c) There are two cam systems – one in each bed.
(d) Needles in the two beds are not face to face but needles in one bed are in between the needles of the other bed so that they do not touch while raised for clearing.
(e) Rib fabrics are double-faced structures as well as balanced structures.
(f) Both face loops and back loops are visible on both the sides of the fabric, and fabric has identical appearance in face and back.
(g) Each course is made of face loop and back loop in alternative order, the order may be 1×1, 2×2, 3×3, 6×3, etc.
(h) Fabric surface is vertically corrugated or ribbed.
(i) Fabric is much thicker, generally double, than single jersey fabric.
(j) Fabric has good extensibility in length direction, but the width-wise extensibility and the recovery are much higher than single jersey fabric which makes it suitable for neck collar, hand cuff, waist band, etc.
(k) Fabric does not curl at the free edges.
(l) Fabric can easily be unroved from the end last knitted.
(m) Rib machine requires finer yarn and results in comparatively costly fabric.

Rib Structure



Features of interlock knitting (machine, process and structure)

(a) Machine has two beds. Machines may be flat or circular, but generally circular.
(b) There are two sub sets of needles in each bed, the sub sets are known as short needles and long needles, respectively.
(c) Two sets of cam system, i.e. cam path in each bed accommodate short and long needles of the corresponding beds.
(d) Needles in two beds face each other – short needles in one bed face the long needles in the other bed and vice versa.
(e) Short needles in one bed make loops in conjunction with short needles in the other bed, similarly long needles in one bed make loops in conjunction with long needles in the other bed.
(f) Separate yarns are to be supplied to the short needles and long needles for loop formation through separate feeders.
(g) Short needles and long needles don't make loop simultaneously but with a time gap.
(h) Loops made by one set of needles are locked by the loops made by the other set of needles.
(i) Minimum two yarns are needed to produce a fabric.
(j) Fabric has double faced as well as very stable structure.
(k) Fabric is equally thicker to rib but much more compact.
(l) Fabric neither curls nor ladder.
(m) Machine is complicated and costly.
(n) Fabrics are dimensional stable, heavy and costly.



Interlock structure.

Comparison of basic weft knitted structures

Property	Plain	1x1 Rib	1x1 Purl	Interlock
Appearance	Different in face & back, V-shapes in face & arcs on back	Same on both sides,like face of plain	Same on both sides,like face of plain	Same on both sides,like face of plain
Extensibility -				
Lengthwise	Moderate (10-20%)	Moderate	Very high	Moderate
Widthwise	High (30-50%)	Very high (>50%)	High	Moderate
Area	Moderate-high	High	High	Moderate
Thickness and Warmth	Thicker and warmer than plain woven made from same yarn	Much thicker and warmer than plain	Much thicker and warmer than plain	Very much thicker and warmer than plain
Unroving	Either ends	Only from end knitted last	Either ends	Only from end knitted last
Curling	Tendency to curl	No tendency to curl	No tendency to curl	No tendency to curl
End-uses	Inner garments, stockings,	Outerwear, Socks,knitwear,	Children´s clothing,	Underwear, trouser suits,

	T-shirts and dresses,base fabric forcoating	under-wear, Collar, cuffs & waist bands in different garments	knitwear, heavy outerwear	shirts, dresses, sportswear,