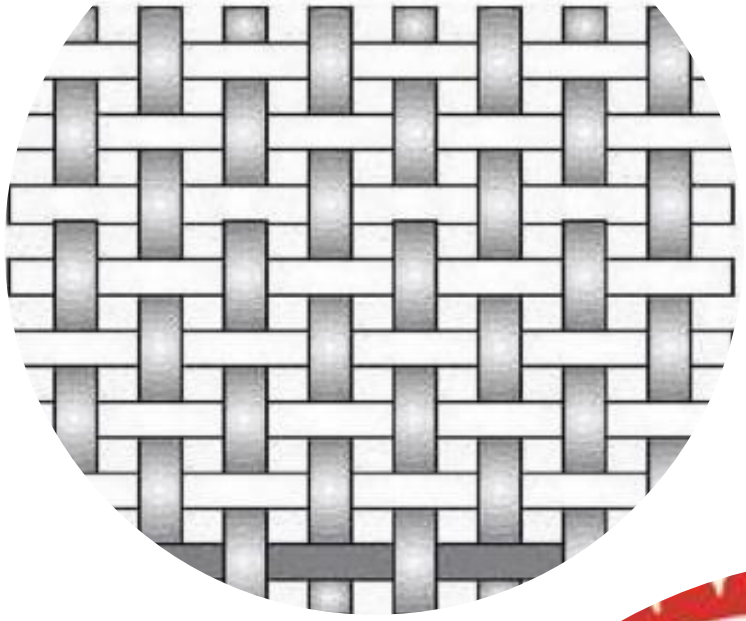
Fabric Manufacturing I (TXL231)



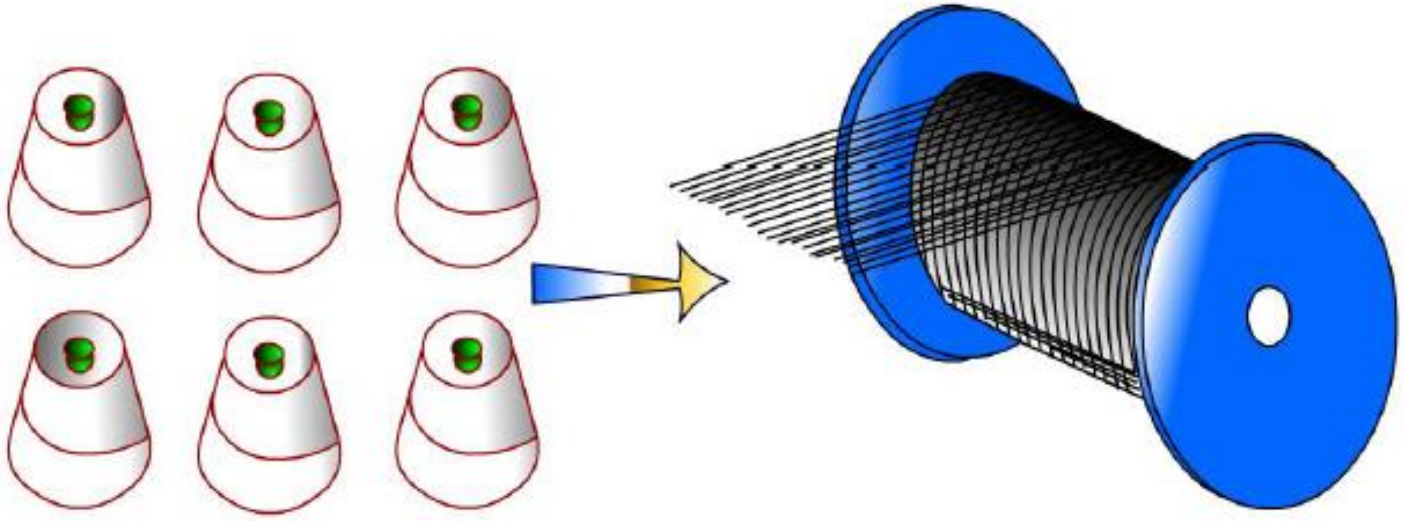
Dr. Sumit Sinha Ray

Asst. Professor

Department of Textile and Fibre Engineering

Warping: Objectives

The objective of warping process is to convert the yarn packages into a warper's beam having desired width and containing requisite number of ends



The yarns are would on the warper's beam in the form of a sheet composed of parallel bands of yarns each coming out from a package placed on the creel

Warping: Objectives

Let us take the following hypothetical example to understand the various options of warping process

- Assume that a piece of woven fabric of 5 m width and 1000 m length is to be produced from warp yarn of 10 Tex arranged 20 yarns per cm in the fabric. This would necessitate production of a beam in which 10,000 yarns are arranged parallel to each other in a sheet form.
- The length of this sheet must be somewhat higher than 1000 m to account for the crimped path of warp in the final fabric as well as wastages during weaving and contraction of fabric during subsequent relaxation processes.

Let contraction of grey fabric during relaxation process = 6%
Let warp crimp in fabric = 5.5%
Let wastage of warp during conversion of beam to fabric = 0.001%

Warping: Objectives

So, based on the previous calculations-

- Length of fabric- 1060 m
- Warp yarn- 10000, each of length 1118 m with wastage count of 1.12 m and that makes them of length 1119.2 m or 1120 m
- Yarn- 10 Tex (10 g/1000 m)
- Warp sheet weight- 112 Kg (10 x 1.12 x 10000/1000 kg= 112 kg)
- If a 2 kg cone contains 10 Tex yarn of length 200,000 m of yarn, then we need 56 cones

BUT!! 56 cones= 56 Ends! In order to generate 10,000 ends from 56 cones, one has to take out 1120 m from each cone in the form of a sheet and then break the yarns from the cones and take out another 1120 m in the form of a sheet and **repeat this process 178.57 (nearly 179) times**

Neither the 178.57 times is a whole number, nor the effort makes sense

Warping: Objectives

One feasible solution- **The number 10,000 has to be therefore broken up into combinations**

↓

Number of cones (**A**) and the number of times (**B**) the yarn has to be broken from a cone with each cone containing **l** m yarn weighing **g** grams.

The possible combinations {A, B, ℓ, and g} are

Very difficult as a very large number of cones each containing a very small quantity of yarn would be required (Case I)

- {10,000, 1, 1200, 12},
- {5000, 2, 2400, 24},
- {2000, 5, 6000, 60},
- {1000, 10, 12,000, 120},
- {500, 20, 24,000, 240}, ← The number of times the yarn has to be broken is reasonably small (Case II)
- {250, 40, 48,000, 480},
- {100, 100, 120,000, 1200}, and
- {50, 200, 240,000, 2400}. ← Reasonably small number of cones each of commercially standard dimensions(Case III)

Warping: Objectives

Reasonably small number of cones each of commercially standard dimensions(Case III)

{50, 200, 240,000, 2400}

The manufacturer knows that the order is not going to get repeated and would like to complete those cones (let's call them special fabric)

Sectional warping

The number of times the yarn has to be broken is reasonably small (Case II)

{500, 20, 24,000, 240}

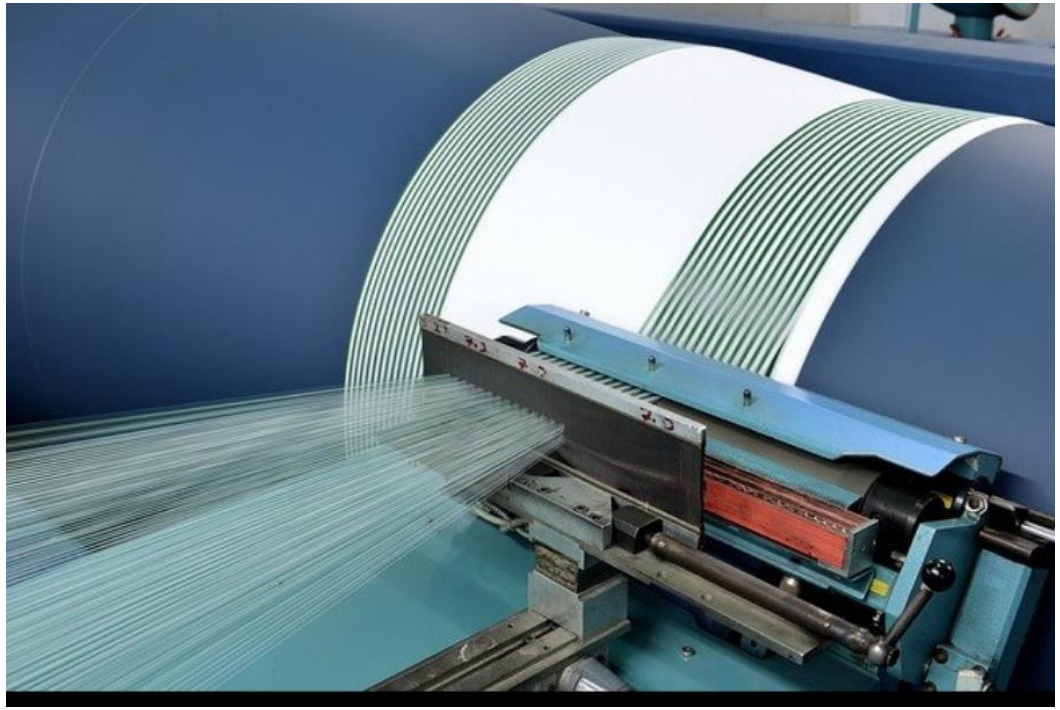
In case cones of 10 tex yarns, cones can be employed either for production of a sufficiently large number of such fabric rolls, say 10 or more, or for production of other beams for which the chosen combination applies (let's call them regular fabric)

No need to keep an inventory of partially consumed cones as cones containing only 240 g material are not normally produced in the manufacturing sector

Beam warping

Warping: Beam and Sectional

Beam warping



Sectional warping

Warping: Requirements

Quality of good warp

- Uniformly strong
- Uniform in cross-section
- Uniform warp tension
- Uniformly sized
- Less hairy and clean

Requirements of warping

- The tension of all wound ends must be uniform
- Warping process should not disturb the mechanical and physical properties of yarns
- The yarns in the sheet should be in a uniform spacing

Warping process involves

- Cone from winding
- Creel
- Control system
- Reed
- Measuring device
- Winding on beam

Warping: Creel and its types

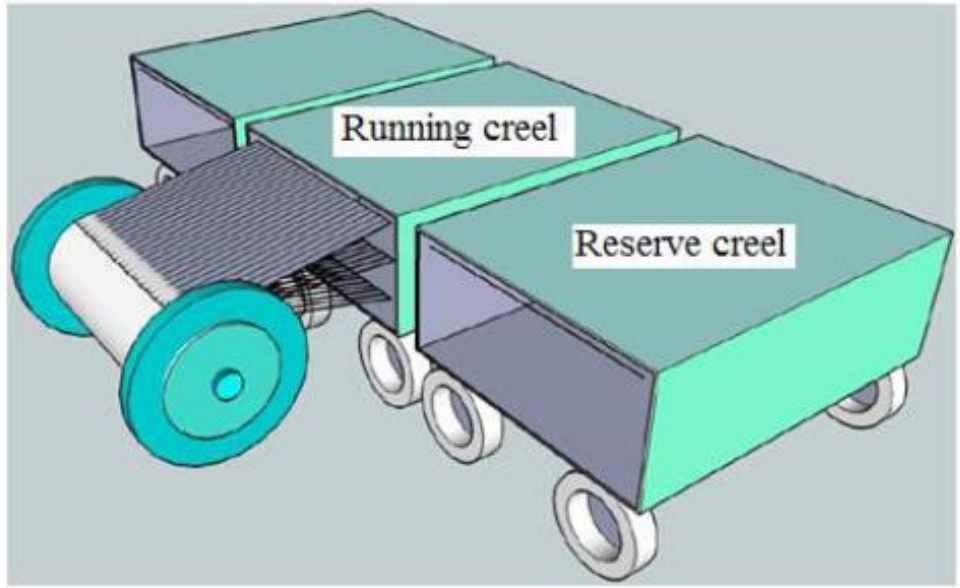
- Single end creel
- Magazine creel
- Traveling or multiple package creel

A creel is a three-dimensional assembly of pegs. Each peg is designed to grip the inside wall of the shell of a cone securely and be strong enough to support a cone in space. As yarn from a cone is withdrawn around its nose, a balloon is formed that is made to pass through a yarn guide, a tensioning system, and a thread detector (broken thread stop motion), all mounted on the frame of a creel.

Warping: Creel and its types

Single end creel: In single end creel, one position of the creel is used for one end on the warper's beam.

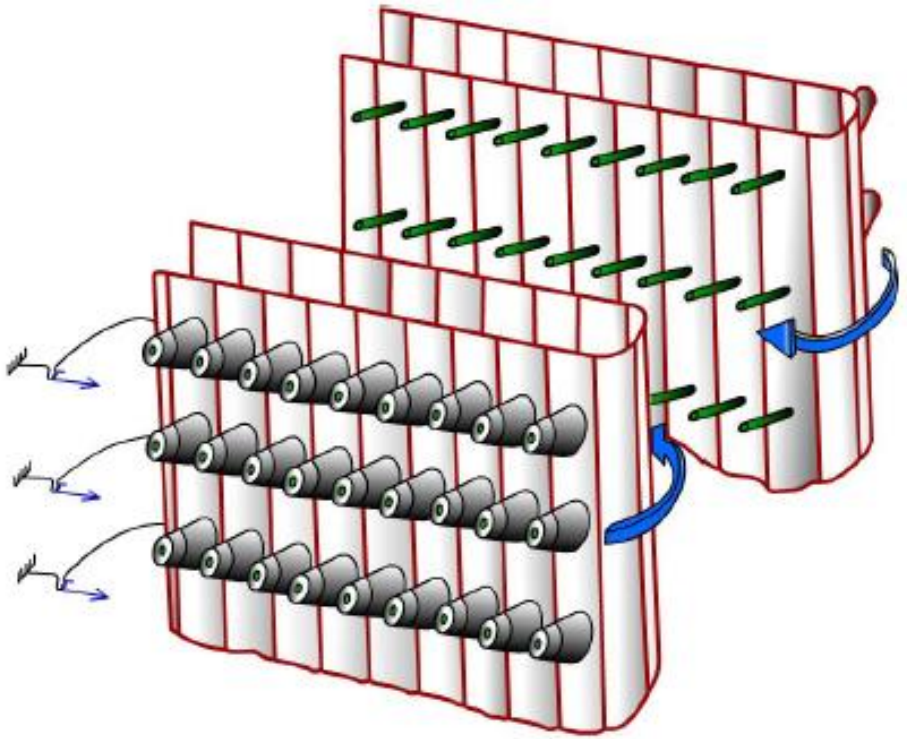
- Two types namely truck creels and duplicated creels
- Truck creel-when the packages from the running creel are exhausted, it is moved sideways, and the reserve creel moves into the vacant space



Warping: Creel and its types

Travelling or Swivelling creel: the pegs (package holders) with full packages can move from inside (reserve) position to the outside (working) position when the running packages are exhausted.

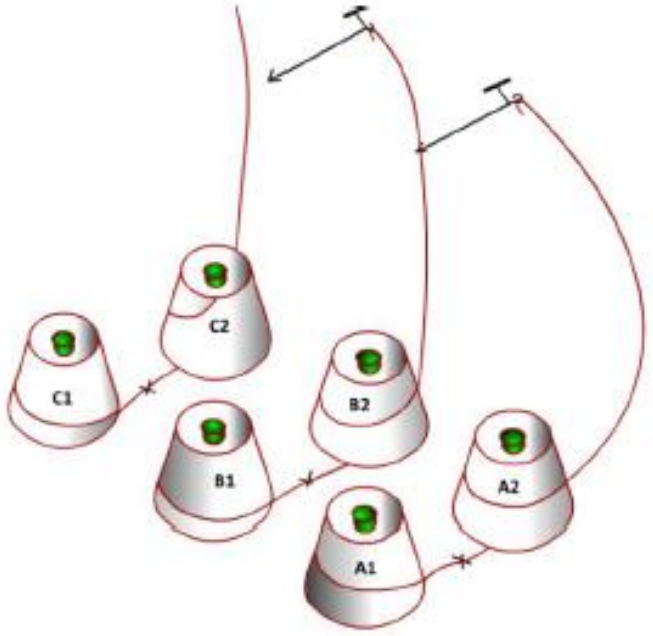
- ❑ Considerable time is saved
- ❑ The operator replaces the exhausted packages with full packages when the machine is running.



Warping: Creel and its types

Magazine creel: the tail end of yarn from one cone is tied with the tip of the yarn of another neighbouring cone.

- When the first cone is exhausted, the transfer of yarn withdrawal to the second cone takes place automatically and machine does not stop
- The creeling time is eliminated which helps to improve the running efficiency of warping process
- Sudden change in unwinding position and tension variation associated with this, some of the yarns break during the transfer (known as transfer failure)
- The magazine creel has reduced capacity. If the creel has 1000 package holders, then the warp sheet can actually have 500 ends



Calculation for Warping Efficiency with Different Creels

Warping operation is being carried out with the following particulars:

- The yarn mass on full beam is 300 kg,
- number of ends is 500,
- yarn count is 30 tex,
- Warping speed is 1000 m/min,
- cone weight is 2 kg,
- end break rate 0.1/100 end/ 1000 m,
- time to repair a break is 0.5 min,
- Beam doffing time is 5 min,
- Creeling time is 45 min/ creel,
- Headstock change time is 3 min/ beam,
- transfer failure is 2%

The mass contributed by a single yarn = 300/500= 0.6 kg

The length of the warp sheet =0.6 x1000/30= 20 km = 20,000 m

Running time = 20,000/1000= 20 minutes

Creeling time = 45 minutes/ creel= 15 minutes/beam

In case of single end creel, this 45 minutes will be divided between three warper's beam as from one cone of 2 kg mass at least three beams will be made.

For duplicated creel, the headstock is moved in front of the new creel which is ready with full packages. So, no creeling time is considered. However, it needs the headstock moving time i.e. 3 minutes.

Number of breaks in warping= (500x 20000x 0.1)/(100 x 1000)=10

Repair time = Number of breaks × repair time per break =10 × 0.5 = 5 min=Time for repairing the transfer failure (2% of 500 ends)

This 5 minutes should be equally allocated among multiple warper's beam as from one cone of 2 kg mass at least three beams will be made. So, when the yarns of two cones are tied, six warper's beam can be made without any further creeling=0.83 min

Calculation for Warping Efficiency with Different Creels

Item	Calculation/ beam	Single-end (min)	Duplicated (min)	Magazine (min)
Running time	20000 yard sheet	20	20	20
Repair time	0.5 min/ break	5	5	5
Beam doffing	5 min/ beam	5	5	5
Creeling time	45 min/ creel	15	0	0
Headstock change	3 min/ headstock	0	3	0
Transfer failure	2 %			0.83
Total time		**45**	**33**	**30.83**
Efficiency %		**44.44**	**60.60**	**64.87**