Introduction (2)

Weaving machines: Shuttleless looms

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Learning Objectives

- Four different types of shuttleless weaving machines
  - Rapier loom
  - Projectile loom
  - Air jet loom
  - Water jet loom

- Advantages and disadvantages of each shuttleless loom
Weaving Machine
Shuttleless loom

- The problems of shuttle loom are the weft yarns are placed inside the shuttle. The shuttle is big and heavy and the machine speed is low and noisy to operate. In addition, a new pirn must be inserted to the empty shuttle for continue operation.

- Shuttleless looms eliminate these problems by placing the cone of yarn at the side of the loom.

- Once the yarn is bought across the loom, the yarn is cut, often leaving a little fringe of the edges of the fabric.
Automatic Shuttle Loom used in 1970s
Shuttleless Loom

- There are FOUR different type of shuttleless looms
- They are
  - Rapier loom (single and double type);
  - Gripper or projectile loom;
  - Water jet and
  - Air jet loom
- Except the weft yarn is placed at the side of the loom, the weaving processes (primary and auxiliary motions) of shuttleless loom is similar to shuttle loom
Shuttleless Loom. Insert weft yarn by means of projectile, rapier, air and water jet

Weft yarn is placed outside the weaving loom.

The speed is faster, quiet and better fabric quality.
Shuttleless loom
Rapier Loom

- A rapier loom uses a rapier to pull the weft yarn across the loom.
- It can be a single rapier or double rapier.
- For a single rapier, a long rapier device is required to extend across the full width of warp.
- For a double rapier loom, two rapiers enter the shed from opposite sides of the loom and transfer the weft from one rapier head to the other near the centre of the loom.
- The advantage of two rapier system is only 50% of the rapier movement is utilized in the weft insertion of single rapier loom.
Yarn is passed from one rapier head (LHS) to other rapier head (RHS).
Saurer 500 – single rapier with gripper head at its two ends

1. Loom degree 60

2. Loom degree 180

3. Loom degree 300
Shuttleless loom
Rapier Loom

▪ Rapier loom in action (Video)
Shuttleless Loom
Projectile loom (I)

- The picking action is accomplished by a small bullet-like gripper which grips the weft yarn and carries it through the shed.
- This is a more positive way of inserting the weft yarn without restoring to the heavy shuttle.
- Because the mass of gripper is low, the forces needed to accelerate it are less and the picking mechanism can be lighter.
- In addition, the running speed of the looms can be increased significantly compared with conventional shuttle loom.
Projectile Loom
Small bullet-like gripper is passed from one side to the other inside the shed.
Projectile Loom

Bullets inside the rail
Shuttleless loom
Projectile loom (II)

- Several grippers are normally used in the loom.
- While one is crossing the loom with weft yarn, the others are returning to the starting position.
- The dragging of the weft yarn across a loom creates strain on this yarn, so projectile looms are not suited for weaving with very weak yarn.
- However, it is excellent for use with heavy and bulky yarns, as well as regular size yarns.
- It is the most versatile of the shuttleless looms in regard to the range of fabric it can produce.
Gripper Projectile Loom
New guide teeth reduce frictional drag on projectiles as well as sley weight.
Shuttleless loom
Projectile loom

- Projectile loom in action (Video)
Jet looms take the weft yarn across the loom by using a high speed of either air or water.

The force of air or water carries the yarn from one side to the other.

Jet looms are faster than projectile or rapier looms (picks per minute).

However, they cannot produce as great a variety of fabrics (no heavy or bulky yarns), nor can they produce as wide a fabric (jets have less yarn-carrying power).

Jet looms also do less damage to the warp since there is no abrasion of this yarn by the jets of air or water, unlike the projectile or rapier.
Air Jet Loom

Multiple air nozzles are used to insert the weft yarn into the shed.
AIR JET WEFT INSERTION SYSTEM
Shuttleless Loom
Air jet (II)

- With the air-jet looms, the initial propulsion force is provided by a main nozzle.
- Relay nozzles (auxiliary nozzles) along the shed produce additional booster jets to help carry the yarns across the loom.
- The fabric width of air-jet loom is normally narrower than rapier or projectile loom.
Air Jet Loom

Main Air Nozzle
Shuttleless Loom
Air jet

- Air jet loom in action (Video)
Water Jet Loom (Toyota)
Shuttleless Loom
Water jet (I)

- With water-jet looms, there is only a main nozzle to provide the propulsion of the weft yarn.
- The loom is very efficient, with only a small amount of water required and is the fastest type of shuttleless loom.
- Water-jet looms are capable of producing 700 picks per min (ppm) for 75-inch fabrics compared to about 180 picks per min for shuttle looms with 44-inch fabric.
Shuttleless Loom
Water jet (II)

- Since wet fabric cannot be stored in a roll, water-jet looms are equipped with efficient drying units.
- The units use vacuum suction and heat to remove the water from the fabric.
- Water-jet looms are best suited for weaving filament yarns made of hydrophobic fibres (water-resistance fiber) like nylon, or polyester/cotton.
- Yarns made of fibres that lose strength when wet (e.g. rayon) should not be used.
# Weaving Production Rates

<table>
<thead>
<tr>
<th>Date</th>
<th>Working Hours to weave 100m plain fabric</th>
<th>Technology Involved</th>
<th>Working Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1750</td>
<td>400 hours (5.5 weeks)</td>
<td>Hand loom worked at home</td>
<td>72 hours/week</td>
</tr>
<tr>
<td>1790</td>
<td>100 hours (1.5 weeks)</td>
<td>John Kay’s flying shuttle</td>
<td>72 hours/week</td>
</tr>
<tr>
<td>1810</td>
<td>100 hours (1.5 week)</td>
<td>Power looms start to be used</td>
<td>72 hours/week</td>
</tr>
<tr>
<td>1840</td>
<td>14 hours</td>
<td>Power looms take over (USA)</td>
<td>72 hours/week</td>
</tr>
<tr>
<td>1900</td>
<td>9 hours</td>
<td>Northrop automatic loom</td>
<td>72 hours/week</td>
</tr>
<tr>
<td>1950</td>
<td>50 mins</td>
<td>One weaver supervising 24 looms</td>
<td>48 hours/week</td>
</tr>
<tr>
<td>1970</td>
<td>25 mins</td>
<td>One weaver supervising 20 looms (projectile)</td>
<td>40 hours/week</td>
</tr>
<tr>
<td>1980</td>
<td>10 mins</td>
<td>Multished looms weaving 3 widths of fabric at a time</td>
<td>35 hours/week</td>
</tr>
</tbody>
</table>
Discussion

- What are the advantages of shuttleless loom over the shuttle loom?
- Amongst all the shuttleless looms, which one runs fastest, and which one produce the most versatile textile fabrics (heavy/medium/fine fabrics)?