INTORDUCTION TO TEXTILE PROCESSES

E CONTENT

Second Semester Textile Technology

Diploma in Textile Technology

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UNIT I

Yarn

Yarn is a continuous length of interlocked fibre, suitable for use of production of textiles, sewing, crocheting, knitting, weaving, embroidery, and rope making.

Thread is a type of yarn used for sewing.

A yarn can be made of staple (short) fibres by any of the several techniques like ring spinning, open end spinning, friction, or air jet spinning etc.

Filament is a fine, single thread like structure of single fibre found in animal or plant. Eg. silk.

The fibres are blended in a fixed proportion to achieve desired qualities of durability, fineness, crease resistance etc.

Ring spinning is the most popular technique of yarn formation. The value and character of a yarn is determined by :

i. Kind and quality of fibre;
ii. Amount of processing for fineness; and
iii. Amount of twist.

PROCESS FLOW CHART OF ITP

Fibre
(spinning)
Yarn
(Weaving, Knitting, Non-woven)
Fabric
(Wet processing: Dyeing, Printing, Finishing)
Finished Fabric

Process Flow Chart involved in Converting Fiber into Yarn

Feed material	Process	objects	End product
Bale	Mixing or Blending	Mixing	Tuft
Tuft	Blow room	opening & cleaning	Lap

Lap	Carding	Opening (to individual state) & Cleaning	Carded sliver
Sliver	Draw frame (breaker)	Doubling, Drawing, Fiber parallelization & orientation	Sliver
Sliver	Draw frame (finisher)	Doubling & Drawing Fiber parallelization & orientation	Sliver
Sliver	Speed frame	Drafting	Roving
Roving	Ring frame	Drafting & Twisting	Yarn on Ring bobbin
Yarn on Ring bobbin	Winding	Thin/weak, thick place removal	cone/ cheese

OPTIONAL PROCESS after Draw frame (Br) & feeding to

Sliver (D/F Br.)	Sliver Lap	Doubling	Lap
Lap	Ribbon Lap	Doubling & Drafting	Lap
Lap	Comber	Noil (short fibre) removal, Nep removal, Fiber parallelization & orientation	Combed sliver

<u>Process Flow Chart involved in Converting Yarn into Woven Fabic</u>

cone/ cheese	Warping	Beam
Beam	Sizing	Sized beam
Sized beam	Loom	Fabric

MIXING AND BLENDING

Sorting is a process carried out to remove such impurities, foreign matter that can not be by machine. Eg. hair, slipper parts, plastic bag, plastic, small fabric. Other object of sorting is to remove such impurities that may demage machine parts. Eg. metals.

Mixing is a combining of similar raw material of different variety or station of cotton, in any proportion. Mixing is normally carried out before or at Blow room stage. Normally it is carried out in case of natural fibres or cotton to be specific, where the fibre received from different stations or field has got different qualities in fiber. Also the properties of same cotton from same field but in different season also differ. Bales from different stations are then mixed to get a steady or consistent quality of yarn for a longer duration. However, mixing can only be carried out in case where the fiber properties are similar. For example, cotton with very high variations in fibre length or fineness cannot be mixed. It is not just mixing of the bales received from any station in any form. The number of bales, the waste percentage to be mixed in a mixing is per decided, and fixed. Mixing is laid in large size mixing bins of around 5mx5mx5m size, and each mixing is of more than a 1000 kg as per the production in a shift.

Objects of mixing

1. To maintain uniform quality of yarn for a longer duration.
2. To improve processing (spinning, weaving, dyeing) performance.
3. To reduce control or control cost of material (cotton).
4. To avoid variations within lot.

Different Methods of mixing

1. Bin mixing
2. Hand mixing
3. Machines like mixing bale opener (MBO), blender, auto mixer.

Conditioning

The material (fibre) in the textile (spinning) mill is received in compressed bale form. To process, it requires to attain its original form and mixing of oil. Conditioning is the process of keeping fibres in normal state in a bin for a predetermined time (normally 24 hours). During this moisture is also sprayed if required.

Blending

Blending is carried normally carried out between different fibres. Blending is mixing of fibres in a fixed ratio to achieve desired yarn properties (benefit of both) or to reduce cost. Blending can be carried out in fibre, lap, sliver or even at roving stage. For example P:C 52:48 belnd (polyester-cotton blend), or P:C 67:33, or P:V 67:33 blend. Polyester has almost nil (0.4%) moisture absorbency, but has high strength while Cotton or Viscose fibres have good moisture absorbency, low strength and abrasion. So a blend of polyester with cotton or Viscose can help in having a good strength, abrasion, crease recovery with moisture absorbency. Also these days Spadex or Lycra is mixed in cotton to get the stretchable effect in jeans or to have fabrics with shape fitting properties and comfort. This improves the functional properties of the fabric to be worn. In another case, Wool is very warm as well as very costly fibre. Acrylic has similar properties as Wool but is much cheaper. So a wool- acrylic blend of 15:85 will reduce the cost of yarn or fabric produced.

Objects of blending

1. To improve functional properties or to have desired property of the yarn or the fabric produced.
2. To maintain economy or to reduce raw material cost.
3. To improve spinning performance, process ability.
4. To get the special effect yarn produced that has consumer appeal.

Stages of blending

1. Producing the fibres itself.
2. Fiber blending at fibre stage i.e. before or at Blow room.
3. Lap blending at carding stage by using two different laps of desired hank.
4. Sliver blending at Draw frame stage by using sliver blending.
5. Roving blending at Speed frame stage by using roving of different fibres.

S. no.	**Mixing**	**Blending**
1.	Mixing is combining of similar raw material (cotton) of different variety or station of cotton	Blending is carried normally carried out between different fibres.
2.	Mixing is not done in fixed proportion.	Blending is done in exact fixed proportion.
3.	To maintain uniform quality of yarn for a longer duration.	It is used to achieve desired yarn properties (benefit of both) like strength, moisture regain, or to reduce cost.
4.	Mixing is done at blow room stage.	Blending can be done at blow room, carding or draw frame stage.
5.	Mixing can only be carried out in case where the fiber properties are similar.	In , blending different fobres like P/C, P/V, P/W are used.

BLOW ROOM

To prepare yarn from fibre it has to be first opened to individual stage and simultaneously cleaned, doubled and drafted to attain desired fineness, and then twisted to get the strength. The process requires a number and sequence of machines. The very first is a sequence of machine called as Blow Room Line. These machine are attached to one another to attain the basic purpose of opening and cleaning. The fibres in the form of tuft are tranfered from one machine to another by way of condenser or air suction. Fibre tufts are fed and material is delivered in form of lap.

In a Blow room line the tuft are broken upto a size of 0.1 mg and impurities are removed from 50 to 70 %. The impurities are either removed below the beater (eg. seeds, trash, chaff or leaves etc), or from above through suction (eg. dust, dirt, fly), or also metal particles (eg. iron, steel particals). However, with these impurities some fibres arre also extracted. To prepare a quality yarn, evenness most desirable property (both thick and thin places). So, the object of Blow room is also to feed card homogenously. Earlier lap was the end product prepared at blow room, and scuture line at the end of Blow room was used to prepare an even lap. Now- a-days, automatic chute feed system helps in direct transfer of the tufts from blow room to card. A chute feed system can feed from 4 to 10 cards froma single blow room line.

Objects of Blow Room

1. To open the fibre tufts (flocks).
2. To clean the material.
3. To have a through mixing and blending.
4. To prepare a suitable package (lap), and/ or to feed material to the card evenly.

Passage of Material through Blow Room Line

In a blow room, a sequence or a line of machines are attached. The fed flocks are of around 10” in diameter, and delivered is around 0.1mg. Each machine is fed with a certain amount of material per unit time. Also this has to be passed on to the next machine after some opening and extracting waste. So the rate of flow should be balanced. Any of the machine can be basically divided in type of feed, type of beating action, grid bars or or waste removal mechanism, and finally delivery mechanism to next mechanism.

Beating mechanism: Since at the start the fibres are in compact form, they are entangled in each other. Thus opening of these flocks is required gently. Hence the first machine has no harsh beater but an inclined spiked lattice. The spikes (nails) used at the starting machines are heavy and becomes finer with each machines. Heavy spikes are used at the starting machines as finer nails will not be able to open heavy sized tufts and will bent or break. The material (flocks) carried by spikes of inclined lattice are beaten up by action of spikes moving in opposite direction. It causes tearing and opening up of lumps. When the tufts breaks to a minimum size, only then will it pass through the inclined lattice and the spiked cylinder moving in opposite direction. Material is carried out on a straight lattice. Beater is another opening device. It is used to tear tufts supplied in form of a sheet, and at a slow pace against beater that runs at a very fast pace of around 1000 rpm. The beater has spikes at it that tears the tuft. The spikes or blades fineness increases as we move to next machine, and the tuft size decreases.

In *Feeding mechanism* As at the starting material is in large tuft form it is presented to the machines or beater in loose form. *As the material passes through a few beaters, t*he size of flock is decreased, sheet of the material is presented to beater by a pair of roller, or a roller and a plate combination. This help in uniform and fixed feed of material. Since the material is held between by the roller while presenting to the beater, it is more properly opened. The material is held between them and the spikes on the cylinder or beater tear them apart leading a *opening action*. They then beat it against the grid bars fitted below the machine that makes another *opening action*. *Waste extraction* is done by Grid bars. These are structures below the beater, spread from ¼ to ¾ of the assembly of beater. These are simple straight to triangular bars fitted through the width of the machine. They can be adjusted singly or in a group of 3-4 bars. Grid bars can also be in form slotted sheets, perforated sheets, triangular single rods, angle bars or blade etc. This beater help to beat the fibres against these grid bars due to centrifugal force. They help to get the waste fall down through it. The more the opening between two grid bars, more will be the trash extracted. However along with the trash, some good fibres also fall down. Waste like dust, dirt and fly or very short fibres are extracted from the top with the exhaust fan. The cage or condenser are attached or fitted with the exhaust fans. Normally these are fitted on top of the machine. Cages are perforated cylindrical sheets. It helps two fulfilling two objects. First it removes the dust, dirt, flies, and second it carries the material to the next machine. Fibres are carried by the suction to the next machine. The dust particles or flies are sucked in by condensor, and carried to the dust filter bags. Dust is collected while clean air is released in air. For *metallic particles* present in the fibres, magnets are fitted at the bent on the pipe joining of starting machines.

The number of machines to be attached in a blow room line depends on the cleanliness required. For example cotton or other natural fibres have more impurities. They will have more machines (4-5). The man made fibres do not have waste so only two openers can be sufficient. A minimum machine should be used. More than the machines required will lead more beat up and damage to the fibres. In case we use a different material that requires a less number of machines, then a *by-pass arrangement* is provided for the machine.

In a conventional blow-room line line, lap is formed. The stage of the blow-room line is scuture that forms the lap. The tufts of fibres are converted in a sheet form. They are passed through a pair of fluted rollers, and then through four calendar rollers on above the other. The tufts are converted in sheet form that is wound on a rod. Normally the hank is around .00125 and the length of the lap is around 40 mts. In a modern blow room line the fibres are directly supplied to the carding machine through air suction. It is called as a chute feed system.

Modern Blow-room Line

Automatic Bale plucker

Monocylinder/ Vario clean

Unimix

ERM cleaner/ Superclean

Chute feed

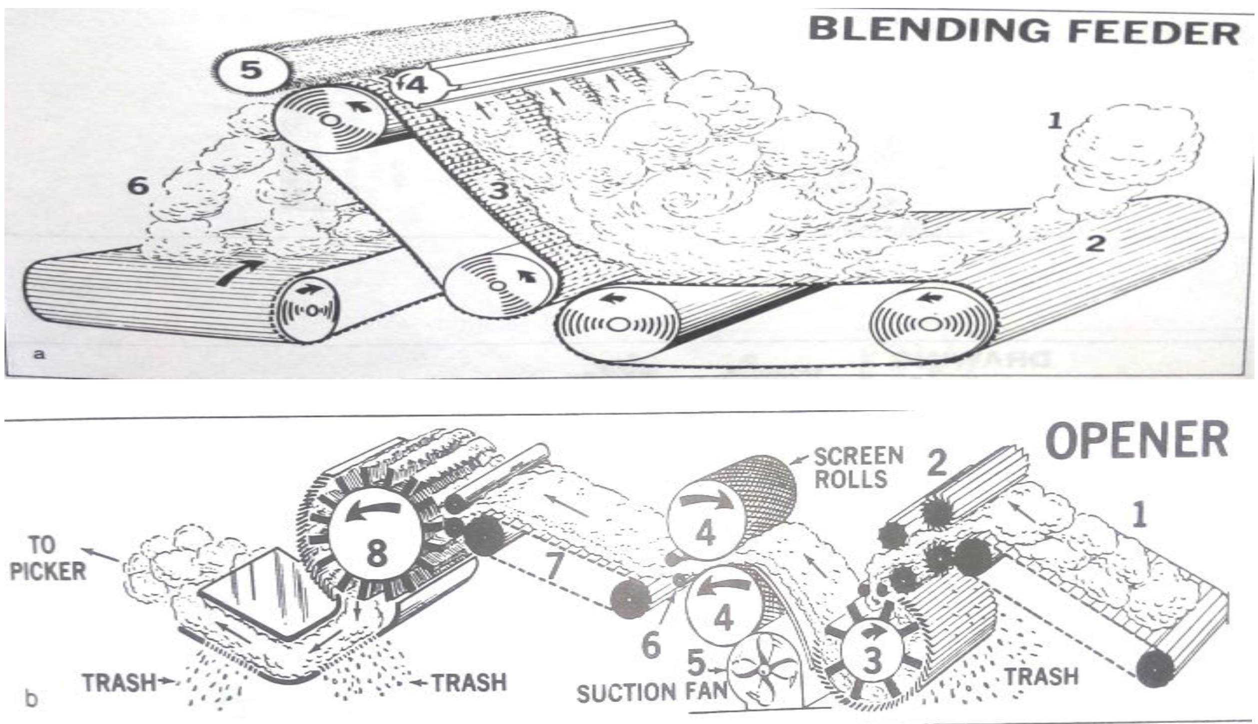
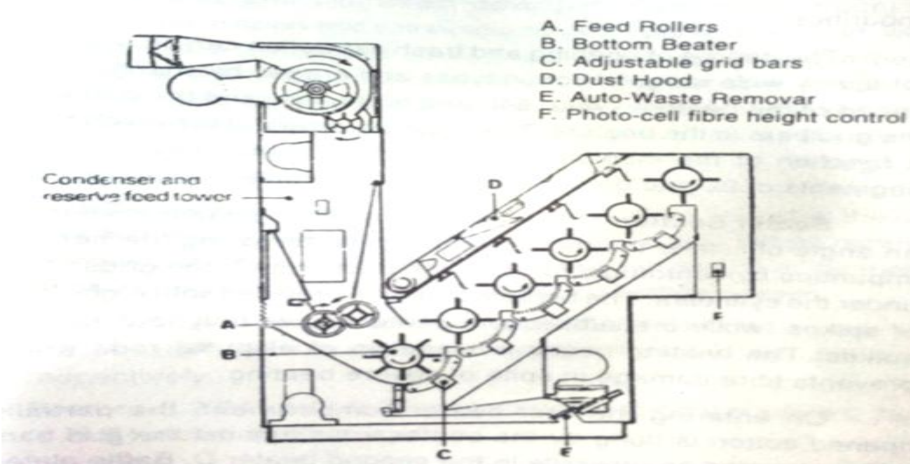


Figure 2-1 Schematic of conventional ring spinning: (*a*) Cotton is passed from bales (1) onto apron (2). Apron moves cotton to blending apron (3). Blending apron has sharp spikes that raise cotton until part of it is knocked off by roll (4). Some of the cotton stays on apron. The cotton knocked back by roll (4) continues to churn and blend until picked up again by apron. Another roll (5) strips off cotton that was not knocked back by previous roll (4). Cotton falls on conveyor belt (6) and is carried to next process. (*b*) Lint cotton falls on apron (1) and passes between feeder rolls (2) to beater cylinder (3). The rapidly whirling beater blades take off small tufts of cotton, knock out trash, and loosen up the mass. The two screen rolls (4) are made of screen material, and air is sucked out of them by fan (5). This draws the cotton from beater and condenses it on the surface of the screen rolls from which it is taken and passed on by the small rolls (6). Air suction through cotton takes out dirt and trash. Conveyor belt (7) passes cotton to another type of beater (8). (Beaters shown are typical of the many types used.) From beater, the cotton passes to a conveyor and is carried to picker. (*c*) Cotton in a loose mass enters picker, which is a series of beaters (2) and screen rolls (3) similar to those described under "opening" but progressively more refined. At the final output of beater and screen system (4), cotton has again been formed into a sheet, or lap. At this point, the "evener" operates to feed more or less cotton to make lap perfectly uniform as it is either wound up into a lap roll (5) on winding rolls (6) and then taken to the carding process, or conveyed as a lap by a chute feeder directly to the card.

ULTRA CLEANER



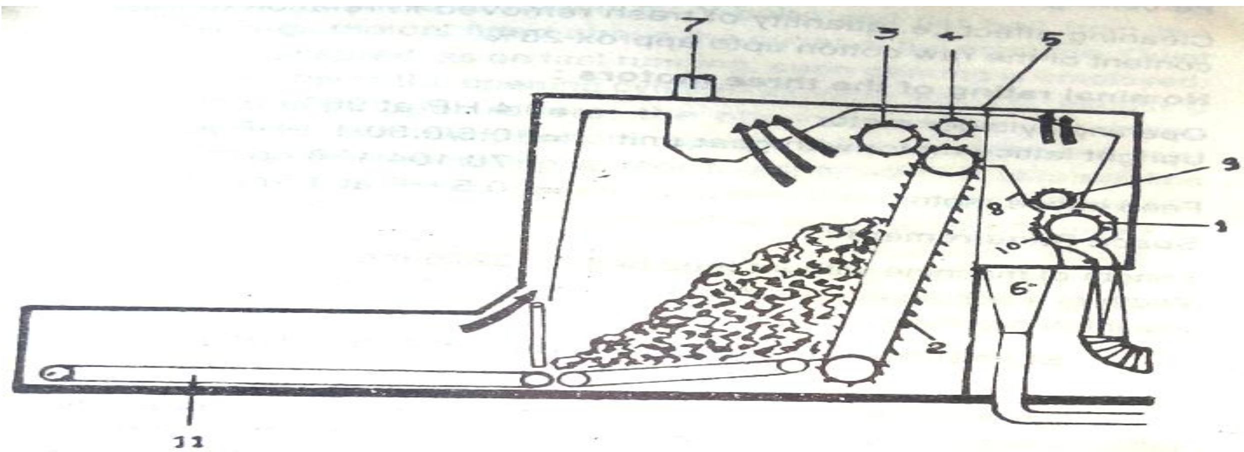


Fig. 8

1. Opening Cylinder
4. Opening Roller
7. Dust Pipe
10. Grid Bar
2. Pinless Lattice
5. Perforated Cover
8. Feed Plate
11. Feed Apron
3. Kickoff Roller
6. Waste Collector
9. Feed Roller
12. Oscillating Bars

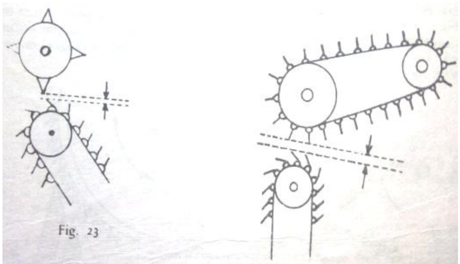
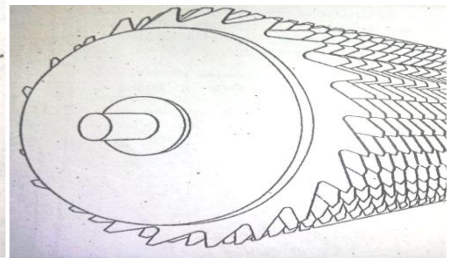
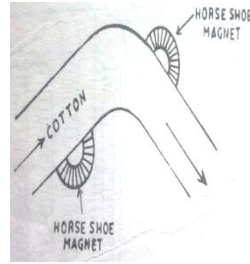
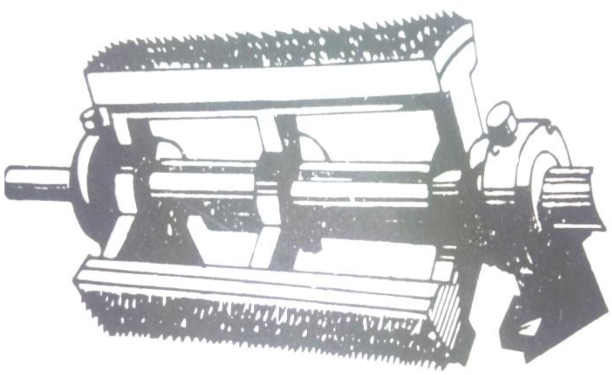


Fig. 23







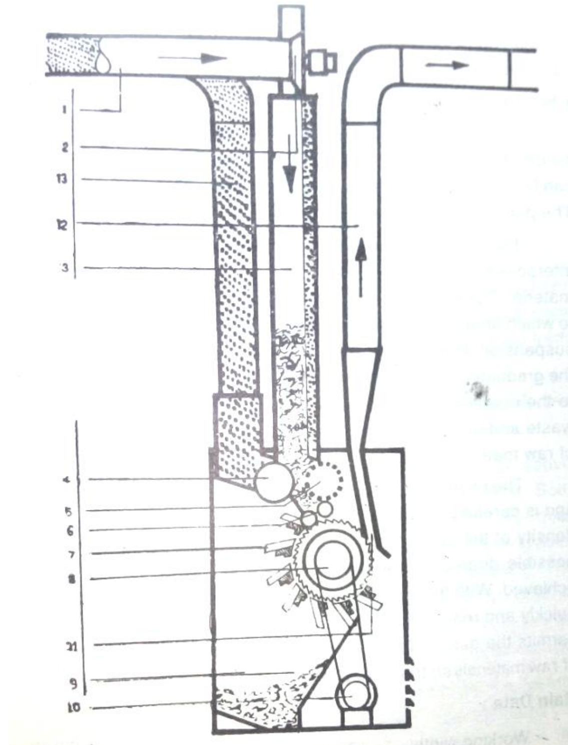


Fig. 33
1. Material Supply 2. Feeding head 3. Laminar trunk 4. Plain drum 5. Dust cager 6. Feed rollers 7. Knife grid 8. Seater 9. Waste chamber 10. Motor for beater 11. Delivery pipe 12. Exhaust air pipe.

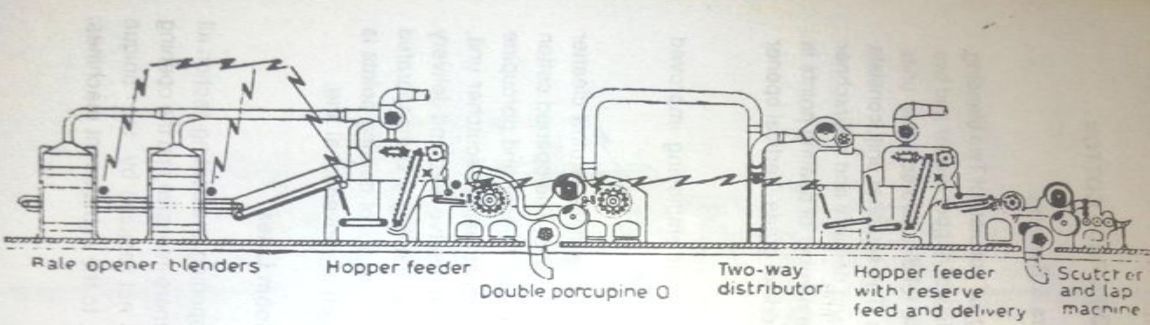

Bale opener blenders
Hopper feeder
Double porcupine O
Two-way distributor
Hopper feeder with reserve feed and delivery
Scutcher and lap machine

Fig. 67

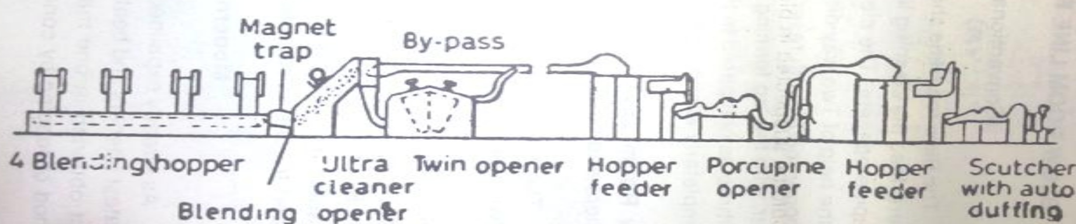

Magnet trap
By-pass
4 Blending hopper
Blending opener
Ultra cleaner opener
Twin opener
Hopper feeder
Porcupine opener
Hopper feeder
Scutcher with auto-duffing

Fig. 68

CARDING

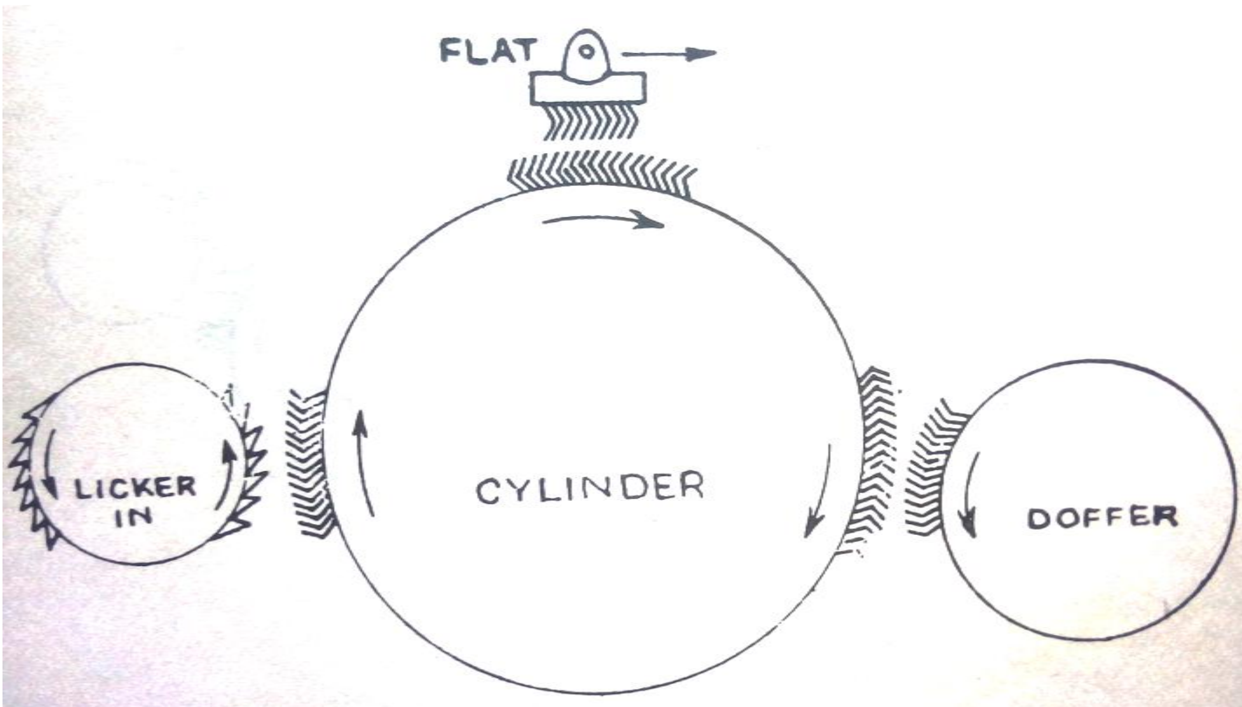
The importance of Carding machine in spinning can be judged from the proverb “well carded is half spun”, and also that ‘card is the heart of spinning”. **A carding machine fulfils the following objectives**:

1. It thoroughly opens the tiny lumps, flocks, or fiber tufts to the individual state.
2. It removes impurities including short fibres.
   The trash or the waste falls down through the grid bars, and are collected by waste extraction unit. Short fibres are collected by the flats fitted above the cylinder. Flats are narrow (about 1.5” wide) cast iron pieces spread along the width of the card. The cleaning achieved by the card is 80-95%. Thus both blow-room and card achieve a cleaning of about 90-95%.
3. It removes the dust present in the material.
4. It helps in removal of neps.
   Neps are entanglement of fibres that cannot be opened. The removal of neps takes place between flats and cylinder of a card machine. Although it is assumed that neps are eliminated by the card but they are mostly opened. The neps increases with the passage of material in each of the machines of blow-room line. The opened neps in carding are hereby the same in the number as generated in blow room.
5. Carding helps in blending of fibres.
   In carding the fibres are opened upto individual state. Also these fibres are repeatedly rotated on cylinder leading to very intimate fibre mixing.
6. It helps in fiber mixing.
   The fibres after the doffer are in web form. The stretch applied while coverting this web into sliver orient the fibres along the sliver axis.
7. To prepare a package (sliver) for feeding material to the next machine.

Passage of Material through a Carding Machine

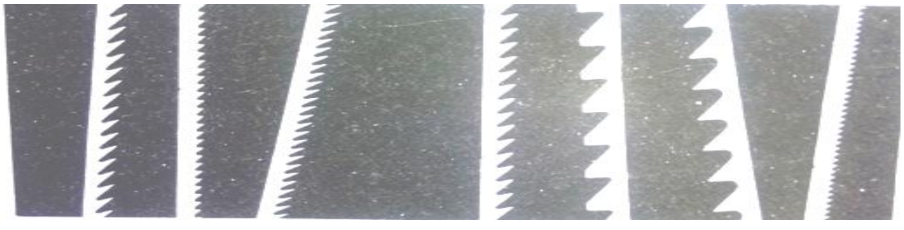
In carding machine lap is fed between a *feed plate* and the *feed roller*. Feed roller is metallic, fluted and around 2.25” diameter. These present the lap to the *licker-in* or taker-in. It is about 9” in diameter, has saw tooth wire fitted, and revolves around 900 rpm. Due to very high speed when compared to the feed roller, and more numbers of saw tooth on the licker-in (about 30,000-40,000), it reduces the fibre tuft size to a great extent. *Mote knife*, that are fitted below liker-in, are extended throughout the width of carding machine. They are knives as bars with about 3” thick. Next to it is *licker-in under casing*. The fibres with the due to centrifugal force are hit against the under casing. It helps in falling of the trash from the gaps between the under casing. The fribres after a few revolutions around the licker-in get transferred to the *cylinder*. Cylinder is huge size, about 50.75” diameter, and fitted with flexible wires (around the size of fine comb). *Back plate* fitted just above and between licker-in and cylinder help in transfer of fibres onto the cylinder. Over the cylinder, flats are fitted.

Flats are T-shaped are metallic strips of about 1.5” width, has flexible pin type teeth, are around 80-116 in numbers, and joined together with a chain. They move very slowly (3-4”/min), and in opposite direction to the cylinder. They help in performing carding action, and extraction of short fibres and neps. At any point of time, there are about 42 flats that are working with the cylinder. Undercasing and/or grid bars are fitted below the cylinder for extraction of impurities. Dust and flies are removed by air suction.the calculation of number of teeth of cylinder to the fibres shows that theoretically each fiber is presented to about more than 10 wires, and thus make it to *individual state*.



While carding

The fibres are then transferred to *doffer* that is about 27” in diameter. It has saw tooth and runs at a slower speed. The fibres thus get condensed. *Doffer comb* is fitted next to doffer. It is thin steel blade moving up and down with about 1000 oscillation/ minute. This causes the striping the fibres from doffer in web form. These fibres are then passed through a number of calendar rollers and finally through trumpet. The trumpet converts the web in *sliver* (a rope like structure) form. This sliver is collected in cans that may be 24” to 42”. A card in case of cotton produces about 4% waste. The sliver hank is normally between 0.1s to 0.15s. **different card clothing are shown below**



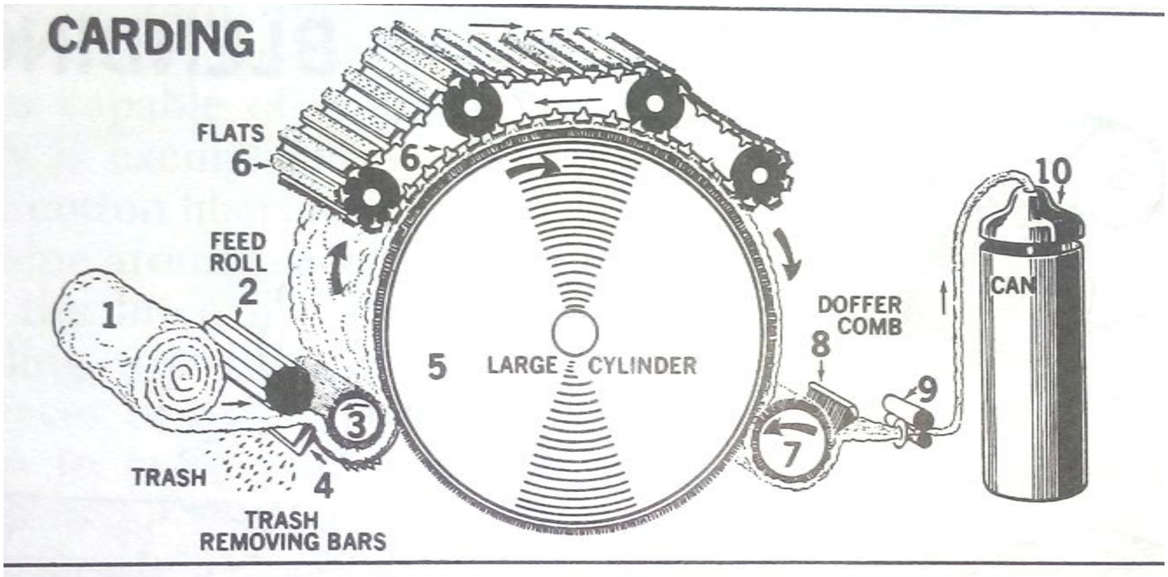
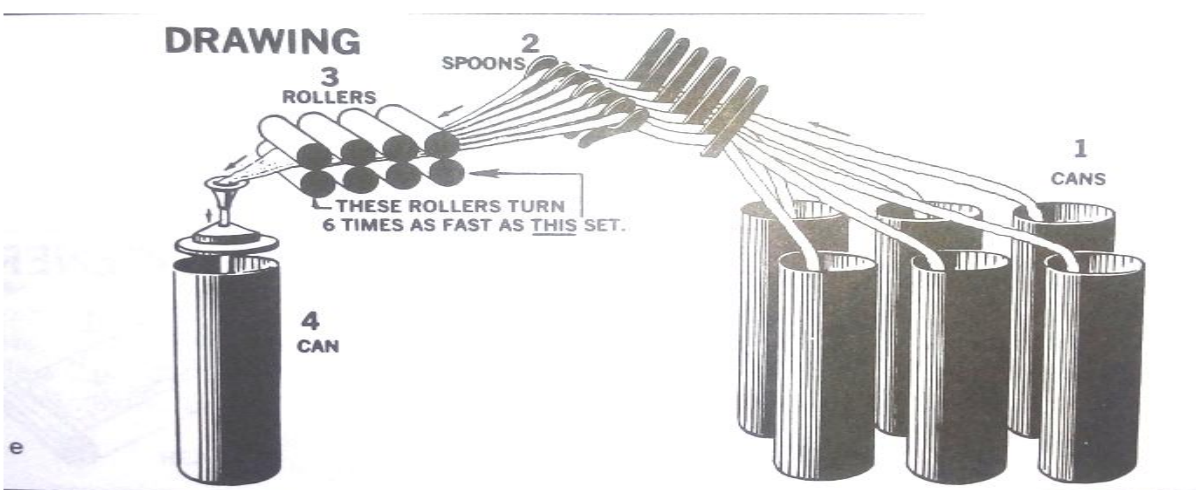


Figure 2-1 (*Continued*) (*d*) The lap (1) from picker unrolls, and feed roll (2) passes cotton to the licker-in roll (3) (covered with sawtoothlike wire). The licker-in roll passes fiber against cleaner bars (4) and gives it up to large cylinder (5), which passes between the thousands of fine wires on surface of cylinder and on flats (6). The cotton follows large cylinder to doffer cylinder (7), which removes lint from large cylinder. The doffer comb (8) vibrates against doffer cylinder and takes lint off in a filmy web that passes through condenser rolls (9), coiler head (10), and then into can. The sliver may be passed from can to combing for further removal of foreign matter and parallelization of fiber or directly to drawing. (*e*) Here, six cans (1) that were filled at cards feed each drawing from delivery. The spoons (2) are connected so that if any one of the six slivers from can should break, the machine automatically stops. This prevents making uneven yarn later. Each of four sets of rolls (3) runs successively faster than preceding set. The last set runs approximately six times as fast as the first set; consequently, sliver coming out is the same size as each one of six going in, but is attenuated to six times the length per minute. The sliver is neatly coiled again in roving can (4) by coiler head. The sliver is now much more uniform and fibers are much more nearly parallel. The sliver is now ready for roving frames. In actual practice, drawing is usually repeated.



Line diagram of a Carding machine (d) shown on top, and Draw frame (e) is just above

UNIT II

DRAWFRAME

As discussed, a carded sliver has fibres oriented in all directions. For getting yarn to be of good tenacity, fibres should be oriented along the direction of axis of sliver or yarn. After which the desired twist be inserted in yarn. Carded sliver is also uneven. A good quality yarn should be even. So the sliver needs to be made even. A thin place in yarn will produce a weak place leading to more yarn breakages in fabric formation.

Draw frame is a machine used to fulfil these objectives. First, doubling of 6 or 8 carded slivers is done. They are then attenuated or drafted to the same number. In carding, the web formed after doffer has the fibres in bent position as hooks. 10 to 20% of fibres are bent from front, while 45 to 65% are bent from back side. These are known as 'leading or minor hooks', and 'trailing or major hooks'.

Objects of Draw frame

1. To straighten the hooks and thus the fibres (by drafting).
2. To make all fibres lie parallel to each other and to the axis of the sliver (by drafting).
3. To make sliver even or improve uniformity of sliver (by doubling).
4. To blend different fibres.

Passage of Material through Draw Frame

A draw frame is a very simple machine. In a conventional draw frame there used to be two deliveries. Now-a-days single delivery machine are also there. At the back side is the *creel* (feeding section) where 6 to 8 carded slivers in cans are aligned in a row. All the fed carded sliver run side by side, and overlap each other. This is called *doubling* and is used to provide evenness of sliver. These slivers are then passed through a series of top and bottom rollers known as the *drafting zone*. The speed of the next set of rollers is more than the previous set of rollers. So the slivers are attenuated. This is called *drafting*. Normally the total draft is equal to the doubling. So the hank of the delivered sliver is same as the hank of fed sliver i.e.6 to 8. Doubling generates evenness while drafting generates unevenness. However, the attenuation or the resistance of feed by fibres due to disorderly state helps in getting oriented towards the sliver axis and straightening of hooks. Giving the whole draft at one go or only in one zone could worsen the unevenness. So, first a gradual draft of around 1.2 to 1.8 is given between the back set of rollers and the middle set of rollers. This is called the *break draft*. Then the slippage between fibres starts to occur, and the rest of draft i.e. *main draft* is given. The same process of drafting (i.e. break and main draft) is also followed in further processes of spinning (speed frame and ring frame). The drafted sliver is then passed through *trumpet,* and is collected in cans.

This collected sliver is again passed through draw frame with the same procedure. A carded sliver is passed twice through the draw frame. The first passage is called the *'breaker draw frame'*, and the second passage is called the *'finisher draw frame'*. This helps in removal of both leading as well as training hooks. Draw frame is also the last stage of formation of uniformity. So, in modern draw frames that run at a very high speed of 800mpm, electronic sensor or *'autoleveller'* are fitted for uniform.

Another purpose of draw frame is blending. Normally two or more different types of raw materials that have different characterstics so that bleding is not possible at blow room or carding stage. For example, cotton is blended with man-made fibres at draw frame (P/C blend). Manmade fibres and cotton fibres have total different waste percentage. In case of man made fibres we don't need to extract impurities while in cotton impurities are to be extracted at blow room and card.

COMBER

Carding is the last stage of removal of impurities. However, short fibres, neps, fine kitty and leaf particles are removed in combing. A yarn requires a minimum number of fibres in its cross section for spinning. This is called *'spinning limit'* of the yarn. Thus if we want to spin a finer yarn we will need a finer fiber. In case of manmade fibres, it could be manufactured, but in case of natural fibres, specifically cotton there is no control over fibre fineness. In cooton finer fibres are longer fibres. So to make a fines quality cotton yarn, we need to remove short fibres. Very short fibres in a fine yarn will also cause thick places, uneven yarn, or a hairy appearance. Short fibres also contribute little to the strength of the yarn. So removal of short fibres in case of cotton will lead to a better yarn. Comber is a machine used for short fibre removal. 12 to 20% of the fibres are removed in combing. Thus the process also considerably increases the cost of yarn production.

Objects of Combing

1. To remove short fibres.
2. Straightening and parralisation of fibres.
3. To remove neps present in the sliver.
4. To produce cleaner and finer fiber and yarn.

Passage of Material through Comber

The fibres in the carded sliver lie haphazardly in all directions. Also the material to comber is fed in lap form. To get both these above mentioned problem solved, carded sliver is passed through ***pre-comber machines***. Earlier (conventionally) two machines were employed, namely ***sliver lap*** (in which sliver were converted to lap), and ***ribbon lap machine*** (used to convert 4 to 8 laps into one by doubling and drafting, for even lap formation). Now-a-days, a single machine ***super lap/ unilap*** is used instead of the two. In it, four to six lines of 8 slivers are fed through the *creel*. Each of these 8 slivers get accumulated to form the lap. These laps are then overlapped one above the other, and drafted to get the final even lap for comber machine. The lap is in on spool of about 9” width.

In a comber there are 6 to 8 creels (feeding points). These laps are first presented to the *combing roller* in leading position. They laps are first presented to the comber in fringes, and are held between the *top* and *bottom nippers* on the back side of the roller. Combing is then carried out by *combing cylinder* with the short fibres being removed. Then the fiber fringe moves forward, and the leading help of the fringe is held between *detaching rollers*. The *top comb* then moves backward through the fringe and removes the short fibres that were earlier held between nippers and not removed. This process also straightens the hooks in the fibres, removes neps and short fibres. These sheets are then passed through the *trumpet*. Normally, four of the slivers are then collected together, doubled and drafted together from the *drafting rollers,* then passed through another *trumpet* above the cans. The material is then collected in cans.

SPEED FRAME

Fly frame is used to convert the draw frame sliver into a thin material. The material contain mild amount of twist. After receiving the sliver, it is now to be attenuated or drafted gradually to the required fineness. Then it is twisted to prepare yarn. A draw frame sliver is not used directly to the ring frame for two reasons. First is related to draft. The total draft required to be given is too high to be given on a single machine (ring frame). It will make the material hairy and generate fly. Also the bobbins are easy for transportation. Speed frame machine is an intermediate process or machine used to give draft for the final preparation of yarn.

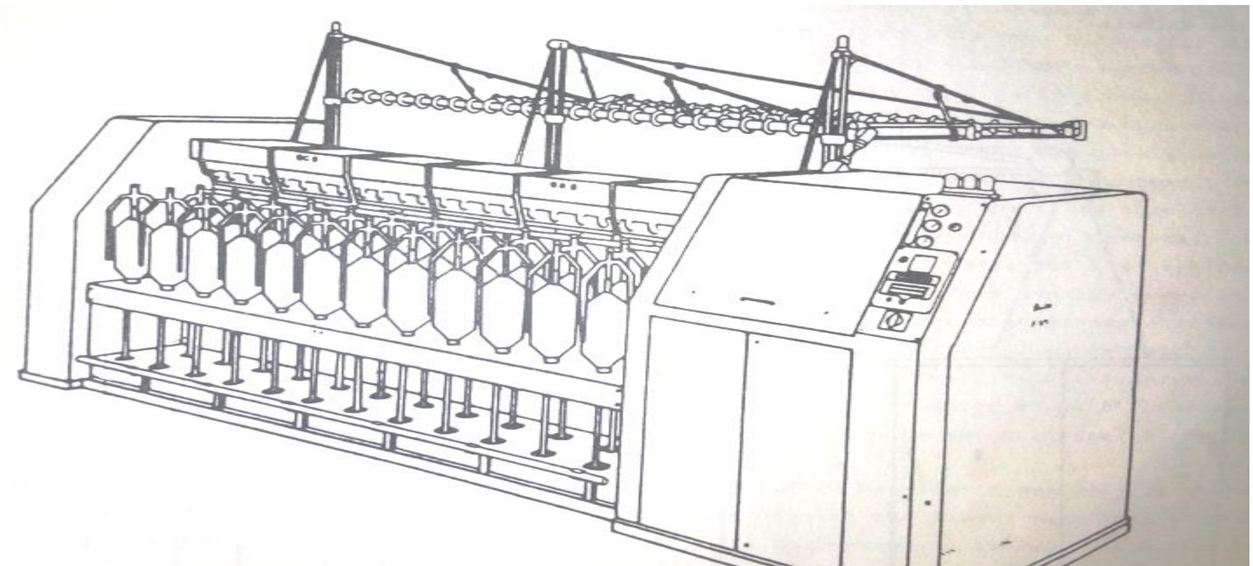
Objects of Speed Frame

1. To reduce sliver to a suitable diameter (i.e. roving) that can be used for ring spinning.
   This attenuation or draft is normally around 10. It is done through by drafting system. As explained in case of draw frame, the drafting system is divided is into two zones (break draft and the main draft).
2. To insert minimum level of twist.
   After being drafted, the fibres are too much oriented, and parallelized. So during winding these fibres will slip amongst themselves and will break. So, a minimum twist is applied so as to allow roving to withstand the slippage and stretch.
3. To prepare a suitable package for the next process.
   Roving is wound on to the roving bobbin the weight of which is around 1kg.

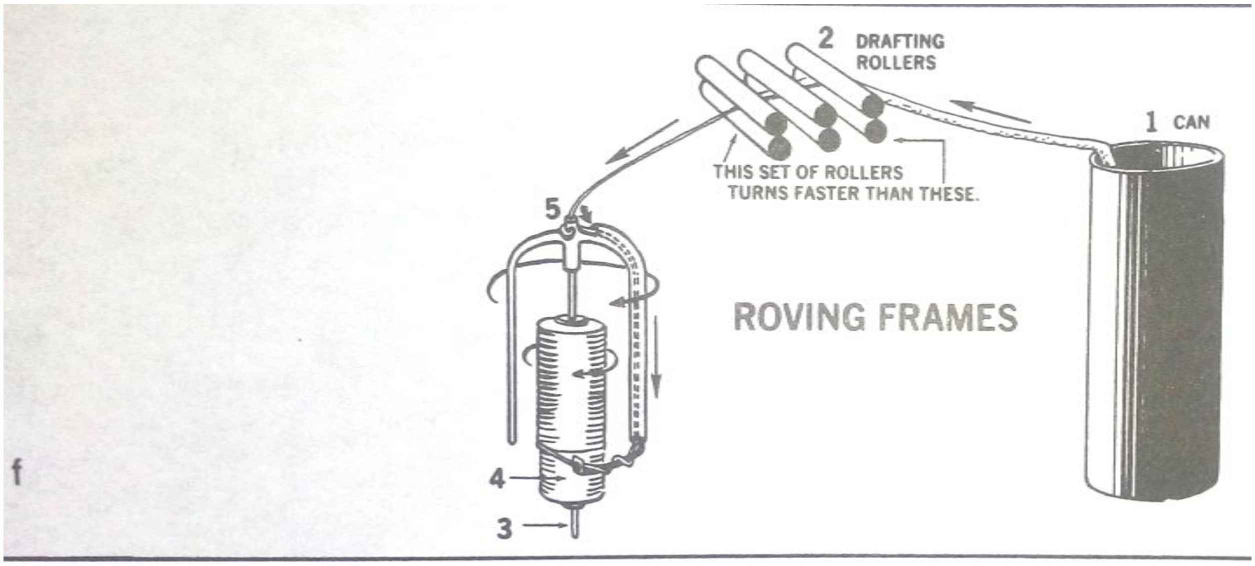
Passage of Material through Speed Frame

In a speed frame, the feed material is sliver and the end product is roving. A speed frame machine has spindles on which roving bobbin is fixed, and roving is collected. Normally the minimum number of spindles is 24, and they are added in multiple of 12 (for example 84, 96, 120 etc). The feed material sliver is brought in cans of 18” to 24” diameter. Creel is fitted widthwise at the back side of the machine, and is used to guide the sliver. There are 3 to 4 rods widthwise and the cans are kept below them in such a way that widthwise gap between them is equal to the gap in spindle. It helps the sliver on their way to the drafting arrangement. Separate *guide rollers* are fitted on the creel. They carry the sliver. The sliver from the cans is then passed over the rods (creel) that get motion from the gearing arrangement. The can arrangement is such that the first can is fixed below the last rod and the next to the second last. So the total rows of cans are 3 to 4,as per the number of rods. The sliver is then passed through a traverse rod, and then through the drafting zone. Normally a drafting zone consists of three set of rollers (diameter 28mm) fitted one above the other. This forms two drafting zones. The back zone with the back set of rollers, and the middle set of rollers give the break draft (normally about 1.14). This helps in breaking of the twist. Then the sliver passes through the middle and the front set of rollers, called the main drafting zone. The main draft is around 8. An apron is passed over the middle set of rollers for better griping of fibres. Thus the fibres do not vibrate or crate too much unevenness in sliver. A cradle is used to give proper tension to the upper and bottom pair of rollers.

The drafted sliver is then brought to the roving bobbin for. The roving bobbin is fitted on to the spindle. A flyer is used to wind the roving on to the bobbin. This speed of winding is equal to the difference in speed of flyer and the bobbin. The rotation of the roving gives the requisite twist for binding yarns together while winding. Spindles with the bobbins are fixed on a bobbin rail. This rail moves up and down so that roving is wound from top to bottom on the bobbin. Normally the roving hank is around 1s.



ng frame.



RING FRAME

The process from blow room to speed frame is named as spinning preparatory. The last process for the formation of yarn is called as ‘spinning’. The name is given as twist or spin is applied for formation of yarn.

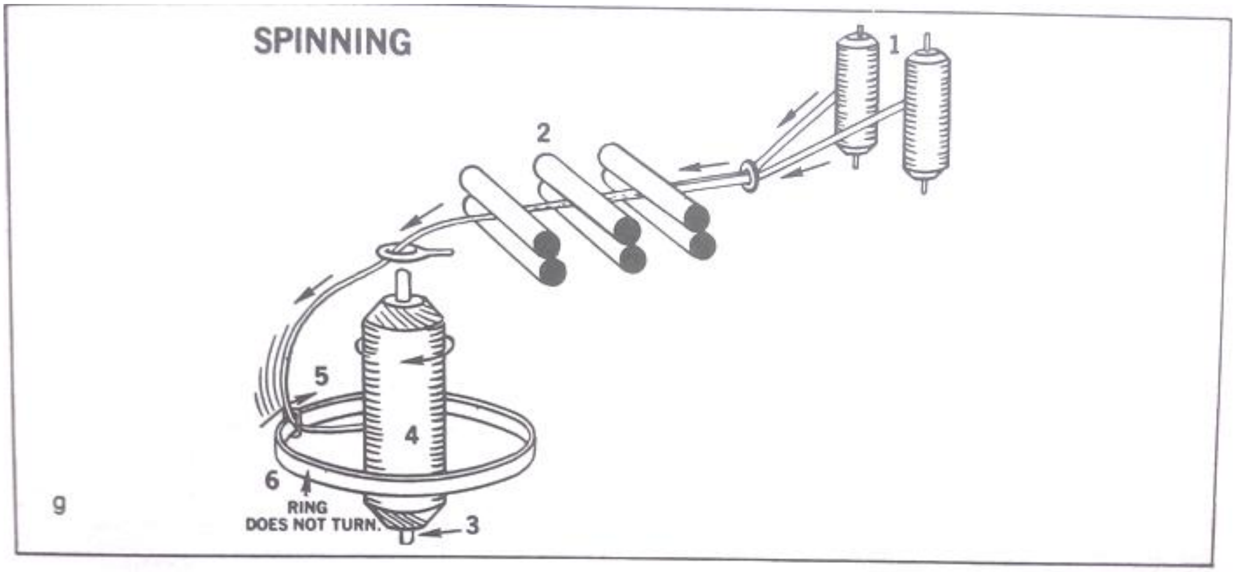


Figure 2-1 (*Continued*) (*f*) The can of sliver (1) from drawing frames is fed between three sets of drafting rolls (2). Each following set of rolls runs faster than preceding set. This pulls sliver and thins it down, making fibers nearly parallel. The spindle (3) turns flyer (5) and is driven at a constant speed. The front rolls (nearest flyer) are set at a speed that gives strand coming out of the rolls a predetermined number of turns of twist per inch as it moves along between rolls and flyer. The bobbin (4) is driven by a source separate from gear that drives spindle and flyer. The bobbin is regulated to turn automatically at a speed sufficiently faster than flyer, which causes roving to wind on bobbin at same rate it is delivered by front roll. (*g*) The principle for spinning is the same as that used for roving except that the operation is more refined and a ring and traveler are used instead of the flyer. From bobbin (1) roving is fed between sets of drafting rolls (2) to draw strand down to its final desired size. The spindle (3) turns bobbin (4) at a constant speed. The front set of rolls is adjusted to deliver yarn at a speed sufficient to insert desired amount of twist as strand moves along. The traveler (5) glides freely around ring (6). The tension caused by drag of traveler causes yarn to wind on bobbin at same rate of speed as it is delivered by rolls. (*All illustrations and copy courtesy of Bibb Manufacturing Co.*)

Ring frame line diagram (g) with parts specifications . (f) shows the parts & line diagram of Speed frame available on last page

Objects of Ring Frame

1. To reduce the roving to the desired degree of fineness.
   Roving hank is normally around 1s. It is then drafted to the required fineness to the count of the yarn required. As usual the total draft is given as break draft and the main draft.
2. To impart required twist to the drafted strand of fibres, for providing strength.
   The twist helps in cohesion of fibres. It is given as per count or fineness of yarn. The fibres are twisted along the yarn axis. With the increase in twist, the strength of the yarn fist increases reaching to a maximum, and then starts to decrease. A less twisted yarn is soft and fuller, while a high twisted yarn is harsh to feel. A fine yarn requires less twist.
3. To wind the spun yarn on a suitable package.

Passage of Material though Ring Frame

Ring frame is the machine used for ring spinning. It is most important machine as the spun yarn production depends on the ring production. The production is carried out on the spindle. A machine has spindle in multiples of 48 (eg. 864, 1008,**)**. The roving bobbin is fitted in the *creel* that is on the top of the machine. Roving is passed over and under the *rods* for guide and then fed to the drafting zone. The drafting zone is similar to that of the speed frame with 3 set of rollers fitted with apron. Break draft is given between back set of rollers, and the front set of rollers give the main draft. To control the movement of fibres a set of aprons (leather belt type) is put on the middle roller, expendable to front roller. To keep distance between the top and bottom apron, a *spacer* is fitted between them to maintain space. *Traverse guide* is fitted behind the rollers to avoid abrasion of the rollers from a single point. The drafted material is then condensed by *condenser*. The drafted material is then wound on a ring bobbin, fitted on a spindle rotating at a speed of more than 18000 rpm. To wind and to get the twist, a *ring* having a *traveler* on it is fitted around the spindle. The yarn from the front drafting roller is then rotated from the tip of roller and the traveler. This high speed rotation causes balloon formation. To avoid balloon entanglement in each other, an *anti-balloon-control* (ABC) ring is fitted. The strand of fibre is then passed through the ring-traveler and wound on to bobbin. Passing of the material through ring-traveller amd its rotation, gives the required twist. 50 to 60gm of material is wound on a ring bobbin.

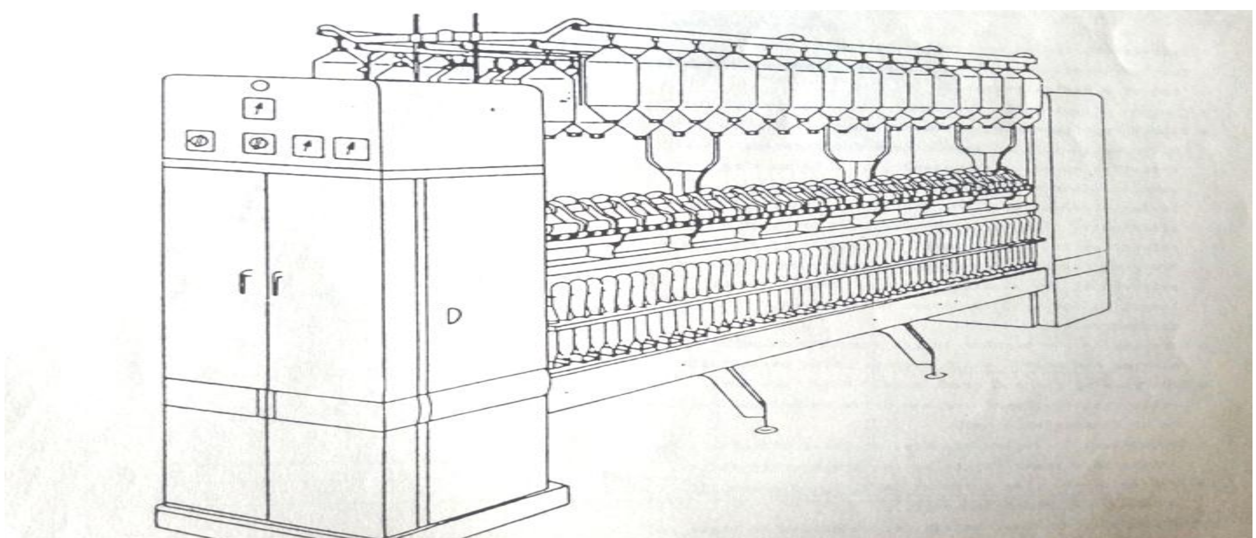


Fig.1. Side view of a ring spinning frame.

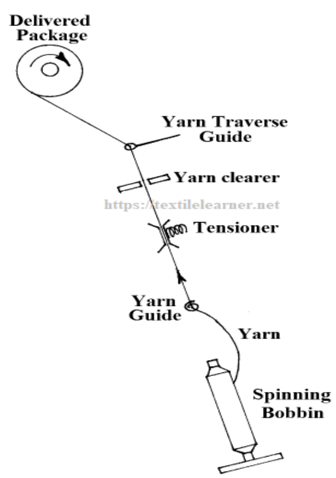
Warp Winding

Warp winding is a process of transferring yarns from ring, bobbin, hank into a suitable package like cone, cheese, flanged bobbin. The main objectives of warp winding are given below:

1. To transfer the yarn from small package to bigger package suitable for next processes.
2). To remove objectionable yarn faults up to optimum level.
3. To remove dirt and dust from the yarn up to some extent.
4. To make yarn smooth by applying wax on the yarn surface, if required.
5. To eliminate yarn knots and bad piecing by using auto splicing in winding process.
6. To increase the efficiency of warping and weaving by bigger size of package of yarn.
7. To make the handling of yarn easy, smooth and safe.

Passage of material through Winding machine

Winding is the transfer of yarn from one form of package to another but, under proper tension and in proper manner. Conventional winding machine is the mother of today's high speed, super speed and automatic winding machines. The working of conventional winding machine is shown in the figure:

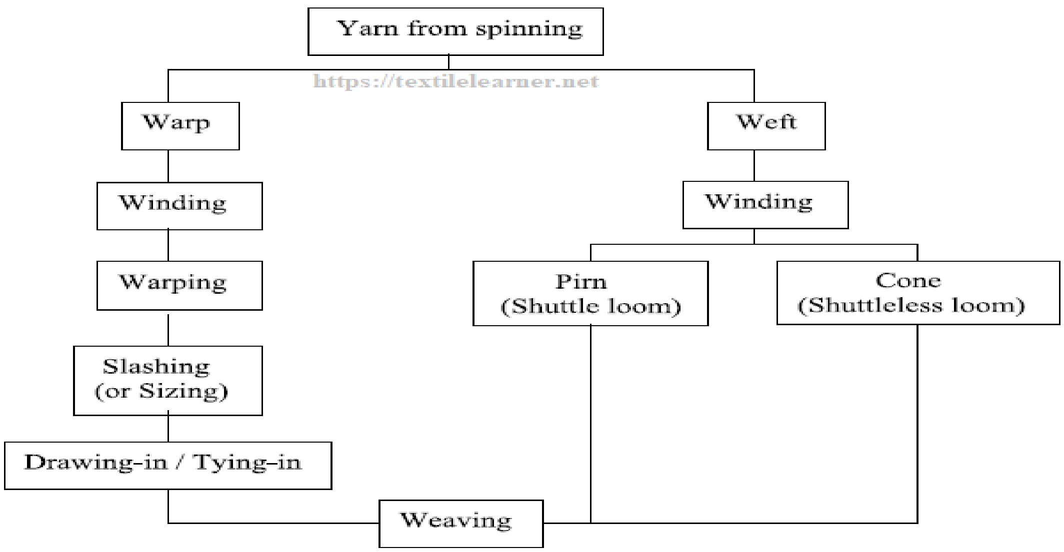


UNIT III

Sequence of process involved in the preparatory processes:

The main processes involved in the weaving preparatory are as follows:

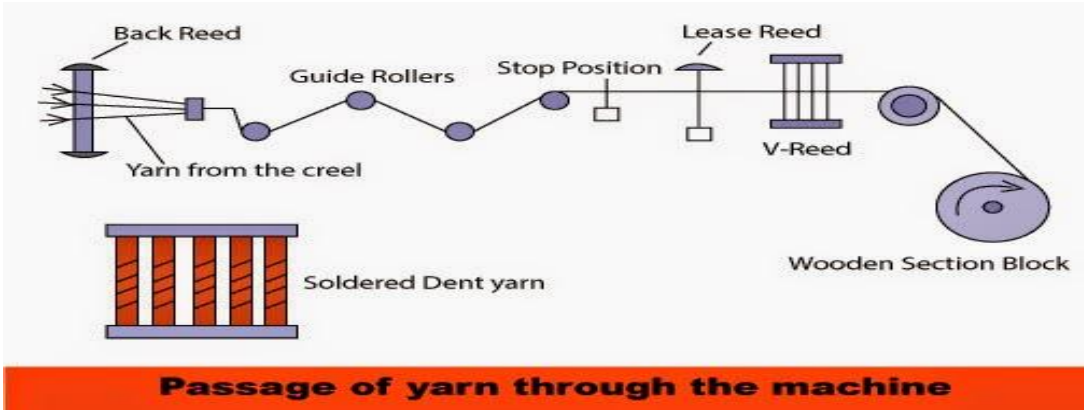
1. Winding (warp winding and weft winding)
2. Warping
3. Sizing
4. Drawing-in and Tying-in



Objects of Warping:

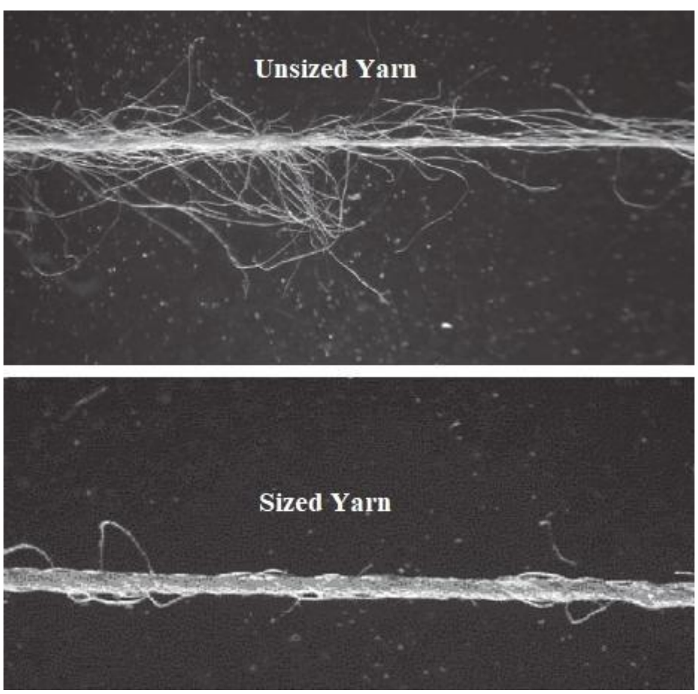
The object of warping process is to prepare a warp sheet of desired length containing a desired number of warp ends which are wrapped on a flanged beam in such a manner that tension in each yarn and density of the warp ends are maintained uniform throughout the warp beam.

1. The yarns in the sheet should be in a uniform spacing.
2. The yarns in the sheet should be in a uniform tension.
3. The yarns in the sheet should be of a predetermined length.
4. The sheet should be containing a predetermined number of ends.
5. There should be no broken end in the beam.



Purpose of Sizing or why warp yarns require Sizing:-

During the process of weaving, the warp yarns are subjected to a great amount of tension by holding them tight between the weaver's beam and the cloth roller and the fraying action of healds and the reed. If, the warp yarns are not sufficiently strong, there will be too many end breakages which will result in loss of production, increase in weaver's workload and poor quality of fabric. In order to make the warp yarns strong and smooth, a coating of thin film of adhesive is applied over them. This process is known as Sizing and the coating is known as Size. The purpose of sizing the yarn is to improve its weave-ability.



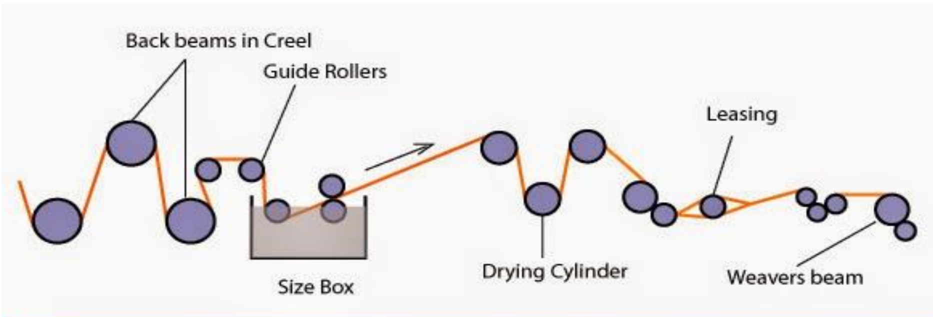
Objects of Sizing:

The main objects of sizing process are given below:

1. To improve the weave-ability of warp yarn.
2. To improve the strength of warp yarns.
3. To make the warp yarns round and smooth and toimprove the abrasion resistance of warp yarn.
4. To reduce the hairiness in warp yarns.
5. To prevent the development of electrostatic charges in the yarn during weaving.
6. To increase the weight of fabric in a specific case.
7. To obtain the optimum efficiency in weaving and good fabric quality.

Passage of Yarn through Sizing Machine:

In slasher sizing machine, the warp yarns are sized in the form of a sheet and all the processes i.e. sizing, drying and beaming are carried in a single passage. The passage of material through a slasher sizing machine is shown in the figure:



Passage of material through a slasher sizing machine

Different Sizing Ingredients and their functions:

Sizing Ingredients: The chemicals to be used in the preparation of sizing liquor are called sizing ingredients. Sizing ingredients may be classified into two categories:

1. Primary Sizing Ingredients
2. Secondary Sizing Ingredients

1. Primary Sizing Ingredients: The primary sizing ingredients includes the following chemicals:

Adhesive agent: The main role of an adhesive agent in the sizing liquor is to form a thin layer (film) on the yarn surface. A major portion of sizing liquor consists of adhesive agents. It penetrates inside the yarn and increases the yarn strength. The protruding fibres also bind with the yarn surface and help to increase yarn strength.

Example: Starch

Binding agent: It is used to make the adhesive film enough strong. The binding agent provides strength to the adhesive film and prevents becoming a crack.

Example: Guar gum, Carboxy methyl cellulose (C.M.C.), Polyvinyl alcohol (P.V.A.), Polyester binder, Acrylic binder

Softening agent: It is used to make the adhesive film more soft and flexible. As we know that the warp yarn passes through different angles so that the adhesive film becomes cracked due to the bending movement of the yarn.

Examples: Vegetable fats (dalda, refined oil), Animal fats (mutton tallow), Synthetic softener (R-soft, textile wax)

2. Secondary Sizing Ingredients: The secondary sizing ingredients of sizing agents are given below:

Antistatic Agent: It prevents the generation of electrostatic charge in the warp yarn during weaving. A very little amount of antistatic agent is used in the sizing liquor. • Sepcostate

Examples: LV-40, PAA-40

Antiseptic Agent: It is used to prevent bacteria or mildew formation in the sized beam or fabric woven from a sized warp. When the sized warp or fabric remains unused, there are chances of bacteria or mildew formation in humid conditions or rainy seasons. Some antiseptic agent is added to the sizing liquor to avoid this problem.

Examples: Salicylic acid, Zinc chloride, Phenol, Emulsifier, Copper sulphate

Hygroscopic agent: The main role of the hygroscopic agent in the sizing liquor is to improve the moisture absorption capacity of warp from the air. Since we know that the strength of cotton increases by increasing moisture percentage, so, when the warp absorbs the moisture during weaving, the warp breakage rate is reduced.

Examples: French chock, China clay

Objects of Drawing-in:

The drawing-in process comes after the preparation of the weaver's beam. The weaver's beam is prepared either in the process of warping (if sizing is not required) or in sizing.

The passing of each end of the weaver's beam through the drop pin, healdframe (according to the drafting) and the dent of the reed (according to the denting order) is known as drawing-in. This process is carried outside the loom in a separate room. It is mostly performed manually but in large scale textile industries, automatic drawing-in machines are used.

The drawing-in process is carried out if a new fabric design is to be produced on the loom. But, if, the fabric of the same design is to be produced on the same loom, then only tying-in or knotting process is carried out to change a weaver's beam on the loom by piecing the corresponding ends of the new weaver's beam with the beam which is going to be exhausted.

UNIT IV

WEAVING

Weaving is one of the most popular methods of formation of fabric. The machine used for woven fabric is *Loom*. For weaving two sets of threads are interlaced at about 90º. Set of thread that is placed length wise or longitudinally is called as *warp* or *end*. The set of thread used traversely or width wise for weaving a fabric is called as *weft* or *pick*. *Weaving* is defined as interlacement of warp and weft.

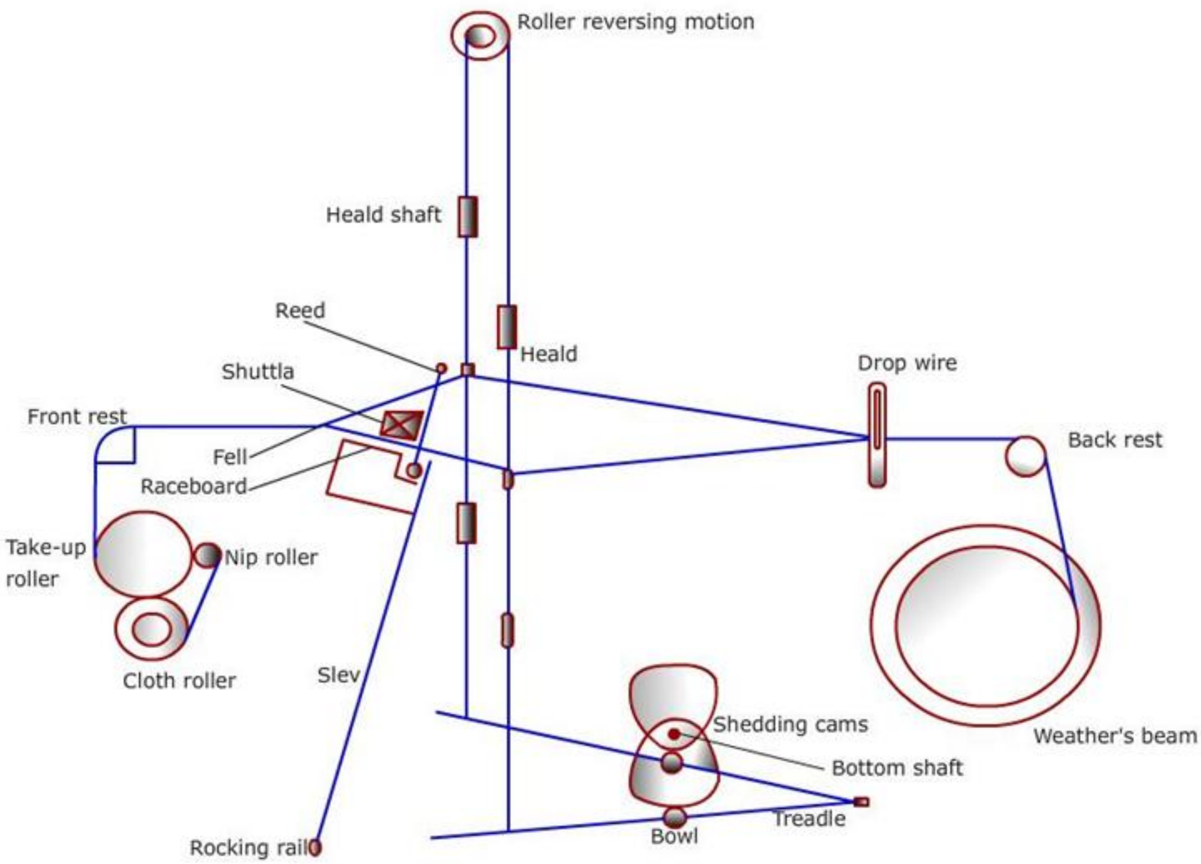
List of Weaving Machines

Hand loom (Primitive loom, Pit loom, Frame loom, Chitranjan loom, Haterlsey loom)

Power loom (Air jet loom, Water jet loom, Rapier loom, Multiphase loom)

Weaving machine and Passage of material

The machine used for weaving is called as *loom*. The passage of material is shown in the figure below. The *warp sheet* is fitted on the back of the loom, on *warper's beam, or weaver's beam* on the back side of the loom. The sheet is then passed over *back rest*. The *drop wires* are then put over to sense the warp breakage. These warps are then passed through different *heald eyes* that is inside the *healds*. These healds are fitted in the heald frame. The heald frames are attached with the ropes, on the roller on the top of the loom, and to the cams from bottom. This helps in giving up and down motion to the heald shafts. Thus the sheet is divided in two layers. This dividing of warp sheets in two layers is called as *shedding*. Then with the help of shuttle, weft or pick is inserted between the two layers from one end to the other end. This is called as *picking.* The shuttle runs on the *sley*. Sley gets a to and fro (forward and backward) motion. This to and fro motion help in beat up of the inserted pick. *Reed* is fitted over the sley. The shuttle lies between the reed and the end of the warp sheet. When the pick is inserted it is then pushed by the *reed* to the point where cloth formation starts. This point where the warp sheet ends and the cloth starts is called as *the fell of the cloth*. The pick inserted by the shuttle. The pushing of this pick by the reed to the fell of the cloth is called as *beat up*. Without the 3 motions of shedding, picking and beat up, and in this sequence, fabric cannot be formed. So these motions are called as *primary motions* of weaving. The cloth is then taken over the *front rest*, on to the *take up roller* and then on the *cloth beam*. As the fabric is made then more warp sheet has to be released (*let off motion*) and the fabric made has to be wound on the cloth beam (*take up motion*). These two motions of let off and take up are necessary for the continuous formation of fabric. These motions are thus called as *Secondary motions*.



Classification of motions

i. Primary motions: motion without which weaving is not possible.
   a. Shedding- dividing the warp sheet in two layers.
   b. Picking- inserting of weft or pick in the shed from one end (selvedge) to another end (selvedge).
   c. Beat up- pushing the last pick inserted to the fell of the cloth.
ii. Secondary motions: motions that help in continuous formation of the fabric.
   a. Let off motion- releasing of the warp sheet from the weaver's beam.
   b. Take up motion- winding the cloth on the cloth beam.
iii. Auxiliary motions: motions used for designing or quality of fabric.
   a. Drop box motion- used for insertion of variety of picks.
   b. Terry pile motion- used to make loops for toweling or absorbency purpose.

Looms can be **classified** on the basis of shedding or picking mechanism used.

Classification as per shedding mechanism

i. Tappet: It is used to produce very small size designs. The repeat of design is on maximum of 6 ends.
ii. Dobby: this shedding mechanism is used to produce medium size designs. The size of design that can be made on a dobby is maximum of up to 40 ends.
iii. Jacquard: This shedding device is used for preparing large size designs that are beyond the capacity of tappet and dobby.

Classification as per picking mechanism

i. Shuttle looms: these are the looms where pick is inserted with the help of shuttle.
   a. Hand looms: looms where pick is inserted with the help of hand.
   b. Power looms: looms where pick is inserted by use of power or motor.
   c. Automatic looms: these looms have an automatic mechanism of changing the shuttle or the pirn that is inside the shuttle. The first type of looms is called as Shuttle change looms, and the other type of looms are known as Pirn or Bobbin change looms.
ii. Shuttleless looms: Shuttle is very heavy and consumes very high power. It also reduces speed of loom. So processes had been developed to either reduce the weight of shuttle, or remove it completely. These are
   a. Rapier looms: having small size grippers.
   b. Air jet looms: use jet of air for inserting pick.
   c. Water jet looms: use water jet for insertion of pick.

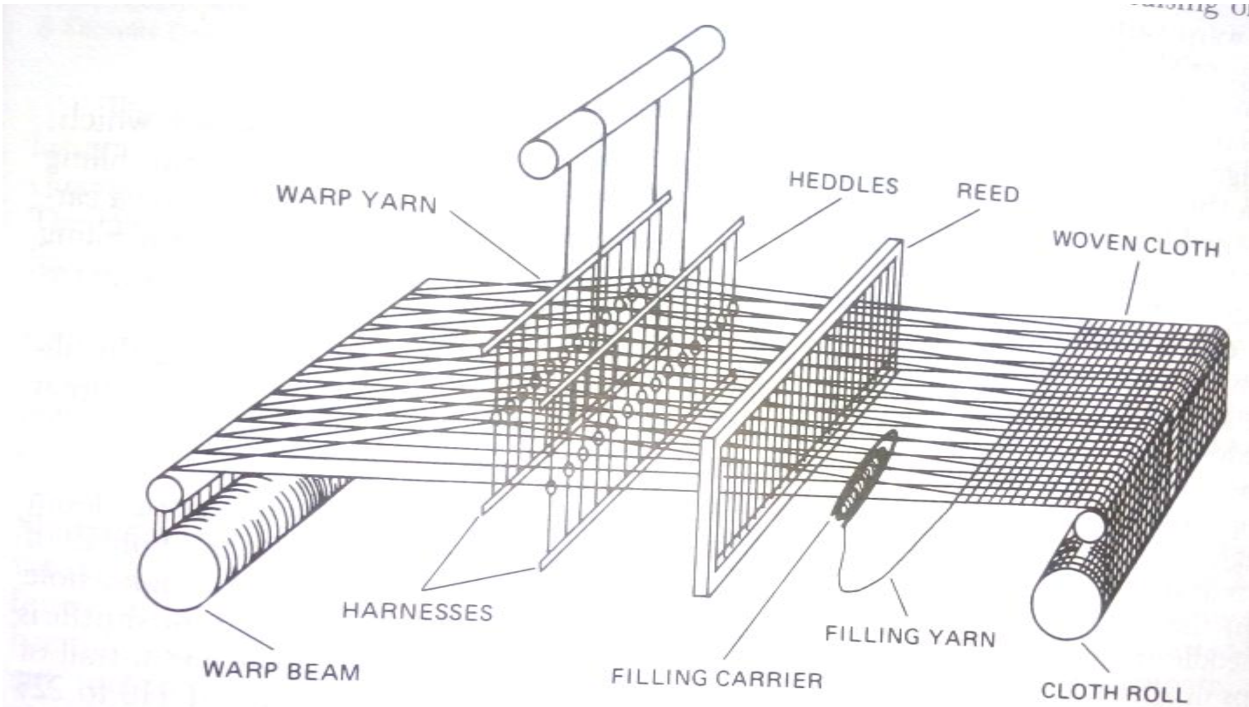


Figure 4-1 Basic structure of a loom.

Comparison of Knitted fabric with Woven fabric : the pointwise comparision is as under

Knitted fabric

i. Weft knitted, or knitted fabric can be made from a single yarn.
ii. Knitting is defined as intermeshing of loops.
iii. A knitted fabric is stretchable. It thus forms shape fitting property. Hence it can used for innerwear, sportswear, and ladies garments.
iv. Knitted fabrics are less elastic. They recover little less to their original position after they are stretched.
v. The structure due to loop formation is such that there are no wrinkle formations in a knitted fabric. It does not require ironing, and is ready to wear after washing only.
vi. A knitted fabric has disadvantage. If a single loop or yarn is broken then the whole fabric starts to open, developing a hole in fabric.
vii. Knitted fabrics are difficult to tear. The pressure applied is distributed to the whole fabric.
viii. The yarn used for knitting are less twisted, and thus produce a fabric that is soft in feel.
ix. A knitted fabric with same wt./yard is more fuller.
x. Knitted fabric has loops. Air can pass very easily through them.

- xi. However the structure also helps to make air packets. This helps in retaining warmth of the body. Hence the knitted fabrics are also used for sweater.
- xii. The loop structure of knitted fabric help in absorbency of water.
- xiii. Design on knitting can be changed very easily.
- xiv. Knitted fabric can be made on simple machines without any preparatory process.
- xv. Thus this can be started with very less investment and space.

Woven fabric

- i. Woven fabric is constructed from two sets of yarn, warp and weft.
- ii. Weaving is defined as interlacement of warp and weft.
- iii. Woven fabrics are rigid, and cannot be stretched.
- iv. Woven fabrics have higher elasticity. It means when stretched they recover to almost the original position.
- v. Woven fabrics need to ironed after washing.
- vi. Any breakage in woven fabric can be mended, and it does not spread bery easily to whole fabric.
- vii. Woven fabric, especially the warp is highly twisted, and is harsh in feel.
- viii. Woven fabrics can be torn easily like a paper, by holding between two fingers.
- ix. A woven fabric with same wt./yard is more intact than a knitted fabric.
- x. Woven fabrics are less permeable to air. Air can not pass through the fabric easily.
- xi. No warmth retaining quality is there in woven fabric due to its structure.
- xii. Due to more twisted and a tight structure these fabrics are less absorbent.
- xiii. To change design on a weaving machine, or loom, warp beam is to be changed if it is warp wise. If the change is in weft, then design on shedding mechanism (dobby, jacquard) is to be changed. It requires extra effort.
- xiv. Woven fabric can need preparatory processes like winding, warping, sizing.
- xv. Hence a lot of investment of money and space is required for its set up.

UNIT V

KNITTING

Knitting is as popular method of fabric construction, as weaving. The popularity had grown since last two decades, and in recent years knitting has overtaken over weaving. The major reasons are:

i. Now all type of yarn including man made can be used for knitting a garment.

ii. There has been more versatility in production of different fabrics. Now almost all type of suiting, shirting, or furnishing fabrics can be made from knitting.

iii. The characteristics of easy to wash-n-wear, wrinkle free, stretchable fabric, make it best for casual wear, inner wear, ladies wear and sports wear.

iv. Also the loops generated help in more warm wear and absorbency purpose.

Definitions in Knitting

In case of weaving we have warp and weft thread. But in case knitting we call them course or wale. Knitting is done by formation of loop or stitch. *Loop* or *stitch* is the basic or fundamental unit of a knitted fabric. It is formed by bending of yarn. *Knitting* is defined as intermeshing of loops. A row of loops intermeshed along the fabric width or in horizontal direction is called as a *Course* (not weft). A row of loop along the fabric length or in vertical direction is called as a *Wale* (not warp). Knitting is done by two ways, course wise as well as wale wise. If knitting is done along the width or the fabric, or course wise then it is *Weft knitting*. If knitting is done along length of the fabric, or wale wise then it is called as *Warp knitting*. Now a day weft knitted was done till last few years. Now warp knitting has also taken up. The properties of warp knitted fabric lies between a weft knitted and a woven fabric structure.

Knitting machines and Passage of material

There are two types of knitting, weft and warp knitting.

i. *Weft Knitting machines* are classified as per the bed shape in which needles are fitted. There are basically two types of knitting machines, *flat bed knitting machine* and *circular bed knitting machine*. The numbers of beds are either one or two. A single bed is required to knit the simple plain knitted structure. The bed is named as *single flat bed* in flat bed. Other knitted structures are in two layers. Thus two beds are required for knitting other knitted fabrics or structures, i.e. rib, purl, or interlock. In flat bed knitting machines, these are called as V-shaped flat bed. L-shaped flat bed (for rib and interlock). In circular knitting machine this single bed is named as *cylinder*. The two beds in circular knitting machine is named as *cylinder* and *dial*. Both beds are at right angle to each other in all type of machines. For making a purl fabric, the two beds in flat bed are at 180°. Only plain knitted fabric is made on single bed knitting machine, and thus form only one layer of loops. It is thus called as *single jersey knitted fabric*. In all other fabrics (rib, purl, and interlock), the loops used for fabric formation are constructed on two beds, that is in two layers, and are thus referred as *double jersey knitted fabrics*.

ii. *Warp knitting machines* are of two types, *tricot and raschel*.

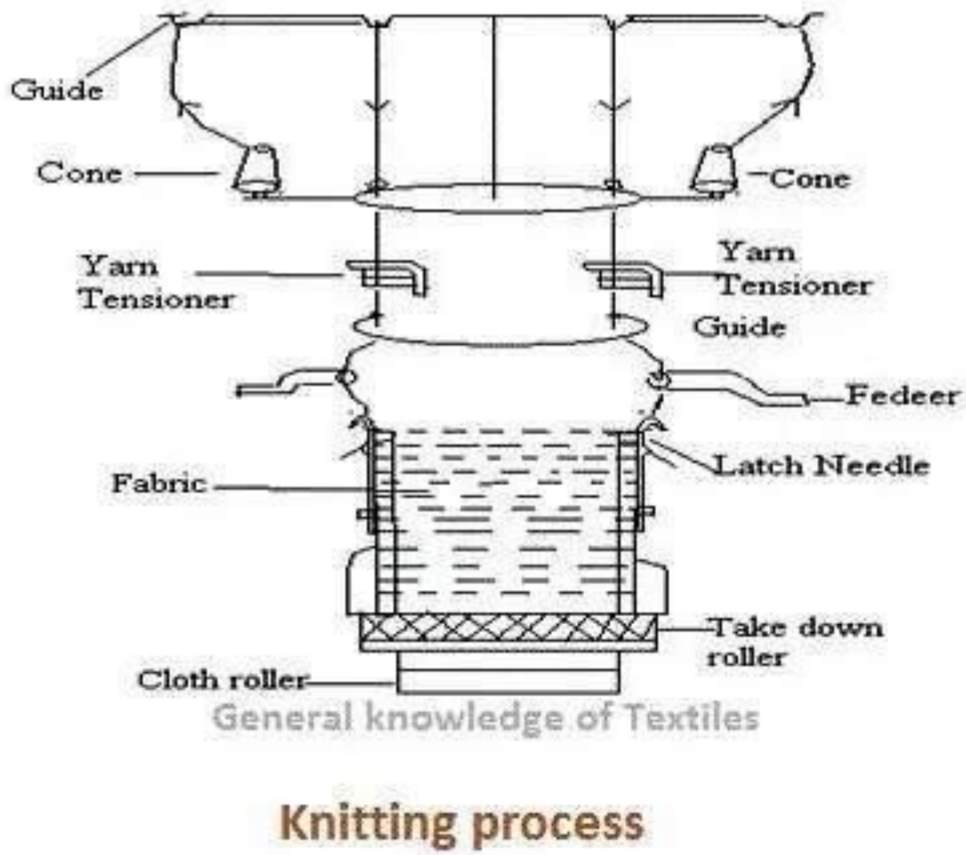


Diagram of Circular knitting machine

A knitted fabric is made by *needle* movement. The needles move up and down vertically. While going up they clear the old loop to make the fabric, and then while coming back they hold the new yarn from the yarn feeder, to make next loop. The movement of the needles is vertical but this movement is generated by the *cam*. The cams moves in horizontal direction, and has specific space cut between them. The needles have a hook at the top for formation of loop, and had a protruding surface at the bottom, called as the butt portion. This protruding portion, or the butt passes through the gap of the cam. This cut makes the butt move up and down, and also the needle. The yarn is fed from the *creel*. In case of weft knitting the *feed package* is cone or cheese. In warp knitting it is a beam. The yarn is then passed through *guide*, and then through *tensioner*. the material or yarn is fed to the needles by *yarn feeder*. The needles are fitted into the *bed* of the machine. Bed may be *flat* or *circular*. In case of circular knitting machine if set of needles is single, then the bed is called as *cylinder*, and the second bed is called as *dial*. The needles move up and down to form a stitch. This movement to the needles is provided by the *cam*. The fabric made is then held by weight or take down mechanism.

Knitted stitches

The stitch or loop is the fundamental unit of knitted fabric. There are 3 type of stitches.

i. *Knit stitch*: This is the normal stitch that we see in a knitted fabric. It has a face and a back. The side of the fabric that appears to be normal is the face side of the loop, and that appears to be back of the fabric is formed by back loops. The combination of these *face* and *back loops* help in making of different basic knitted fabrics.

ii. *Tuck stitch*: This stitch is formed when the last loop is help alongwith the next loop. It means two loops of different courses are held together. This help in developing derivatives of different of basic knitted fabrics.

iii. *Float or Miss stitch*: it is formed when a stitch is not formed. In this case wither the new stitch is formed on its place by use of another yarn, or the loop from the last course that is below it takes its place. Like a tuck stitch, it also helps in developing derivatives of different of basic knitted fabrics.

Basic Knitted fabrics

While discussing various stitches, we had discussed that various stitches forms different type of knitted fabrics. Combination of face and back loops of a simple knit stitch form the different type of knitted fabrics, and its combination along with tuck and float stitches form different derivatives of these knitted fabrics. Normally there are four type of knitted fabrics, plain, rib, purl and interlock. The basic knitted fabrics are:

i. *Plain knitted fabric*: It is the simplest and most widely used knitted fabric. It is developed by using knit stitches side by side, horizontally as well as vertically, to form knitted fabric. It is made on single set of needles. The fabric can be made on flat knit or in circular (tubular) form. Since this is the only knitted fabric made in single layer, it is also called as *single jersey fabric*.

ii. *Rib knitted fabric*: This fabric can be developed by knitting face and back loop alternatively. It means that odd number of wales (vertical column of loops) will be made of face loops, and the next or even wales (vertical column of loops) will be of back loops. This will be made on two sets of needles, and is thus in two layers. It is called as *double jersey knitted fabric*. One knitting face, and other knitting back loops in the same row, means face and back loops alternately. This fabric shows horizontal lines (vertical gap type), and is very stretchable widthwise. All extremities in knitted fabrics like collar, end of the sleeves, and the bottoms of the T-shirts, sweaters are made of rib. It is extremely stretchable widthwise. Due to this, it is also used for ladies wear and shape fitted fabric.

iii. *Purl knitted fabric*: This fabric is made by knitting alternate courses (horizontal row of loops) of face and then back loops. It appears like purl or as if the fabric is being worn from reverse. The machine used is has two beds fitted at 180º to each other and forms a double jersey fabric.

iv. *Interlock knitted fabric*: This fabric is combination of two ribs fitted or fixed in a single fabric. A rib fabric shows vertical line type gaps. The other rib fabric fits into the first one in this gap, and thus appear as a plain fabric from the front and the back. This fabric is therefore equal to two fabrics in thickness and weight.

Comparison of Weft and Warp knitting : the point wise difference is as under

Weft Knitting

i. Single yarn can make the whole fabric.
ii. The fed material is cone or cheese.
iii. The fabric is constructed weft wise, or course wise.
iv. Needles knit sequentially, that is needles knit one after the other.
v. The production is less than warp knit.
vi. The fabric prepared may be low quality than warp knitted.
vii. Production speed decreases with increase in the design.
viii. No preparatory process is required. So the extra investment of machine, space, man power is not there.
ix. Machines are low cost.
x. A less skilled labour can operate.
xi. Due to these reasons the fabric produced is less in cost.
xii. The fabric is more stretchable width wise and length wise than warp knit.
xiii. Difficulty in cutting and tailoring.
xiv. Loop structure:

Warp Knitting

i. The number of yarns required is equal to the number of needles.
ii. The fed material is by beam.

iii. The fabric is constructed warp wise, or wale wise.
iv. Needles knit concurrently, that is all needles knit together.
v. The production is very high than weft knitting.
vi. The fabric prepared of very even quality.
vii. Production speed do not decreases much with designing.
viii. Preparatory process is required. So the extra investment of machine, space, man power is not there.
ix. Machines are high cost.
x. A skilled labour is required to operate.
xi. Due to these reasons the fabric cost is high.
xii. The fabric is less stretchable width wise and length wise than weft knit fabric.
xiii. Easy in cutting and tailoring.
xiv. Loop structure:

Numbering System

For measuring the linear density, or the fineness or coarseness of yarn length and weight of the yarn is taken. There are two systems for its measurement. Direct and indirect.

In *direct system* the finer yarn means low number and a coarse yarn means a higher number. It is denoted by 'weight per unit length' of yarn. The main systems are:

i. Tex- weight in grams of 1000 mts of yarn.
ii. Denier- weight in grams of 9000 mts of yarn.
iii. Decitex- weight in grams of 10,000 mts of yarn.
30 tex means that 1000 mts of yarn will be of 30 grams, and 20 tex means 1000 mts of yarn will have 20 grams of weight. So 20 tex will be finer than 30 tex. 30 denier will mean that 9000 mts of yarn will have 30 grams weight.

In *indirect system* more the number finer will be the yarn. It is denoted by 'length per unit weight'. The main systems are:

i. English count- Number of hank of 840 yards in a pound. It is donated by s.
ii. Worsted count- Number of hank of 560 yards in a pound.

A 30s means that that in one pound of yarn will have 30 length of 840 yards, and a 40s will have 40 lengths of 840 yards in one pound. So a 40s will be finer than a 30s.