Dry finishing

Contemporary wool dyeing and finishing

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Topics

1. Drying
2. Conditioning
3. Raising
4. Cropping
5. Pressing
6. Atmospheric decatising
7. Pressure decatising
8. Sponging
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10. Inspection

1. Drying

Mechanical de-watering

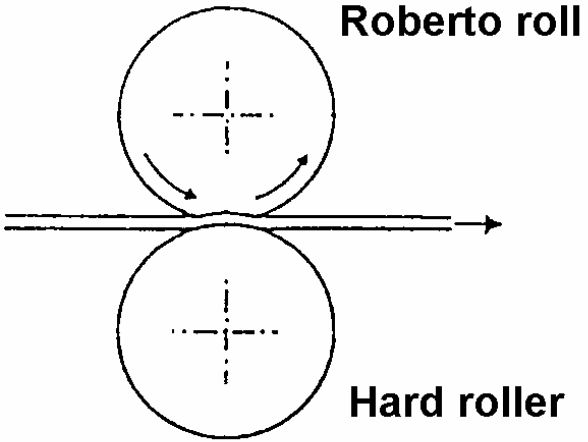
- The cost of drying can be reduced significantly if mechanical methods are used to remove excess moisture from fabric before any heating is begun. Three de-watering methods are widely used:
  - spin hydroextraction
  - mangling
  - suction slot extraction.

Water removal by hydroextraction

- Water is removed by centrifugation from roped up fabric.
- Batch process.
- Simple and cheap.
- Water removal can be uneven.

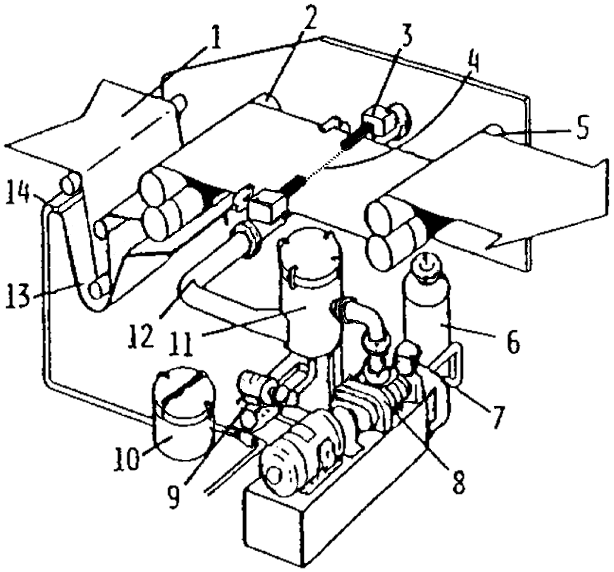
Water removal by mangling

- Continuous in open width.
- Even water removal.
- Leaves a minimum of around 60% water on the fabric.
- There are many different designs for mangles.
- High pressure squeezing with at least one hard roller is most common.
- The Roberto roll has a special porous surface and it can remove water very efficiently.



Water removal by vacuum extraction

- Water is removed by suction as fabric passes over a suction slot.
- Continuous in open width.
- Even and efficient water removal.

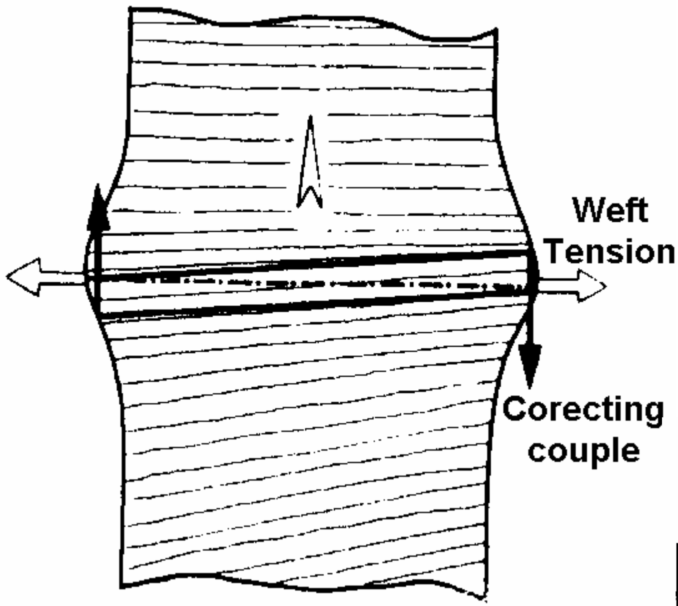


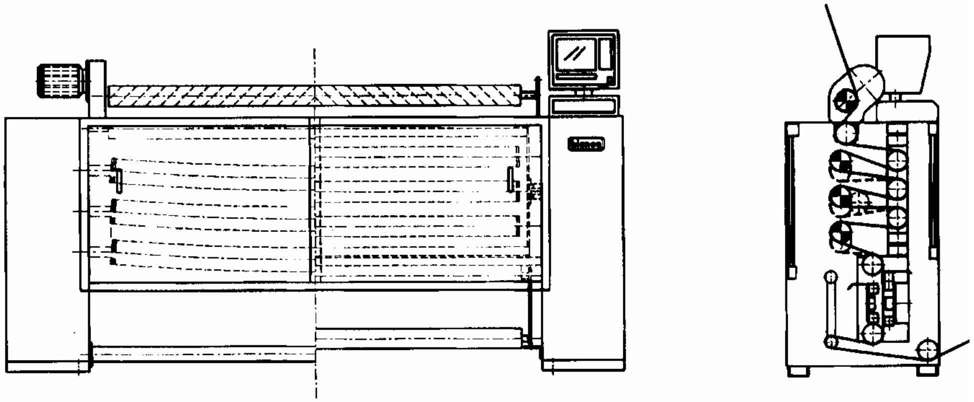
A typical industrial pad/vacuum unit for liquor application or dewatering (without the mangle) with filtration and recirculation of the extracted solution. (1) fabric; (2) pad rollers; (3) automatic slot sealer; (4) vacuum slot; (5) drive rollers; (6) chimney, muffler and drain; (7) butterfly valve; (8) vacuum pump; (9) recycling pump; (10) filter; (11) cyclone separator; (12) vacuum tube; (13) pad bath; (14) recycled solution.

Weft straightening

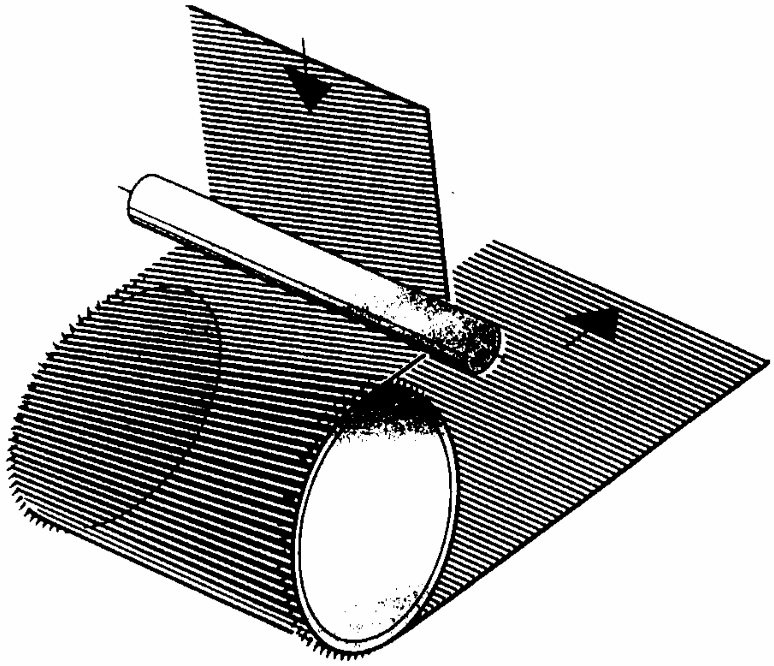
- Before any open-width setting operation, such as stenter drying or pressure decatising, it is essential to straighten fabric so that the warp and weft are at right angles. There are two types of weft straightening machines:
  - roller machines
  - pin-wheel machines.

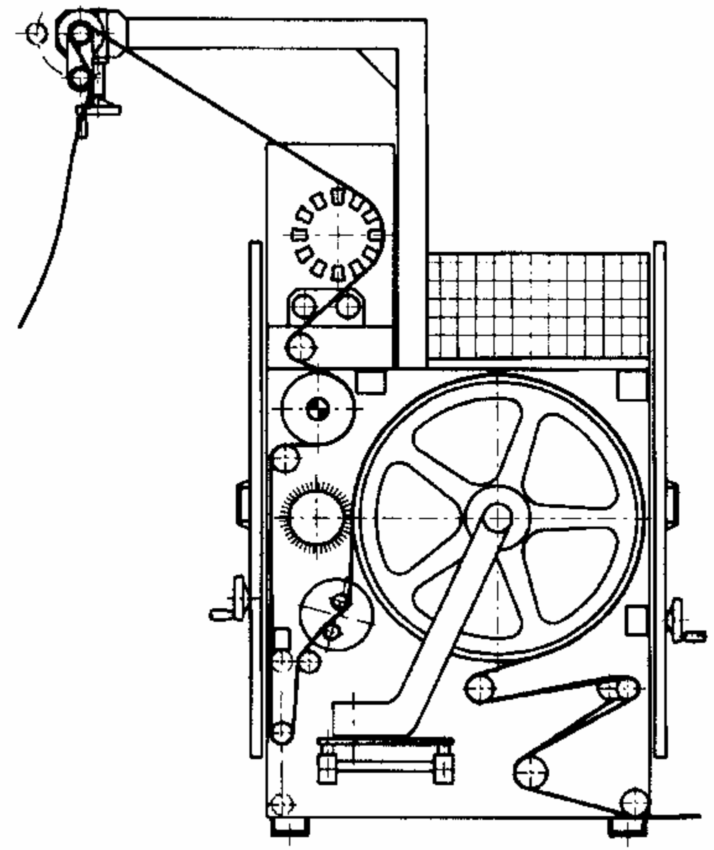
A Bianco roller weft straightener





Bianco pinwheel weft straightener





Stenter drying

- The stenter is one of the most important finishing machines in any plant.
- Heat and mass transfer in drying has been extensively studied.
- In practice, modern stenters can be adjusted:
  - to give good control of fabric dimensions
  - to run at their optimum productive capacity
  - to control the regain of the dried goods accurately.

Drying

- Four types of drying methods can be used with textiles:
  - radiation - electric or gas powered
  - conduction - drum driers
  - hot air - gas fired stenters
  - radiofrequency.

Types of dryers

- Four types of hot air driers are most commonly used for wool:
  - stenter (or tenter)
  - drum dryer
  - festoon dryer
  - brattice dryer.
- Stenters are most commonly used and they permit control of fabric dimensions during drying.
- Drum, festoon and brattice driers do not provide dimensional control.
- Drum and brattice driers are also used for loose wool and top.

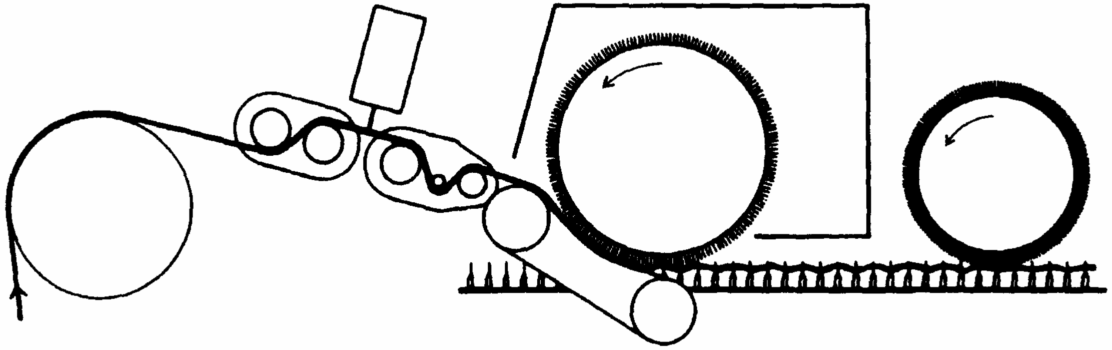
Stenter drying

- The aim of stenter drying is to remove water from fabric while it is held at predetermined dimensions.
- Fabric becomes cohesively set during drying. The theory of cohesive setting and the dimensional changes that occur are discussed later.

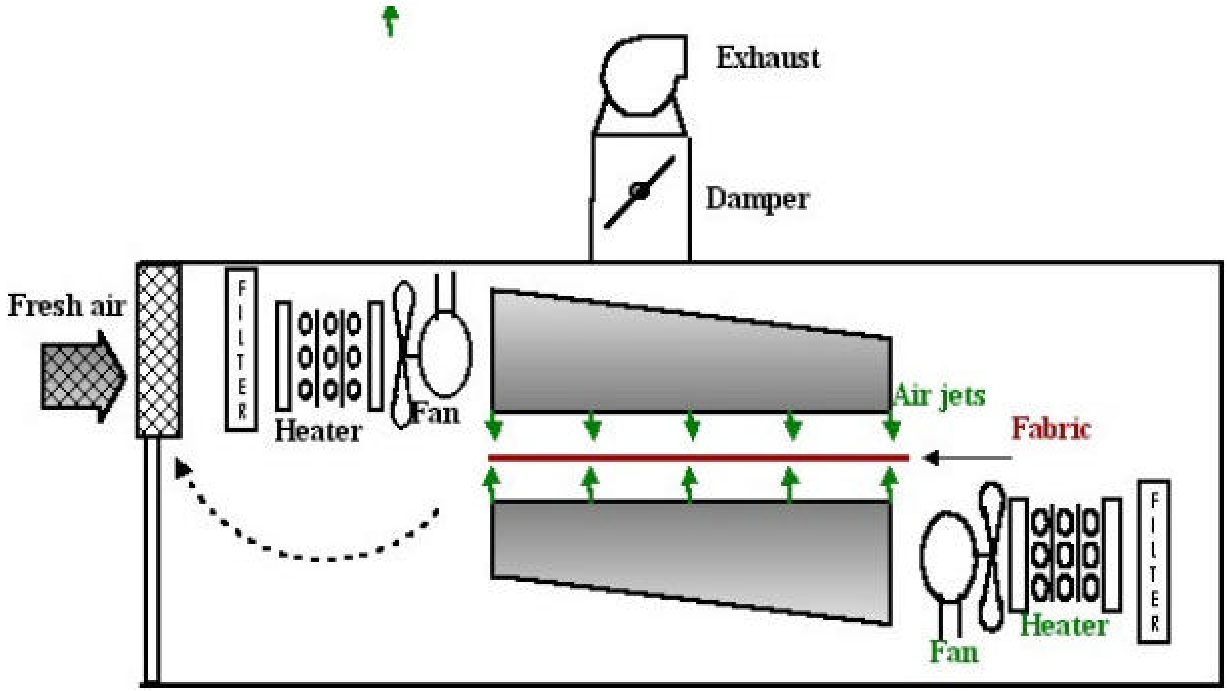
Stenter drying

- In stentering, the selvages of a fabric are fed onto pins or gripped by clips mounted on two endless chains that run in movable guides through a heating chamber.
- The pins hold the edges of the fabric to a pre-set width (generally a little wider than wet width), while the fabric is dried.
- The length at which a fabric is dried is controlled by varying the speed at which the fabric is fed onto the pins, relative to the speed that the pin chain moves through the machine (see next slide). A faster feed rate is referred to as overfeed and a slower feed rate as underfeed. Typically underfeed/overfeed can be varied in the range -10% to +40%.
- Values of overfeed or underfeed should be regarded as purely nominal unless the fabric is fed to the input of the overfeed device *without any tension*. Tensioning of fabric before it enters the stenter causes the actual overfeed to be less than that set on the machine. The more extensible the fabric, the more prone a fabric will be to stretching and the more likely that the actual overfeed will be lower than the set value.

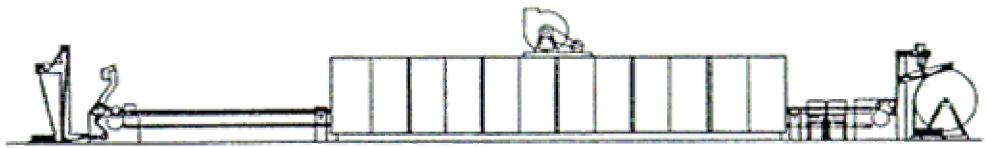
A schematic of the overfeed device on a stenter



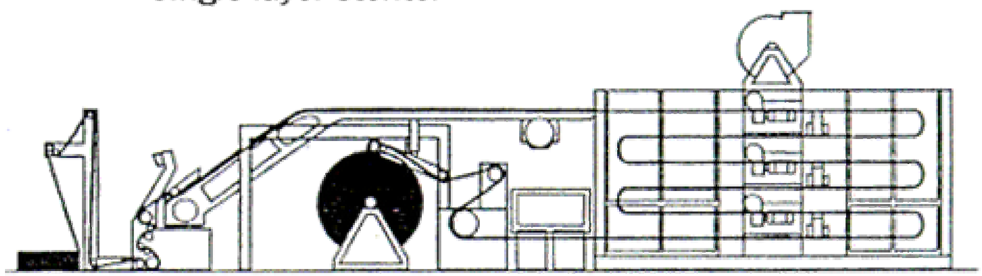
Schematic of a stenter



Stenters

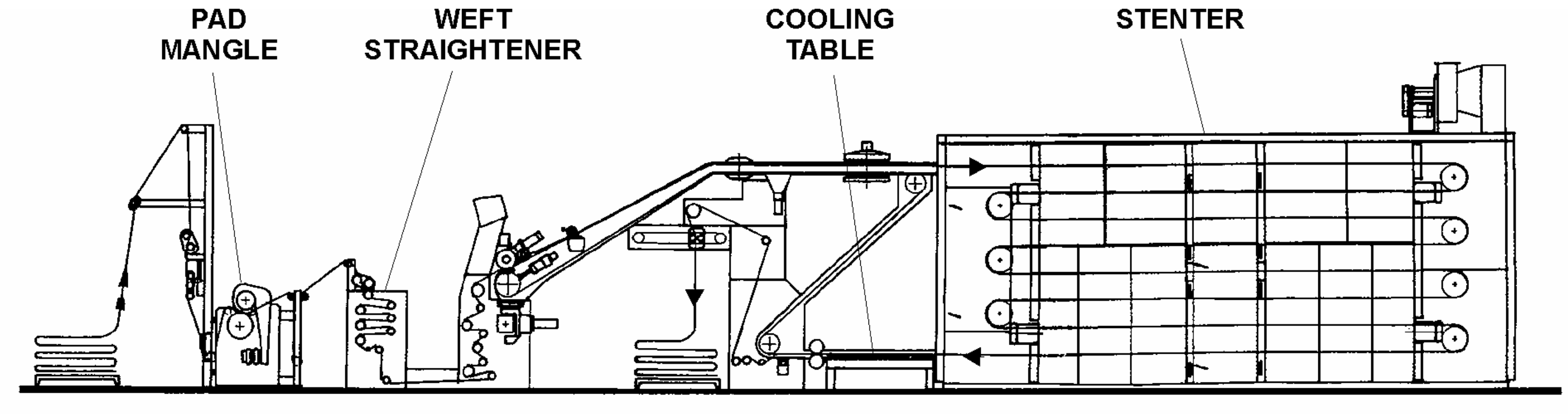


Single-layer stenter



Multi-layer stenter

A Santalucia multilayer stenter



This shows a typical installation complete with pad mangle and weft straightener. This type of configuration is optimal for the application of finishing chemicals and polymers to fabrics. The mangle can also be used to extract water evenly from fabric before drying, although it may be difficult to reduce the water content below about 60% with a mangle designed to apply finishes.

Drying

- To avoid yellowing, wool is rarely dried above 150ºC. Multilevel machines operating at temperatures as low as 110ºC are now available and have advantages because of reduced thermal damage to wool. Processing speeds are usually at least 25 metres per minute.
- Modern stenters are usually provided with cooling equipment to reduce the temperature of fabric after it emerges from the heating bays and before it is batched up or cuttled. Cooling systems usually blow or suck ambient air over or through the fabric but vary considerably in effectiveness.
- In most cases, it is desirable that the fabric should be close to ambient temperature at the end of the drying process.

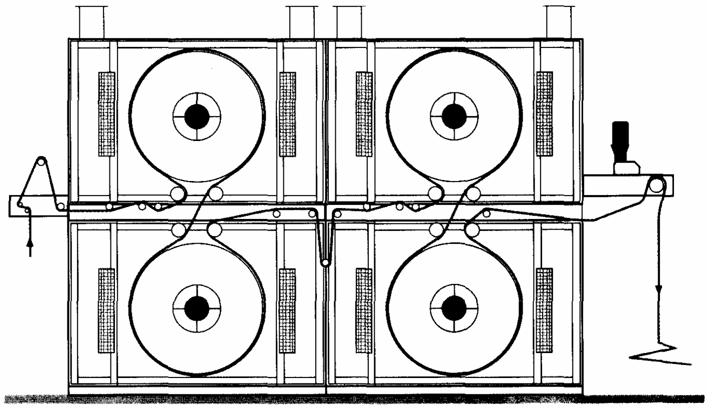
Control of drying

- Most stenters provide sensors mounted at the input, inside and output of the machine to measure such parameters as temperature, humidity and water content.
- Because of variations between fabrics, stenter settings such as bay temperatures and processing speeds may need to be adjusted for best performance with different types of fabrics.
- Correct use of sensors to control drying can ensure optimal drying conditions.
- A 9^{o}C difference between the fabric temperature and the wet bulb temperature at the fabric exit corresponds with the fabric coming to standard regain.

Drying

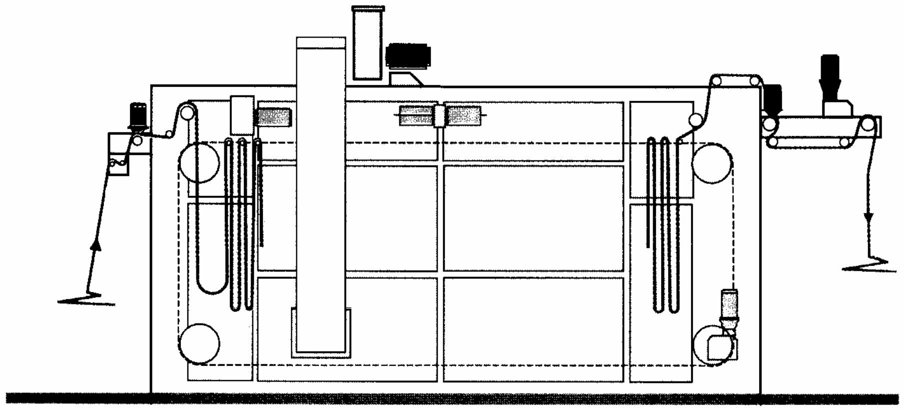
- Relaxation shrinkage may be introduced into hydrophilic fabrics during drying. The exact amount depends on a number of factors which include the amount of stretch or overfeed, the hygral expansion of the fabric and the temperature and regain at which the fabric is removed from the stenter pins.
- If the water content of a hydrophilic fabric is uneven before drying, the common practice is to overdry the fabric so it emerges from the stenter at a low regain. Excessive overdrying is highly undesirable because it leads to problems in obtaining even regain distribution in the wool during subsequent conditioning at ambient relative humidity. Experience has shown that with wool fabric it takes many weeks for very dry fabric to condition to a uniform regain when it is cuttled (or stored as a rectangular plait) uncovered in a mill.

Drum dryer



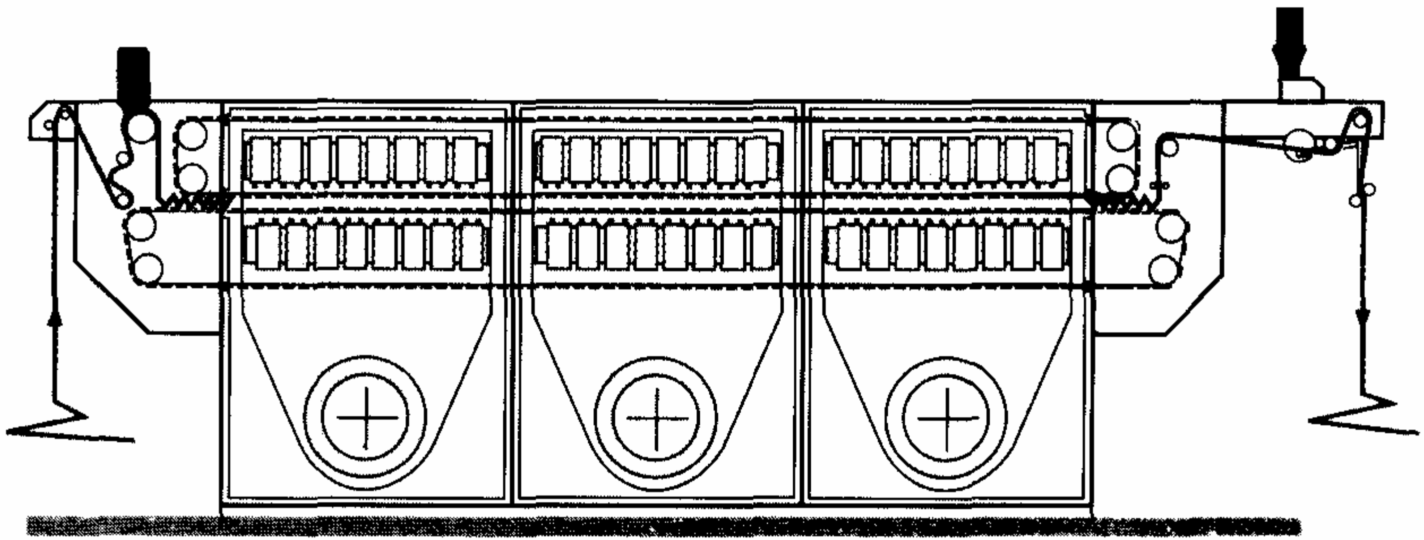
- Perforated drum dryers are made by many machinery makers such as Arioli, MAT and Sperotto Rimar.
- This type of dryer can be used after fabric has been set and scoured continuously in open width, because final fabric dimensions usually do not need to be set at this stage in processing.

Festoon dryer



- Festoon or brattice (conveyer) dryers, and radiofrequency dryers can be used after sponging, or with other machines for relaxing fabric, because they can potentially allow fabric to dry and relax without restraint.
- In this type of machine fabric is hung in loops while hot air is blown over the surface of the fabric.

Brattice dryer



- This type of dryer is often used for knitted fabrics as it allows the fabric to dry in a relaxed state. The fabric is usually overfed onto a perforated belt to assist relaxation.

2. Conditioning

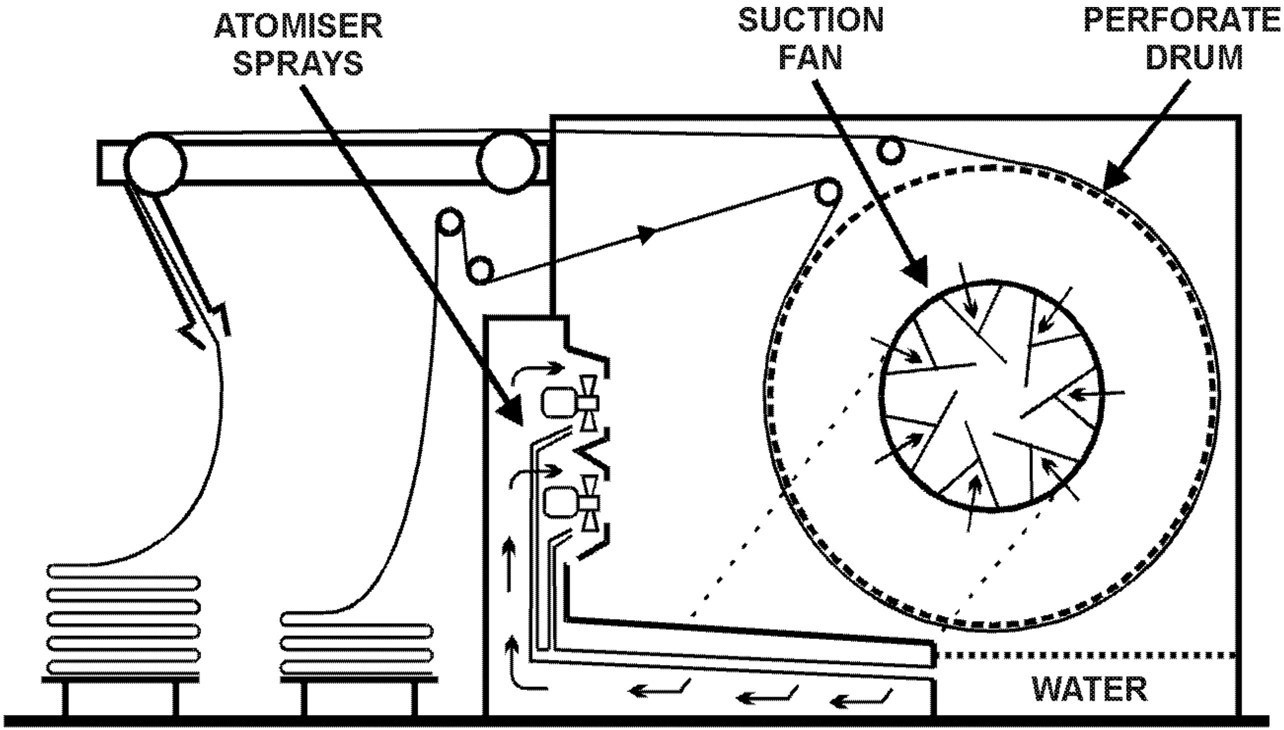
Conditioning

- The purpose of conditioning is to add moisture to wool fabric during dry finishing.
- A regain of at least 14% should be regarded as a minimum value, if satisfactory results are to be obtained in dry finishing processes such as brushing, cropping, pressing and pressure decatising.

Conditioning machines are based on one of four principles:

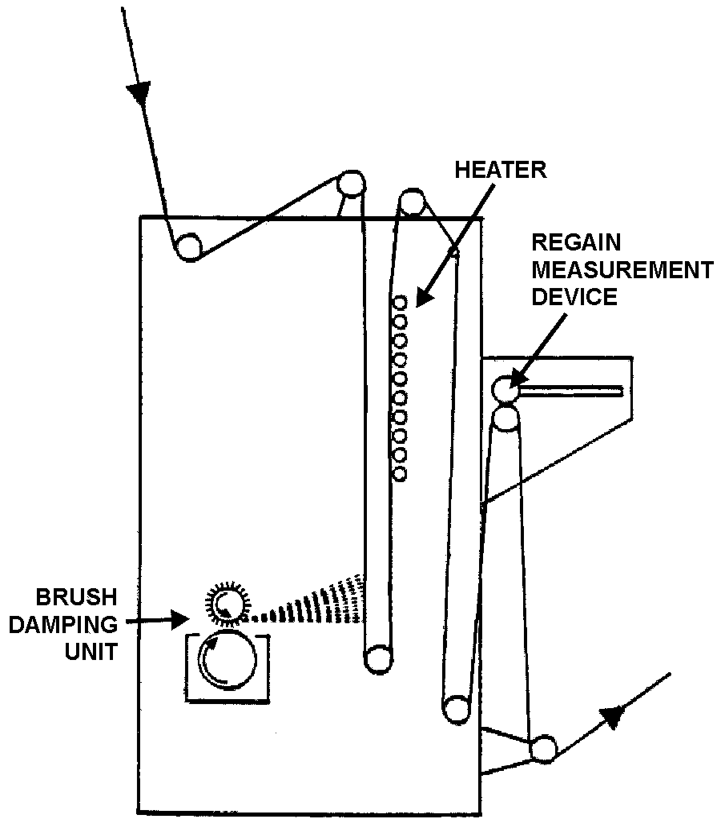
- exposure of fabric to moist air
- spraying of water onto the fabric
- immersion of fabric in hot water followed by evaporative cooling
- steaming of fabric followed by cooling.

Conditioning in moist air - the fog machine



Conditioning with water sprays

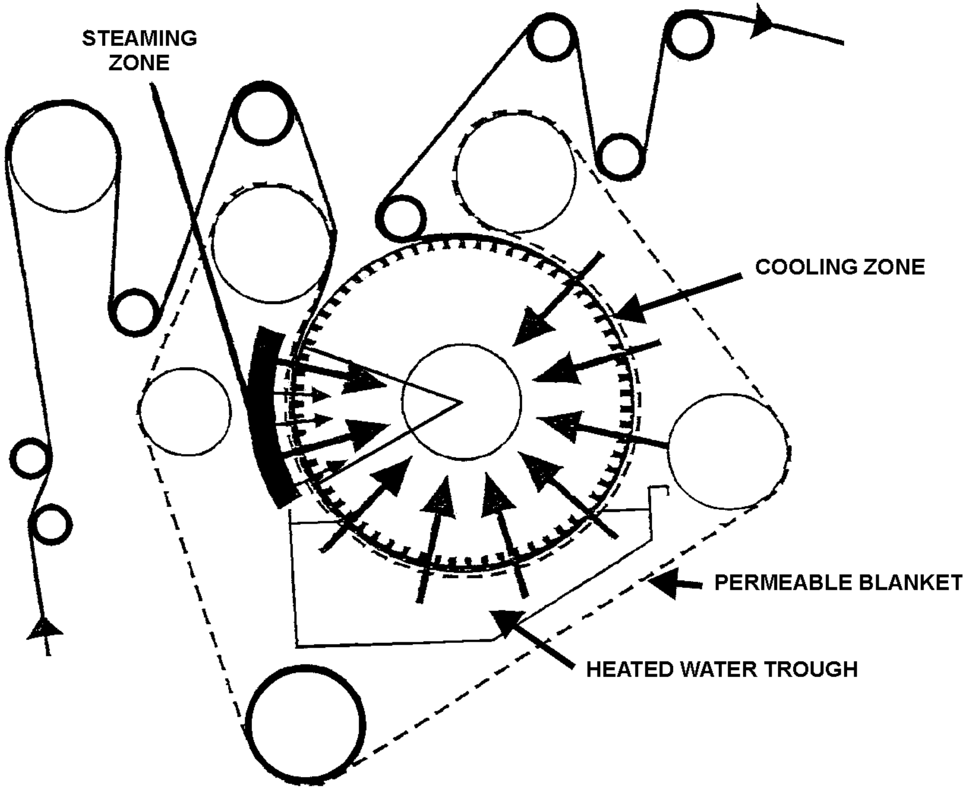
- The most modern brush dewing machine is the Igrofast (Biella Shrunk).
- This machine is electronically controlled and incorporates a regain measuring device to allow very accurate moisture application.
- After damping, the fabric is briefly heated, presumably to redistribute the moisture and increase its rate of uptake.



Conditioning in hot water followed by evaporative cooling

- Conditioning to regains between 20% and saturation is possible with the Menschner Hygrocor machine. In this machine, fabric is sandwiched between two permeable wrappers and passed around a rotating suction drum that is partly immersed in hot water. As the fabric passes around the drum it is firstly steamed, then passed through water and finally air is drawn through the fabric to cool it.

The Hygrocor machine



Conditioning by steaming and cooling

Steaming followed by cooling is not an effective procedure for raising the regain as only a relatively small amount of water is condensed on fabric as it is heated to 100^{o}C (about 6% by weight). Most of the moisture is likely to be lost by evaporative cooling as the fabric returns to room temperature.

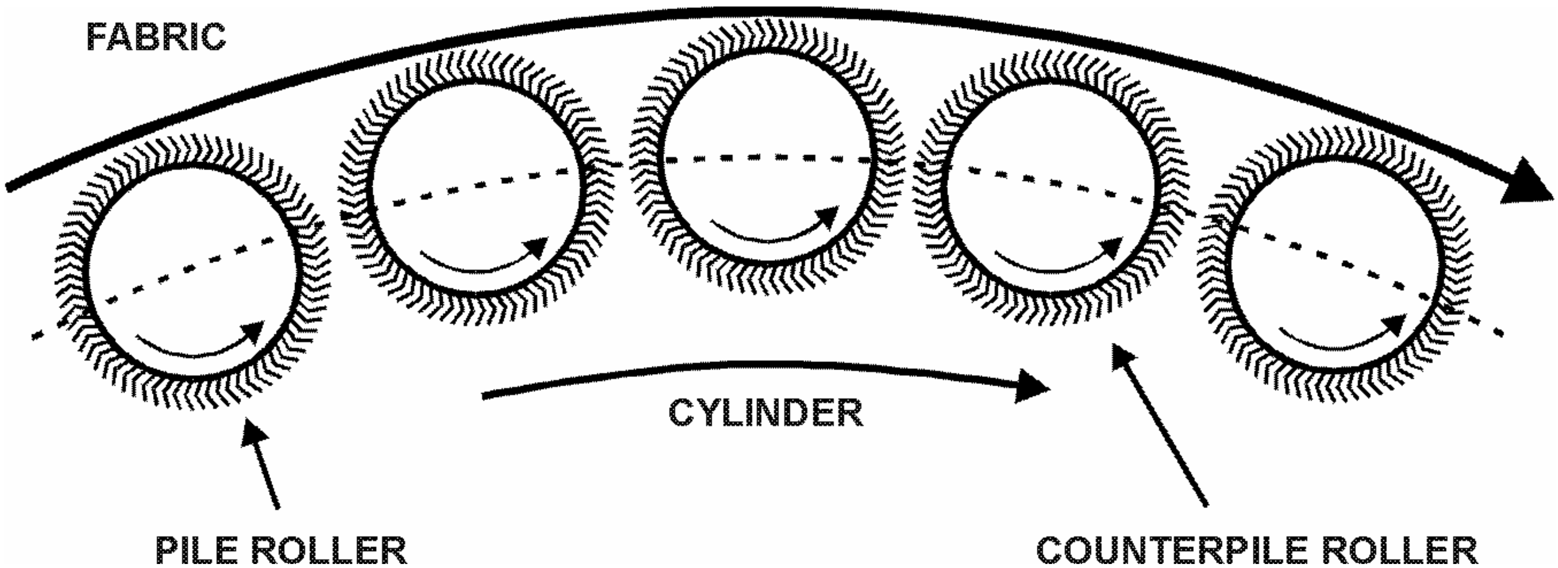
3. Raising

Raising

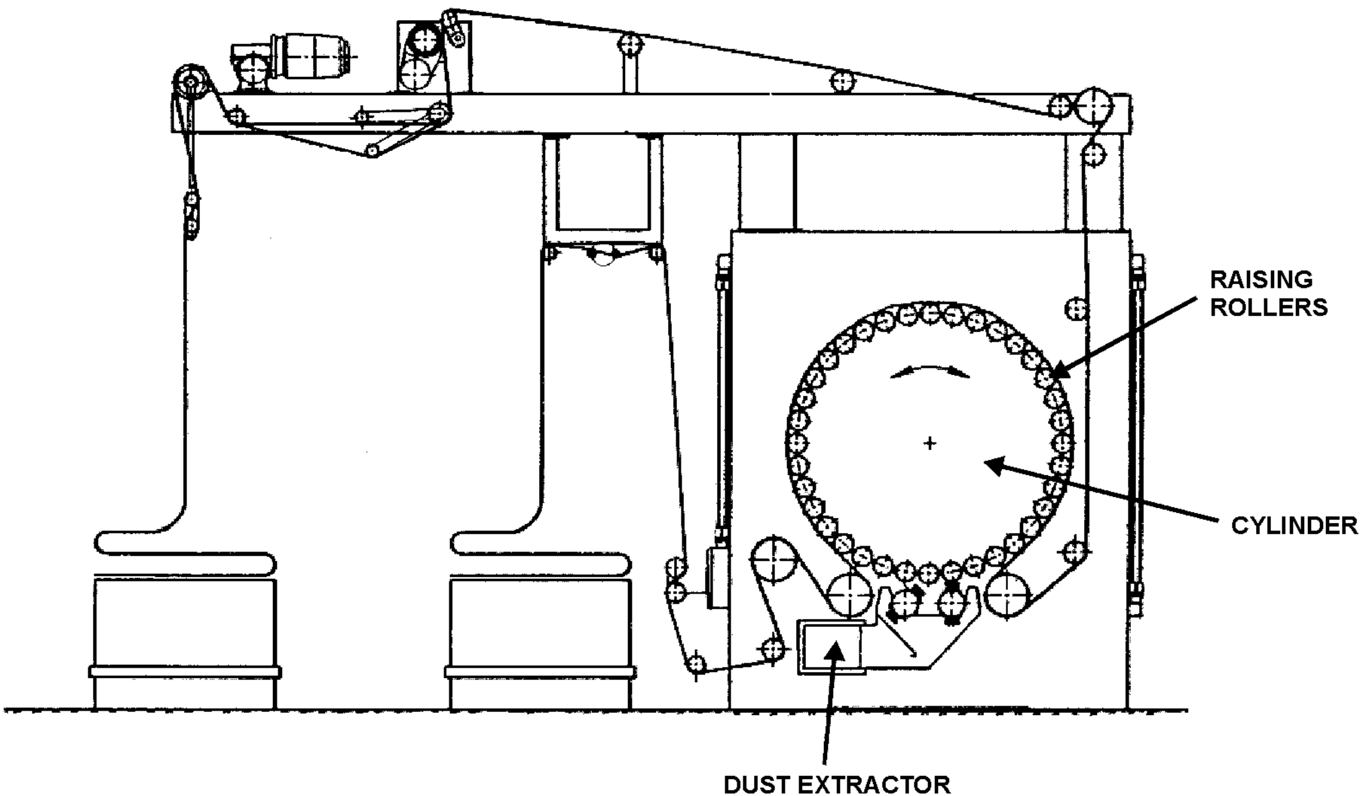
The objectives of raising are:

- to develop the required surface appearance of a fabric by increasing the thickness of the layer of surface fibres
- to increase fabric softness
- as a preliminary process prior to brushing, cropping or milling
- to produce pile fabrics
- to change the orientation of the pile.

Double action raising machine



Lafer double-action raising machine

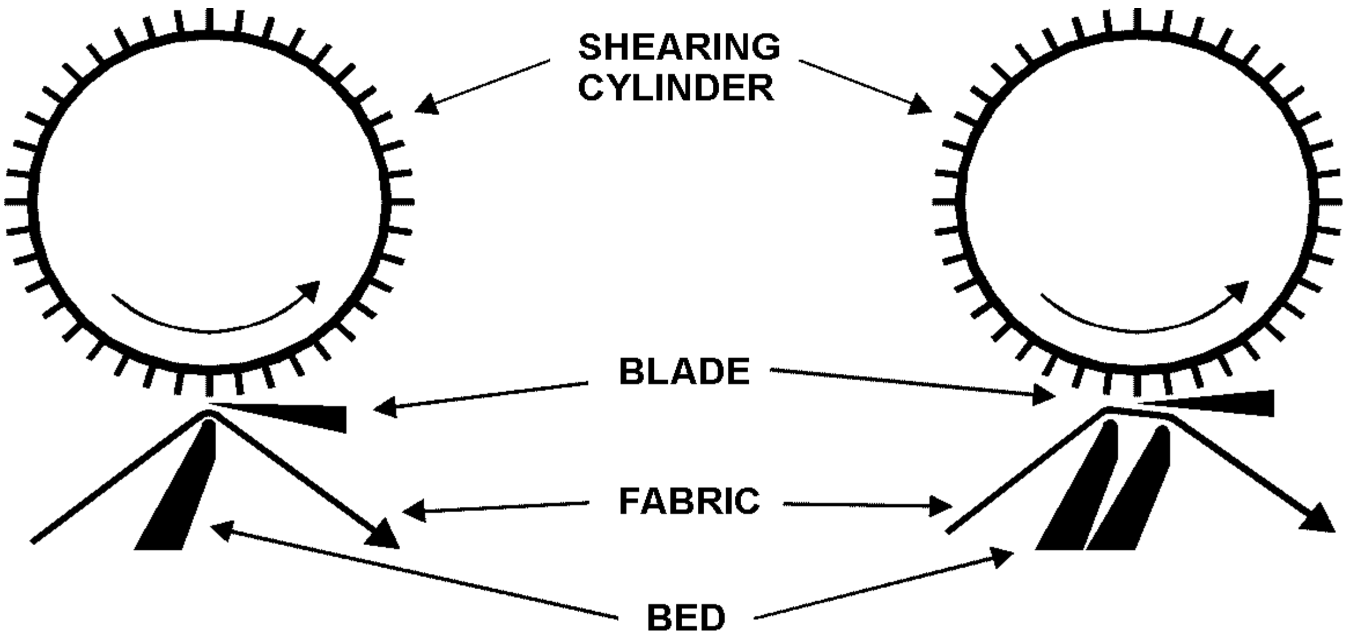


4. Cropping

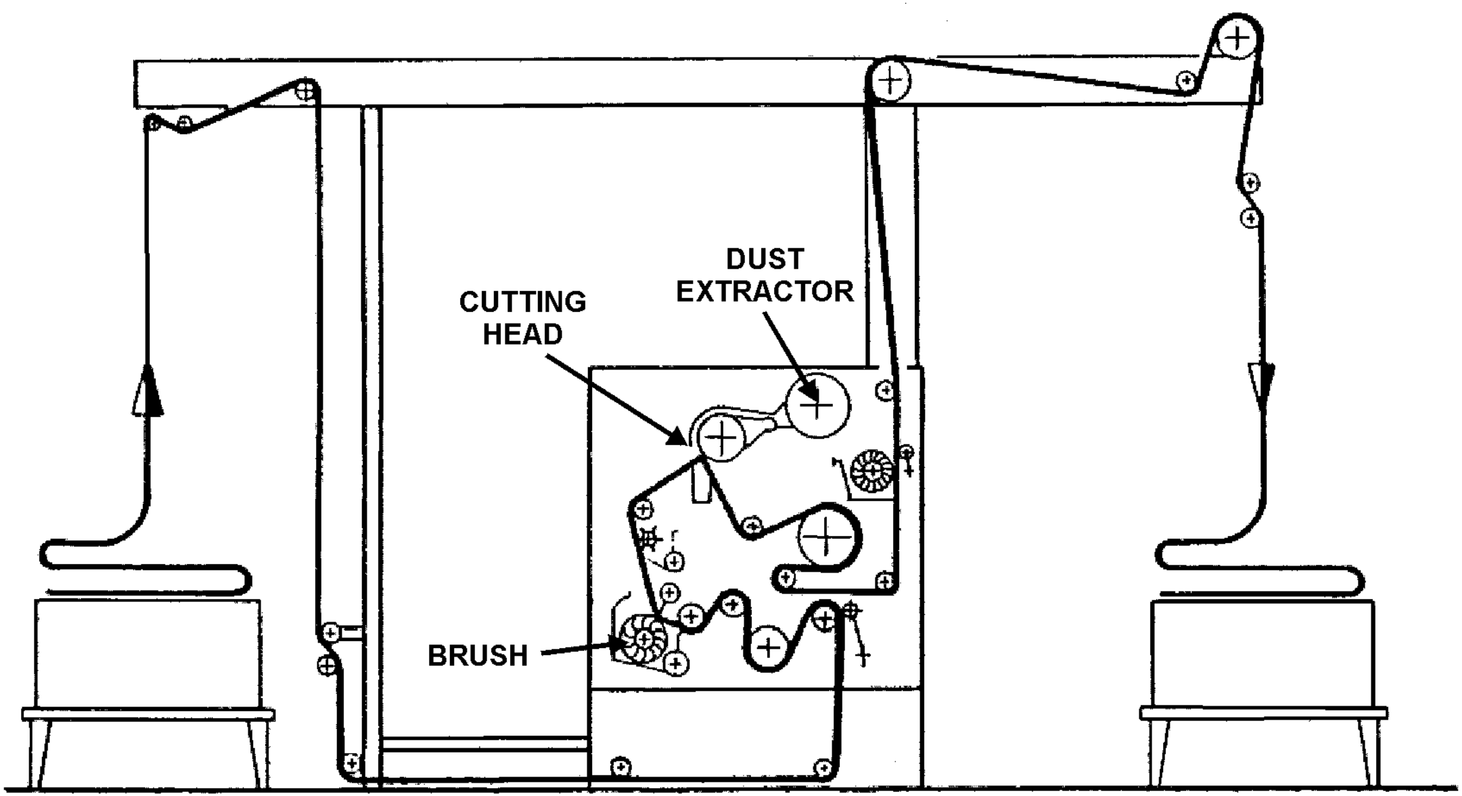
Cropping

- Cropping or shearing creates an even surface by cutting the fibres projecting from a fabric (the pile) to a uniform length.
- Both worsted and woollen fabrics are normally cropped at some point in dry finishing.
- If a fabric is to be given a clear finish, the surface fibres are cut as short as possible.
- Woollen fabrics are cropped to give an even nap to the fabric.

Solid and hollow bed cropping machines



Lafer single head shear



5. Pressing

Pressing

- Pressing reduces fabric thickness, imparts lustre, and produces a smooth handle.
- Pressing may be used as a preparation for pressure decatising.
- During pressing, only cohesive set is introduced into fabrics.
- The effect is partially removed when fabric is steamed without constraint and is completely lost when fabric becomes wet.

Pressing

In principle, fabric is briefly compressed at high pressure between smooth heated surfaces and then cooled. Three types of press are in common use:

- paper press
- rotary press
- belt press.

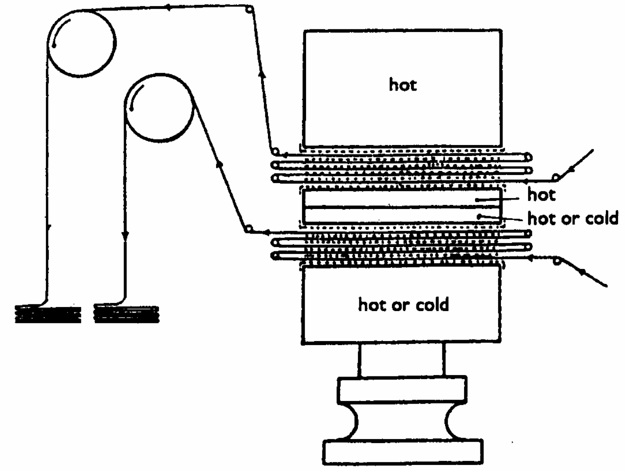
Paper pressing

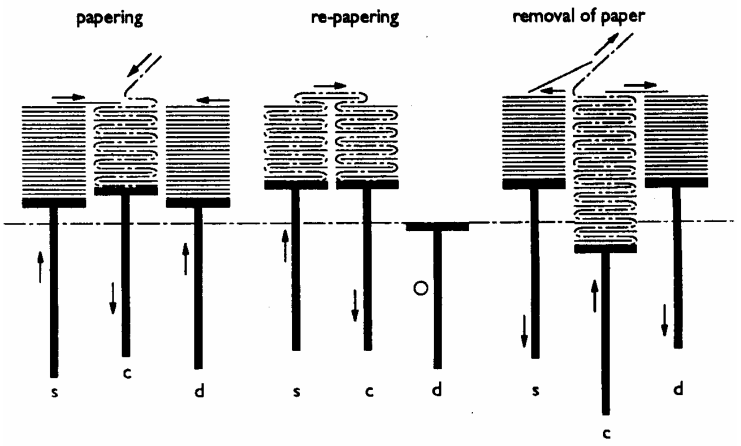
- In a paper press, fabric is pressed at a pressure of about 10 MPa - 40 MPa in a large hydraulic press while cuttled and interleaved with sheets of glazed cardboard called press papers.
- The press papers are pre-heated to around 60ºC, usually by using internal electric heating elements.
- Heating is maintained for about one hour as the pressure in the press is increased to the maximum level.

Paper pressing

- The batch is allowed to cool for about 12 hours before the fabric is removed, re-cuttled and the pressing procedure is repeated.
- During the second pressing cycle, the fabric previously outside the press papers is moved to the centre of the batch.
- Unique handle and lustre are obtainable with paper pressing.
- However, the process is highly labour intensive and the production rate is low. Two operators can load, turn and unload fabric at a total rate of about six metres per minute.

Paper pressing





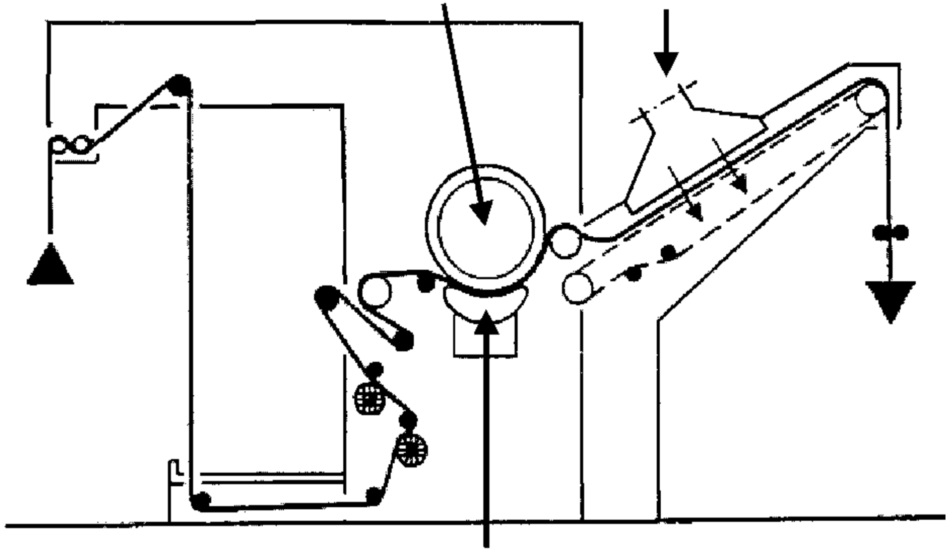
Rotary pressing

- A conventional rotary press consists of a mat-finished cast iron driven metal cylinder about 400 mm to 800 mm in diameter and a fixed, hydraulically-loaded polished brass shoe (Figure 1.22).
- Both the cylinder and shoe are heated to between 120^{o}C and 135^{o}C. Fabric is pressed between the cylinder by the shoe (with the fabric face against the shoe) and then is rapidly cooled without restraint.

Rotary pressing

- After pressing, cooling and conditioning may be carried out by circulating cool air through the fabric with a blower system.
- The cylinder must not be allowed to become smooth otherwise the fabric may slip, so the cylinder is regularly etched with ammonium chloride solution.
- The disadvantage of this type of machine is that the fabric is under tension while it is being pressed.
- Rotary presses have been superseded by belt presses.

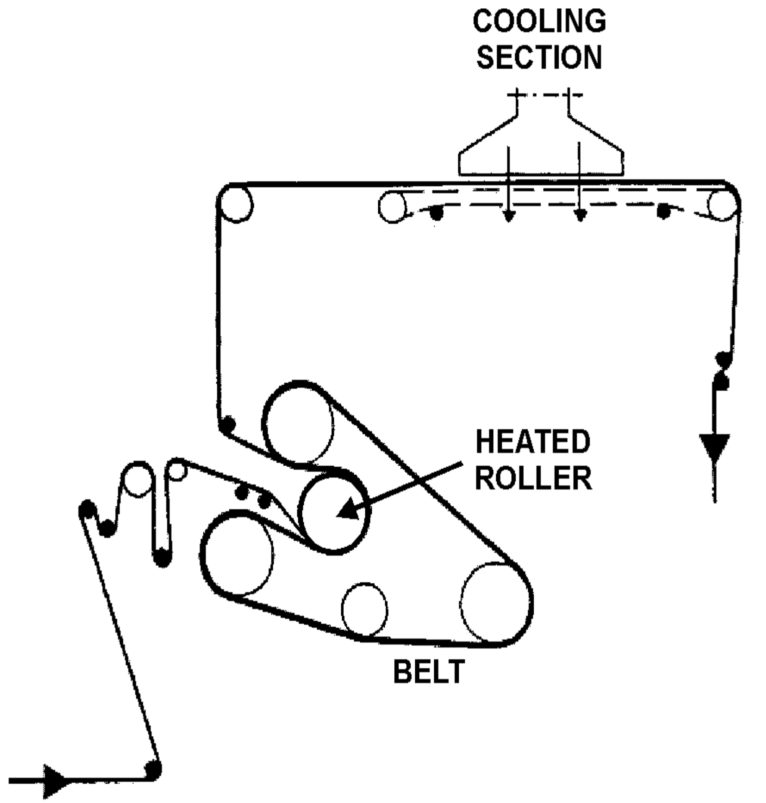
Menschner rotary press



Belt pressing

- Fabric is held against a heated metal roller by a rubber-coated endless belt under high tension.
- The fabric may be sprayed with water and then preheated with steam before it comes into contact with the heated roller.
- As in the rotary press, roller temperatures may be as high as 135^{o}C.
- Fabric is cooled after pressing, usually by drawing ambient air through it while it passes around a drum or across a cooling table.

Contipress (m-tec) belt press

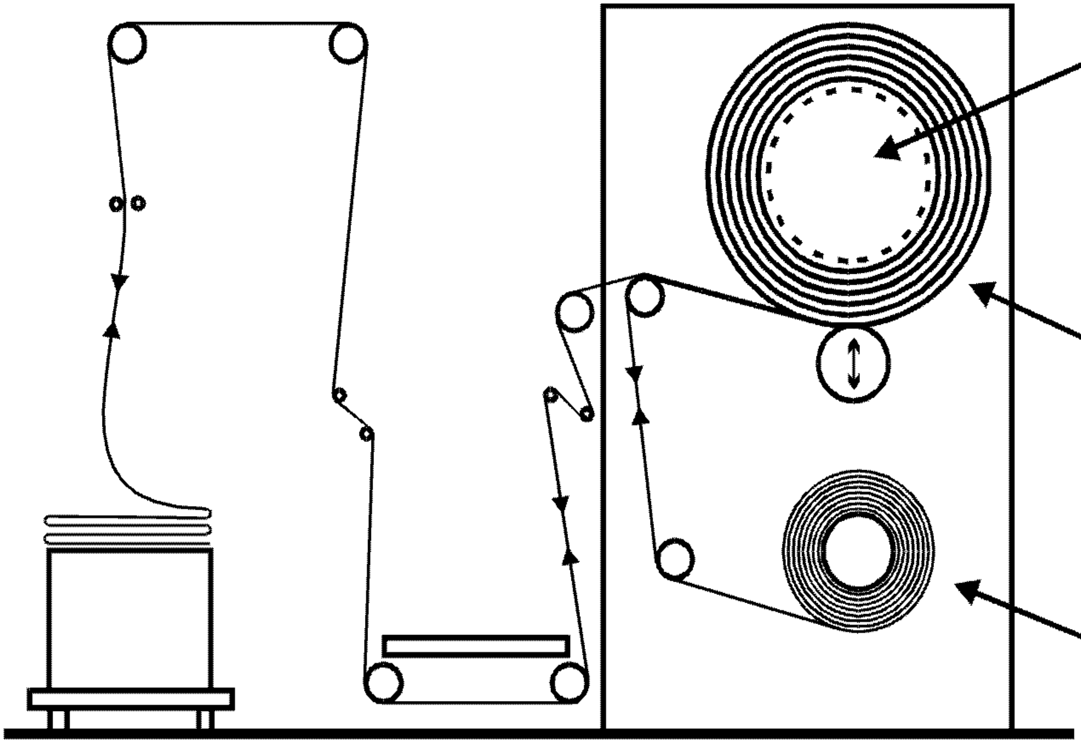


6. Atmospheric decatising

Decatising

- Decatising is also called blowing, open blowing and decating.
- In this process, fabric is rolled up with a cotton or cotton/synthetic wrapper and steam is forced through the roll for up to 10 minutes.
- After steaming, the fabric and wrapper are cooled by drawing air at ambient temperature through the roll.

A batch decatiser



Decatising

- Decatising imparts cohesive set to fabric and is used to reduce fabric thickness and increase surface smoothness.
- Depending on the surface texture of the wrapper, smooth, lustrous and textured surface effects may be obtained.
- Normally, little permanent set is introduced (less than 40% when measured by the crease angle method) even with prolonged steaming times.

Decatising

- Decatising of loom-state fabric (greasy blowing) may not adequately stabilise fabrics before dyeing if they have been woven from highly twisted yarns and have low cover factors.
- Soiling of wrappers used for greasy blowing makes frequent scouring necessary.

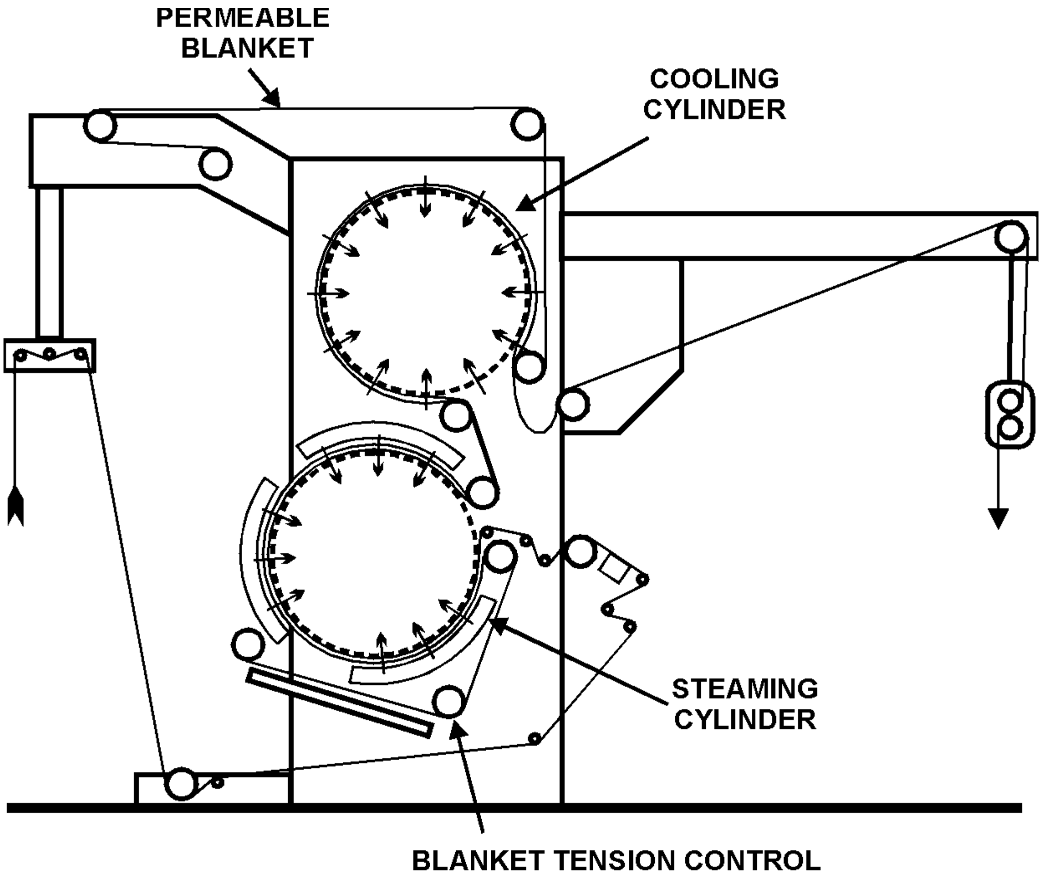
Continuous decatising

- Continuous decatisers, operating on a similar principle to batch decatisers, impart cohesively set flat finish to fabrics, but little permanent setting takes place.
- Usually, fabric is sprayed with water, to raise the regain before continuous decatising.

Continuous decatising

- The dampened fabric is held by a continuous (usually permeable) wrapper and passes around two perforated cylinders, where firstly steam then cold air is forced through the fabric.
- In some machines, the main drum is divided into sections so that steaming and vacuum cooling can be carried out on a single cylinder.

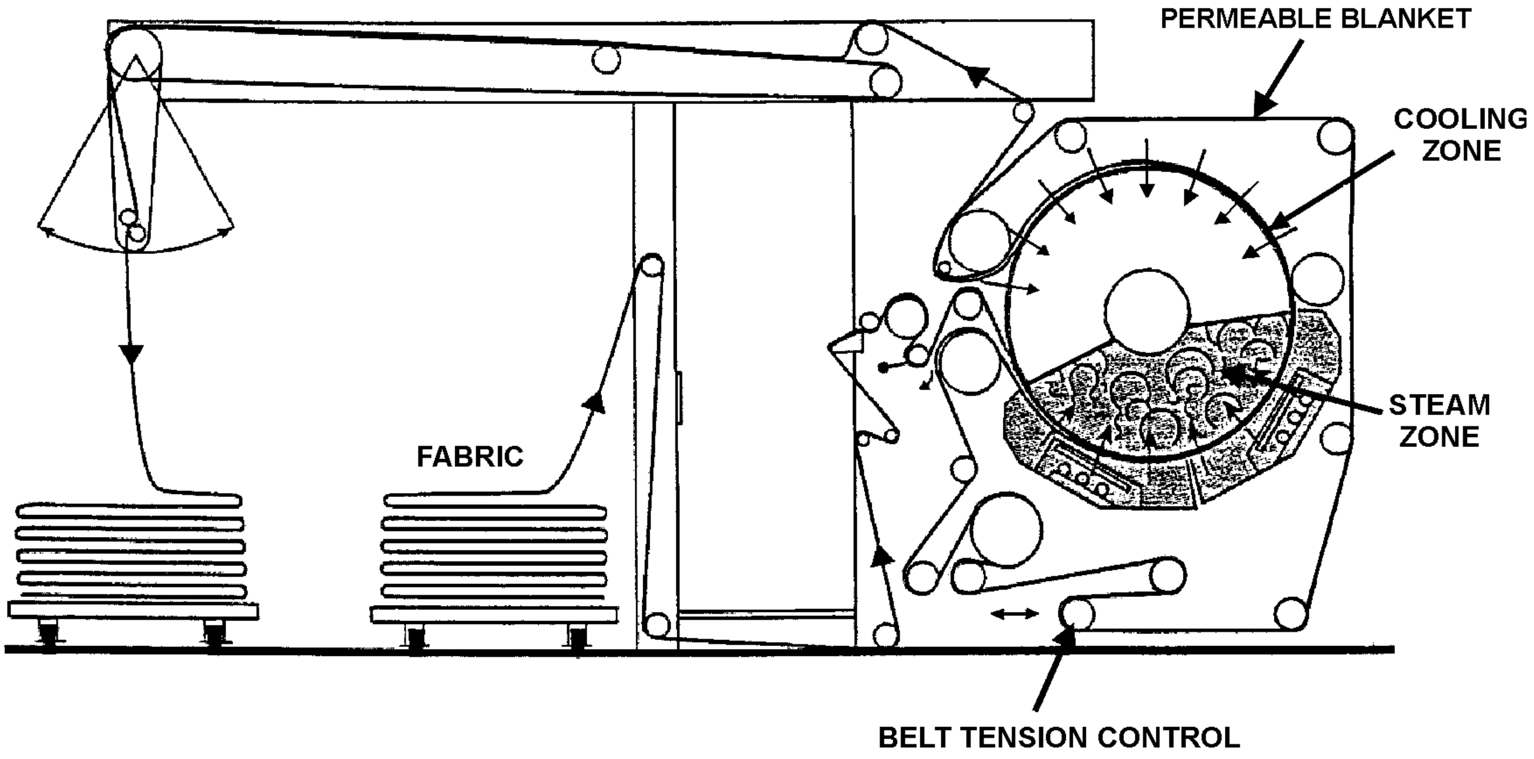
Double cylinder continuous decatiser



Continuous decatising

- In the Superfinish (m-tec) machine, steam is generated when wet fabric is held against a solid heated drum by a permeable blanket.
- While it has been suggested that these machines could be used for chemically-assisted permanent setting, the idea does not appear to have been taken up in industry, perhaps because chemically resistant wrappers would be required.

A single cylinder decatiser



Wet decatising

- If fabric is loaded into a decatiser wet rather than at ambient regain higher levels of permanent set can be obtained.
- The amount of permanent set can be similar to that obtained by crabbing or beam dyeing and may be as high as 70%.
- The fabric might be already wet from a previous process, such as scouring, or may be padded with water containing a small amount of wetting agent.

Wet decatising

- The fabric may be rolled up with or without a wrapper.
- If a wrapper is not used, undesirable moiré effects can be introduced.
- If a wrapper is used, its regain must be controlled between each treatment by the use of drying cylinders.
- After steaming, the temperature is lowered by passing cool air through the fabric.
- If a chemical setting agent is added to the pad liquor, the treatment times can be shortened, because permanent setting is more rapid.

Wet decatising

- One disadvantage of chemical setting in wet decatising is the reduced life of wrappers.
- Chemically set fabrics can produce problems in dyeing because dye uptake rates are usually altered and uneven chemical treatment can lead to uneven dyeing.

7. Pressure decatising

The role of pressure decatising in finishing

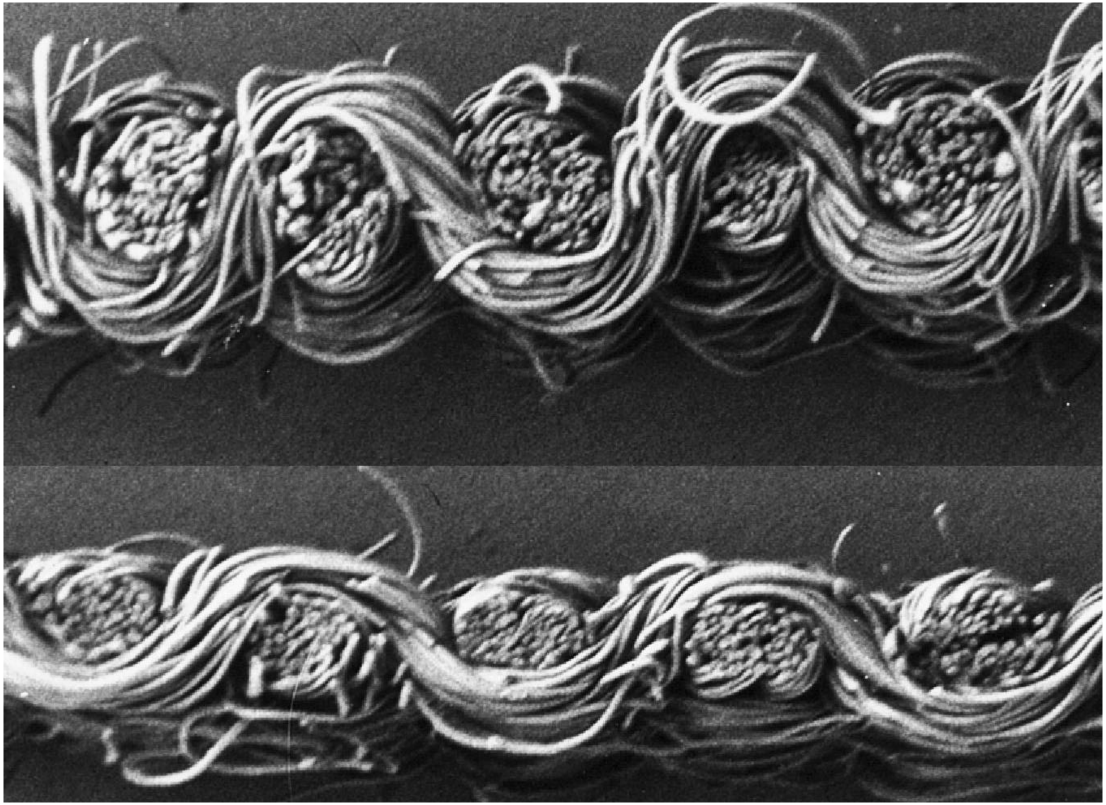
The possible results of pressure decatising are as follows:

- permanent reduction in fabric thickness
- increase in surface smoothness
- increase in fabric suppleness
- a change in the relaxed dimensions of fabric
- changes to the dimensional properties (relaxation shrinkage and hygral expansion) of fabric.

The role of pressure decatising in finishing

- Pressure decatising can be used to stabilise fabric before dyeing but the processing route is expensive because it involves an extra drying step.
- Usually, fabric will be scoured before pressure decatising to avoid soiling of the wrapper. If a solvent scouring machine is available, wrappers may be scoured economically and decatising of greasy fabric may be an option.
- The most common use of pressure decatising is in the late stages of finishing.

Cross sections of a fabric before (upper) and after pressure decatising (lower)



Operation of the pressure decatiser

The machinery and methods used for pressure decatising will be described.

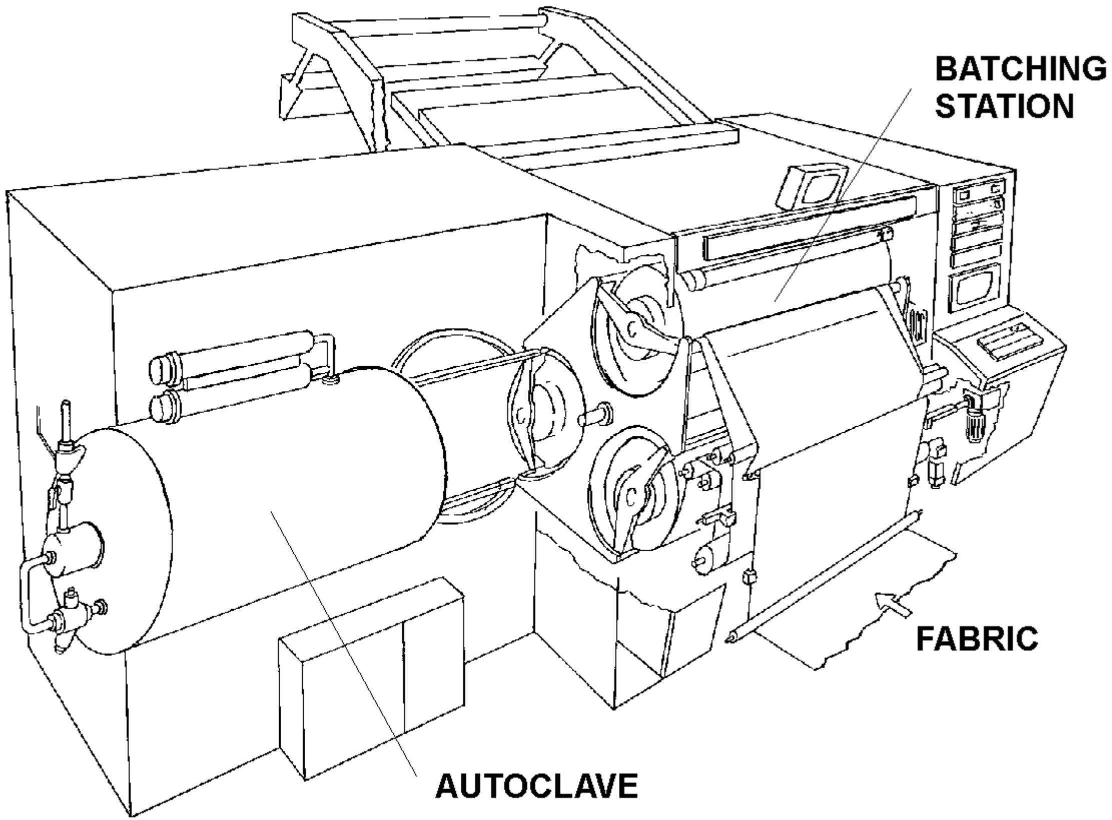
The effects of the following operating parameters are discussed with reference to their influence on the amount of permanent set imparted and other changes in wool fabric properties and appearance:

- wrapper type
- purging
- steam condition
- steam pressure
- treatment time
- fabric regain
- fabric pH.

General description of the process

- In the pressure decatising process, wool fabric is treated in an autoclave (pressure vessel) with steam at greater than atmospheric pressure.
- This occurs while the fabric is interleaved with a wrapper and wound into a batch on a hollow perforated cylinder.
- The next slide shows the principal components of a typical batch pressure decatising machine.

A batch pressure decatising machine (Biella Shrunk)



The most common basic components are as follows:

1. a station to prepare the fabric/wrapper batch and to unroll the batch after steaming
2. a transfer system to move the batches to and from the autoclave
3. an autoclave with heated walls, preferably with connection to a vacuum pump
4. provision for cooling the fabric after treatment.

Batching

- After the cylinder, fabric and wrapper assembly is placed in the autoclave, steam is forced through the layers of fabric and wrapper.
- The direction of steam flow can usually be varied from outside-to-inside or alternatively inside-to outside.
- Before the fabric is steamed under pressure, the air within the autoclave and fabric/wrapper assembly must be removed and replaced with steam.

Purging

- Removal of air is achieved by purging the system with steam. Steam can be blown through the batch under relatively high pressure. Alternatively, a vacuum pump can be used to remove most of the air before steam is introduced at a lower pressure.
- Purging is necessary to ensure that the temperature inside the pressure vessel reaches the desired value.
- At a pressure of 200 kPa, the presence of 20% (by volume) of air in saturated steam can lower the temperature by 7^{o}C.

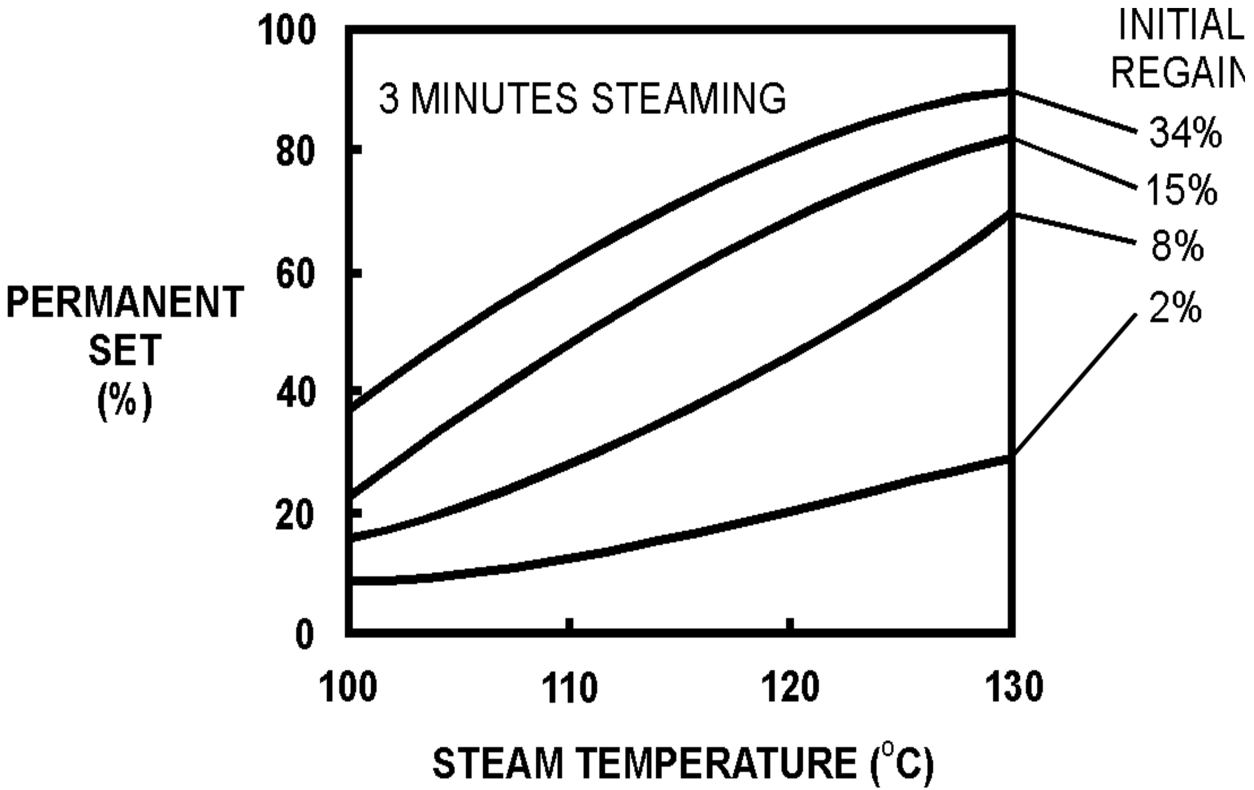
Purging

- During purging, steam penetrates the package as a fairly discrete front.
- Condensation of steam occurs at the front and the fabric temperature rises rapidly. Air is displaced from the fabric ahead of the front.
- The condensed steam increases the regain of the fabric, facilitating the permanent setting of the wool.
- An important function of purging is the removal of air from the wool. The oxygen in the air can react with wool causing yellowing and lowering the permanent setting effect. Also, some dyes are not stable to oxidation and dyed colours can be affected to a greater or lesser extent.

Setting during pressure decatising

- During the process of pressure decatising, both cohesive and permanent set are introduced into fabric.
- As a rule, the amount of permanent set imparted increases with:
  - temperature (above 100ºC)
  - treatment time
  - moisture content of the fabric
  - pH of the fabric.
- Practical limits on temperature, time and pH are set to avoid yellowing and excessive damage to wool.
- Fabric is normally steamed under pressure for up to five minutes at temperatures between 105ºC and 130ºC.

The relationship between initial regain and steam temperature for one particular fabric



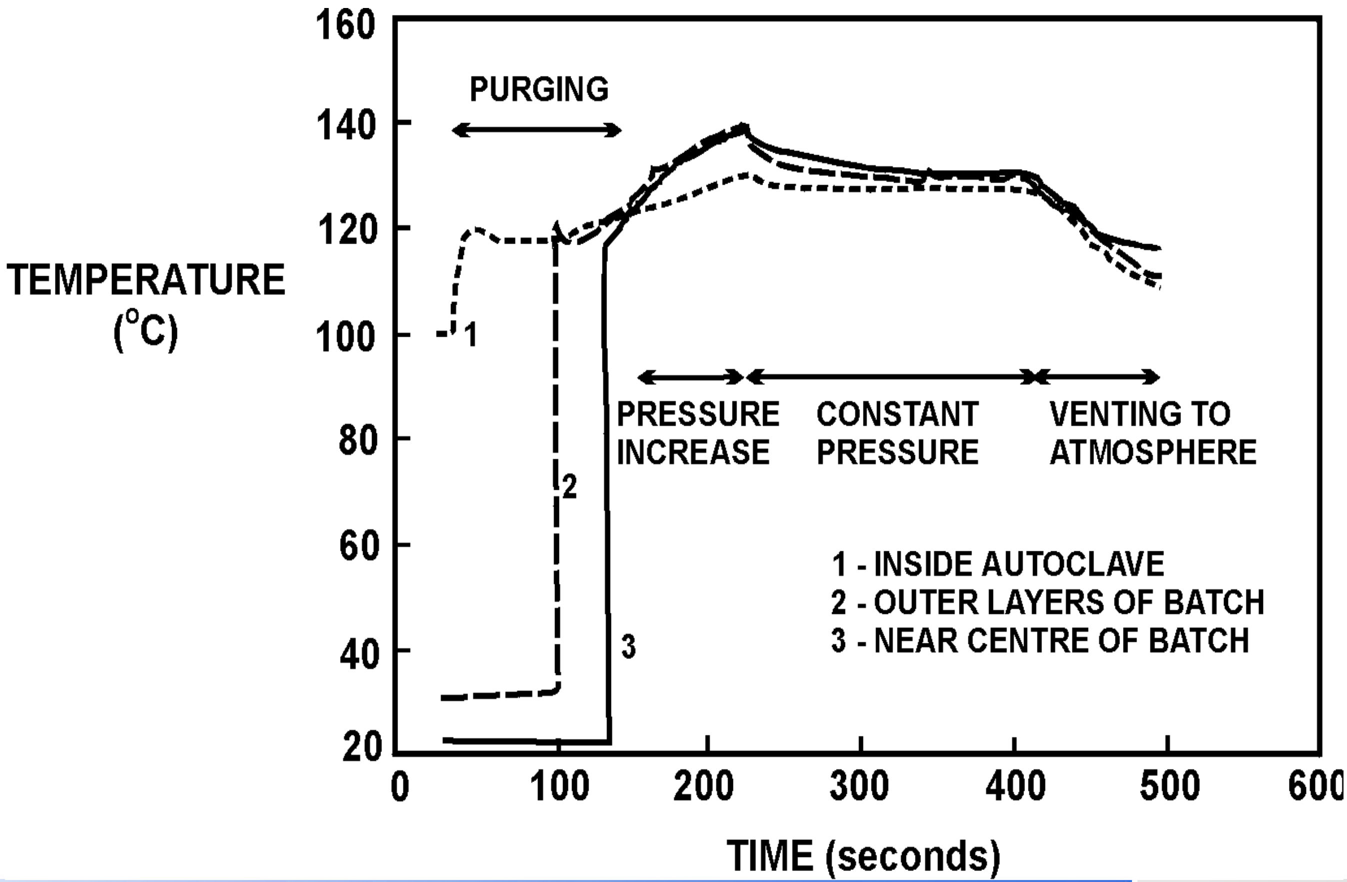
Recent machinery developments

- The pressure decatising process is primarily a batch process.
- Most of the developments and improvements incorporated into commercial pressure decatising machines have been aimed at improving three aspects of the process:
  - increasing production rate
  - reducing variation within batches
  - reducing variation between batches.

The effect of the initial regain of the wool

- As the steam front reaches a particular layer of fabric and condensation occurs, the condensed water is available for absorption by the fibres of both the wool fabric and the wrapper.
- The absorption of water by the wool and cotton (which may be present in the wrapper) results in the liberation of energy known as "heat of sorption".
- This energy is evolved when water is chemically absorbed by any hydrophilic material. In this case, it can increase the temperature of the fabric and wrapper above the steam temperature.
- The amount of heat liberated per unit mass of wool depends on the initial and final regains of the wool and wrapper and is greatest when the regain is lowest.

Temperatures at different positions inside a machine during pressure decatising



AUSTRALIAN WOOL
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The importance of regain control

- It has been found that pressure decatising wool fabric that has not been adequately conditioned will not only result in a lower level of permanent set, but a greater likelihood of yellowing due to the temperature of the batch being considerably above the steam temperature.
- In practice, fabric ready for pressure decatising in a mill may be warm and at a low regain. Processes usually carried out before pressure decatising include stentering and rotary pressing. Immediately after these processes, fabrics are likely to have regains between 2% and 8%. This range of values is less than optimal for pressure decatising.
- A conditioning process to increase the regain of fabric to at least 15% to 20% is highly desirable if efficient permanent setting is to be achieved.

The physical effect of the wrapper

- The variables associated with different wrappers, such as thickness, density, weave, and fibre composition, all effect the outcome of the process.
- However, with a particular wrapper, the main variables are wrapper tension, temperature and regain.

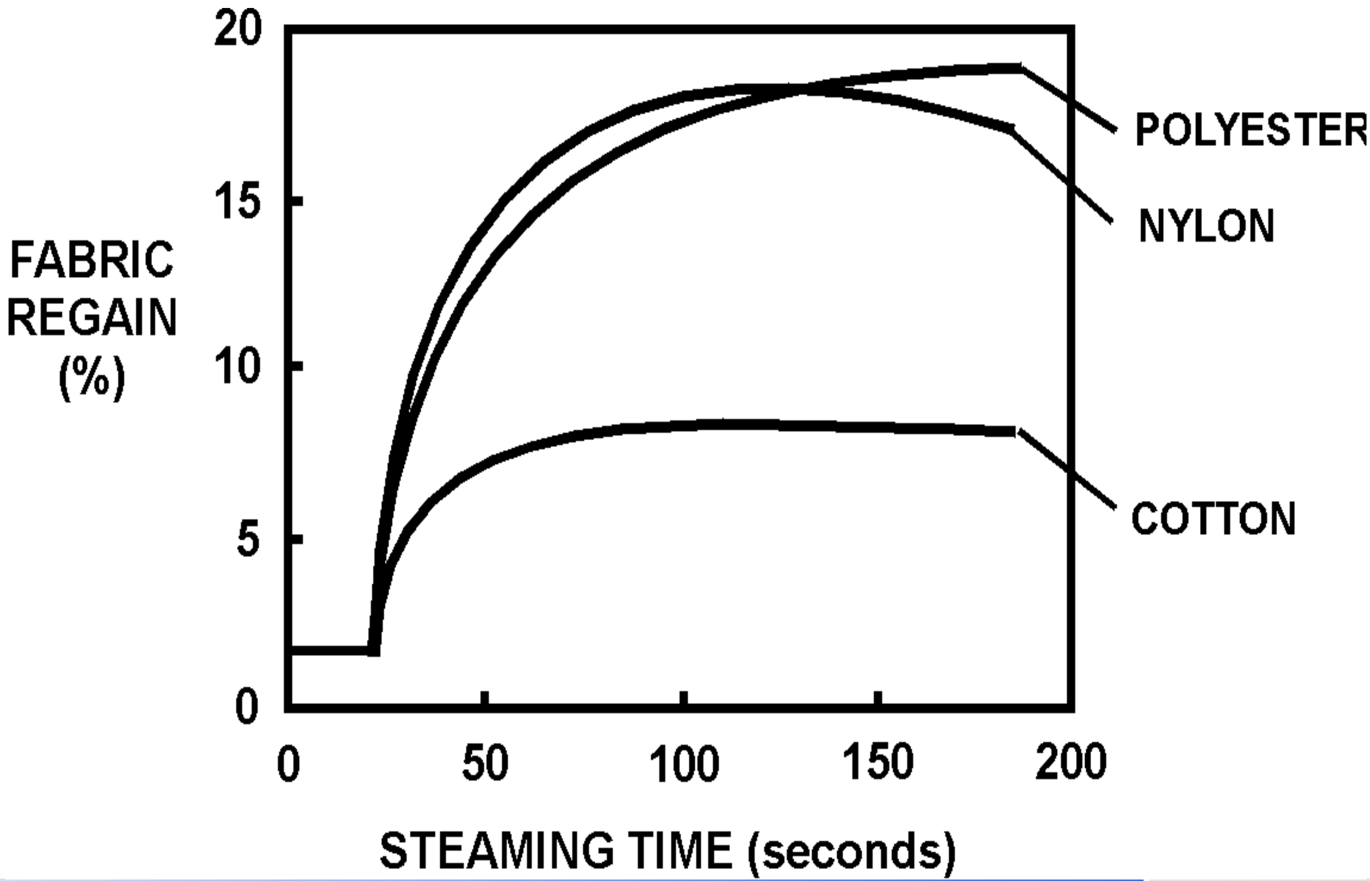
Wrapper composition

- The moisture that condenses in the batch of fabric during the heating phase may exceed the absorption capacity of the wrapper.
- Excess condensed water may remain as free water in the wrapper, or it may be absorbed by the wool fabric being treated.
- The transfer of free water from the wrapper to the wool fabric can further increase the fabric regain.

Water absorption and the type of wrapper

- Absorption of the extra water will further raise the fabric temperature due to the evolution of extra heat of sorption. The next Figure shows the calculated changes in regain that may be expected when fabric, initially at a low regain, is steamed with wrappers made from cotton, polyester or nylon.
- The expected increase in regain of wool steamed with a cotton wrapper, is much smaller than with a polyester or nylon wrapper.
- With wrappers which are unable to absorb all the condensed water, the regain achieved by the wool during steaming can be expected to increase as the ratio of the wrapper mass to wool fabric mass in the batch increases.

Changes in regain of wool fabric during pressure decatising with different wrappers



Wrapper tension

- Wrapper tension needs to be carefully controlled. Fabric needs to be restrained under enough pressure to produce the desired changes in surface texture and fabric thickness.
- There are lower limits on wrapper tension if wrapper collapse is to be avoided. Symptoms of wrapper collapse are permanently set wrinkles, creases or other distortions in the weft direction. As in so many aspects of the pressure decatising process, a compromise is required.

Wrapper (cont.)

- When a wrapper is in continuous use with a regular cycle of rolling, steaming and unrolling, it will tend to gradually increase in regain.
- On some machines, drying rollers are provided to keep the wrapper from becoming saturated with water.
- When a batch is formed with a warm wrapper that may have been heated in previous decatising cycles, the wrapper may heat the wool fabric. Temperatures between about 60^{o}C and 70^{o}C have been measured in the middle of a package before it was placed in the autoclave of a commercial machine.

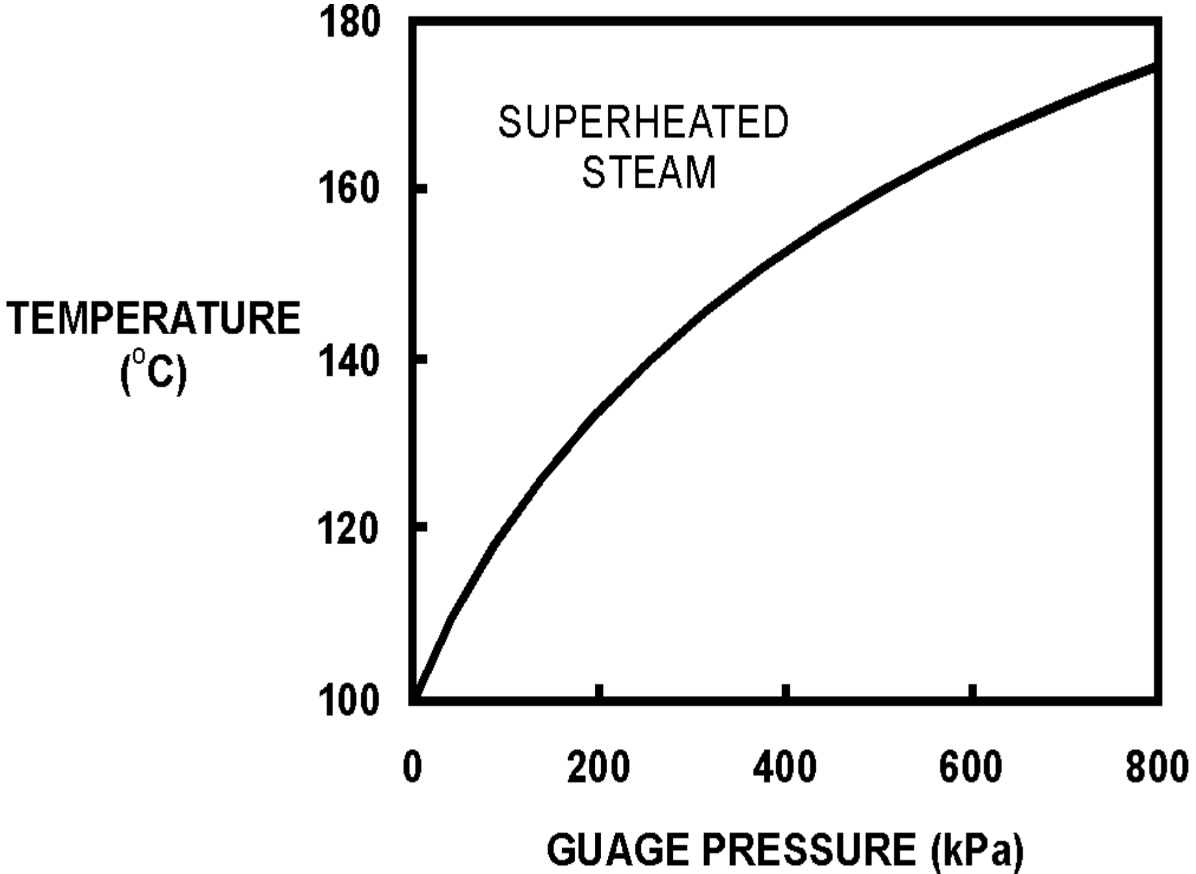
Wrapper (cont.)

- As a result, less water will be condensed on the warmed fabric in the centre of a batch to heat it to 100ºC than on fabric at ambient mill temperature.
- About 3% of water would be condensed on fabric initially at 60ºC, compared with about 6% for fabric at 20ºC.
- The increase in regain of the wool fabric during the process will be progressively smaller as the wrapper temperature rises.
- An initial temperature gradient in the batch will result in a regain variation in the fabric with consequent effects on the amount of permanent set introduced.

Steaming under pressure

- The steam temperature inside the decatiser is usually controlled by varying its pressure.
- Steam is normally supplied to the decatiser at pressures between 700 kPa and 900 kPa.
- For consistent results, the steam pressure, temperature and relative humidity should be constant.
- It is highly desirable that the steam which comes in contact with the fabric should be saturated.
- The roll of fabric are usually steamed under pressure for up to five minutes at temperatures between 105^{o}C and 130^{o}C.

The temperature and pressure of saturated steam



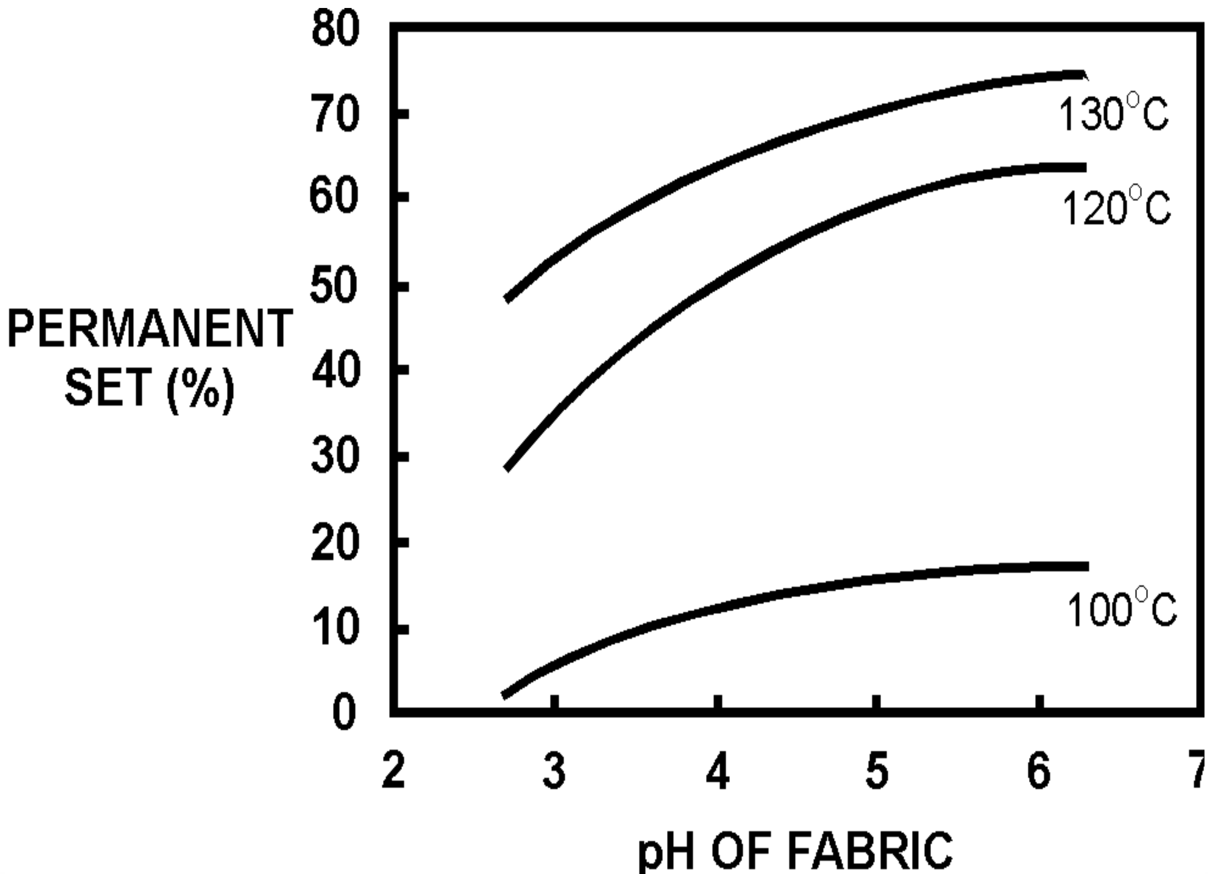
Cooling down

- If the fabric is unwrapped from the decatiser package while it is still hot, cohesive set may not be imparted during cooling.
- This procedure is used by some finishers to reduce cohesively set lustre after pressure decatising.
- Relaxation shrinkage may be reduced if the fabric is unwound and cooled without tension.
- This is a risky procedure because relaxation shrinkage may be introduced in an uncontrolled way it the fabric is inadvertently stretched while it is cooling.

The effect of fabric pH

- The amount of permanent set introduced into a fabric increases with fabric pH.
- The highest amounts of permanent set are obtained at around pH 6. Higher pHs are not desirable because of the likelihood of damage to the wool.
- It should be noted that a fabrics dyed with 1:1 premetallised and acid levelling dyes may have a low pH and be difficult to set. In this case, adjustment of the fabric pH to a higher value after dyeing is highly desirable.

The effect of fabric pH on the amount of permanent set introduced



Fabric handle

- Another important result of pressure decatising is a change in the suppleness of fabric.
- Generally, the suppleness of colour woven fabrics can be increased while piece-dyed fabrics may become less supple.
- However, there is little quantitative information available on the relationship between subjective handle and the operating parameters of the process.

Treatment conditions and fabric yellowing

- The requirement for permanent setting has to be balanced against the yellowing of wool which occurs at elevated temperatures.
- The fabric yellowing increases with the temperature at which fabric is steamed.
- Yellowing can be affected by the initial regain of the fabric.

Summary

- To achieve the best results, the process conditions should be optimised along the lines given in the following slides.
- However, all of these factors need to be considered in conjunction with an understanding of the way in which they may interact to affect the fabric properties.

Fabric:

- initial regain at least 14%
- initial temperature not too high (as close to ambient as possible)
- pH as high as practicable (if possible, not less than 4.5).

Purging:

- as rapid and complete as possible, preferably vacuum assisted
- temperature (steam pressure) as low as possible.

Steam:

- should be saturated
- during the pressure cycle, a longer time at lower temperature is preferable to a high temperature for a short time.

Cooling:

- fabric temperature should be returned as close to ambient as possible
- lustre can be reduced if the batch is unwound warm
- relaxation shrinkage may be reduced if the fabric is unwound and cooled without tension
- relaxation shrinkage may be increased if tension is applied as the fabric cools.

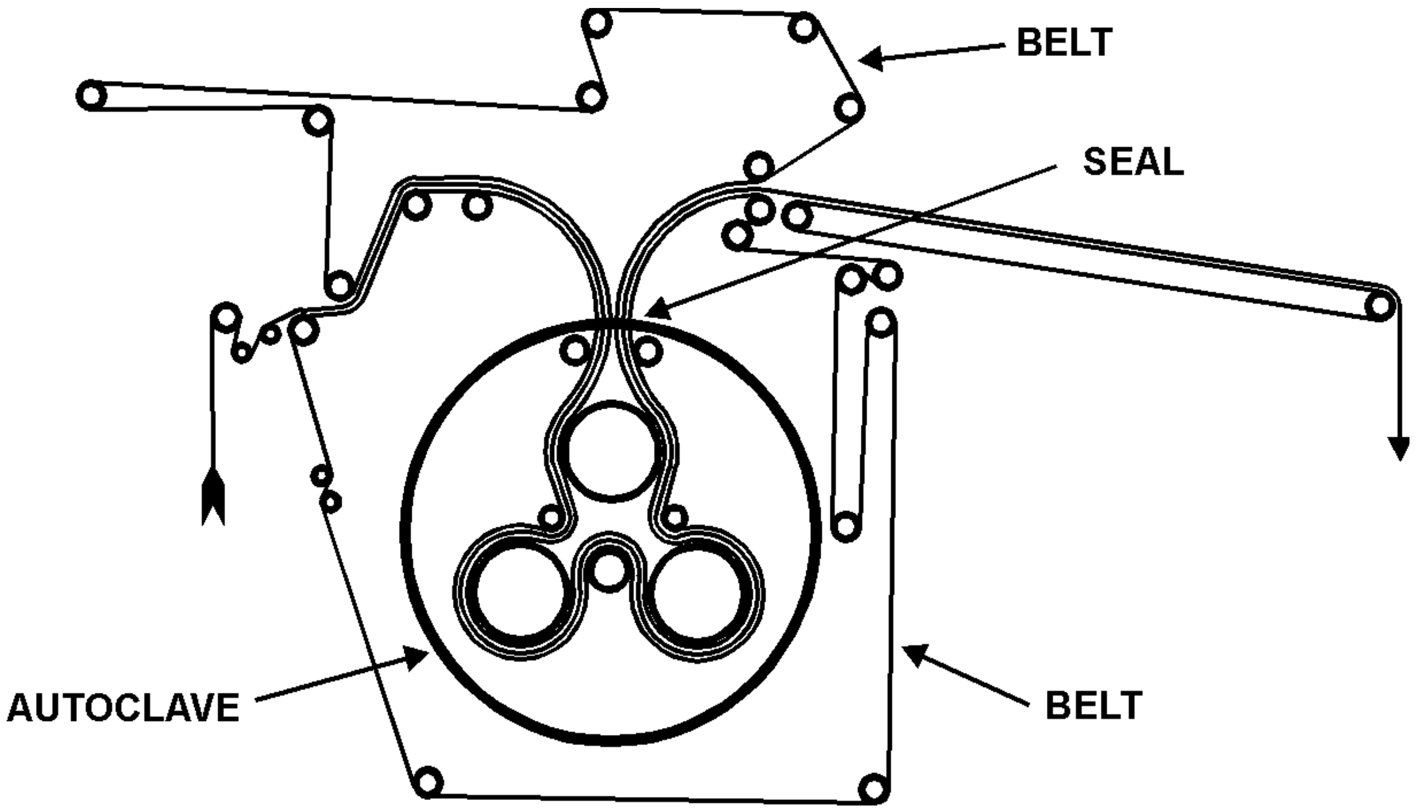
Continuous pressure decatising

- Continuous pressure decatisers are under development by several machinery manufacturers, but as yet, none are widely used by industry.
- Generally, the amount of permanent set introduced is only moderate.
- The range of finishes is not as wide as can be obtained with a batch decatiser.

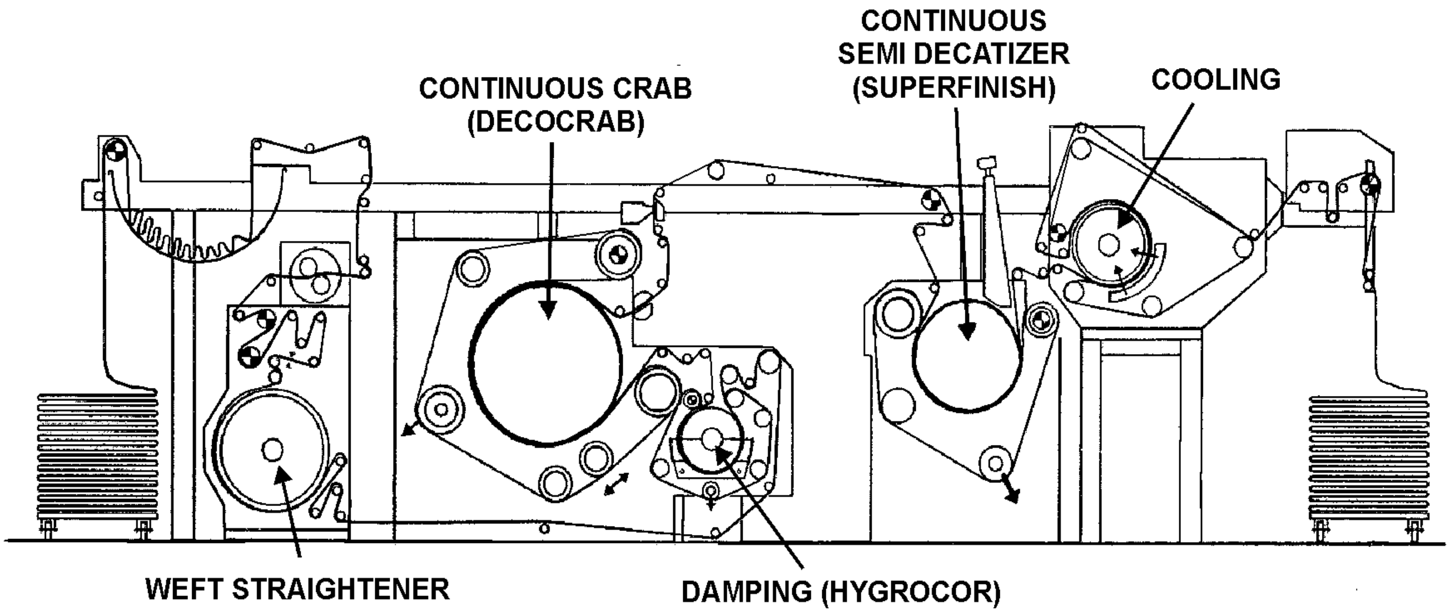
Continuous pressure decatising

- In the Ekofast (Mather and Platt) machine, fabric is compressed between two belts and passes continuously through special seals into an autoclave where it is heated in saturated steam at up to 140ºC, with a residence time of about one minute.
- Some permanent set is imparted to fabric (typically 50%).
- In an alternative approach, the Permafix (m-tec) machine uses a continuous crab and a decatising unit in series to impart permanent set.

Ekofast machine



A Permafix (m-tec) machine

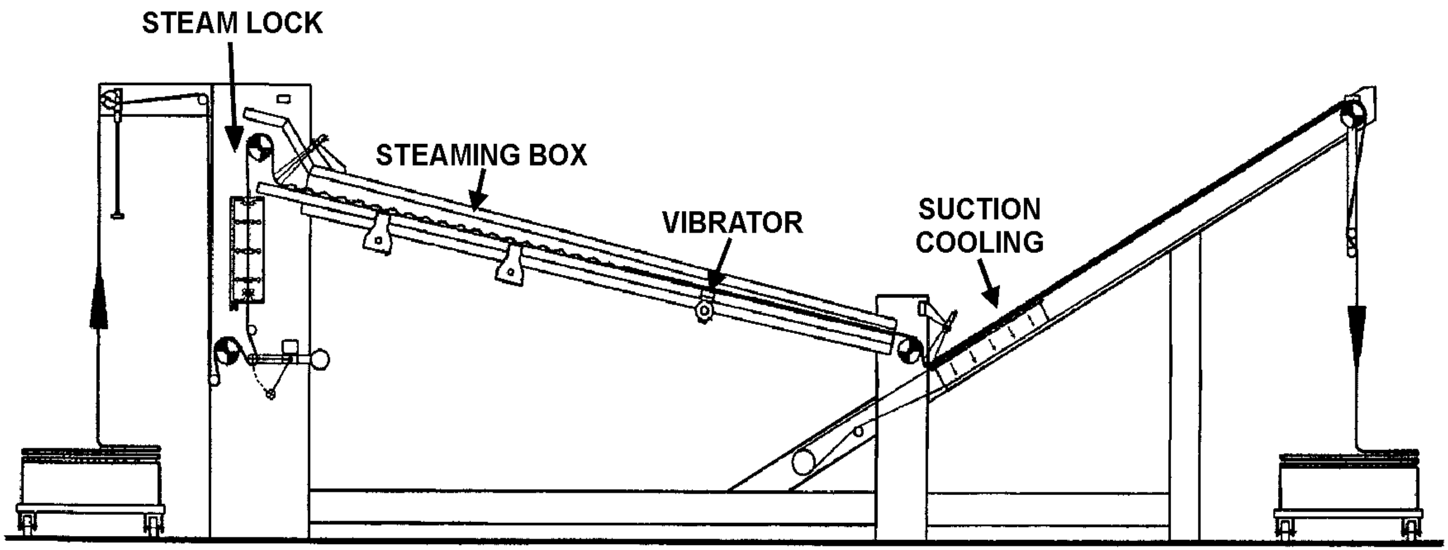


8. Sponging

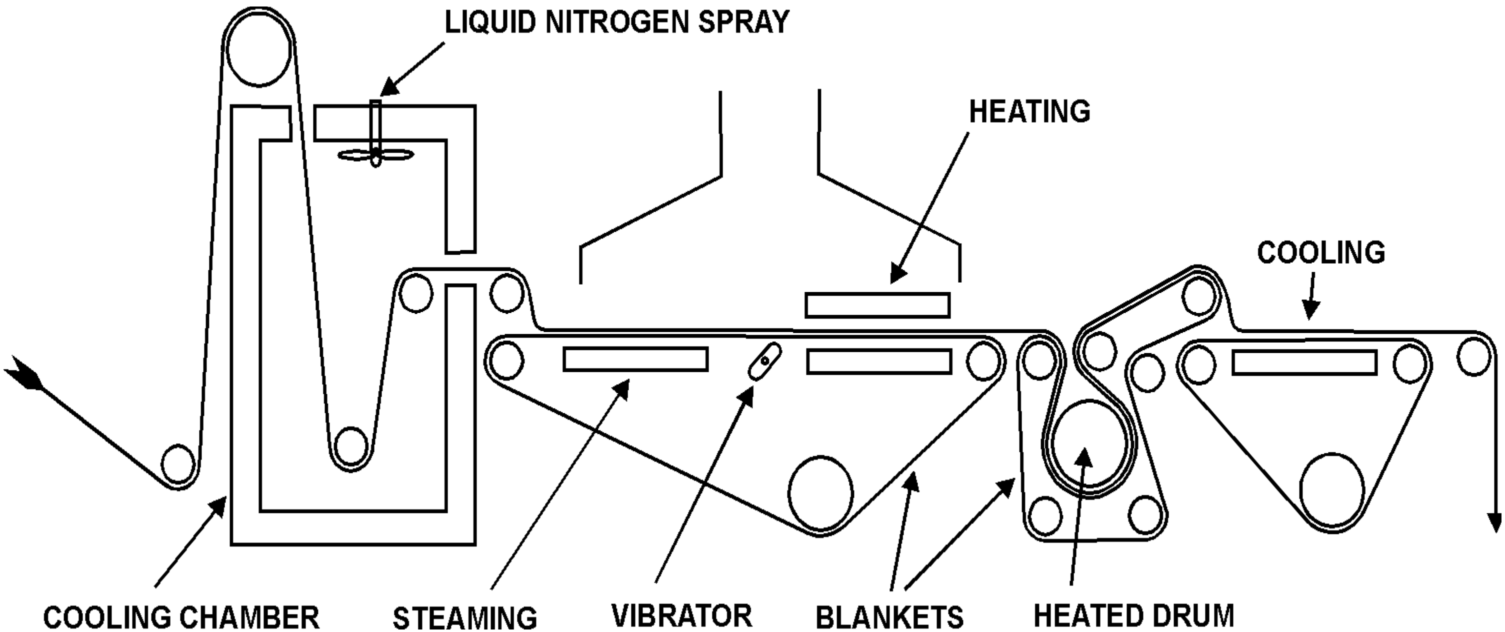
Sponging

- Sponging partially, or completely, relaxes fabric and reduces relaxation shrinkage.
- Sponging is usually used at the end of a finishing sequence or to prepare fabric for tailoring.
- Relaxation is achieved by feeding fabric onto a perforated belt or brattice where it is steamed, cooled and dried without tension.

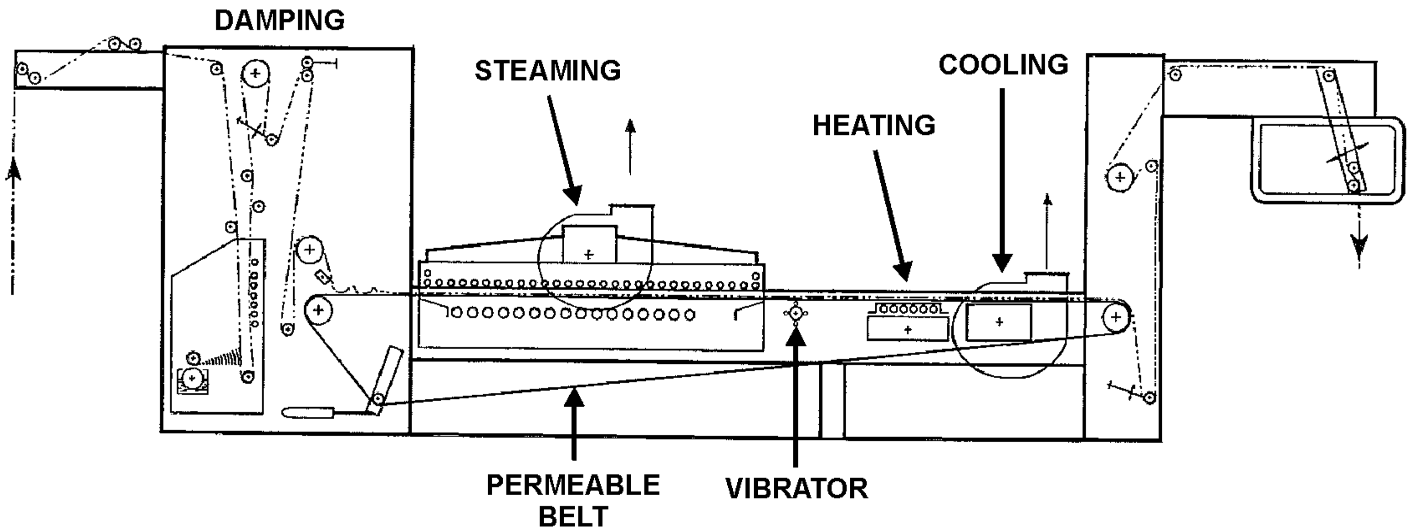
Shrinkomat (m-tec) sponging machine



Juki sponging machine



Biella Shrunk sponging machine



9. Steam framing

Steam framing

- Steam framing is a very convenient method for precise control of fabric dimensions.
- This procedure can be used as an alternative to sponging.
- Fabric is cohesively set at new dimensions while the relaxed dimensions of the fabric and its hygral expansion are unchanged.

Steam framing

- Fabric is transported through the machine on a pin frame similar to that used in a stenter.
- This enables the dimensions of fabric to be accurately controlled.
- After passing through a section in which it is steamed at atmospheric pressure, fabric is dried and cooled before being removed from the pin frame and rolled up.
- A typical modern machine is marketed by TMT as the Vaporama.

10. Inspection

Inspection

Fabric is inspected on three occasions during finishing operations:

- after weaving
- after wet finishing
- when fabric is ready for dispatch.

A Corimatex final inspection station