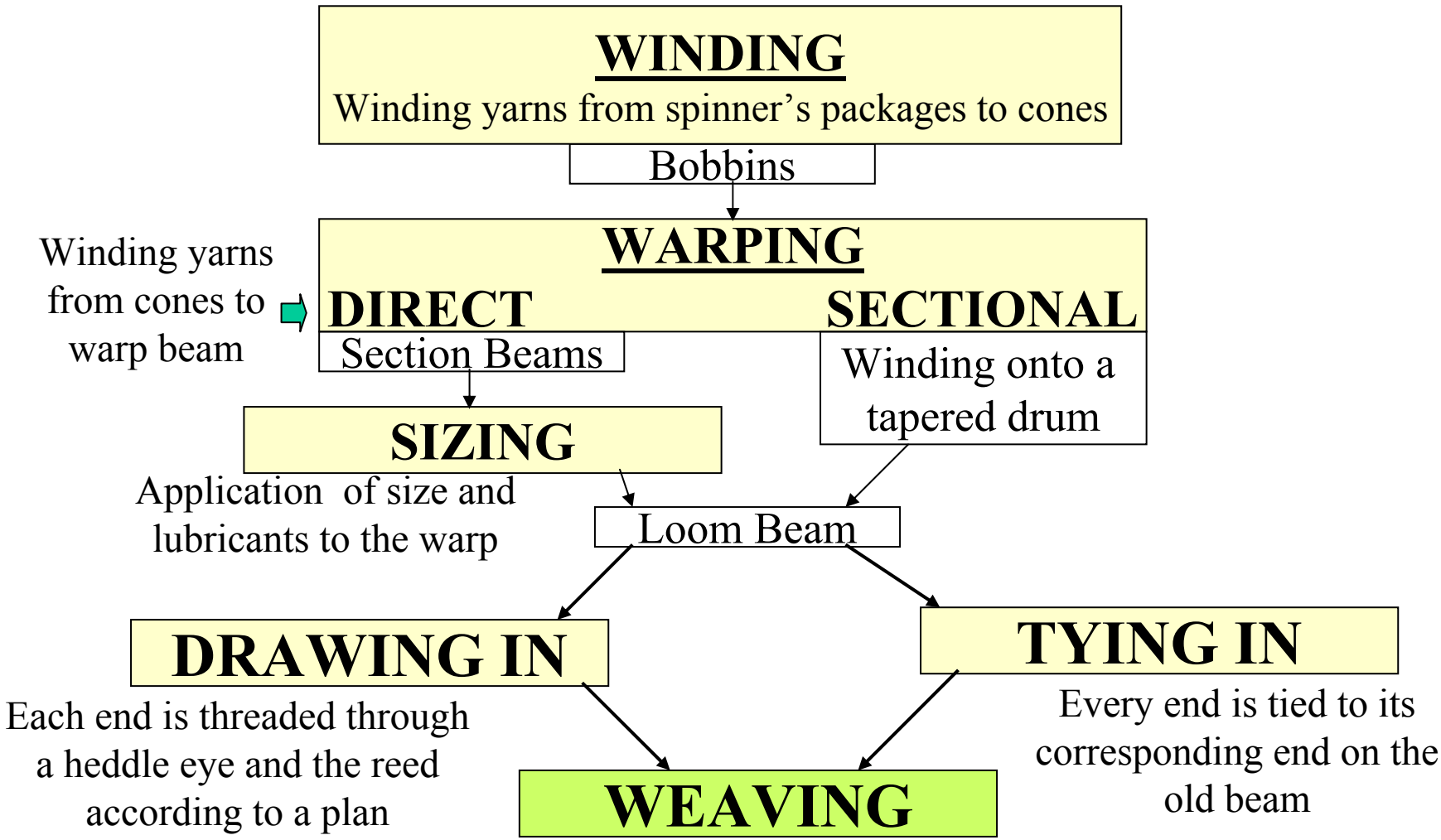
WEAVING TECHNOLOGY II

Basic Operations in Weaving Process

Prof.Dr. Emel Önder

Ass.Prof.Dr.Ömer Berk Berkalp

Warp Preparation Flow Chart



Winding

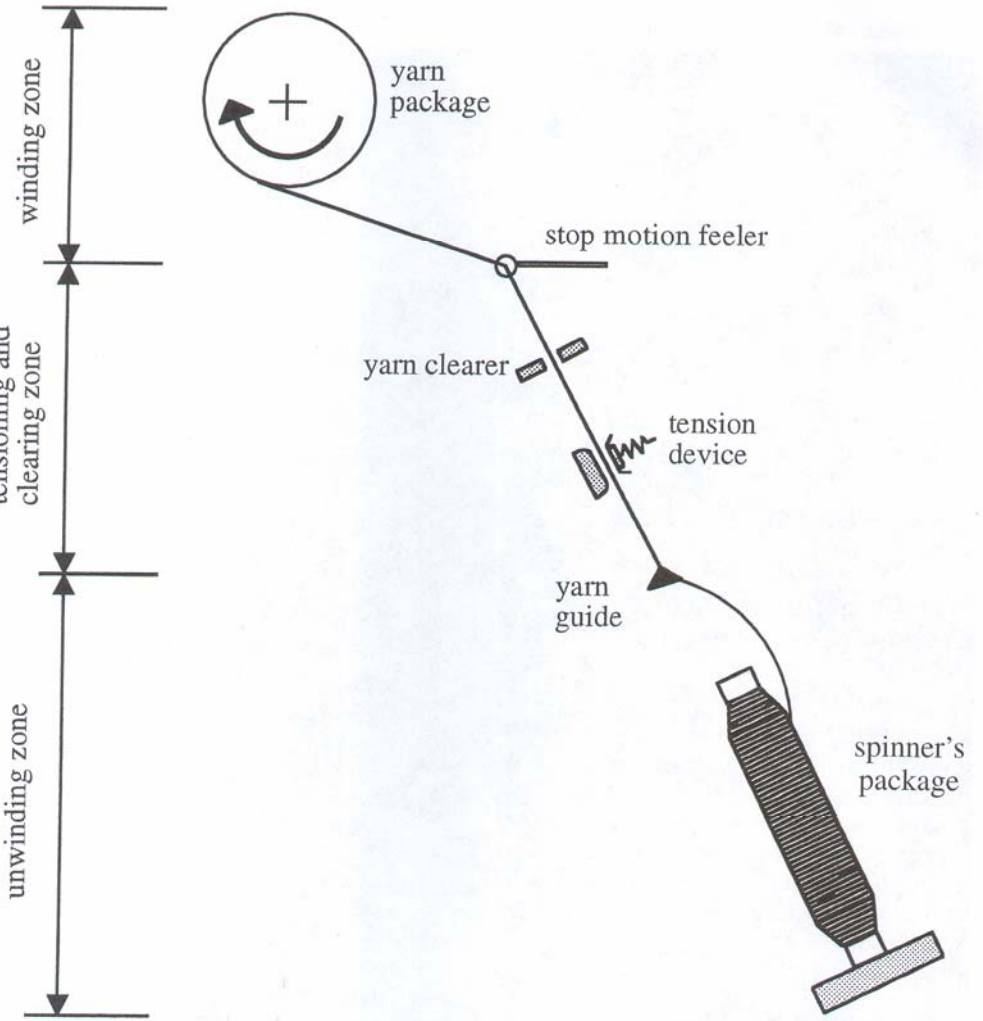


FIGURE 4.2 Schematic of winding process.

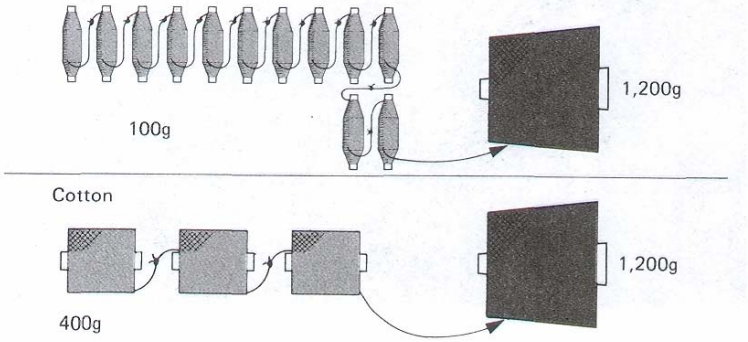
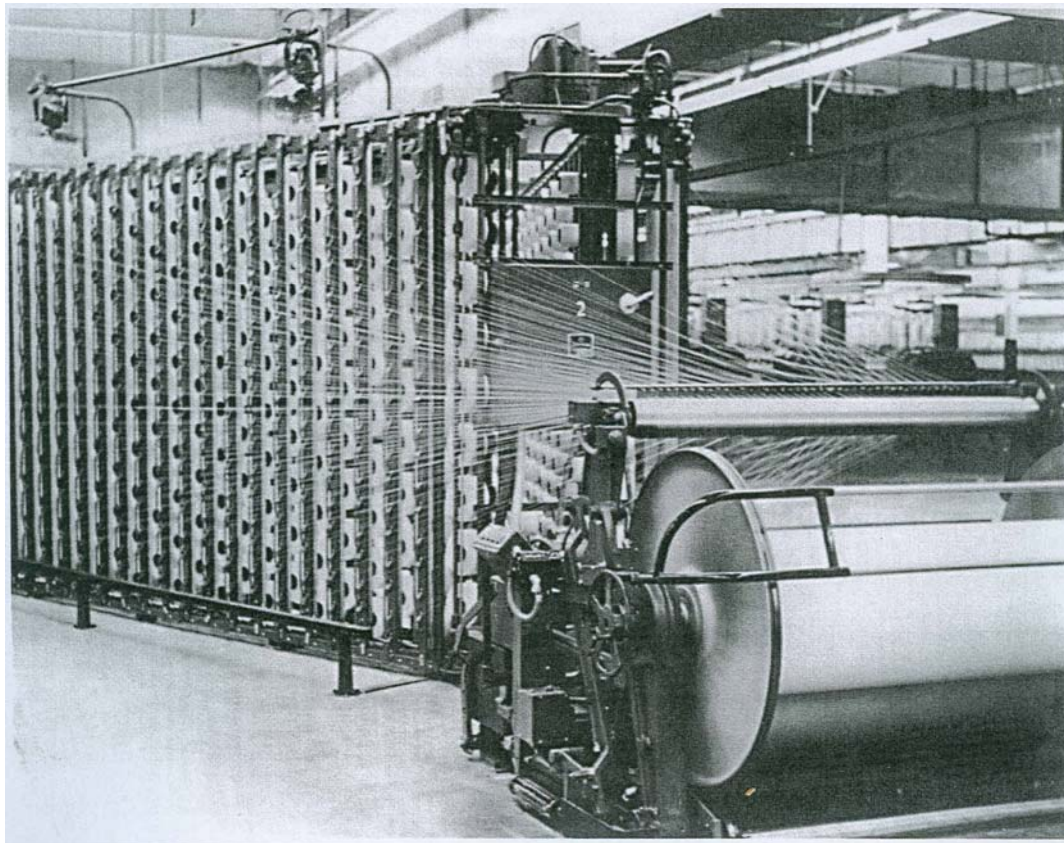


FIGURE 4.3 Building large packages (courtesy of Murata).

Beam Warping (Direct Warping)

- **Beam warping** is used for long runs of grey fabrics.
- As an intermediate stage **warper's beams** which may contain up to 1,000 ends are produced.
- Then the threads of 6-12 warper's beam are combined at the slashing (sizing) stage and wound onto a **weaver's beam (loom beam)**.



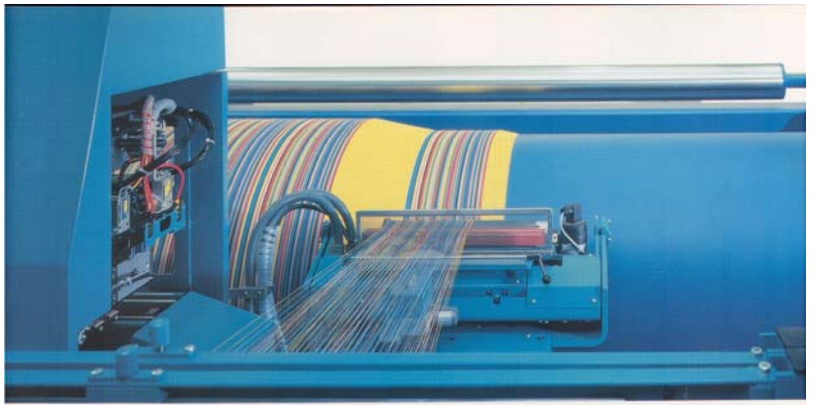
Beam Warping (Direct Warping)

Sizing

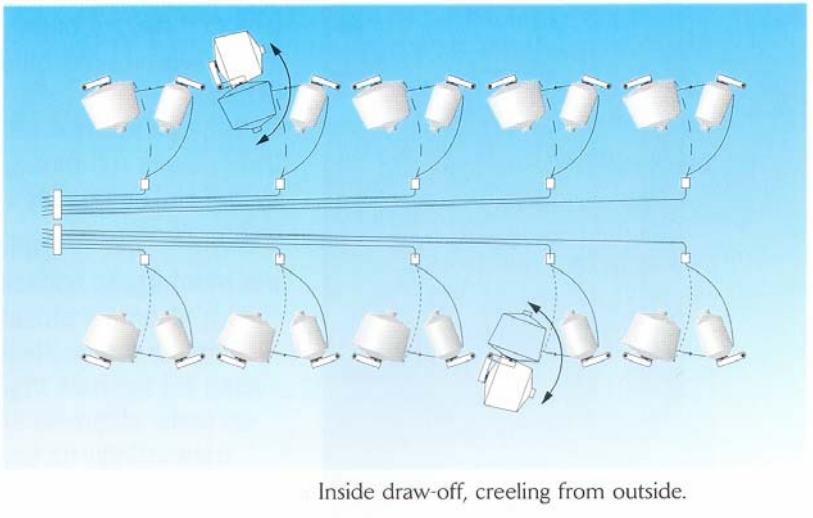
- In order that the warp yarns can withstand the complex stresses to which they are subjected in the weaving machine, they are previously strengthened by coating them with a thin film of **size**, and then drying.
- The size is usually a starch paste containing softening and other ingredients.
- Starch sizes are usually not satisfactory for synthetic fiber threads and have to be replaced by special sizes (often containing synthetic polymers) which will adhere better to the threads.

Sectional Warping

- **Sectional warping** is used for short runs, especially for fancy patterned fabrics.
- In this case, **sections of the warp** which may contain up to 1,000 ends are first wound onto a **drum tapered** with a given cone angle.
- So **cross wound sections** are combined on the drum, and thus each layer of warp contains the same number of ends on the drum.
- Then the warp threads altogether are transferred onto a weaver's beam by unwinding the drum.
- In this method the warp threads are not necessarily processed in sizing.

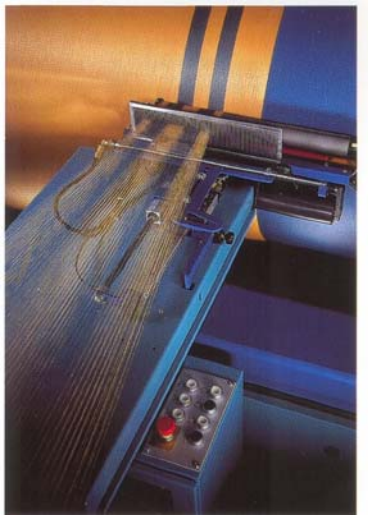


Creels



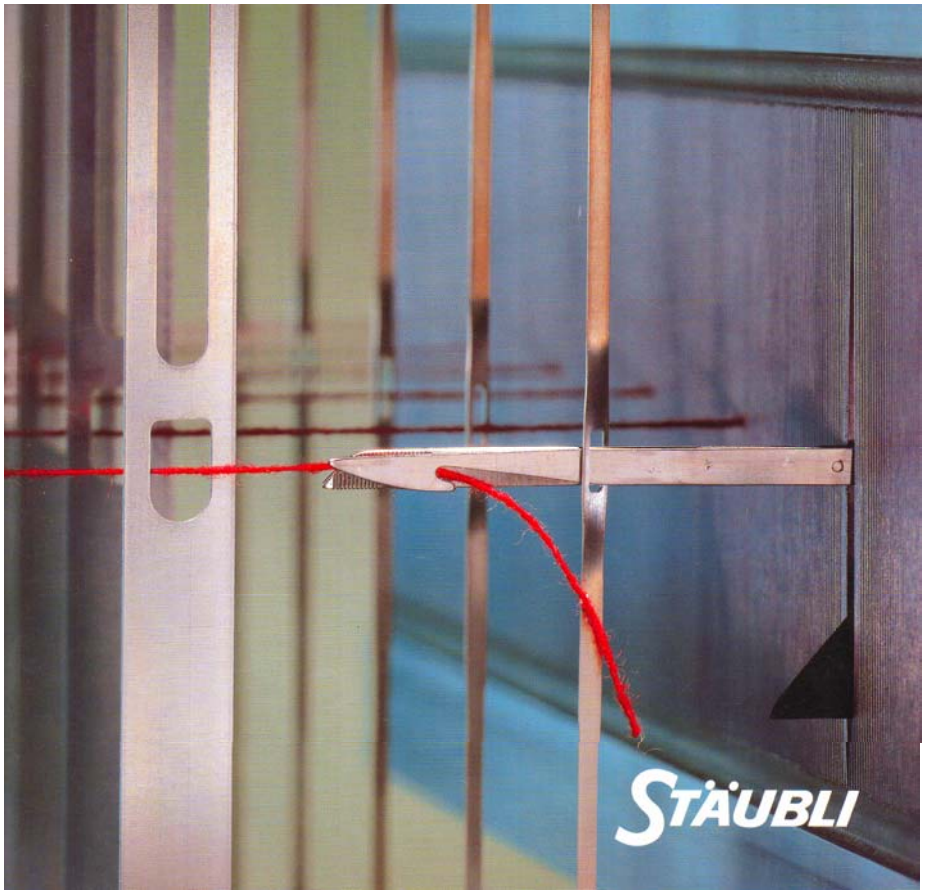
Inside draw-off, creeling from outside.

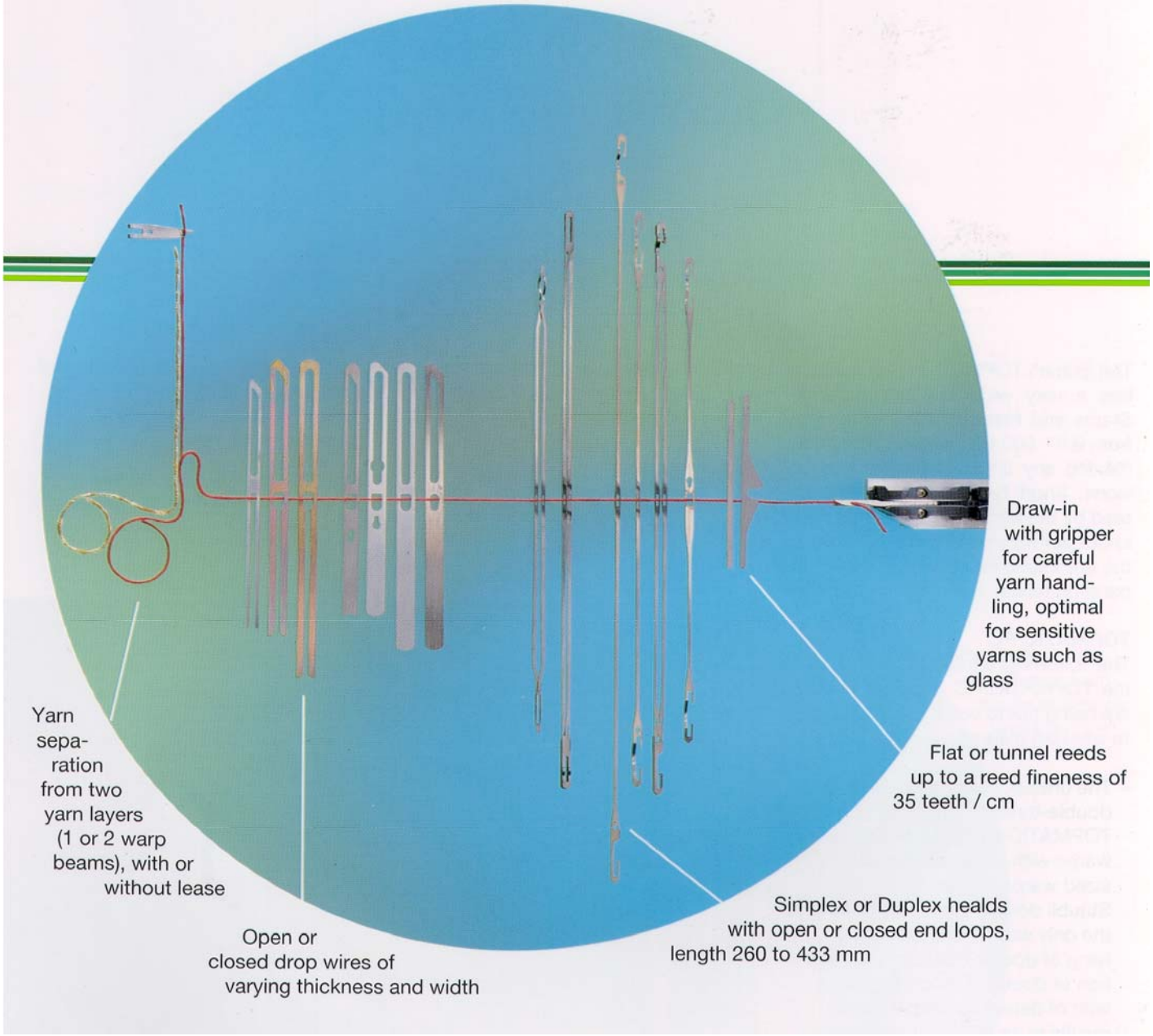
Sectional Warping



Drawing-in Draft (DID)

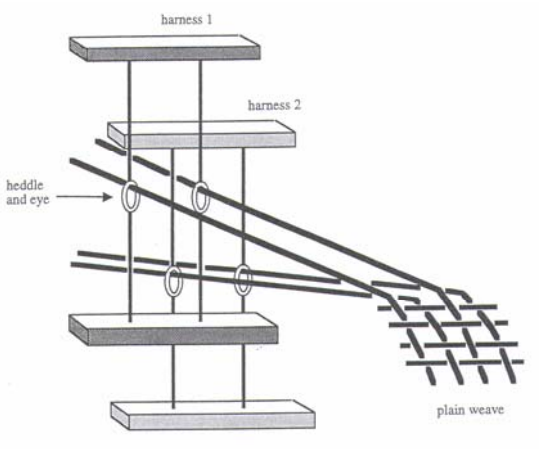
- Before the weaver's beam is mounted on the loom, each end is threaded through a **heald eye** and the **reed**; it also supports a **drop wire**.




Draw-in with gripper for careful yarn handling, optimal for sensitive yarns such as glass
Flat or tunnel reeds up to a reed fineness of 35 teeth / cm
Simplex or Duplex healds with open or closed end loops, length 260 to 433 mm
Open or closed drop wires of varying thickness and width
Yarn separation from two yarn layers (1 or 2 warp beams), with or without lease

Drawing-in Draft (DID)

- The **drawing-in draft** indicates the pattern of the arrangement of warp threads on different heald frames.
- Wherever possible, the ends which are to be woven similarly should be drawn through the same heald frame.
- Types of DID: **straight draft**, **pointed draft**, **skip draft, fancy drafts, etc**.



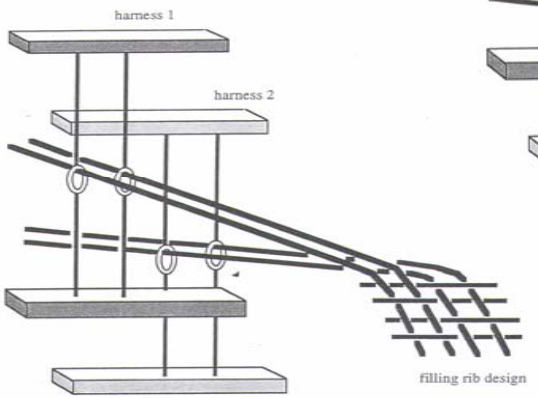


FIGURE 5.6 Filling rib obtained by changing the entering order of Figure 5.5.

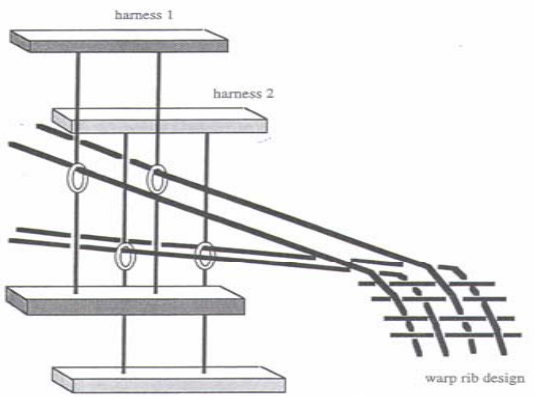
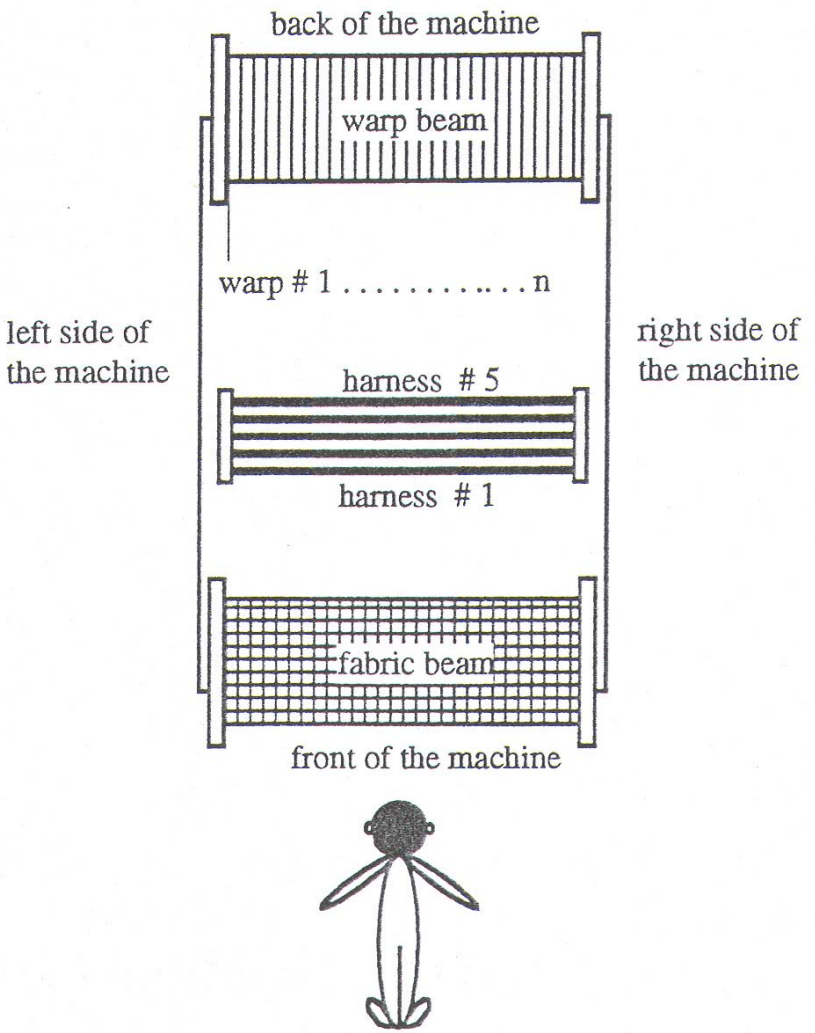


FIGURE 5.7 Warp rib obtained by changing the lifting order of Figure 5.5.

Major reference points on a weaving machine.

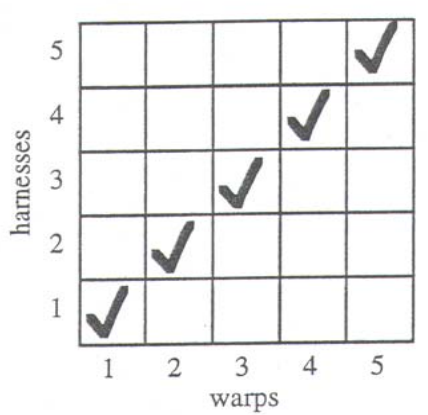
- The front of the machine is where the fabric beam is, and is also called "weaver' s side".
- The back of the machine, where the warp beam is, is called "warp side".

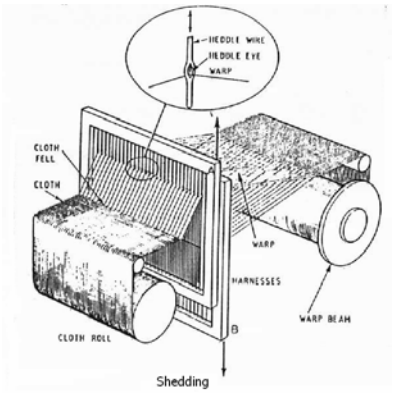


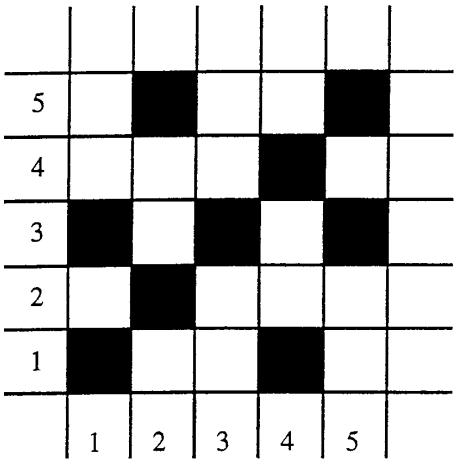
Drawing-in-Draft (DID)

- DID is the process of assigning each warp end to a harness frame.
- Drawing-in-Draft (DID) diagram indicates which warp end is attached to which harness as shown in Figure.
- The vertical columns in the DID represent the warp threads and the horizontal rows represent the harnesses frames which are numbered sequentially from bottom to top.

DID diagram for the design







Weave diagram of a 5 harness design

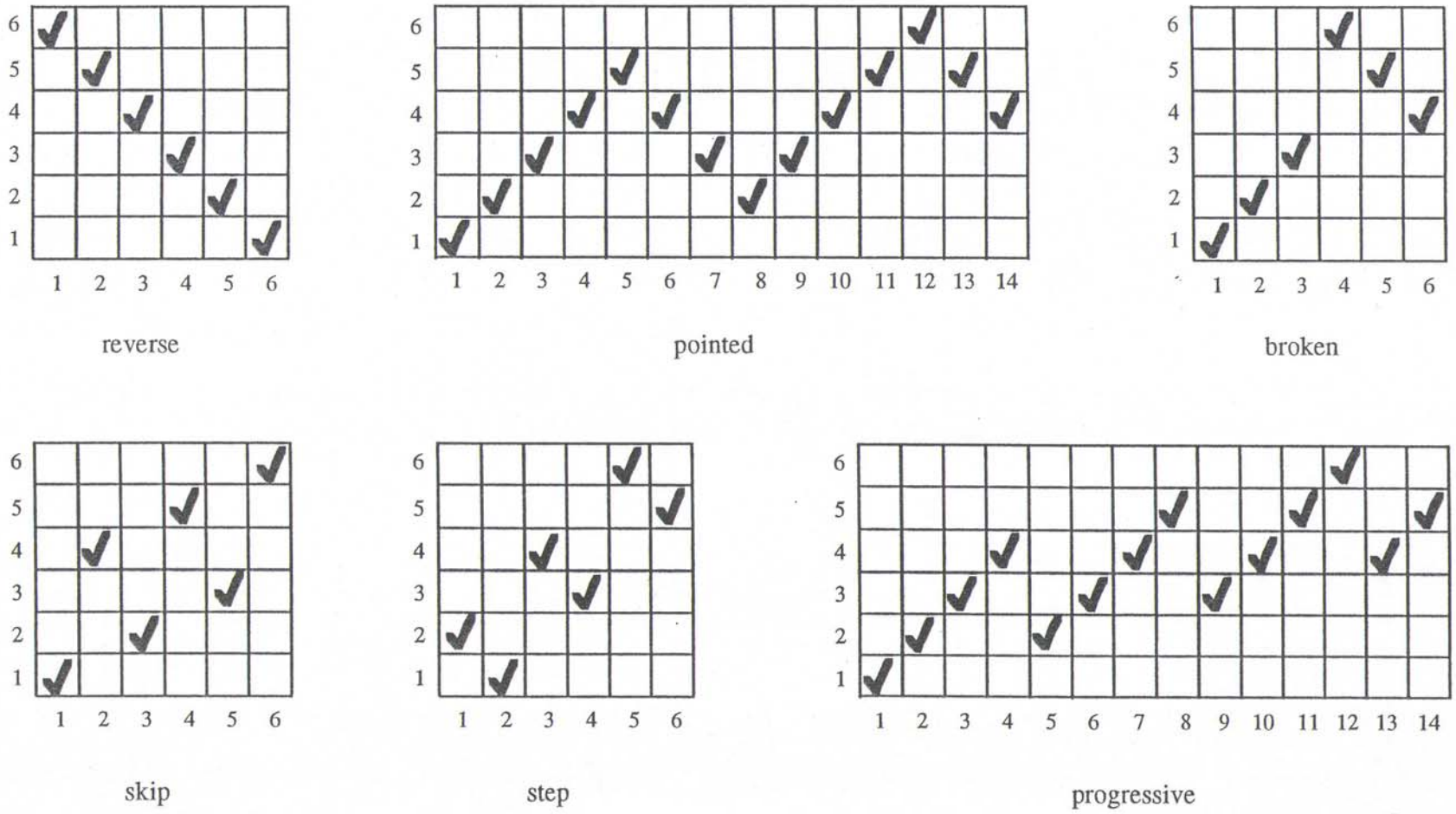
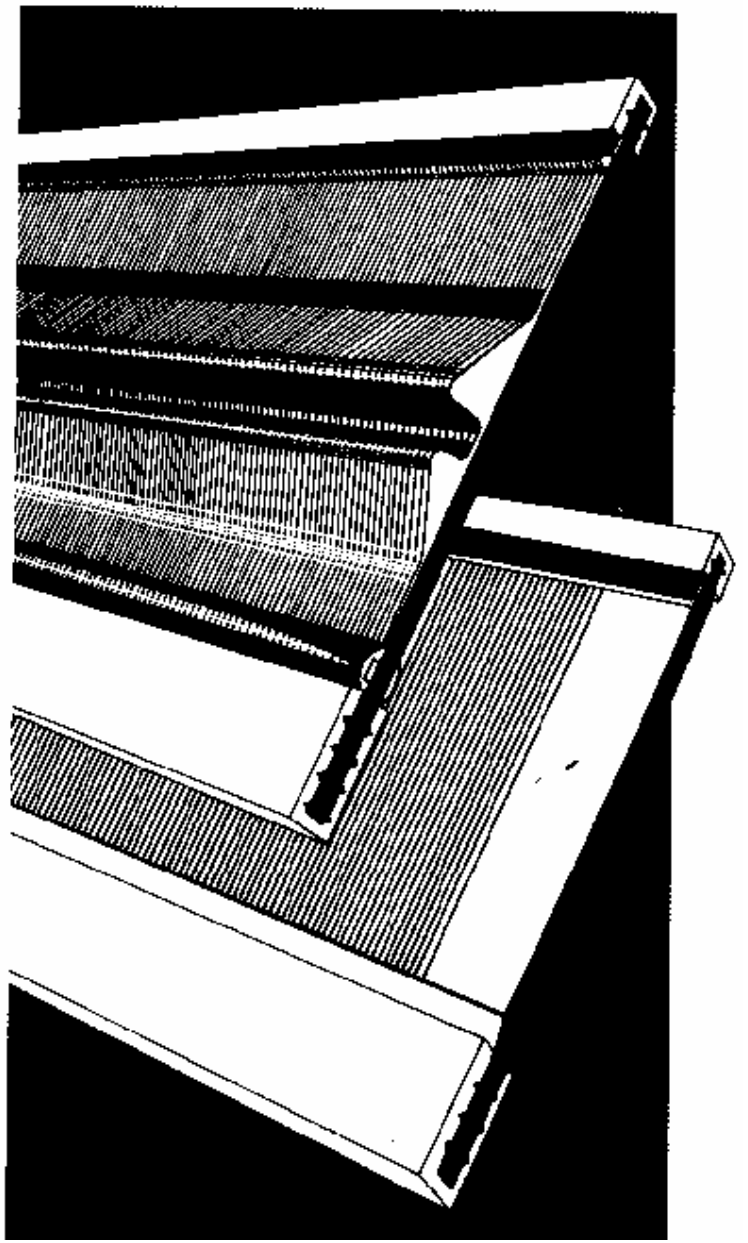


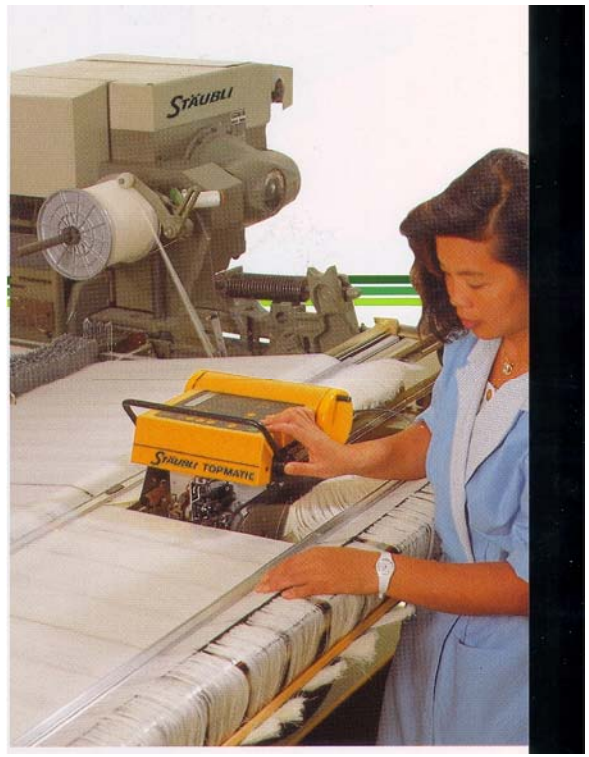
FIGURE 4. Different drawing plans.

- The reed is a comb-like structure consisting of regularly spaced wires. The word dent is commonly used to describe the space between two reed wires.
- Denting means drawing the warp thread through the dent as required by reed plan and this determines more accurately the width of the fabric and the ends per cm.

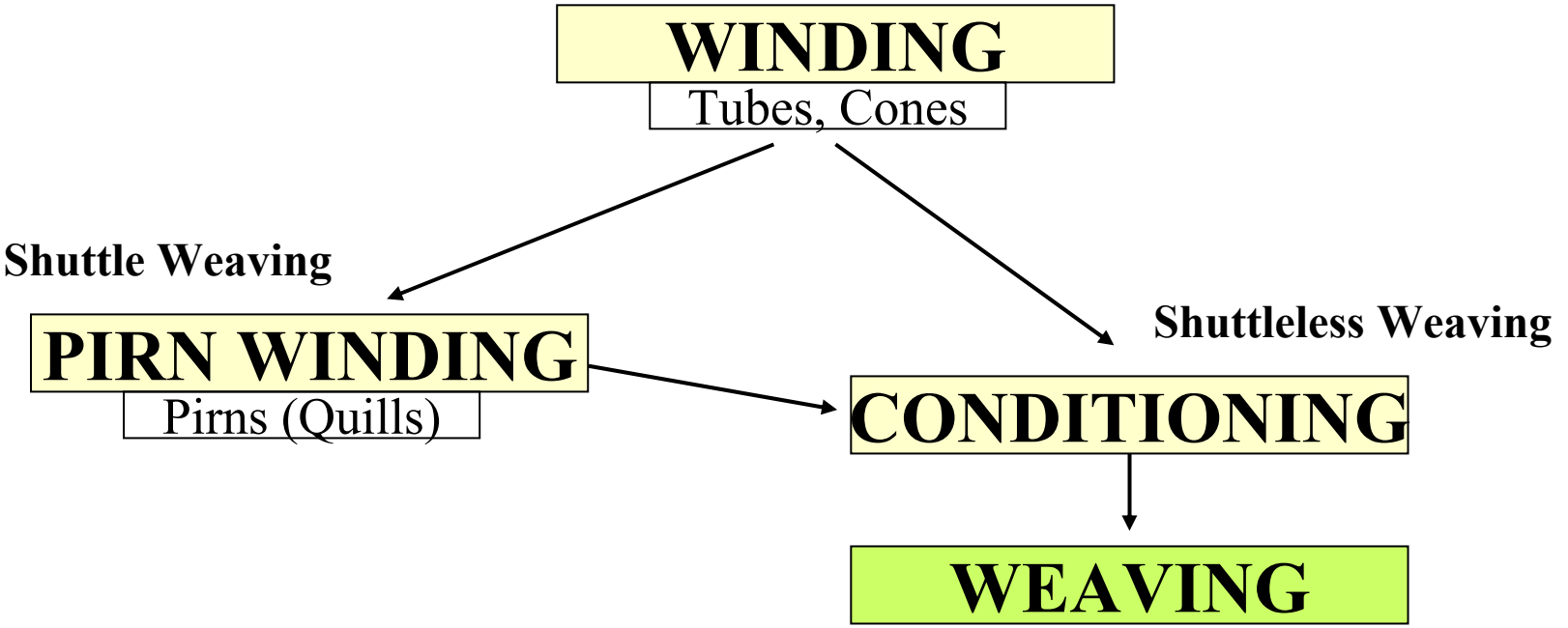


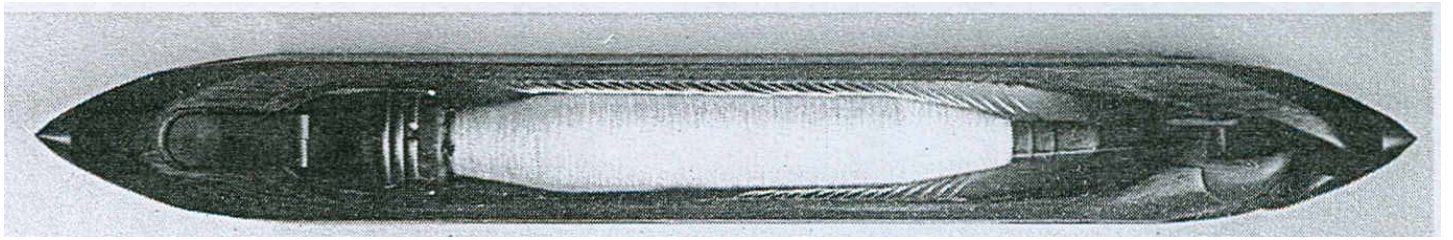
Tying-in

- **Tying-in** is used when a fabric is being mass produced.
- The tail end of the warp from the exhausted weaver's beam is tied to the beginning of the new warp.
- Therefore, if every end on the new beam is tied to its corresponding end on the old beam, the drawing-in process can be omitted.
- Following the tying-in process, all knots are pulled through the drop wires, heddles and the reed. The loom is now ready for operation.



Weft Prepartion Flow Chart





- The wooden shuttle (into which is quill or pirn on which yarns are wound) carries yarn across the loom.

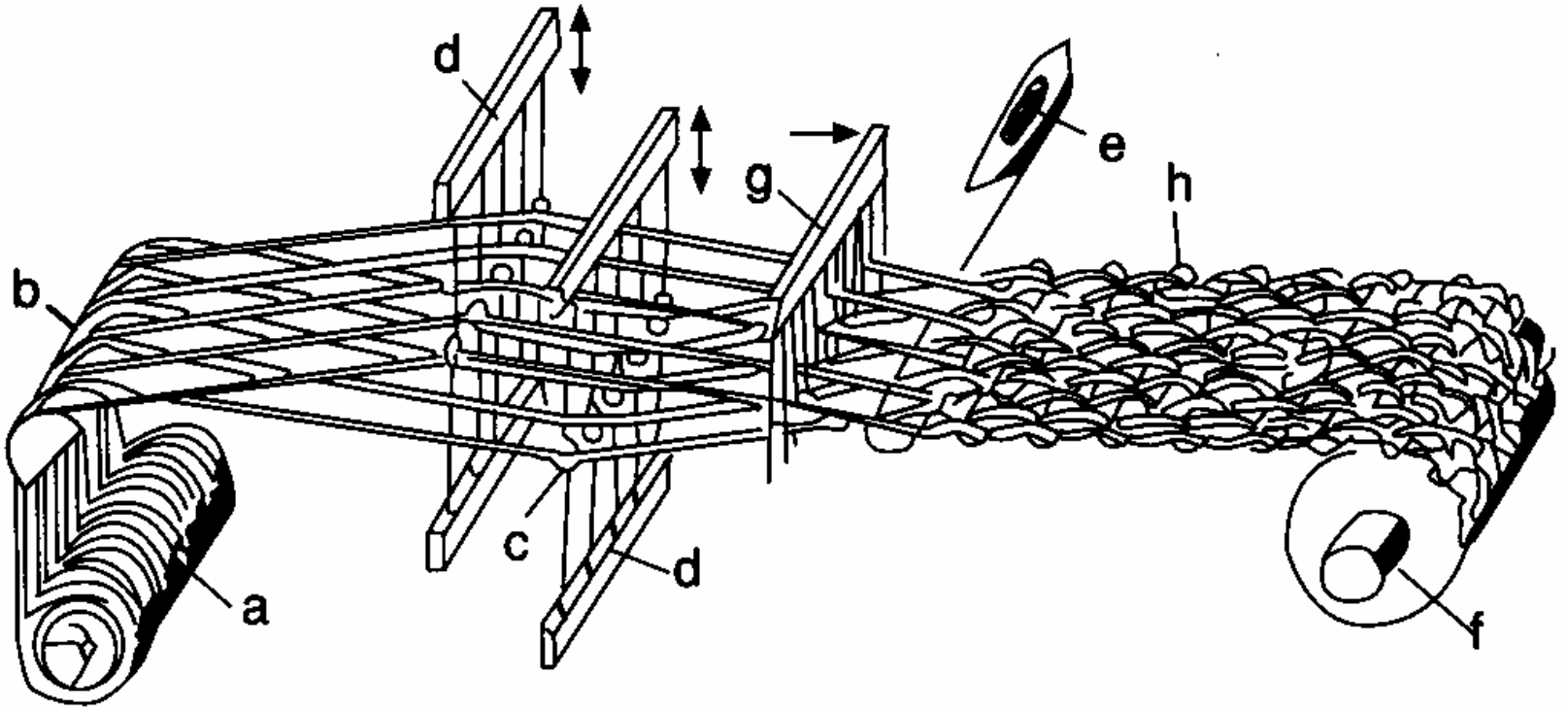
Basic motions and essential parts of a loom

- In order to interlace warp and weft threads to produce a fabric on any type of loom, three operations are necessary:
  1. shedding: separating the warp threads into two layers to form a tunnel known as the shed,
  2. picking: passing the weft thread through the shed,
  3. beating-up: pushing the newly inserted length of weft, known as the pick, into the already woven fabric at a point known as the fell.
- These three operations are often called the primary motions of weaving.
- These motions must occur in a given sequence, but their precise timing in relation to one another is also of extreme importance on a power loom.

Basic motions and essential parts of a loom

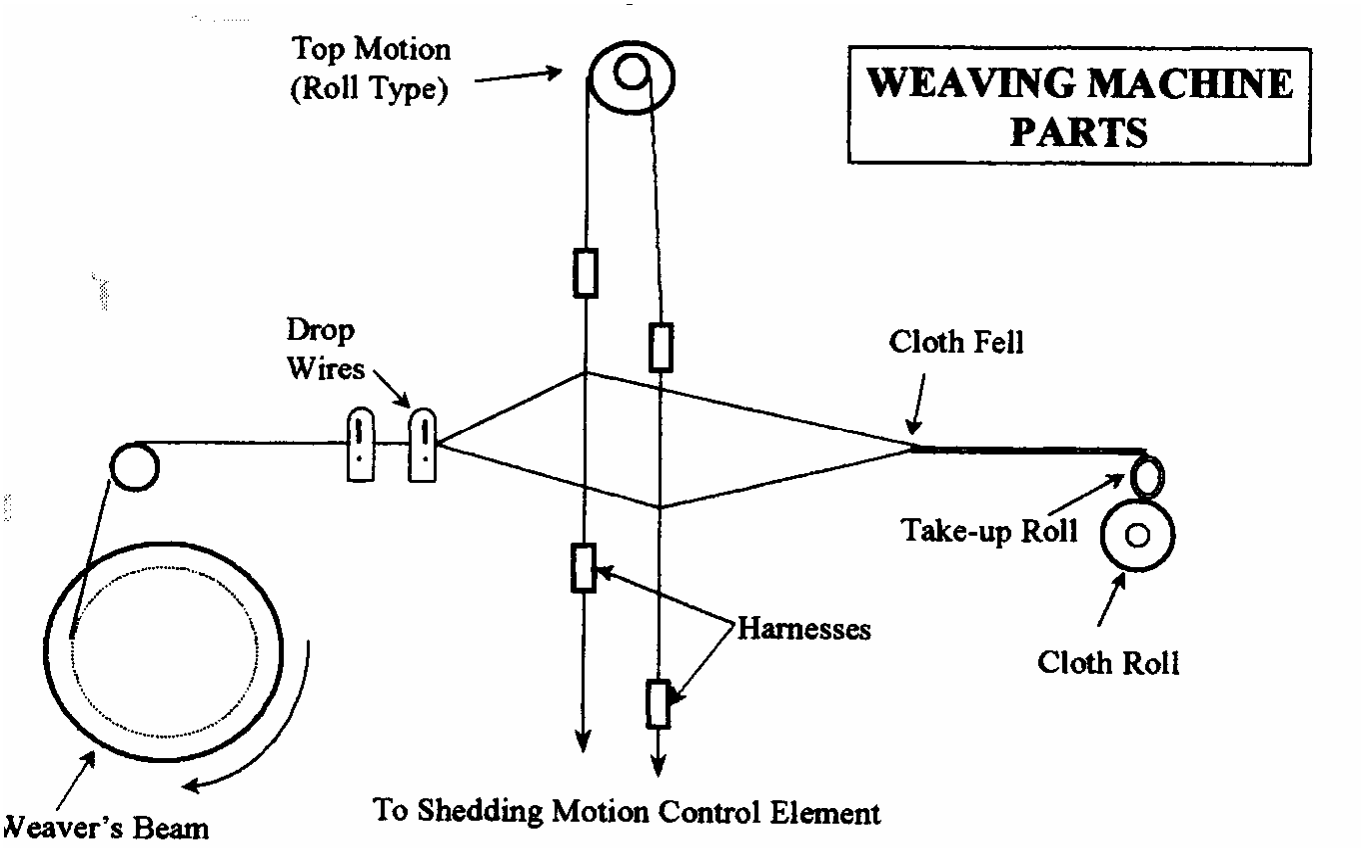
- Two additional operations are essential if weaving is to be continuous:
  4. warp control (or let-off): this motion delivers warp to the weaving area at the required rate and at a suitable constant tension by unwinding it from a weaver's beam; and
  5. cloth control (or take-up): this motion withdraws fabric from the weaving area at the constant rate that will give the required pick spacing and then winds it onto a roller.
- After these operations took place, a weaving cycle is completed.
- Weaving cycles are repeated over and over again until the cloth reaches the desired length.

Basic motions and essential parts of a loom



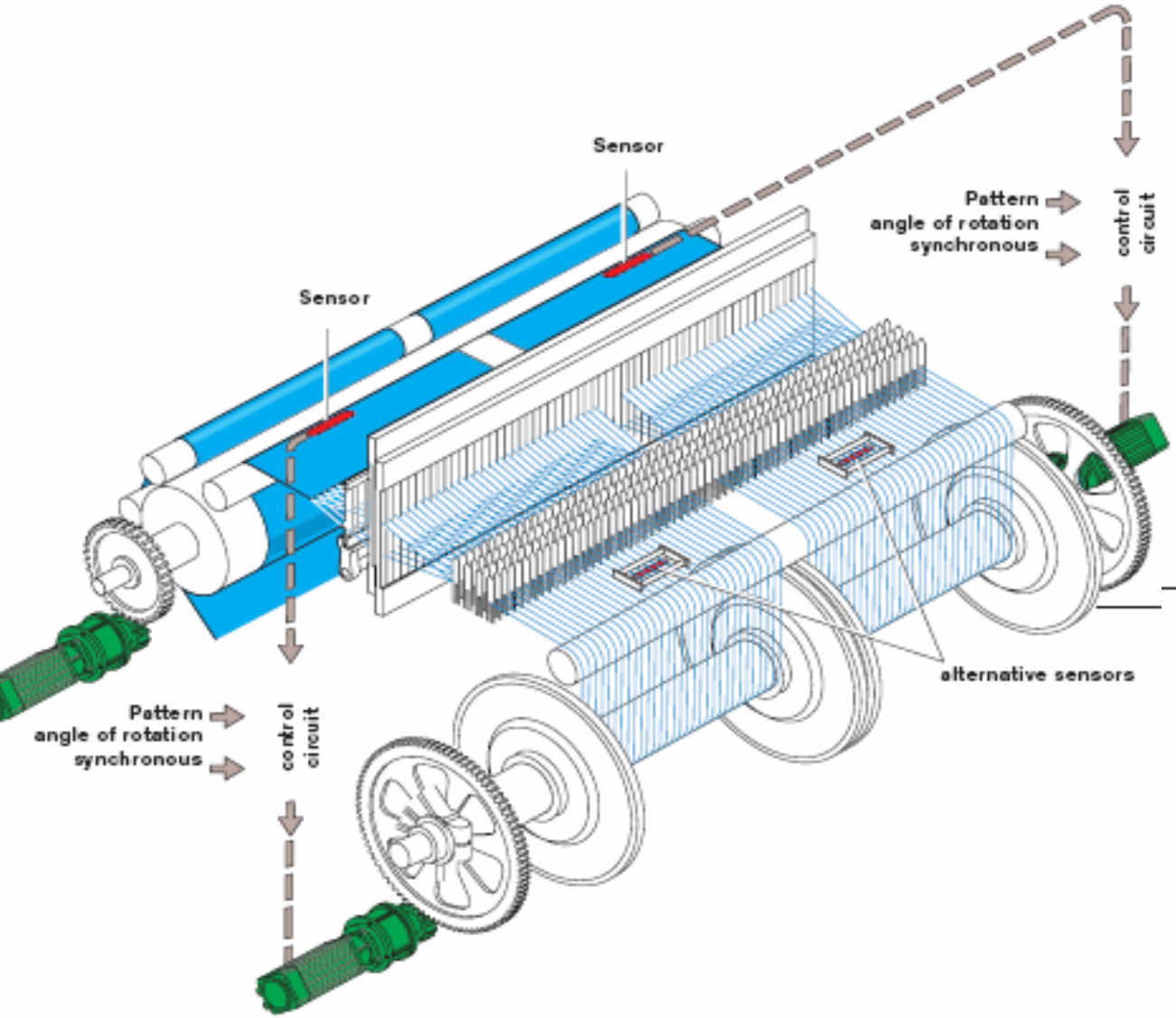
a-Weaver's Beam
b- Back Rest
c-Healds (heddles)
d- Heald Frames

e- Shuttle-Weft Yarn
f- Cloth Beam
g- Reed
h- Woven cloth


WEAVING MACHINE PARTS
Top Motion (Roll Type)
Drop Wires
Cloth Fell
Take-up Roll
Harnesses
Cloth Roll
Weaver's Beam
To Shedding Motion Control Element

Passage of the warp through an ordinary loom and essential parts of the loom

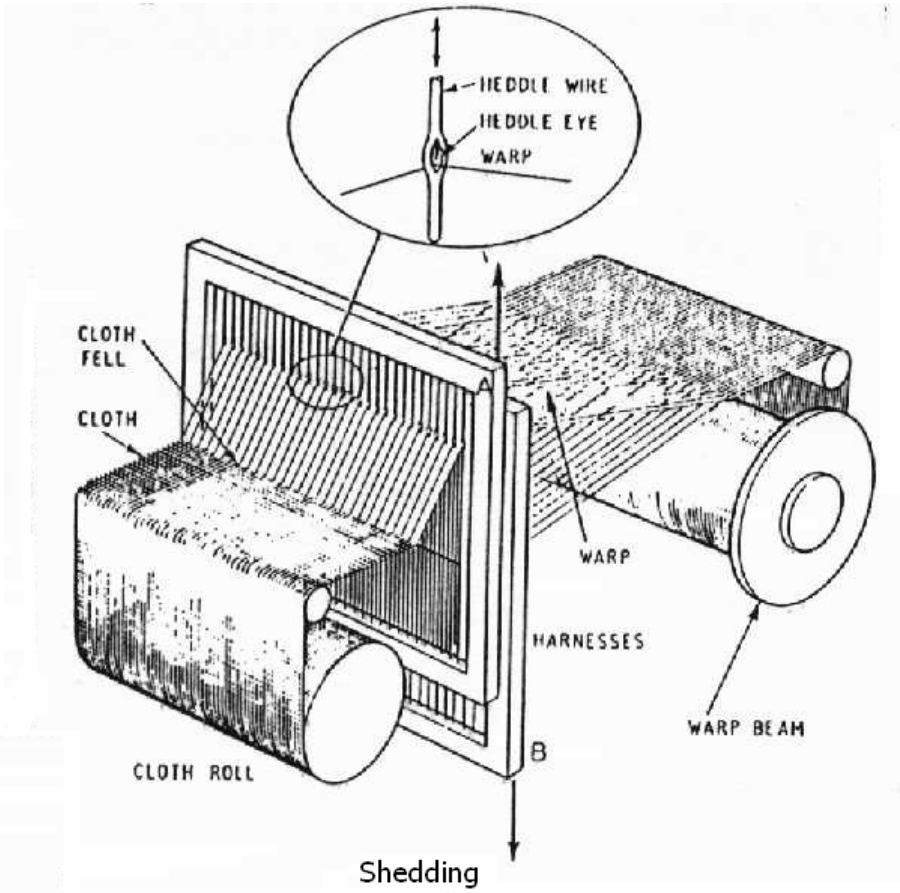
- The warp unwound from the weaver's beam passes round the back rest (back bearer) and comes to the heald frames (harnesses), which are responsible for separating the warp sheet for the purpose of shed formation.
- It then passes through the reed (swinging frame in front of the heddles), which holds the threads at uniform spacing and is also responsible for beating-up the last inserted pick.
- All the threads unite again in the fabric at the point of cloth fell.
- the cloth then passes over the front rest (breast beam), round the take-up roller, and is wound onto the cloth roller (cloth beam or merchandise beam).
- A drop wire signals the loom to stop immediately after a warp end breaks off.
- In conclusion, the warp from the beam is fed to the weaving zone where it is converted into fabric and this fabric is then taken-up on a cloth roll.



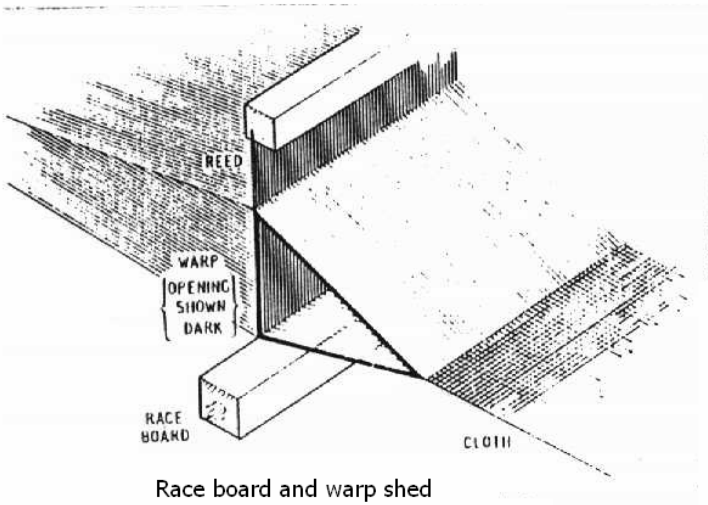
Let-off and take-up motions are identica
in construction, simplifying handling as
well as spare part inventory. Each motio
utilizes a resolver as the measuring
system, connected together with the
sensor to a control circuit. Even when
weaving with twin beams the precision
of the entire system is maintained. The
accuracy of setting the warp tension on
the display is in the region of 1 gram an
in the case of the take-up, up to 0.01
pick/ cm.

Shedding Motion

- The motion forms "the shed" by dividing the warp ends into two sheets, thus providing a path for the weft. This is done by raising and/or lowering frames.
- The frames' movement is dictated by the weave design and pattern of assigning warp ends to frames (DID).



Shedding



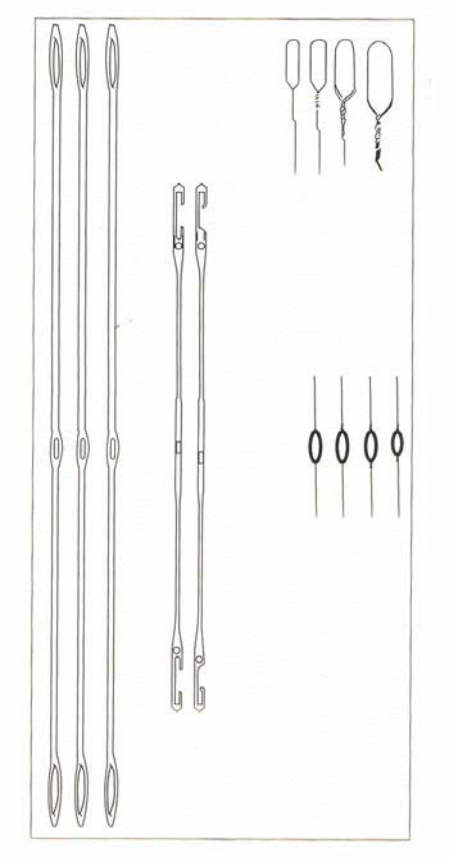
Race board and warp shed

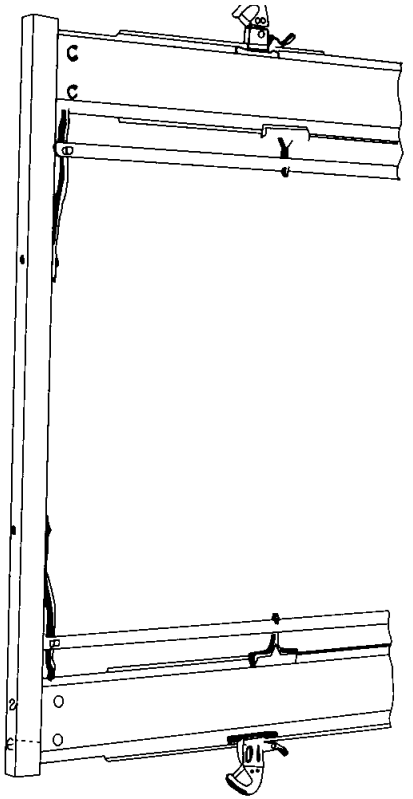
Triangular warp shed formed by the two warp sheets and the reed

Shedding Motion

- In most cases, shedding is controlled by the motion of the heald frames (or harnesses) each of which is capable of oscillating vertically.
- These frame-like structures contain a multiplicity of wires or flat stripes known as heddles or healds and each of these contains an aperture through which one end may be threaded. These apertures are called heddle eyes.
- The heald frame is a wooden or metal frame, its width is slightly greater than that of the warp. Twisted wire or flat steel healds are free to move sideways on bars mounted just inside of the framework of the heald frame.

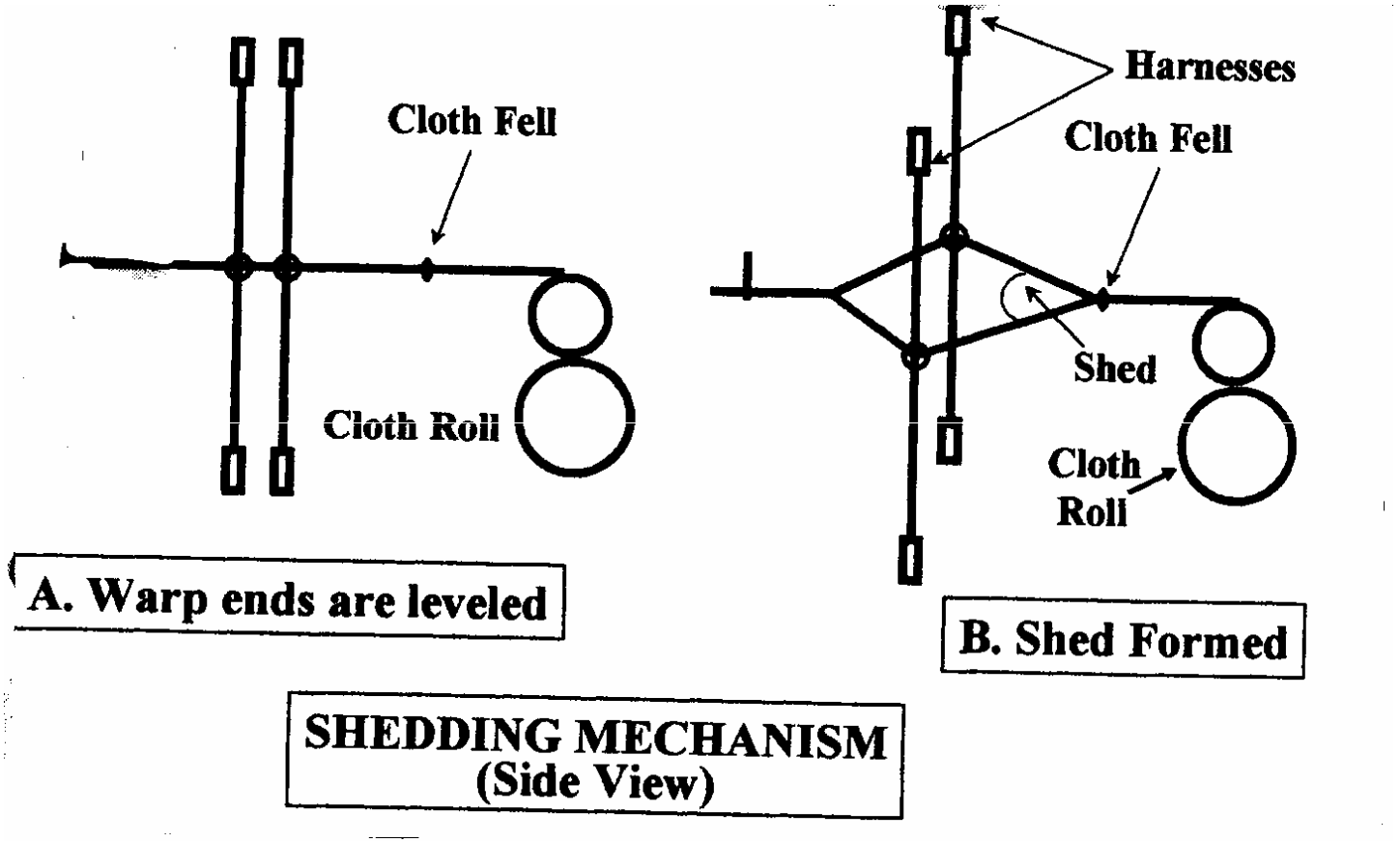
Healds & Frames





Shedding Motion

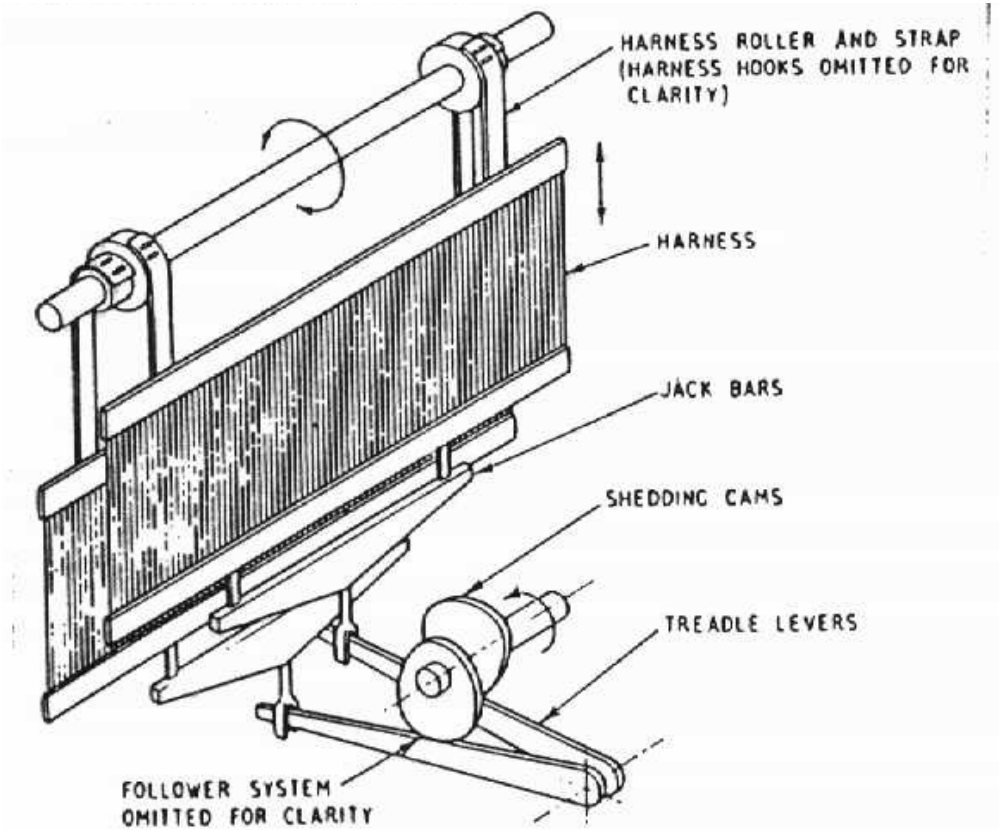
- By using two or more heald frame, each of which controls its own group of warp yarns, it is possible to generate the desired fabric structure.
- For example, in a plain weave, group A will comprise all the odd numbered warp ends and will be in the up position, group B will comprise all the even numbered warp ends and be in the down position.
- After the filling has been inserted, group A is moved downward and group B is moved upward to give a new warp shed and another length of filling can be inserted.
- Groups A and B are then interchanged again and the process continues.

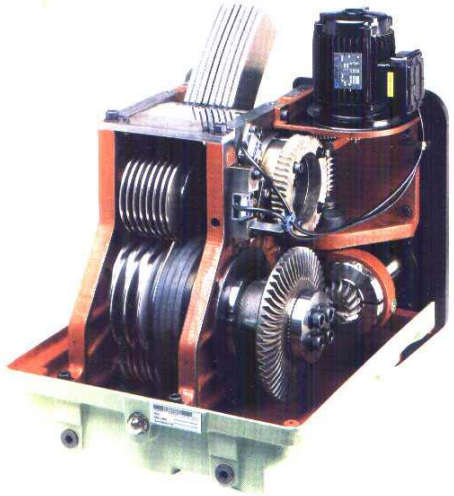

Cloth Fell
Cloth Roll
A. Warp ends are leveled
Harnesses
Cloth Fell
Shed
Cloth
Roll
B. Shed Formed
SHEDDING MECHANISM
(Side View)

Shedding Mechanisms

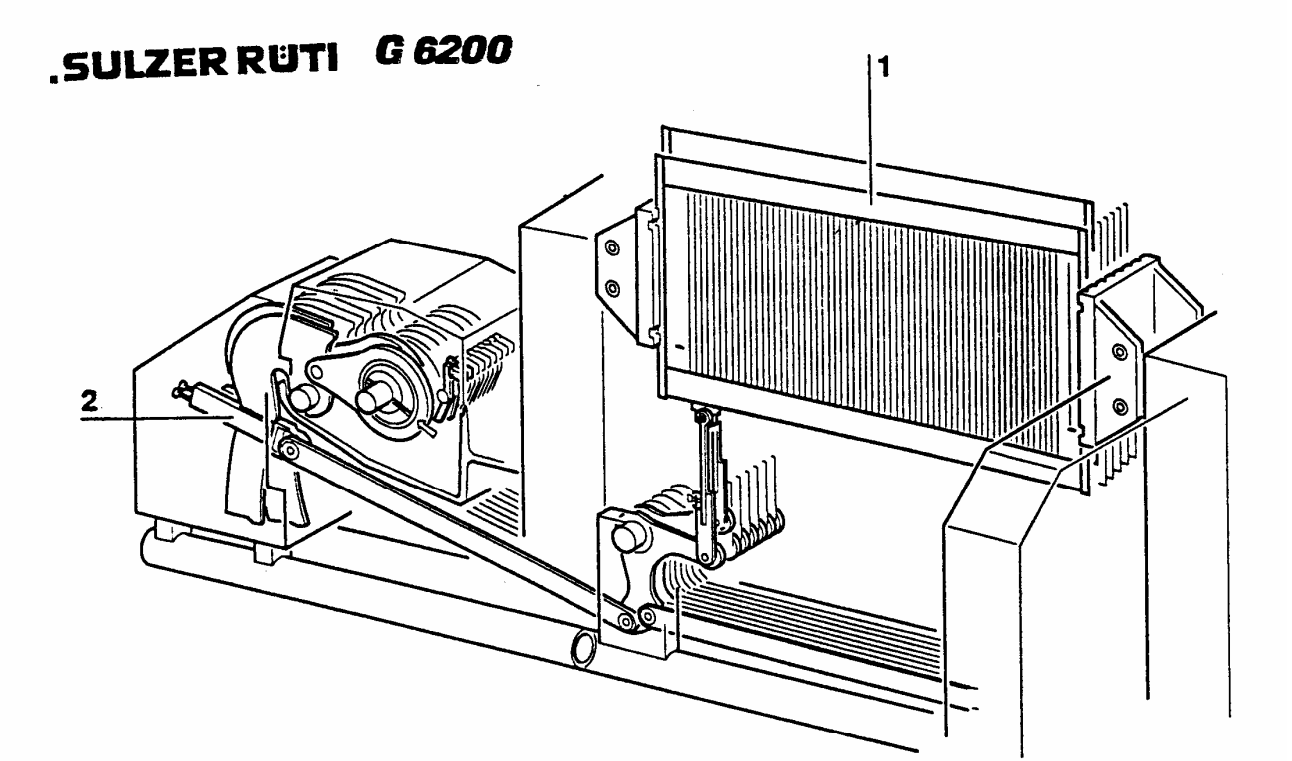
- Shedding mechanisms convert the design instructions into the movement of the heald frames.
- The three main types of shedding mechanism are cam (tappet), dobby, and jacquard.
- The lift of the heald frames can be achieved by using a cam or dobby mechanism. In the jacquard loom, there is no heald frame to be driven but each heddle is attached to a wire or cord.
- Each mechanism has its own limitations. There are some mechanical or technical differences between these mechanisms in addition to the differences in operational limitations.

Cam Shedding





FIMTEXTILE

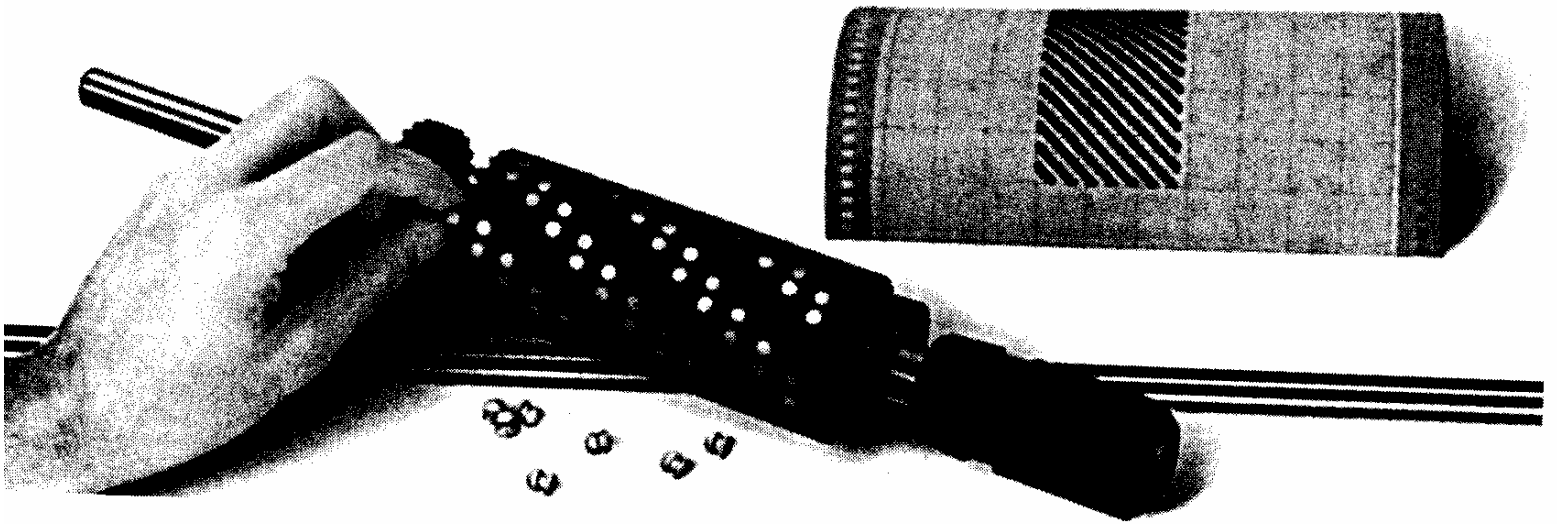


1 Shafts
2 Jack runners

Electronically controlled "Stäubli" rotary dobby

This dobby permits weaving with up to 16 or 28 heald shafts **1**.

It is controlled by entering the fabric and machine-specific parameters at the terminal. The shed opening angle is modified symmetrically by moving jack runners **2**.



Card cylinder for a modern dobby mechanism (courtesy of Staubli).

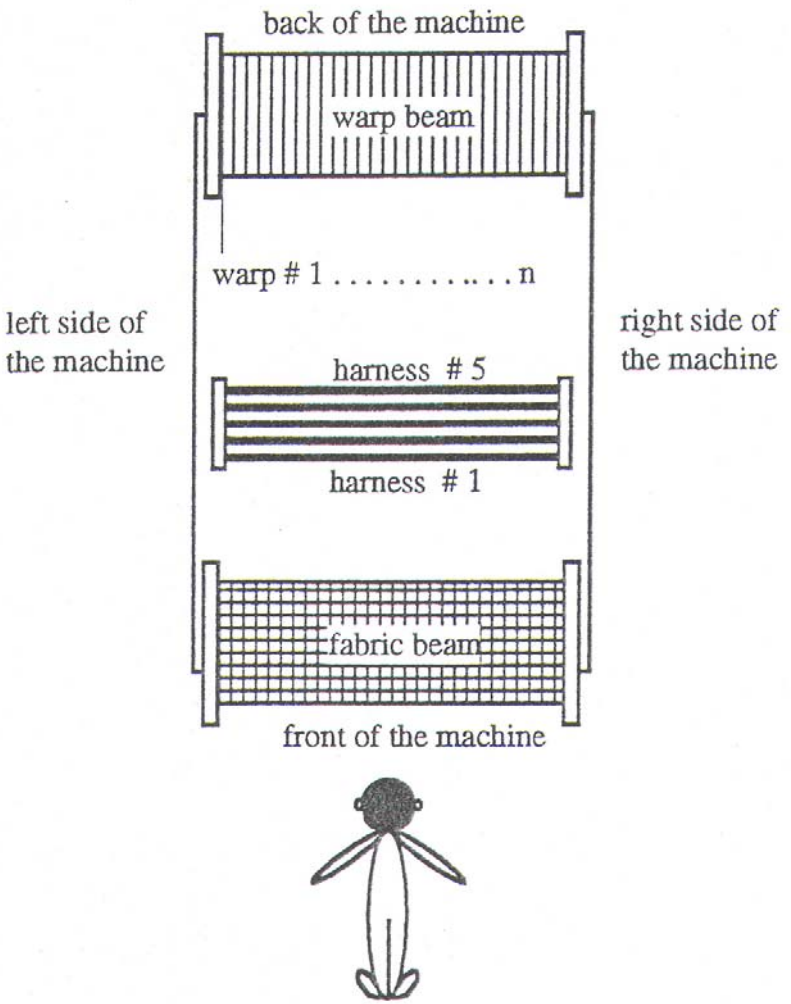
A weaving machine equipped with a jaquard mechanism for weaving figured fabrics

Fabric Design

- In order to produce a fabric on a weaving machine with a required texture, the following plans are necessary:
  - Weave or design,
  - Drawing-in Draft,
  - Lifting Plan (Chain Plan or Cam Plan) and
  - Reed Plan
- The weave or design is the pattern (or order) in which the interlacing between the warp and weft threads takes place.
- The drawing-in draft (DID) shows the arrangement of the warp threads on the different heald frames.
- The lifting plan (peg plan , chain plan) represents the pattern in which the heald frames are lifted or lowered at every pick in the repeat.
- The reed plan shows the arrangement of the warp threads in the reed dent.

Major reference points on a weaving machine.

- The front of the machine is where the fabric beam is, and is also called "weaver' s side".
- The back of the machine, where the warp beam is, is called "warp side".



Major reference points on a weaving machine.

- Facing the machine from front, the right of the observer indicates the right side of the weaving machine. This is the side where the pick is received (receiving side).
- The left side, where the pick is inserted from, is called the picking side.
- The warp yarns are numbered starting from the left side of the weaving machine.
- The harness frame numbering starts from the front side of the loom.
- These reference points are important to avoid confusion among the professionals.

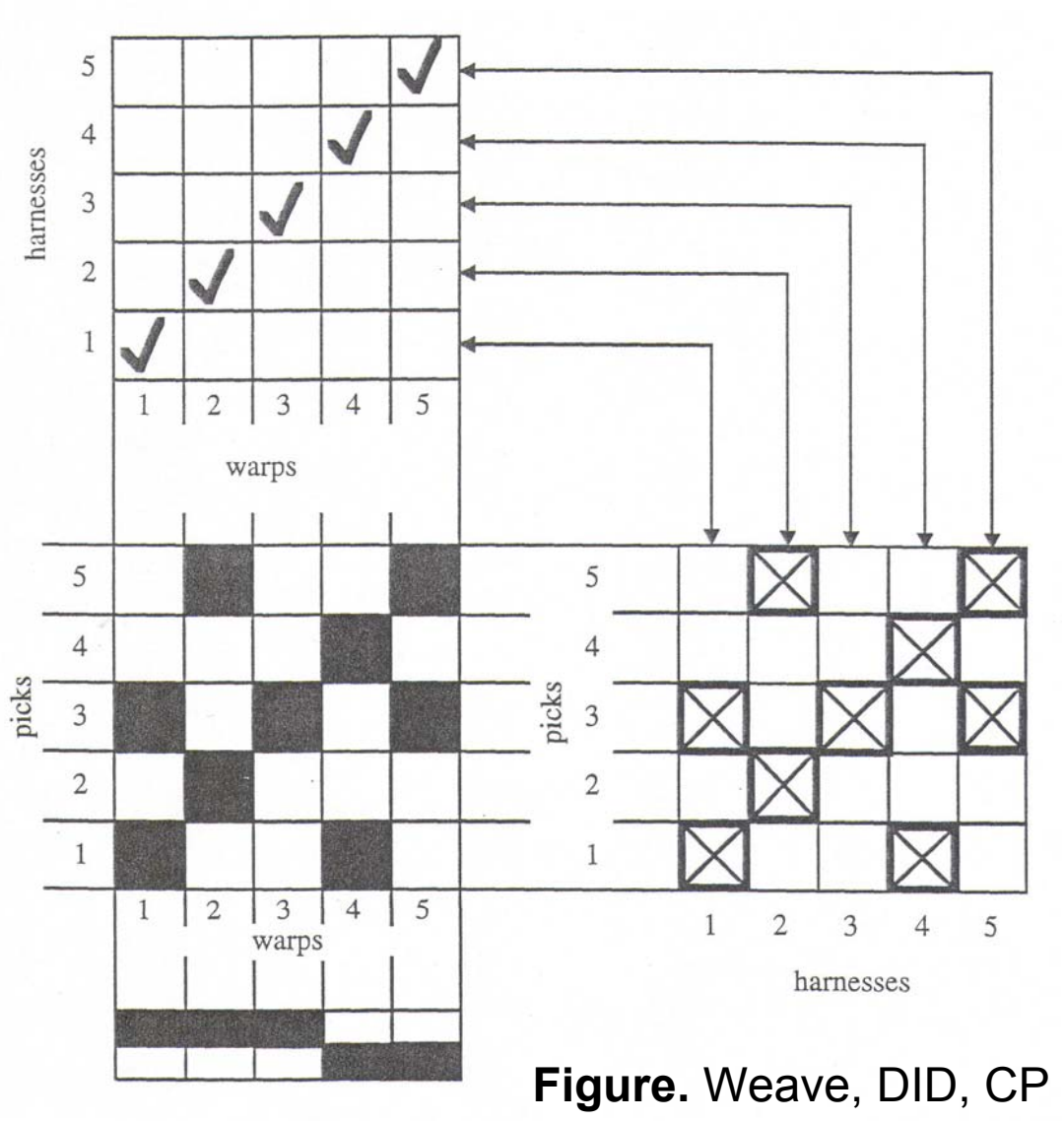
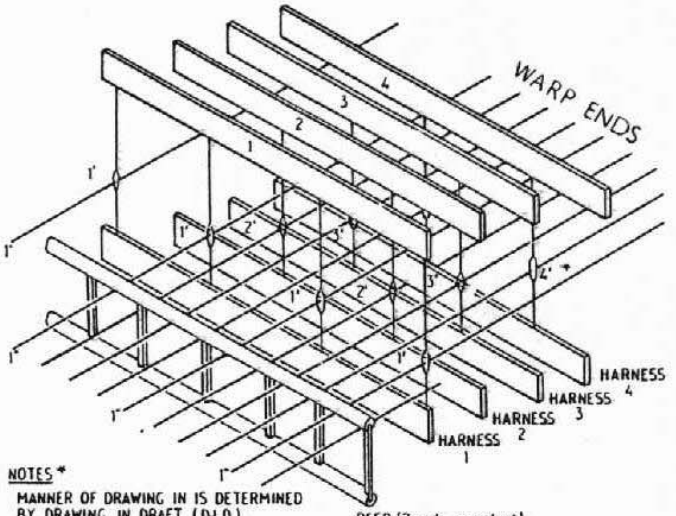
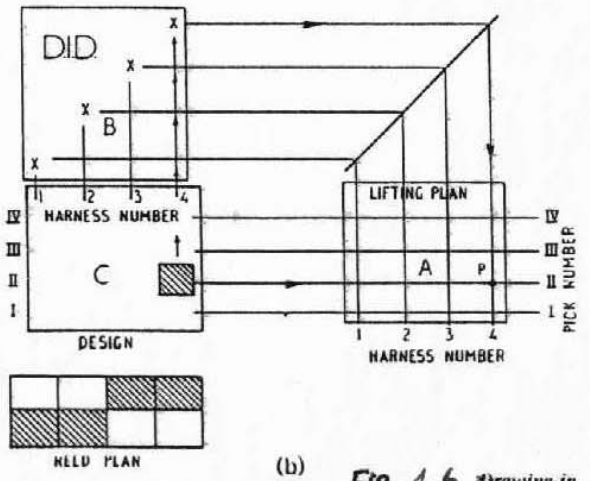


Figure. Weave, DID, CP and reed plan

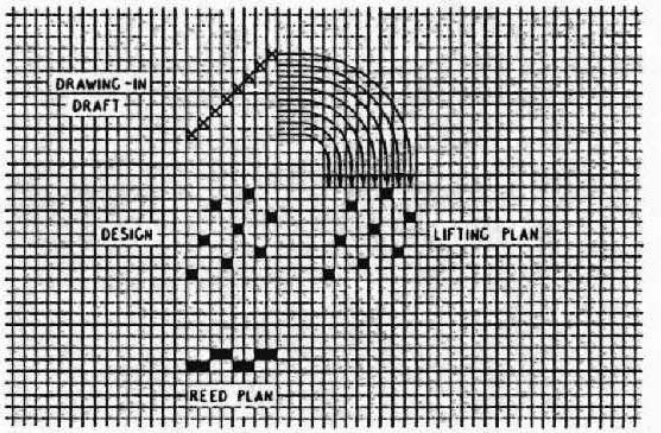


(a)

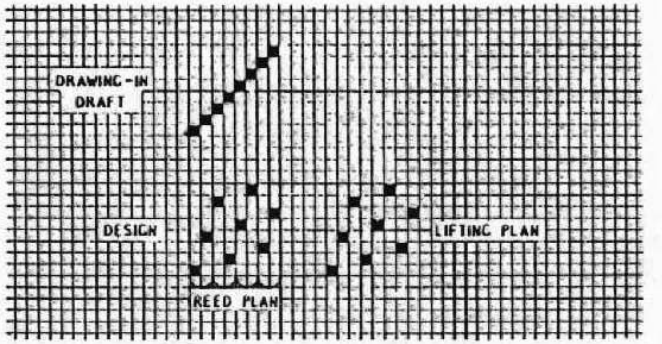


(b)

Fig. 1.6 Drawing-in.



(c)



(d)

Fig. Drawing-in draft, lifting and reed plans

Construct DID and CP of min. No. of harnesses for the following designs

- As shown in the folllowing Figure the interlacing pattern for the first warp end in the weave repeat is different from the second, third, and fourth ends, and it is controlled by the first heald frame. So, the first column of the lifting plan is the same with the first column of the design.

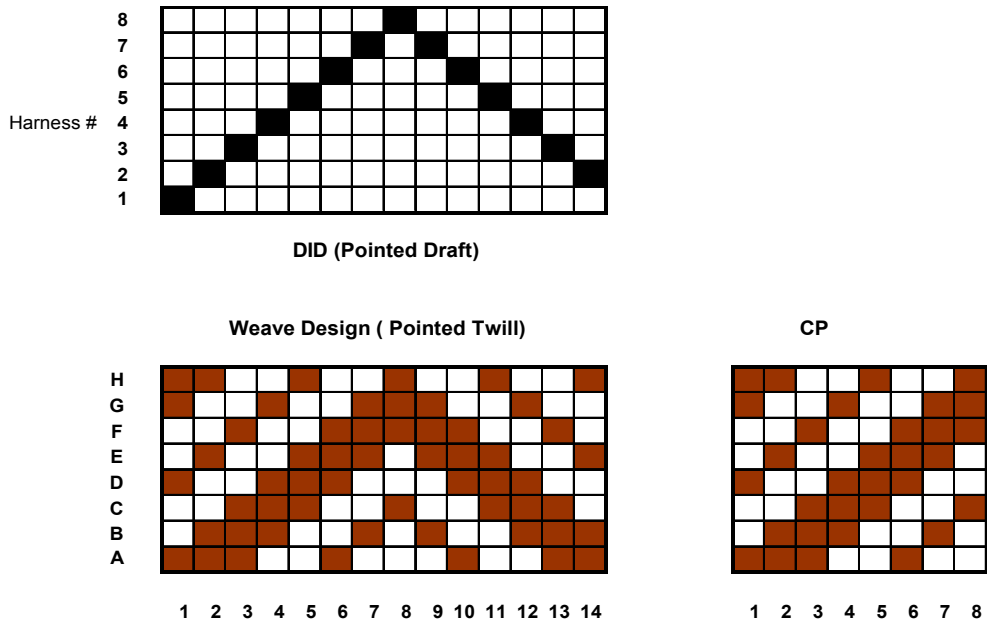
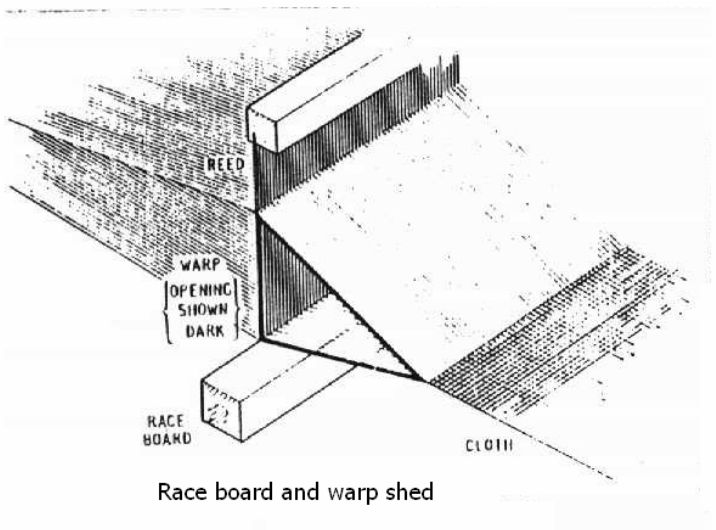


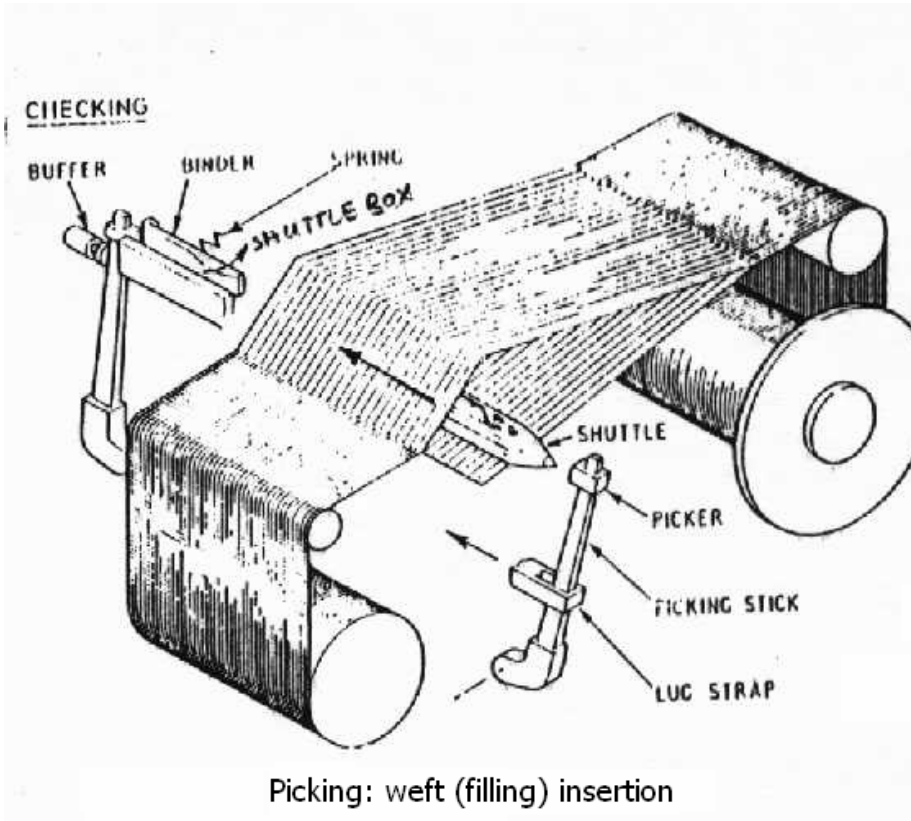
Figure. Example #2

Weft Insertion Motion- Picking

- This motion follows the shedding motion.
- On conventional looms the filling yarn is inserted by means of a shuttle on which a pirn is mounted..



Race board and warp shed



Picking: weft (filling) insertion

•As the shuttle travels a length of weft yarn is laid down along the path of the shuttle.

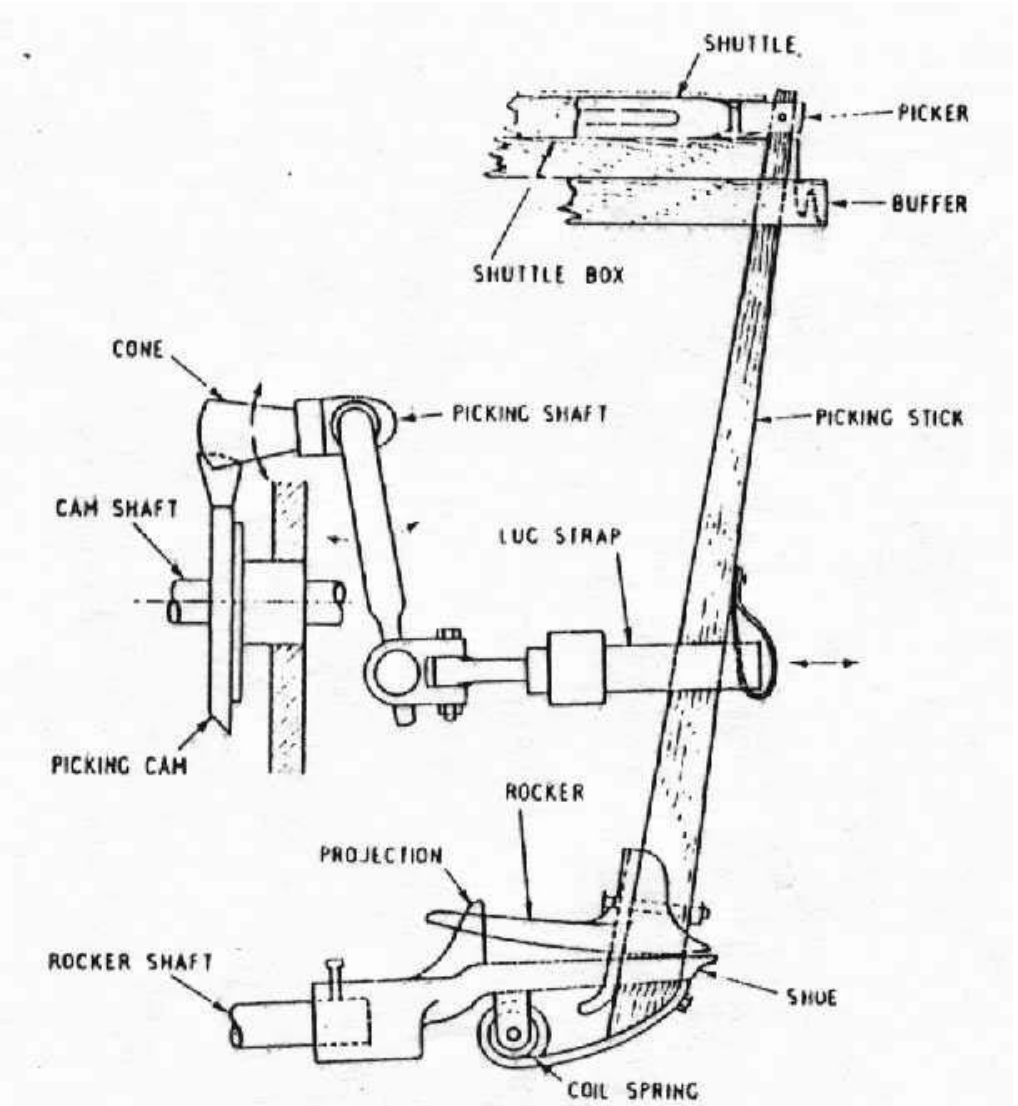
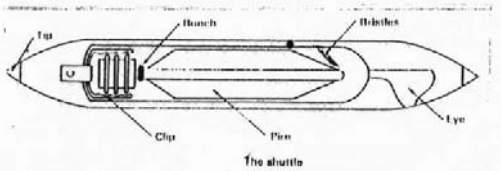
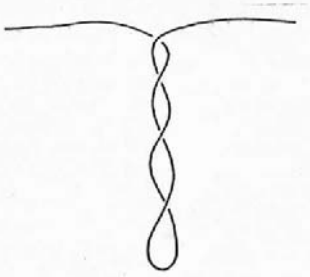


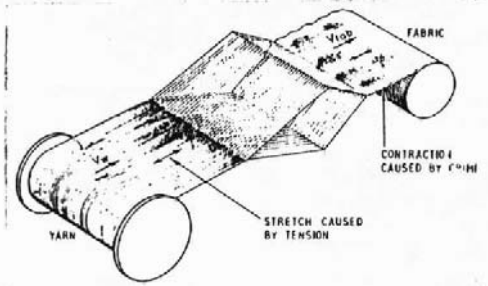
Fig. 1.10 Cone underpick mechanism.



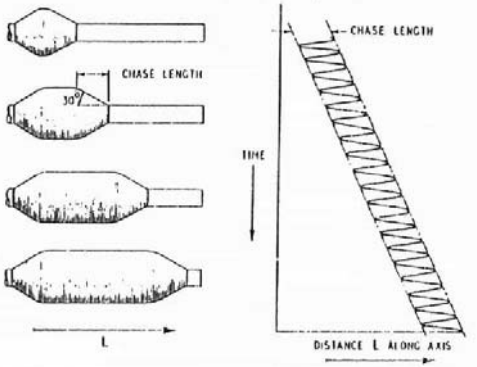
The shuttle



Yarn Snarl

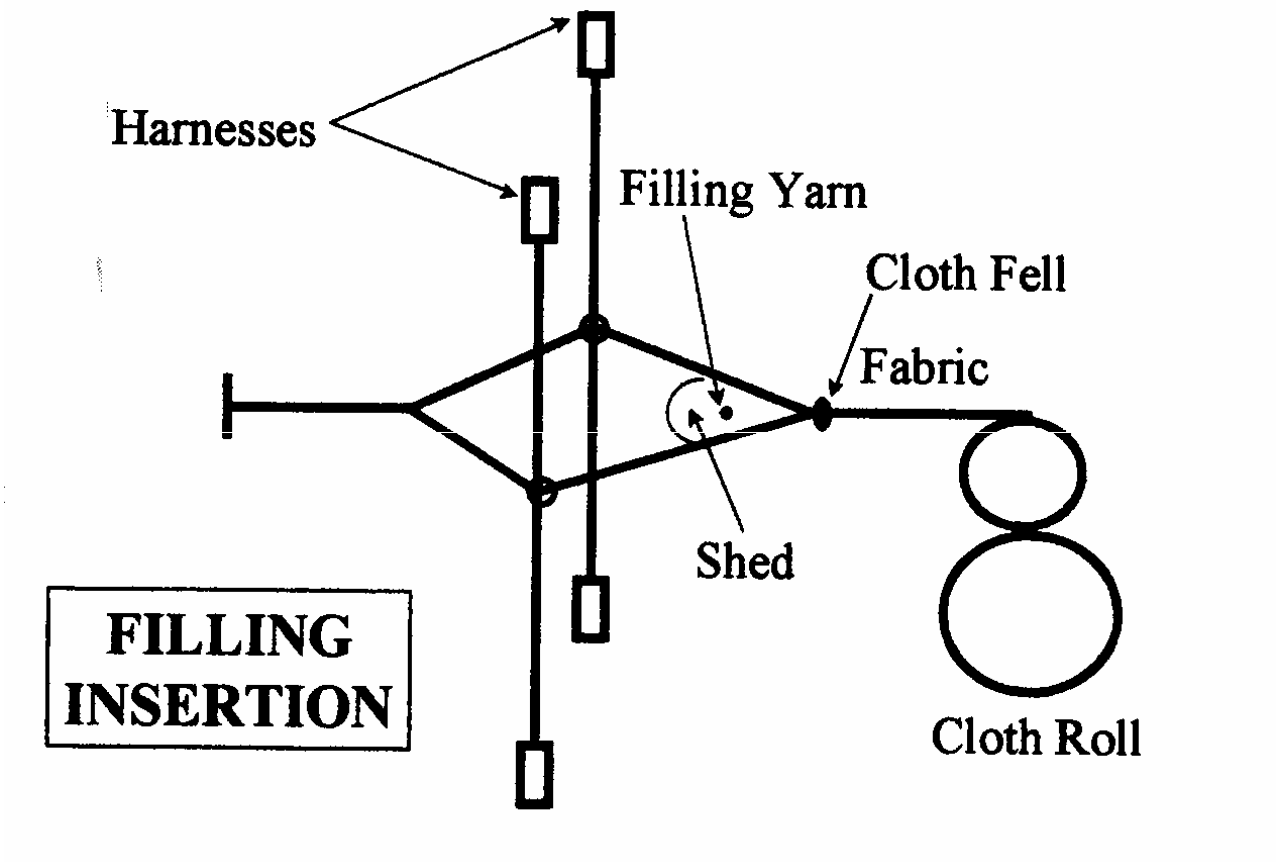


Warpwise length changes during weaving



STAGES IN BUILDING A QUILL

PROGRESSIVE RECIPROCATING TRAVERSE

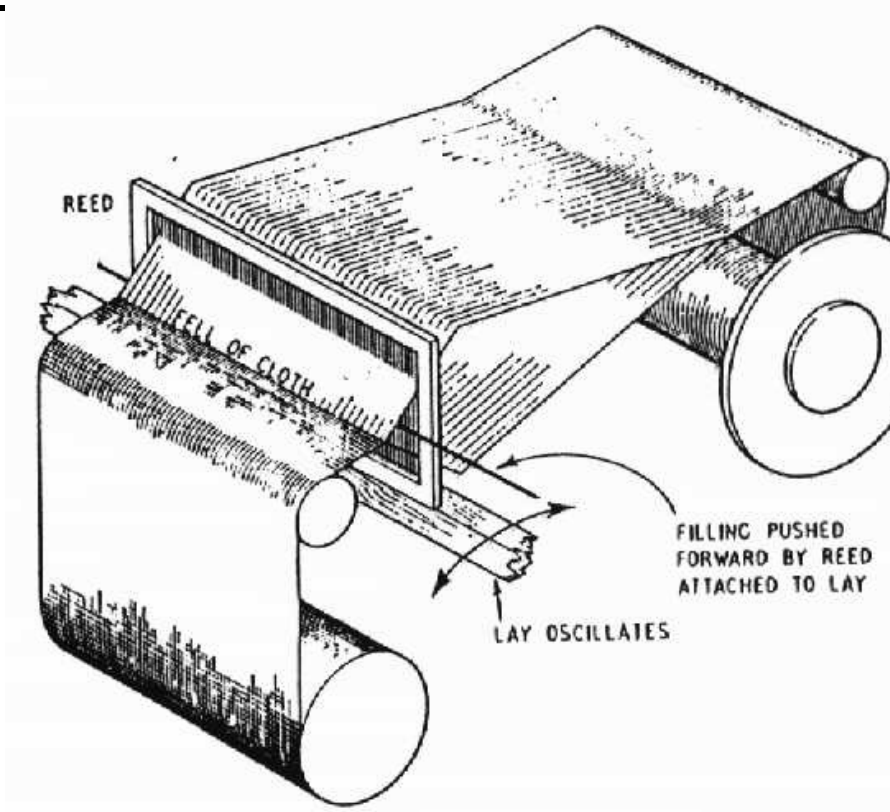

Harnesses
Filling Yarn
Cloth Fell
Fabric
Shed
FILLING INSERTION
Cloth Roll

Beat-up Motion

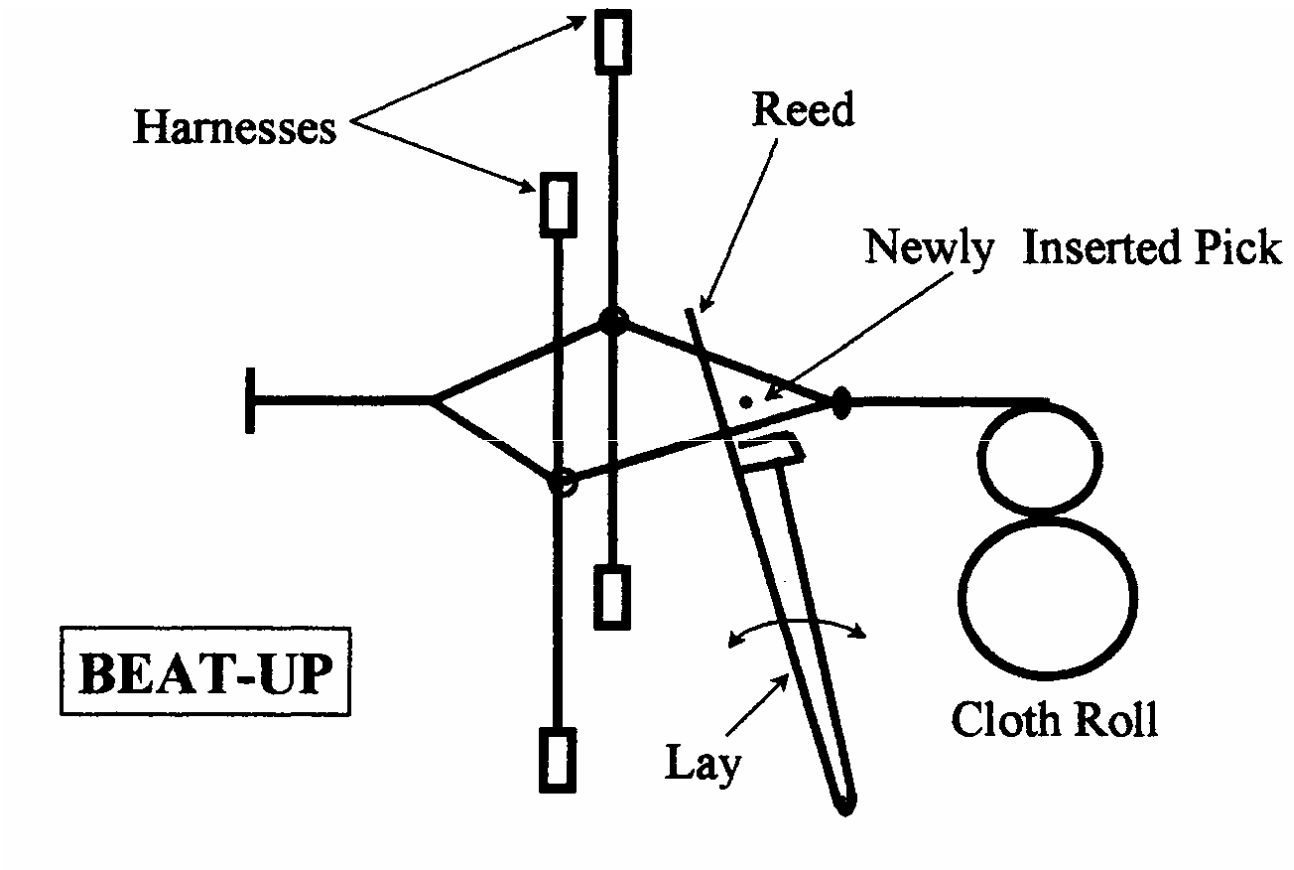
- The newly inserted yarn or pick is pushed at high force to the fell of the cloth by the reed wires

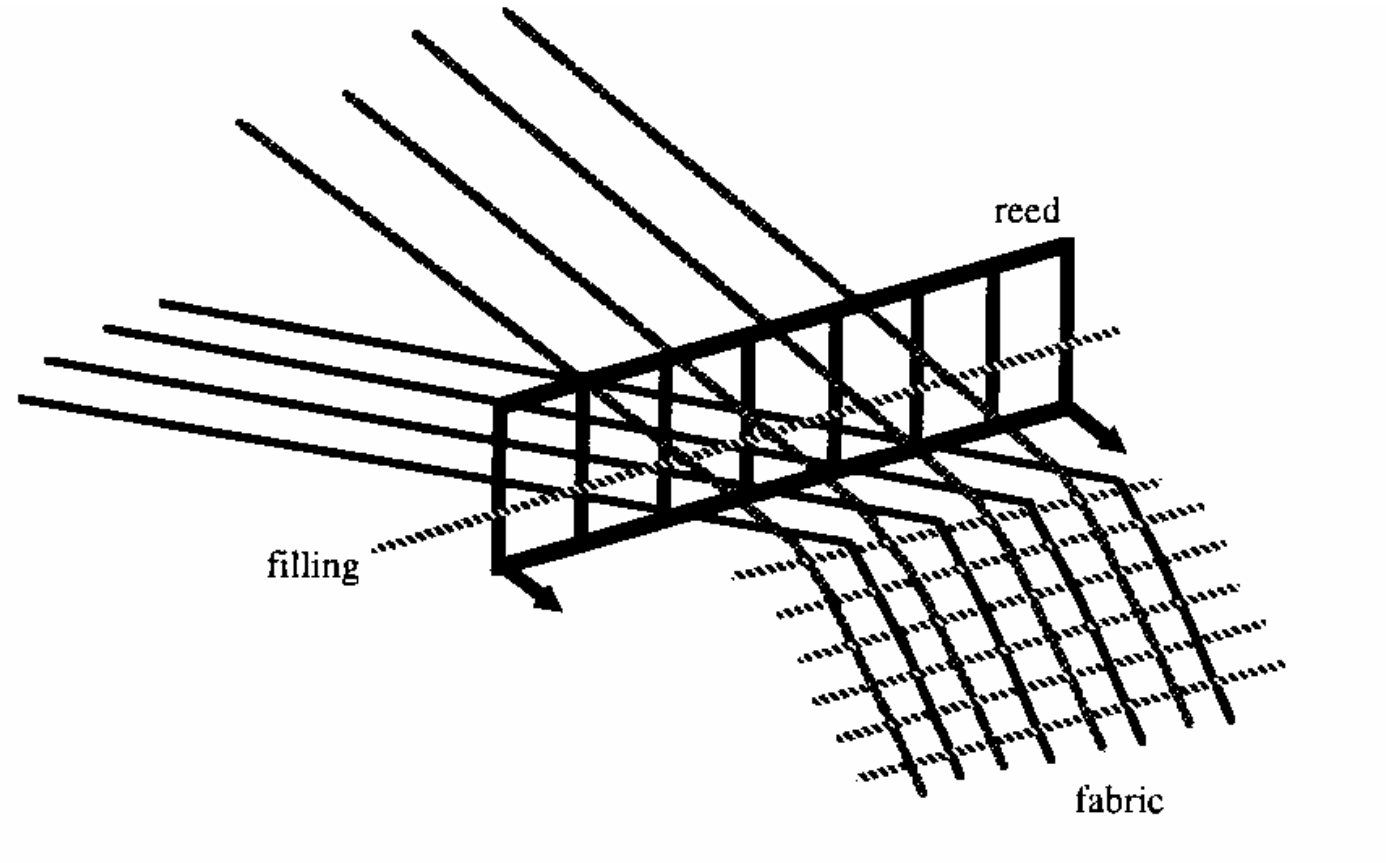
Beat-up Motion

- When the filling has been laid in the warp shed, it lies at a distance from its proper position.
- The newly inserted yarn or pick is pushed at high force to the fell of the cloth by the reed.



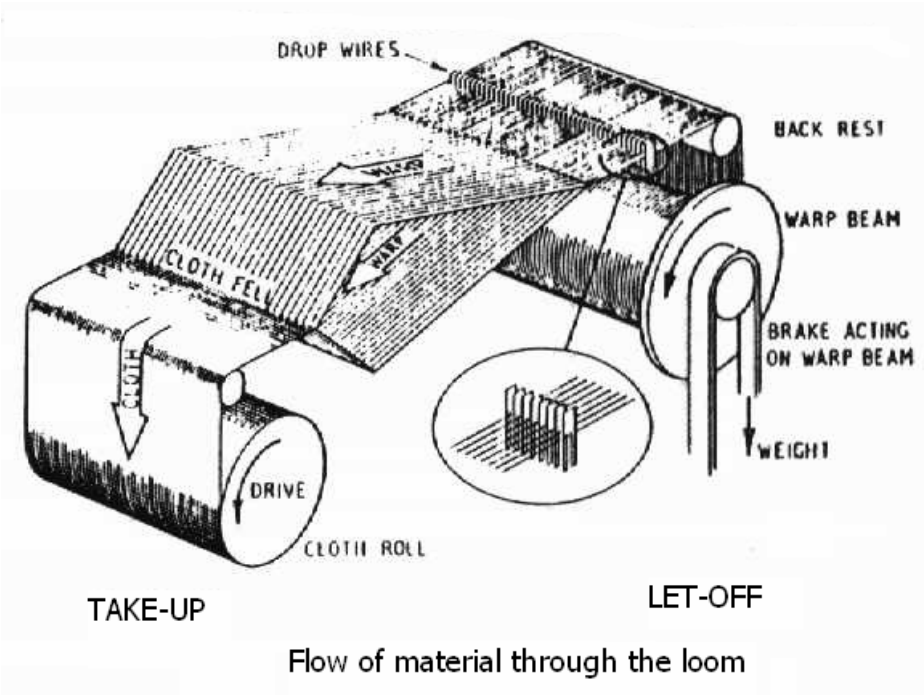
Beat-up


Harnesses
Reed
Newly Inserted Pick
BEAT-UP
Lay
Cloth Roll


reed
filling
fabric

Warp and Weft Control

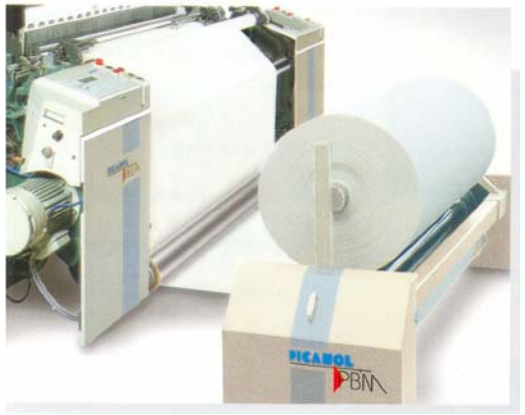
- To ensure the continuity of the weaving process, the woven fabric is collected on a roll called the "cloth roll".
- The cloth roll is rotated by the take up motion to collect a fabric length that equals the space between two picks.
- Simultaneously, the warp is released or fed through the loom to substitute for the amount of fabric that is taken up by the cloth roll. The motion that releases the warp is called "let-off motion".
- **The take-up and let-off motions are dependent.**

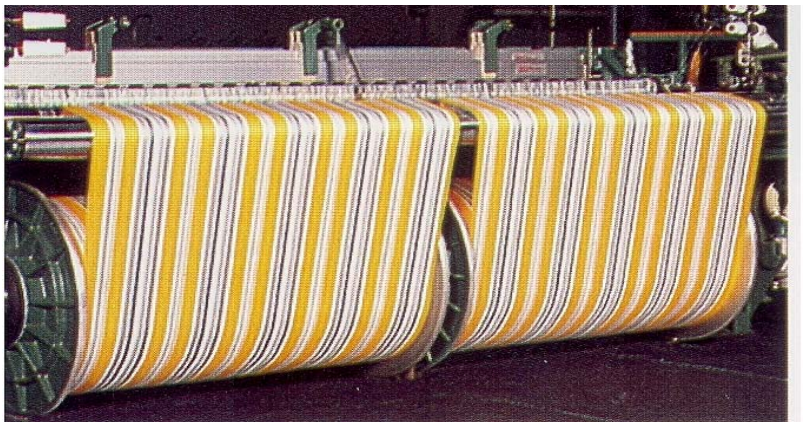


Flow of material through the loom

- In addition to these 5 primary & essential motions, there are control devices designed to stop the loom in the case of a yarn breakage or other event which cause damage to the loom and some other monitoring devices.

Batching motion





Take-up & cloth roller

Twin loom beams