

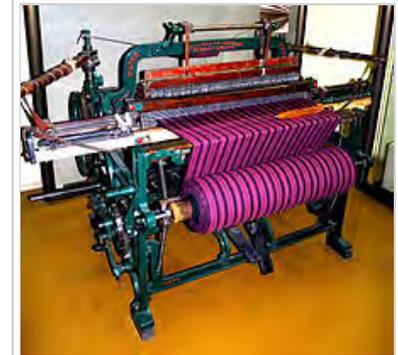
# Loom

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A **loom** is a device used to weave cloth and tapestry. The basic purpose of any loom is to hold the warp threads under tension to facilitate the interweaving of the weft threads. The precise shape of the loom and its mechanics may vary, but the basic function is the same.

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A foot-treadle operated Hattersley & Sons, Domestic Loom, built under license in 1893, in Keighley, Yorkshire.



A woman in Konya, Turkey, works at a vertical loom

## Etymology

The word "loom" is derived from the Old English "*geloma*" formed from ge-(perfective prefix) and "*loma*", a root of unknown origin; this meant utensil or tool or machine of any kind. In 1404 it was used to mean a machine to enable weaving thread into cloth.<sup>[1]</sup> By 1838 it had gained the meaning of a machine for interlacing thread.

## Weaving

Weaving is done by intersecting the longitudinal threads, the **warp**, i.e. "that which is thrown across",<sup>[2]</sup> with the transverse threads, the **weft**, i.e. "that which is woven".

The major components of the loom are the warp beam, heddles, harnesses or shafts (as few as two, four is common, sixteen not unheard of), shuttle, reed and takeup roll. In the loom, yarn processing includes shedding, picking, battening and taking-up operations. These are the principal motions.

- **Shedding.** Shedding is the raising of part of the warp yarn to form a shed (the vertical space between the raised and unraised warp yarns), through which the filling yarn, carried by the shuttle, can be inserted. On the modern loom, simple and intricate shedding operations are performed automatically by the heddle or heald frame, also known as a harness. This is a rectangular frame to which a series of wires, called heddles or healds, are attached. The yarns are passed through the eye holes of the heddles, which hang vertically from the harnesses. The weave pattern determines which harness controls which warp yarns, and the number of harnesses used depends on the complexity of the weave. Two common methods of controlling the heddles are dobbies and a Jacquard Head.
- **Picking.** As the harnesses raise the heddles or healds, which raise the warp yarns, the shed is created. The filling yarn is inserted through the shed by a small carrier device called a shuttle. The shuttle is normally pointed at each end to allow passage through the shed. In a traditional shuttle loom, the filling yarn is wound onto a quill, which in turn is mounted in the shuttle. The filling yarn emerges through a hole in the shuttle as it moves across the loom. A single crossing of the shuttle from one side of the loom to the other is known as a pick. As the shuttle moves back and forth across the shed, it weaves an edge, or selvage, on each side of the fabric to prevent the fabric from raveling.
- **Battening.** Between the heddles and the takeup roll, the warp threads pass through another frame called the reed (which resembles a comb). The portion of the fabric that has already been formed but not yet rolled up on the takeup roll is called the fell. After the shuttle moves across the loom laying down the fill yarn, the weaver uses the reed to press (or batten) each filling yarn against the fell. Conventional shuttle looms can operate at speeds of about 150 to 160 picks per minute.<sup>[3]</sup>



Weaving demonstration on a 1830 handloom in the weaving museum in Leiden



Shuttles

There are two secondary motions, because with each weaving operation the newly constructed fabric must be wound on a cloth beam. This process is called taking up. At the same time, the warp yarns must be let off or released from the warp beams. To become fully automatic, a loom needs a tertiary motion, the filling stop motion. This will brake the loom, if the weft thread breaks.<sup>[3]</sup> An automatic loom requires 0.125 hp to 0.5 hp to operate.

## Types of looms

### Back strap loom

A simple loom which has its roots in ancient civilizations consists of two sticks or bars between which the warps are stretched. One bar is attached to a fixed object, and the other to the weaver usually by means of a strap around the back. On traditional looms, the two main sheds are operated by means of a shed roll over which one set of warps pass, and continuous string heddles which encase each of the warps in the other set. The weaver leans back and uses his or her body weight to tension the loom. To open the shed controlled by the string heddles, the weaver relaxes tension on the warps and raises the heddles. The other shed is usually opened by simply drawing the shed roll toward the weaver. Both simple and complex textiles can be woven on this loom. Width is limited to how far the weaver can reach from side to side to pass the shuttle. Warp faced textiles, often decorated with intricate pick-up patterns woven in complementary and supplementary warp techniques are woven by indigenous peoples today around the world. They produce such things as belts, ponchos, bags, hatbands and carrying cloths. Supplementary weft patterning and brocading is practiced in many regions. Balanced weaves are also possible on the backstrap loom. Today, commercially produced backstrap loom kits often include a rigid heddle.



A back strap loom with a shed-rod.

## Warp-weighted loom

The warp-weighted loom is a vertical loom that may have originated in the Neolithic period. The earliest evidence of warp-weighted looms comes from sites belonging to the Starčevo culture in modern Serbia and Hungary and from late Neolithic sites in Switzerland.<sup>[4]</sup> This loom was used in Ancient Greece, and spread north and west throughout Europe thereafter.<sup>[5]</sup> Its defining characteristic is hanging weights (loom weights) which keep bundles of the warp threads taut. Frequently, extra warp thread is wound around the weights. When a weaver has reached the bottom of the available warp, the completed section can be rolled around the top beam, and additional lengths of warp threads can be unwound from the weights to continue. This frees the weaver from vertical size constraints.

## Drawloom

A drawloom is a hand-loom for weaving figured cloth. In a drawloom, a "figure harness" is used to control each warp thread separately.<sup>[6]</sup> A drawloom requires two operators, the weaver and an assistant called a "drawboy" to manage the figure harness.

## Handloom

A handloom is a simple machine used for weaving. In a wooden vertical-shaft looms, the heddles are fixed in place in the shaft. The warp threads pass alternately through a heddle, and through a space between the heddles (the shed), so that raising the shaft raises half the threads (those passing through the heddles), and lowering the shaft lowers the same threads — the threads passing through the spaces between the heddles remain in place. This was a great discovery in the 13th century.

## Flying shuttle

Hand weavers could only weave a cloth as wide as their armspan. If cloth needed to be wider, two people would do the task (often this would be an adult with a child). John Kay (1704–1779) patented the flying shuttle in 1733. The weaver held a picking stick that was attached by cords to a device at both ends of the shed. With a flick of the wrist, one cord was pulled and the shuttle was propelled through the shed to the other end with considerable force, speed and efficiency. A flick in the opposite direction and the shuttle was propelled back. A single weaver had control of this motion but the flying shuttle could weave much wider fabric than an arm's length at much greater speeds than had been achieved with the hand thrown shuttle.

The *flying shuttle* was one of the key developments in weaving that helped fuel the Industrial Revolution. The whole picking motion no longer relied on manual skill and it was just a matter of time before it could be powered.

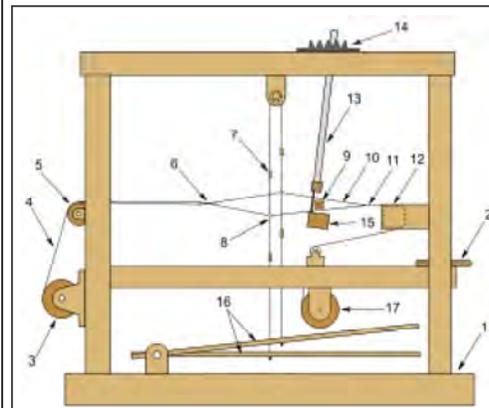
## *Haute-lisse* and *basse-lisse* looms

Looms used for weaving traditional tapestry are classified as *haute-lisse* looms, where the warp is suspended vertically between two rolls, and the *basse-lisse* looms, where the warp extends horizontally between the rolls.

## Ribbon weaving

## Traditional looms

Elements of a foot-treadle floor loom



1. Wood frame
2. Seat for weaver
3. Warp beam- let off
4. Warp threads
5. Back beam or platen
6. Rods – used to make a shed
7. Heddle frame - heald frame - harness
8. Heddle- heald - the eye
9. Shuttle with weft yarn
10. Shed
11. Completed fabric
12. Breast beam
13. Batten with reed comb
14. Batten adjustment
15. Lathe
16. Treadles
17. Cloth roll- takeup

Several other types of hand looms exist, including the simple frame loom, pit loom, free-standing loom, and the pegged loom. Each of these can be constructed, and provide work and income in developing societies.<sup>[7]</sup>

## Power looms

Edmund Cartwright built and patented a power loom in 1785, and it was this that was adopted by the nascent cotton industry in England. The silk loom made by Jacques Vaucanson in 1745 operated on the same principles but was not developed further. The invention of the flying shuttle by John Kay was critical to the development of a commercially successful power loom.<sup>[8]</sup> Cartwright's loom was impractical but the ideas behind it were developed by numerous inventors in the Manchester area of England where, by 1818, there were 32 factories containing 5,732 looms.<sup>[9]</sup>

Horrocks loom was viable, but it was the Roberts Loom in 1830 that marked the turning point.<sup>[10]</sup> Incremental changes to the three motions continued to be made. The problems of sizing, stop-motions, consistent take-up, and a temple to maintain the width remained. In 1841, Kenworthy and Bullough produced the Lancashire Loom<sup>[11]</sup> which was self-acting or semi-automatic. This enables a youngster to run six looms at the same time. Thus, for simple calicos, the power loom became more economical to run than the hand loom – with complex patterning that used a dobby or Jacquard head, jobs were still put out to handloom weavers until the 1870s. Incremental changes were made such as the Dickinson Loom, culminating in the Keighley-born inventor Northrop, who was working for the Draper Corporation in Hopedale producing the fully automatic Northrop Loom. This loom recharged the shuttle when the pirn was empty. The Draper E and X models became the leading products from 1909. They were challenged by synthetic fibres such as rayon.<sup>[12]</sup>

From 1942 the faster and more efficient shuttleless Sulzer looms and the rapier looms were introduced.<sup>[13]</sup> Modern industrial looms can weave at 2,000 weft insertions per minute.<sup>[14]</sup>

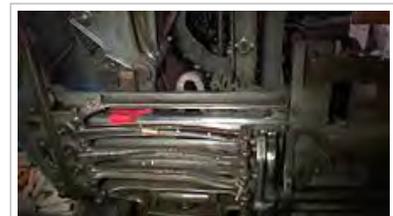
## Weft insertion

Different types of looms are most often defined by the way that the weft, or pick, is inserted into the warp. Many advances in weft insertion have been made in order to make manufactured cloth more cost effective. There are five main types of weft insertion and they are as follows:

- **Shuttle:** The first-ever powered looms were shuttle-type looms. Spools of weft are unravelled as the shuttle travels across the shed. This is very similar to projectile methods of weaving, except that the weft spool is stored on the shuttle. These looms are considered obsolete in modern industrial fabric manufacturing because they can only reach a maximum of 300 picks per minute.
- **Air jet:** An air-jet loom uses short quick bursts of compressed air to propel the weft through the shed in order to complete the weave. Air jets are the fastest traditional method of weaving in modern manufacturing and they are able to achieve up to 1,500 picks per minute. However, the amounts of compressed air required to run these looms, as well as the complexity in the way the air jets are positioned, make them more costly than other looms.
- **Water jet:** Water-jet looms use the same principle as air-jet looms, but they take advantage of pressurized water to propel the weft. The advantage of this type of weaving is that water power is cheaper where water is directly available on site. Picks per minute can reach as high as 1,000.



Two Lancashire looms in the Queen Street Mill weaving shed, Burnley



A 1939 loom working at the Mueller Cloth Mill museum in Euskirchen, Germany.



A Picanol rapier loom

- **Rapier loom:** This type of weaving is very versatile, in that rapier looms can weave using a large variety of threads. There are several types of rapiers, but they all use a hook system attached to a rod or metal band to pass the pick across the shed. These machines regularly reach 700 picks per minute in normal production.
- **Projectile:** Projectile looms utilize an object that is propelled across the shed, usually by spring power, and is guided across the width of the cloth by a series of reeds. The projectile is then removed from the weft fibre and it is returned to the opposite side of the machine so it can get reused. Multiple projectiles are in use in order to increase the pick speed. Maximum speeds on these machines can be as high as 1,050 ppm.

## Shedding

### Dobby looms

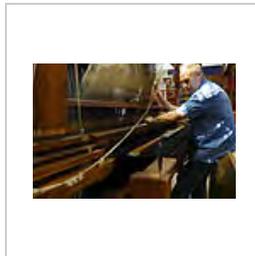
A doobby loom is a type of floor loom that controls the whole warp threads using a doobby head. Dobby is a corruption of "draw boy" which refers to the weaver's helpers who used to control the warp thread by pulling on draw threads. A doobby loom is an alternative to a treadle loom, where multiple heddles (shafts) were controlled by foot treadles – one for each heddle.

### Jacquard looms

The **Jacquard loom** is a mechanical loom, invented by Joseph Marie Jacquard in 1801, which simplifies the process of manufacturing textiles with complex patterns such as brocade, damask and matelasse.<sup>[15][16]</sup> The loom is controlled by punched cards with punched holes, each row of which corresponds to one row of the design. Multiple rows of holes are punched on each card and the many cards that compose the design of the textile are strung together in order. It is based on earlier inventions by the Frenchmen Basile Bouchon (1725), Jean Baptiste Falcon (1728) and Jacques Vaucanson (1740)<sup>[17]</sup> To call it a loom is a misnomer, a Jacquard head could be attached to a power loom or a hand loom, the head controlling which warp thread was raised during shedding. Multiple shuttles could be used to control the colour of the weft during picking.



Hand operated Jacquard looms in the Textile Department of the Strzemiński Academy of Fine Arts in Łódź, Poland.



Battening on a jacquard loom in Łódź.



Following the pattern, holes are punched in the appropriate places on a jacquard card.

## Circular looms

A circular loom is used to create a seamless tube of fabric for products such as hosiery, sacks, clothing, fabric hose (such as fire hose) and the like. Circular looms can be small jigs used for Circular knitting<sup>[18]</sup> or large high-speed machines for modern garments.<sup>[19]</sup> Modern circular looms use up to ten shuttles driven from below in a circular motion by electromagnets for the weft yarns, and cams to control the warp threads. The warps rise and fall with each shuttle passage, unlike the common practice of lifting all of them at once.

## Gallery



*Model of Navajo Loom*, late 19th century, Brooklyn Museum.jpg



An early nineteenth century Japanese loom with several heddles, which the weaver controls with her foot



A Jakalteq Maya brocade weaver working on a hair sash on a back strap loom.



Hand loom at Hjerl Hede, Denmark, showing grayish warp threads (back) and cloth woven with red filling yarn (front)



Oaxacan artisan Alberto Sanchez Martinez at loom

## See also

- Fashion and Textile Museum
- Shuttle (weaving)
- Textile manufacturing
- Timeline of clothing and textiles technology
- Weaving (mythology)

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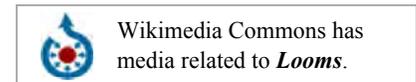
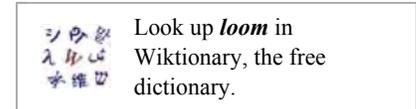
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## External links

- Handloom construction: Practical guide to constructing viable handlooms, Joan Koster,1978



([https://web.archive.org/web/20140302081647/http://www.cd3wd.com/cd3wd\\_40/vita/handloom/en/handloom.htm](https://web.archive.org/web/20140302081647/http://www.cd3wd.com/cd3wd_40/vita/handloom/en/handloom.htm)) (archived link, March 2, 2014)

- Loom demonstration video (<https://www.youtube.com/watch?v=fUCPh9AsS0>)
- "Caring for your loom" article (<http://www.woolfestival.com/articles/loomcare.htm>)
- "The Art and History of Weaving" (<http://www.faculty.de.gcsu.edu/~dvess/ids/fap/weav.html>)
- The Medieval Technology Pages: "The Horizontal Loom" (<http://scholar.chem.nyu.edu/tekpages/loom.html>)

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