Chapter- 5:

Weaving Mechanism

The Fabric weaving is accomplished on sophisticated, high speed, precision **loom**. But for understanding the complicated operations of a weaving, the machine can be broken down into simple functions, related to the process of cloth formation with particular reference to those functions which have the greatest influence upon the structure and the appearance of fabrics.

5.1. PASSAGE OF YARN ON THE LOOM

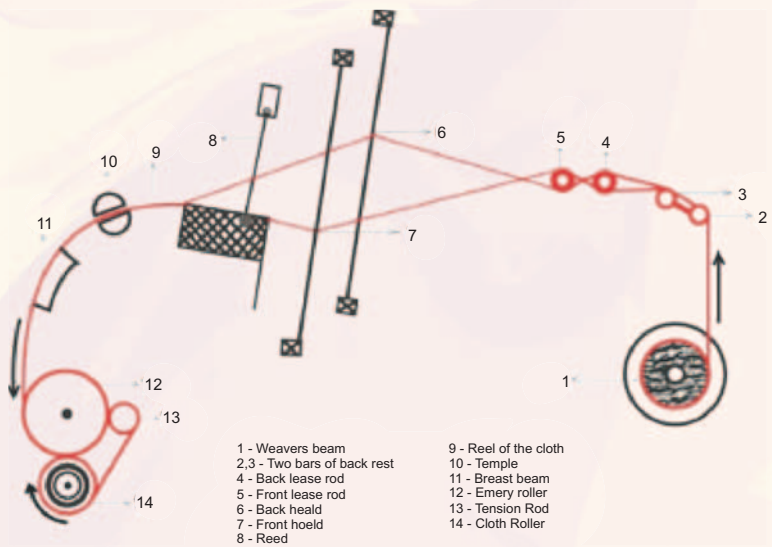

Fig 5.1: Line Diagram of Passage of Yarn (Ends) on the Loom

The passage of warp through the loom is as shown in the diagram (Fig 5.1). The warp leaves the **Weaver's Beam (No. 1)** and passes over the **Back Rest (No. 2, 3)**. From here half the warp ends pass over the **Back Lease Rod 1 (No. 4)** and under the **Back Lease Rod 2 (No. 5)** and the remaining half pass under lease rod 1 and over the lease rod 2. This divides the warp sheet into two parts which avoids entanglement and facilitates straightening of warp ends. The lease rods also help in forming an even shed. After this the warp yarns are drawn through the **Heald Shafts (No. 6, 7)** as per the design requirement. The Heald Shafts contain **Heald Wires** with **Heald Eyes** at the center through which the warp ends are passed. The warp ends next pass through the **Reed (No.8)** which is like a flat wire comb. The point 9 is the "**Cloth Fell**"; it is the point where the warp and weft become a cloth, as the reed beats up the last inserted weft up to this

point. The cloth is then held at each side by **Temple (No.10)**. This holds the cloth fell out to the width of the warp sheet. The cloth is then passed over the **Breast Beam (No.11)** and goes partly around the **Emery Roller (No.12)**, then over the **Tension Rod (No.13)** to be wound onto the **Cloth Roller (No.14)**.

5.2. IMPORTANT PARTS OF A LOOM

5.2.1. Heald Shaft

This part is related to the Shedding Mechanism. It can be made up of wood or metal. It carries number of heald wires, at the center of which is the heald eye. The ends of warp sheet pass through these heald wires. The number of Heald shafts used in weaving depends on the **Repeat** of the weave. The main functions of heald shafts are:

- It helps in shed formation
- It helps in identifying the broken warp thread.
- It determines the order of lifting and lowering the warp ends for a pick

5.2.2. Reed

It is a metallic comb which is made up of number of wires. The gap between these wires is known as **Dent**. The reed performs the following functions:

- It pushes the last inserted pick to the fell of the cloth.
- It keeps the warp ends in its position and avoids entanglement.
- It determines the fabric density, i.e. the number of ends per inch of the fabric.

5.2.3. Warp Beam

This is also known as the **Weaver's Beam**. The warp sheet is wound on to this beam and it is fixed at the back of the loom.

5.2.4. Back Rest

Back Rest or Back Beam is above the weaver's beam. It acts as a guide to the warp sheet coming from the weaver' beam and also as a sensor for sensing the warp tension

5.2.5. Breast Beam

The breast beam or the front rest is between the temples and the cloth roller at the front of the loom and it acts as a guide for the cloth being wound on to the cloth

roller. The front rest along with the back rest keeps the warp sheet and cloth in the horizontal position and maintains proper tension to facilitate weaving

5.2.6. Cloth Beam

It is also called as cloth roller. The woven cloth is wound on to this roller. This roller is at the front of the loom

5.3. BASIC OPERATIONS IN WOVEN CLOTH PRODUCTION

The weaving process consists of three basic operations which form a continuous cycle whether in the simplest hand-loom or in the most complex automatic loom. These **Primary Motions of Weaving** are as follows:

5.3.1. Shedding -

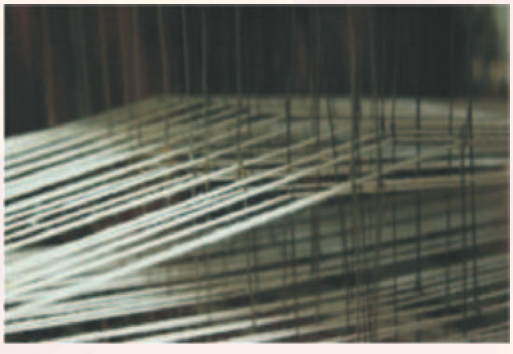

Fig 5.2: Shedding of Warp Sheet

The separation of the warp threads into upper and lower layers forming a Shed, or a tunnel, through which the weft is passed (Fig.:5.2).

5.3.2. Picking -

Fig 5.3: Picking with a Shuttle

The insertion of the weft thread, which traverses across the fabric, through the shed (Fig.:5.3).

5.3.3. Beating-up -

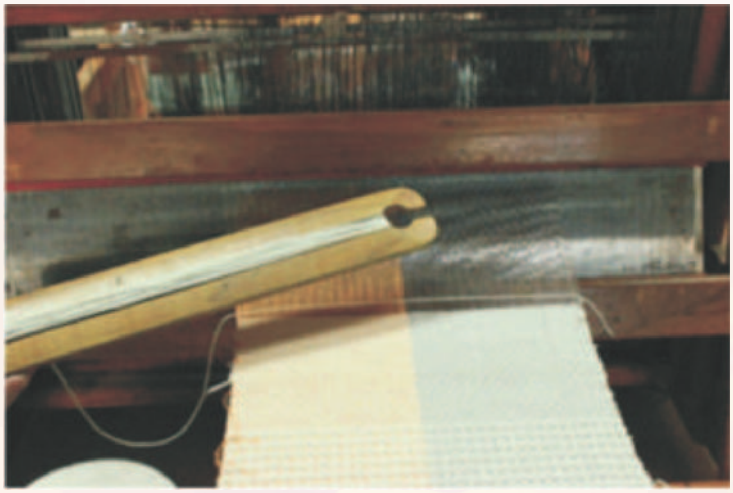

Fig 5.4: Beating with the Reed

The carrying forward of the last inserted pick or weft, to the fell of the cloth (Fig.:5.4).

The picking and the beating-up operations are fixed no matter what type of fabric is being produced, but the shedding motion is variable and can be described as the heart of weaving as it is here that the nature of the interlacing or the weave, is decided. The different shedding motions are described further in the chapter.

In addition to the three principal operations, several ancillary motions are required for control purpose. Some of these are mechanical devices connected with the safety and the continuity of weaving operations, but influence of some motions can alter the cloth appearance considerably.

These Auxiliary motions are as follows:

5.3.4. Warp Let-Off -

This determines the rate at which the warp is fed forward and the tension of the warp yarn. The tension is largely responsible for the configuration of warp ends in the cloth and two fabrics of identical design but woven with varying degrees of tension may appear different and may possess different characteristics

5.3.5. The Cloth Take-Up -

This determines the speed of cloth withdrawal and therefore, the density of spacing of the weft picks (i.e. the Picks per inch) in the cloth

The other mechanisms are as follows:

5.3.6. Warp-Protector motion -

This stops the loom to prevent excessive damage to the warp threads, cloth, and reed if a shuttle becomes trapped between the top and bottom shed lines and the reed is failing to complete its traverse.

5.3.7. Warp and Weft-Stop Motion -

This will stop the loom almost immediately if a warp end or a weft thread breaks, thus avoiding defects in the fabric.

Yarns must remain completely parallel from warp beam to cloth beam and not cross each other. If they do cross each other it may cause warp yarns to break, which ultimately results in fabric defects.

5.4. WEAVING

The weave structure in the fabric is determined by two factors.

- The order in which the warp threads are threaded in the heald shafts and in the reed.
- The combination of heald shafts raised or lowered at a time, and the sequence in which the heald shafts are raised or lowered

5.5. IMPORTANT WEAVING TERMINOLOGIES

5.5.1. Fabric Density

The fabric density is defined as the number of ends and picks in a unit of a fabric. It is measured as ends per inch and picks per inch

5.5.2. Ends per inch (EPI)

This is defined as the number of ends in one inch of the fabric. To get the required warp density, reeds of different counts are used.

5.5.3. Reed Count

The Reed Count is defined as number of dents in two inches. Through each dent, two, three or more ends can be passed. So for example, if you are using a Reed Count of 32s, it means there are 16 dents in one inch, so with 2 ends per dent, the EPI would be 32 (16x2=32). Reeds of different counts are available which help in making fine or thick cloth or changing the number of ends per dent can help to achieve open or close fabric.

5.5.4. Picks per inch

This is defined as the number of picks in one inch of the fabric. The density of picks can be varied by changing the take-up speed. If the take-up speed is high then Picks per inch is less. This is so because as the fabric is wound at the greater speed the picks are being laid further apart, where as if the take up is slow then the picks per inch is higher as the fabric is now being wound at a slower speed.

5.5.5. Selvedge

The selvedge of the fabric is the self-finished edges of the fabric.

5.5.6. Total warp ends

This is defined as the total number of ends across the width of the fabric. This is a product of the Ends per inch of the fabric and Width of the fabric to be woven.

For example, if the EPI of the fabric is 30 and 60 inch wide fabric is to be woven, then the Total Warp Ends will be equal to 1800 (30x60)

5.6. SHEDDING MECHANISM

As you learnt that the shedding, during which the warp threads are manipulated to produce a given interlacing, is achieved by threading each end through an eye of a heald wire, and raising or lowering this wire dependent on whether it is required to lift the end above the weft, or to keep it below the weft during picking. This can be achieved in the following three ways:

5.6.1. Tappet Shedding Mechanism -

In this the heald wires are not operated singly but are attached to heald frame and hence rise or fall together with the movement of the shaft. The tappet system is used to control the shedding where, due to simplicity of interlacing; only few heald shafts are required. But this imposes limitation on length of design. For these reasons tappet principle of shedding is employed mainly for high speed production of standard cloths where changes of structure are infrequent, and simplicity offers some advantage.

5.6.2. Dobby Shedding Mechanism -

Here as well, the heald wire are attached to heald shaft like for tappet shedding, but this system offers considerably greater scope for producing figured effects and are often capable of controlling up to 24 healds.

Fig 5.5: Cloth woven with Dobby Mechanism

5.6.3. Jacquard Shedding Mechanism -

Fig 5.6: Cloth woven with Jacquard Mechanism

These looms allow weaving of complex patterns. They are used for weaving designs which are beyond the scope of Dobby Shedding like brocades, damask, etc. i.e. the designs which consists of more than 24 different order of interlacing.

In these looms there are no heald shafts. Each heald wire is controlled separately by the Jacquard mechanism and hence thousands of ends can work in different fashion and repeat upon similar number of picks

Summary:

The actual Weaving process is a complex process comprising of series of operations. But the weaving mechanism is explained in this chapter by breaking it down into simple functions. With help of a line diagram all the parts of the looms are explained. The machine is broken down into simple functions, related to the process of cloth formation. Particular reference to those functions is given which have the greatest influence upon the structure and the appearance of fabrics. The chapter explains the basic operations for woven cloth production. It will also introduce the students to all the weaving terminologies that will be used while actual making of a fabric.