WEAVING MACHINES (LOOMS)
Classification

(Based on weft insertion system)

Looms

Shuttle Looms

Shuttle-less Looms

Non-automatic Looms  Automatic Looms

Projectile  Rapier  Air-jet  Water-jet
Classification
(Based on number of phases)

Looms

Single phase
- Shuttle
  - Flat
  - Circular

Multiphase
- Shuttle-less
  - Filling wave (Circular)
  - Warp wave (Flat)
- Projectile
- Rapier
- Air-jet
- Water-jet
Drawing-in for weaving

- Reed
- Heald wire
- Drop pin for warp stop
- Weaver’s beam
Material passage through different parts of loom
Motions of the loom

- Primary motions
- Secondary motions
- Auxiliary motions
Primary motions

These are the mechanisms which are essentially required on a weaving machine for the operation to be carried out.
Primary motions

- Shedding: Done with Tappets, Dobby, Jacquard
- Picking: With Shuttle/Shuttle-less
- Beat up: By Crank/Cam
Secondary motions

These mechanisms are needed for a continuous weaving operation. They cause the material to move forward on the weaving machine.
Secondary motions

Let off: Releasing the warp sheet from the weaver’s beam in a controlled manner with uniform tension and speed. Classified as; Negative/Positive

Take up: Winding of the woven fabric onto the cloth beam. Done with Wheel take up/Positive take up motion
Auxiliary motions

These mechanisms are required for defect-free weaving operation and to stop the machine automatically when such a fault occurs. Without these, the process will continue, but there will be occurrence of faults due to warp breakage, weft breakage etc. the machine has to be stopped manually for attending these faults and a substantial length of defective fabric would be produced by that time.
Auxiliary motions

**Warp stop motion:** To stop the machine even when a single warp breaks and to facilitate detection of broken end.

**Warp protectory motion:** Mainly on shuttle-looms to prevent shuttle smash, when it is entrapped inside the shed and avoid any possible breakage of several warp ends.

**Weft stop motion:** To stop the loom when there is a weft break or the weft package replenishes on non-auto looms.
Tappet shedding

It is used for simple weaves like plain, twill etc.
Tappet/Cam shedding

- Negative tappets with reversing motion – Shuttle looms

- Positive tappets/cams – Shuttle-less looms
Positive cam shedding

- Robust mono-block housing
- Integral automatic shed levelling device
- Quick change of cams and bevel wheel pair
- Precise transmission of movement to the heald frames
- Oil bath lubrication or circulation type lubrication electronically monitored
Dobby shedding

A dobbay shedding is used for some complex designs like derivatives of twills, combination weaves, satin derivatives etc. where upto 48 heald shafts can be used.
Dobby shedding

Negative dobbý: Climax dobbý, Paper dobbý etc. – Used in Shuttle looms

Positive dobbý: Cam dobbý – Used mostly on Shuttle-less looms
Positive cam dobbly

Cams

Followers
Staubli positive cam dobbý

- Robust mono-block housing
- Modular construction to enhance accessibility
- Highest quality components
- Extremely resilient, consistent and reliable
- Shed opening simple to adjust
- Low maintenance
- Circulation type lubrication electronically monitored
- Electronic control, by independent Stäubli control unit, via integral control unit or weaving machine electronics
Jacquard shedding

Jacquard shedding is used for most complex and intricate designs where individual heald wires need to be controlled independently. Maximum figuring with 1600 hooks can be done.
Jacquard shedding

- Mechanical Jacquards: Shuttle looms
- Electronic Jacquards: Shuttle-less looms mostly Rapier looms
Mounting of Jacquard

- Jacquard
- Framework for Jacquard mounting
- Loom frame
Mechanical Jacquards
Electronic Jacquard
Electronic Jacquard

Hooks to control warp ends
### Working Principle

#### SELECTION 100% ELECTRONIC

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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<tbody>
<tr>
<td>Magnetical and electronical optimised single coil solenoid</td>
<td>based on the unique Bonas patent</td>
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<tr>
<td>Compatible throughout the whole range</td>
<td></td>
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<tr>
<td>Minimal current is required for perfect selection</td>
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<tr>
<td>High quality guide material reduces friction resulting in low maintenance and extended life</td>
<td></td>
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<tr>
<td>Individual part exchange</td>
<td></td>
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<tr>
<td>Practical and easy exchange of self-locating solenoid boards without special tools</td>
<td></td>
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<tr>
<td>Surface mounted electronics ensuring high standards of quality</td>
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Computer Aided Manufacturing

**CONTROLLER**
- Practical and efficient interface between user and jacquard
- Large colour touch screen (10.4”)
- Clear display of information with icons and easy navigation between functions
- Monitoring production data
- Patterns can be loaded on hard disk ≥ 40 GB
- Pattern transfer
  - floppy drive
  - USB
  - network
- Ethernet communication

**PC EDIT**
- Integrated feature for all controllers
- Reading, storing, on-line editing and other design modifications on the controller with user-friendly multilingual software with on-screen help
- Multiple views of the design can be viewed simultaneously
- Warp and weft colours are displayed enabling both sides of the fabric to be seen
- Increased productivity by reducing downtime
- System can be used on PC
Electronic Jacquard (Staubli)

- Easy to adapt and versatile
- Easy to integrate (low profile and judicious location of the perforated plate)
- Safe, straightforward access to make machine adjustments
- Minimize thread stress (low harness depth)
- Strengthened lifting mechanism
- Easy, accurate shed opening adjustment
- Quick fitting and removal of the harness
- Optimum ventilation
- Convenient programming and control with the JC6 controller
- Minimal, straightforward maintenance
Weft insertion systems

- Shuttle
- Projectile
- Rigid rapier
- Flexible rapier
- Air-jet
- Water-jet
Disadvantages of Shuttle picking

- Heavy mass of shuttle (approx. 500 gm)
- High energy consumption
- Low speed and productivity
- More defects in fabric
- More downtime
- More maintenance cost/time
- More low skilled man power requirement
- More wastage
- More vibration of machine parts
- More noise and so on…
Concept of Shuttle-less weaving

- To eliminate the heavy weight weft carrier
- To eliminate unnecessary to & fro movement
- To eliminate the movement of entire weft package
- To minimize power consumption in picking
- To improve quality of woven fabric
- To improve productivity
Non-shuttle weft carriers

- Gripper projectile
- Giver and Taker Rapier heads
- Air stream
- Water stream
Projectile weaving

Projectile weaving machines fulfill all of the textile industry’s requirements in regard to quality and performance. With projectile weft insertion virtually any yarn can be woven, e.g. cotton, wool, silk, mono- and multifilaments and tapes, as well as hard fibres like jute and linen, and even metal.
Projectile weaving

The robust, technologically mature engineering design gives the textile industry the following advantages:

- Low power consumption
- No material loss, by tucked-in selvedges
- Top reliability, functionality, and ease of operation
- Low servicing and maintenance costs
- Long-term retention of value through upgradation
Projectile weaving

- Yarn package
- Yarn feeder
- Picking lever
- Weft cutter
- Guide teeth
- Projectile
- Reed
- Receiving end
Projectile weaving

- Weft feeder
- Picking lever
- Projectile
- Weft cutter
- Tucking-in needle
Projectile weaving
Projectile weaving
Projectile weaving
Positive cam shedding

1. Tappet motion
2. Double cams
3. Roller levers
4. Shafts
Electronic rotary dobby shedding
Weft insertion cycle

1- Projectile
2- Projectile feeder
3- Weft tensioner lever
4- Weft brake
5- Weft end gripper
6- Weft cutter
7- Tucking needles
8- Projectile brake
Weft insertion cycle

1- Projectile
2- Projectile feeder
3- Weft tensioner lever
4- Weft brake
5- Weft end gripper
6- Weft cutter
7- Tucking needles
8- Projectile brake
Torsion bar picking mechanism

1- Picking shoe
2- Projectile
3- Projectile lifter
4- Tension flange
5- Knee joint
6- Roller lever
7- Oil brake
8- Cam
9- Torsion rod
10- Picking shaft
11- Picking lever
12- Roller
Torsion bar picking mechanism

1- Picking shoe
2- Projectile
3- Projectile lifter
4- Tension flange
5- Knee joint
6- Roller lever
7- Oil brake
8- Cam
9- Torsion rod
10- Picking shaft
11- Picking lever
12- Roller
Passage of projectile

Through the channel of the guide teeth
Cam Beat up motion

Reed 1  Guide teeth

Sley 2

Double cams

1. Reed
2. Sley
3. Guide teeth
4. Double cams
Tuck-in selvedge mechanism
Different type of selvedges

- Fringed
- Closed
- Tucked-in
- Leno
Projectile loom manufacturers

Sulzer, the pioneer of projectile looms
Rapier weaving
Rapier weaving

- Single rapier: A single rapier head moves the entire width of the machine;
- Double rapier: Two rapier heads covering half the width each;
  - Rigid rapier
  - Flexible rapier
Classification based on weft transfer mechanism

- Tip transfer: Dewas system
- Loop transfer: Gabler system
Single rapier system
Rigid double rapier system (Dewas)
Rigid double rapier system (Gabler)
Flexible rapier system
Flexible rapier system
Flexible rapier system
Flexible rapier system
Rapier heads

1. Right-hand gripper head
2. Left-hand gripper head
3. Yarn clamp
4. Tongue
5. Rapier tape
Weft colour selection mechanism
Rapier loom manufacturers

Dornier
Somet
Picanol
Sulzer
Vamatex
Jacob Muller
Airjet weaving
Weft insertion passage
Modern Features

- Equipped for symmetrical width reduction
- Newly designed relay nozzles and valves for highest performance
- Equipped for fitting a superstructure – one of the many modular features
- Split frame for style change in less than 30 minutes
- Optimised insertion preparation for up to eight colours or yarn types
- Fast, simple width changes
- Ultimate flexibility, with the same standard design for cam, doby and jacquard motions
- Warp beam and cloth roll can be changed quickly without tools
- Sumo main motor with direct drive
Systems of weft insertion

- Single nozzle, confusor guide and suction system
- Multiple nozzles and guide system
- Multiple nozzles and profile reed system
Single nozzle system

Yarn insertion

Beating

Reed
Warp
Air
Guide
Multiple nozzles with guides
Multiple nozzles with profile reed
Positioning of sub-nozzles
Types of sub nozzle

"Shower relay nozzle"

3-6 Bar
(43.5-87 psi)

6 Bar
(87 psi)

3 Bar
(43.5 psi)

Single hole relay nozzle
Developments in sub-nozzles

Conventional sub-nozzle

Tapered sub-nozzle
Positive cam shedding
Positive dobbý shedding

1. Drive pulley
2. Synchronous belt
3. Dobby
4. Magnet assembly
5. Spring motion
6. Control hook
7. Lifting Knife
8. Cam
9. Cable traction
10. Balance lever
11. Control hook
Yarn Pre-winder/Accumulator

1. Thread guiding tube
2. Measuring band
3. Stopper pin
4. Sensor
Air supply to main nozzle

1 Main nozzle tube
2 Weft yarn
3 Pressure control valve
4 Tandem nozzle
Air supply to sub-nozzles
Beat up motion

Diagram with labels:
1. Main shaft
2. Sley crank gear
3. Driving arm
4. Sley tube
5. Sley
6. Reed
7. Reed holder
8. Aluminium profile
Tuck-in selvedge mechanism
Air-jet loom manufacturers

- Sulzer
- Tsudakoma
- Picanol
- Toyoda
- Dornier
- Somet
- Muller AG
Water-jet weaving
Principle of weft insertion

Adhesion of weft with the water stream
Water-jet weaving

- Suitable for filament weaving
- Non-aqueous based size materials to be used
- High productivity
- Very good quality
- Stable filling insertion
- Energy conservation
- Less vibration
Water-jet loom manufacturers

- Tsudakoma
- Toyoda
- Nissan
- Elitex
Multiphase weaving
Multiphase weaving

Warp direction wave: Multiple wefts are inserted into a waving warp sheet with multiple sheds along the warp direction.

Filling direction wave: Multiple sheds formed in the weft direction for simultaneous passage of multiple wefts.
Weaving rotor (Warp wave)

1. Shed forming element
2. Beat up comb
3. Weft channel
4. Warp positioned
5. Upper shed
6. Lower shed
Weft insertion by airjet

1. Supply bobbins
2. Weft measuring rollers
3. Weft controller
Multiple sheds in weft direction
Multiphase loom manufacturers

Sulzer- M8300
A typical Sulzer Textil innovation: the M8300 Multi-phase weaving
- How it works! The M8300 multi-phase weaving machine produces simple, standard fabrics with an extremely high weft insertion rate. The three priorities in this revolutionary development were performance potential, ecology and economy. Even at market launch, its performance was three to four times that of a modern air-jet weaving machine.
M8300

The performance of the M8300 is far superior to other weaving machines. The M8300 produces simple standard fabrics with extremely high weft-insertion rates. Special emphasis has been placed on producing fabrics with this machine that meet the high quality standards set today. This has been convincingly achieved by the elimination of insertion faults and creating the basic requirements for uniform fabric appearance.
Sulzer Textil M8300 is the result of a development strategy focused on performance potential, ecology and economy. Even in the development stage the multi-phase weaving machine already surpassed by far the performance of any other contemporary air-jet weaving machine. As the weft is inserted continuously without interruption and at an even pull-off speed of only 20-25 m/s, the stress on the yarn is significantly reduced. This points to potential for further performance boost in the future.
Weft wave multiphase weaving

Circular looms