RING FRAME

The ring spinning will continue to be the most widely used form of spinning machine in the near future, because it exhibits significant advantages in comparison with the new spinning processes.
Following are the advantages of ring spinning frame

- It is universaly applicable, i.e.any material can be spun to any required count
- It delivers a material with optimum charactersticss, especially with regard to structure and strength.
- it is simple and easy to master
- the know-how is well established and accessible for everyone
    - Functions of ringframe
        - to draft the roving until the reqired fineness is achieved
        - to impart strength to the fibre, by inserting twist
        - to wind up the twisted strand (yarn) in a form suitable for storage, transportaion and further processing.
    - **DRAFTING**
      Drafting arrangement is the most important part of the machine. It influences mainly evenness and strength The following points are therefore very important
        - drafting type
        - design of drafting system
        - drafting settings
        - selection of drafting elements like cots, aprong, traveller etc
        - choice of appropriate draft
        - service and maintenance
    - Drafting arrangement influence the economics of the machine - directly by affecting the end break rate and indirectly by the maximum draft possible.
    - If higher drafts can be used with a drafting arrangement, then coarser roving can be used as a feeding material.This results in higher production rate at the roving frame and thus reducing the number roving machines required, space, personnel and so on.
    - In fact increase in draft affects the yarn quality beyond certain limit. Within the limit some studies show that increase in draft improves yarn quality. The following draft limits have been established for practical operation:
        - carded cotton- upto 35
        - carded blends - upto 40
        - combed cotton and blends(medium counts) - upto 40
        - combed cotton and blends(fine counts) - upto 45
        - synthetic fibres - upto 50
    - The break draft must be adapted to the total draft in each case since the main draft should not exceed 25 to 30. It should be noted that higher the break draft, more critical is the break draft setting
    - The front top roller is set slightly forward by a distance of 2 to 4mm relative to the front bottom roller, while the middle top roller is arranged a short distance of 2mm behind the middle bottom roller.
    - Overhang of the front top roller gives smooth running of the top rollers and shortens the spinning triangle. This has a correspondigly favourable influence on the end break rate.
    - Rubber cots with hardness less than 60 degrees shore are normally unsuitable because they can not recover from the deformation caused by the pressure on the top roller while running.
    - Soft rubbercots for toprollers have a greater area of contact, enclose the fibre strand more completely and therefore provide better guidance for the fibres.However softer cots wear out significantly faster and tend to form more laps.
    - Normally harder rubbercots are used for back top rollers, because the roving which enters the back roller is compact , little twisted and it does not require any additional guidance for better fibre control.
    - In the front top roller, only few fibres remain in the strand and these exhibit a tendency to slide apart. Additional fibre guidance is therefore necessary.Therefore rubbercots with hardness levels of the order 80 degrees to 85 degrees shore are mostly used at the back roller and 63 degrees and 65 degrees at the front roller.
    - If coarse yarns and synthetic yarns are being spun, harder rubbercots are used at the front roller because of increased wear and in the case of synthetic yarns to reduce lapups.
    - **Three kinds of top roller weighting(loading) are presently in use**

        - spring loading
        - pneumatic loading
        - magnetic weighting
    - With pneumatic loading system, the total pressure applied to all top rolers is obtained by simple adjustment of the pressure in the hose using pressure reducing valve. Moreover the rubbercots will not get deformed if the machine is stopped for a longer duration, because the pressure on top rollers can be released to the minimum level.
    - The fibre strand in the main drafting field consists of only a few remaining fibres. There is hardly any friction field and fibre guidance provided by the rollers alone is inadequate. Special fibre guiding devices are therefore needed to carry out a satisfactory drafting operation. Double apron drafting arrangements with longer bottom aprons is the most widely used guding system in all the modern ringframes.
    - In doube apron drafting system two revolving aprons driven by the middle rollers form a fibre guiding assembly. In order to be able to guide the fibres, the upper apron must be pressed with controlled force against the lower apron. For this purpose, a controlled spacing (exit opening), precisely adapted to the fibre volume is needed between the two aprons at the delivery. This spacing is set by "spacer" or "distance clips".Long bottom aprons have the advantage in comparison wiht short ones, that they can be easily replaced in the event of damage and there is less danger of choking with fluff.
    - Spindles and their drive have a great influence on power consumption and noise level in the machine
      The running characteristics of a spindle, especially imbalance and eccentricity relative to the ring flange, also affect yarn quality and of course the number of end breakage. Almost all yarn parameters are affected by poorly running spindles. Hence it should be ensured that the centering of the spindles relative to the rings is as accurate as possible. Since the ring and spindle form independent units and are able to shift relative to each other in operation, these two parts must be re-centered from time to time. Previously, this was done by shifting the spindle relative to the ring, but now it is usually carried out by adjusting the ring.
    - In comparison with Tangential belt drive, the 4-spindle drive has the advantages of lower noise level and energy consumption, and tapes are easier to replace.
    - Lappet guide performs the same sequence of movements as the ringrail, but with a shorter stroke, this movement of the guide ensures that differences in the balloon height caused by changes in the ring rail positions do not become too large. This helps to control the yarn tension variation with in control, so that ends down rate and yarn characteristics are under control.
    - Spindles used today are relatively long. The spacing between the ring and the thread guide is correspondigly long, thus giving a high balloon. This has two negative influence
        - A high balloon results in large bobbin diameter leading to space problems
        - Larger the balloon diameter , higher the air drag on the yarn.This inturn causes increased deformation of the balloon curve out of hte plane intersecting the spindle axis.This deformation can lead to balloon stability, there is increase danger of collapse.

      Both these disadvantages result in higher yarn tension, thereby higher endbreaks.In order to avoid this, balloon control rings are used. It divides the balloon into two smaller sub-balloons. Inspite of its large overall height, the double-balloon created in this way is thoroughly stable even at relatively low yarn tension.

    - Balloon control rings therefore help to run the mahcine with long spindles(longer lift) and at high spindle speed, but with lower yarn tension. Since the yarn rubs against the control ring, it may cause roughening of the yarn.
    - Most ends down arise from breaks in the spinning triangle, because very high forces are exerted on a strand consisting of fibres which have not yet been fully bound together in the spinning triangle.
- RING and TRAVELLER COMBINATION:
  The following factors should be considered
    - materials of the ring traveller
    - surface charecteristics
    - the forms of both elements
    - wear resistance
    - smoothness of running
    - running-in conditions
    - fibre lubrication
- For the rings two dimensions are of primariy importance. 1.internal diameter 2. flange width.
- Antiwedge rings exhibit an enlarged flange inner side and is markedly flattened on it upper surface.
  This type of profile permitted to use travellers with a lower centre of gravity and precisely adapted bow(elliptical travellers), which in turn helped to run the machine with higher spindle speeds. Antiwedge rings and elliptical travellers belong together and can be used in combination.
- Low crown profle has the following advantage. Low crown ring has a flattened surface top

and this gives space for the passage of the yarn so that the curvature of the traveller can also be reduced and the centre of gravity is lowered.In comparison with antiwedge ring, the low crown ring has the advantage that the space provided for passage of the yarn is somewhat larger and that all current traveller shapes can be applied, with the exception of the elliptical traveller. The low crown ring is the most widely used ring form now.

- The ring should be tough and hard on its exterior. The running surface must have high and even hardeness in the range 800-850 vikcers. The traveller hardness should be lower (650-700 vickers), so that wear occurs mainly on the traveller, which is cheaper and easier to replace. Surface smoothness should be high, but not too high, because lubricating film can not build up if it too smooth.
- A good ring in operation should have the following features:
  - best quality raw material
  - good, but not too high, surface smoothness
  - an even surface
  - exact roundness
  - good, even surface hardness, higher than that of the traveller
  - should have been run in as per ring manufacturers requirement
  - long operating life
  - correct relationship between ring and bobbin tube diameters
  - perfectly horizontal position
  - it should be exactly centered relative to the spindle
- In reality, the traveller moves on a lubricating film which builds up itself and which consists primarily of cellulose and wax. This material arises from material abraded from the fibres.If fibre particles are caught between the ring and traveller, then at high traveller speeds and with correspondingly high centrifugal forces, the particles are partially ground to a paste of small, colourless, transparent and extremely thin platelets.
  The platelets are continually being replaced during working. The traveller smoothes these out to form a continuous running surface.The position, form and structure of lubricating film depends on
  - yarn fineness
  - yarn structure
  - fibre raw material
  - traveller mass
  - traveller speed
  - heigh of traveller bow

  Modern ring and traveller combination with good fibre lubrication enable

- traveller speeds upto 40m/sec.
  Traveller imparts twist to the yarn. Traveller and spindle together help to wind the yarn on the bobbin.
  Length wound up on the bobbin corresponds to the difference in peripheral speeds of the spindle and traveller.
  The difference in speed should correspond to length delivered at the front rollers. Since traveller does not have a drive on its own but is dragged along behind by the spindle.
- High contact pressure (upto 35 N/square mm)is generated between the ring and the traveller during winding, mainly due to centrifugal force. This pressure leads to generation of heat. Low mass of the traveller does not permit dissipation of the generated heat in the short time available. As a result the operating speed of the traveller is limited.
- When the spindle speed is increased, the friction work between ring and traveller (hence the build up) increases as the 3rd power of the spindle rpm. Consequently if the spindle speed is too high, the traveller sustains thermal damage and fails. This speed restriction is felt particularly when spinning cotton yarns of relatively high strength.
- If the traveller speed is raised beyond normal levels , the thermal stress limit of the traveller is exceeded, a drastic change in the wear behaviour of the ring and traveller ensues. Owing to the strongly increased adhesion forces between ring and traveller, welding takes place between the two. These seizures inflict massive damage not only to the traveller but to the ring as well.Due to this unstable behaviour of the ring and traveller system the wear is atleast an order of magnitude higher than during the stable phase. The traveller temperature reaches 400 to 500 degrees celcius and the danger of the traveller annealing and failing is very great.
- The spinning tension is proportional
  - to the friction coefficient between ring and traveller
  - to the traveller mass
  - to the square of hte traveler speed
    and inversely proportional
  - to the ring diameter
  - and the angle between the connecting line from the traveller-spindle axis to the piece of yarn between the traveller and cop.

- The yarn strength is affected only little by the spinning tension. On the other hand the elongation diminishes with increasing tension, for every tensile load of hte fibres lessens the residual elongation in the fibres and hence in the yarn. Increasing tension leads also to poorer Uster regularity and IPI values.
- If the spinning tension is more, the spinning triangle becomes smaller . As the spinning triangle gets smaller, there is less hairiness.
- SHAPE OF THE TRAVELLER:
  The traveller must be shaped to match exactly with the ring in the contact zone, so that a single contact surface, with the maximum surface area is created between ring and traveller. The bow of the traveller should be as flat as possible, in order to keep the centre of gravity low and thereby improve smoothness of running.
- However the flat bow must still leave adequate space for passage of the yarn. If the yarn clearance opening is too small, rubbing of the yarn on the ring leads to roughening of the yarn, a high level of fibre loss as fly, deterioration of yarn quality and formation of melt spots in spinning of synthetic fibre yarns.
- WIRE PROFILE OF THE TRAVELLER:
  - **Wire profile influences both the behaviour of the traveller and certain yarn characteristics, they are**
    - contact surface of the ring
    - smooth running
    - thermal transfer
    - yarn clearance opening
    - roughening effect
    - hairiness

    MATERIAL OF THE TRAVELLER

  - The traveller should
    - generate as little heat as possible
    - quickly distribute the generated heat from the area where it develops over the whole volume of the traveller
    - transfer this heat rapidly to the ring and the air
    - be elastic, so that the traveller will not break as it is pushed on to the ring
    - exhibit high wear resistance
    - be less hard than the ring, because the traveller must wear out in use in preference to the ring
  - In view of the above said requirements, traveller manufacturers have made efforts to improve the running properties by surface treatment. "Braecker" has developed a new process in which certain finishing components diffuse into the traveller surface and are fixed in place there. The resulting layer reduces temperature rise and increases wear resistance.
  - Traveller mass determines the magnitude of frictional forces between the traveller and the ring, and these in turn determine the winding and balloon tension. Mass of the traveller depends upon
    - yarn count
    - yarn strength
    - spindle speed
    - material being spun
  - If traveller weight is too low, the bobbin becomes too soft and the cop content will be low. If it is unduly high, yarn tension will go up and will result in end breaks. If a choice is available between two traveller weights, then the heavier is normally selected, since it will give greater cop weight, smoother running of the traveller and better transfer of heat out of traveller.
  - When the yarn runs through the traveller, some fibres are liberated. Most of these fibres float away as dust in to the atmosphere, but some remain caught on the traveller and they can accumulate and form a tuft. This will increase the mass of traveller and will result in end break because of higher yarn tension. To avoid this accumulation , traveller clearers are fixed close to the ring, so that the accumulation is prevented. They should be set as close as possible to the traveller, but without affecting its movement. Exact setting is very important.
  - Specific shape of the cop is achieved by placing the layers of yarn in a conical arrangement. In the winding of a layer, the ring rail is moved slowly but with increasing speed in the upward direction and quickly but with decreasing speed downwards. This gives a ratio between the length of yarn in the main (up) and cross(down) windings about 2:1.
  - The total length of a complete layer (main and cross windings together) should not be greater than 5m (preferably 4 m) to facilitate unwinding. The traverse stroke of the ring rail is ideal when it is about 15 to 18% greater than the ring diameter.
  - End break suction system has a variety of functions.
    - It removes fibres delivered by the drafting arrangement after an end break and thus prevents mulitple end breaks on neighbouring spindles.

- It enables better environmental control, since a large part of the return air-flow of the aircondition system is led past the drafting system, especially the region of the spinning triangle.
- In modern installations, approx. 40 to 50 % of the return air-flow passes back into the duct system of the airconditioning plant via the suction tubes of pneumafil suction system.
- A relatively high vacuum must be generated to ensure suction of waste fibres
  - for cotton - around 800 pascals
  - for synthetic - around 1200 pascals
- A significant pressure difference arises between the fan and the last spindle. This pressure difference will be greater , the longer the machine and greater the volume of air to be transported. The air flow rate is normally between 5 and 10 cubic meter/ hour.
- Remember that the power needed to generate an air-flow of 10 cubic meter/ hour , is about 4.5 times the power needed for an air-flow of 6 cubic meter/ hour, because of the significantly higher vacuum level developed at the fan.

SPINNING GEOMETRY:

- From Roving bobbin to cop, the fibre strand passes through drafting arrangement, thread guide, balloon control rings and traveller. These parts are arranged at various angles and distances relative to each other.
  The distances and angles together are referred to as the spinning geometry,has a significant influence on the spinning opeartion and the resulting yarn. They are
  - yarn tension
  - number of end breaks
  - yarn irregularity
  - binding-in of the fibres
  - yarn hairiness
  - generation of fly etc.

Spinning Triangle:

- Twist in a yarn is generated at the traveller and travel against the direction of yarn movement to the front roller. Twist must run back as close as possible to the nip of the rollers, but it never penetrates completely to the nip because, after leaving the rollers, the fibres first have to be diverted inwards and wrapped around each other. There is always a triangular bundle of fibres without twist at the exit of the rollers, this is called as SPINNING TRIANGLE. Most of the end breaks originate at this point. The length of the spinning triangle depends upon the spinning geometry and upon the twist level in the yarn.
- The top roller is always shifted 3 to 6 mm forward compared to bottom roller. This is called top roller overhang.This gives smoother running and smaller spinning triangle. The overhang must not be made too large, as the distance from the opening of the aprons to the roller nip line becomes too long resulting in poorer fibre control and increased yarn irregularity.
- Continuous variation of the operating conditions arises during winding of a cop.The result is that the tensile force exerted on yarn must be much higher during winding on the bare tube than during winding on the full cop, because of the difference in the angle of attack of the yarn on the traveller. When the ring rail is at the upper end of its stroke, in spinning onto the tube, the yarn tension is substantially higher than when the ring rail is at its lowermost position. This can be observed easily in the balloon on any ring spinning machine.
- The tube and ring diameters must have a minimum ratio, between approx. 1:2 and 1:2.2, in order to ensure that the yarn tension oscillations do not become too great.
- Yarn tension in the balloon is the tension which finally penetrates almost to the spinning triangle and which is responsible for the greater part of the thread breaks. It is reduced to a very small degree by the deviation of the yarn at the thread guide. An equilibrium of forces must be obtained between the yarn tension and balloon tension.