Chapter 1

Introduction

1. Introduction

1.1 Introduction

Weaving is one of three major methods of producing fabric. Woven fabrics are highly preferred for many of the apparel and home textile products and to some extent for technical textile products. Production of woven fabrics involves winding, warping, sizing, drawing-in and weaving processes apart from yarn spinning process. Yarn is packed in an individual form up to winding stage which means that the wound bobbin contains one yarn of very large length. This bobbin is useful for variety of end uses like as weft for shuttle and shuttleless loom, for knitting process etc.

The final woven fabric has several thousands of warp threads woven with weft yarn. The weft yarn is supplied directly on the loom. So producing a suitable system of supplying required number of warp threads wound for sufficient length on a suitable package is necessary to carry out the weaving process continuously. This task is done in two steps namely warping and sizing. The objective of the warping process is to convert the single yarn packages (last product of the winding process) into multi thread beam. The beam produced at the warping stage will have the several hundreds of warp yarns wound in the form of parallel sheet. The number of threads wound at a time will be decided by capacity of the creel used.

There are two most popular methods of carrying out the warping process as below:

1. Direct warping
2. Sectional warping

1.2 Direct warping

Direct warping is used mainly for producing beams containing mono coloured warp threads. The machine comprises of two main elements namely the creel and

the headstock. The process involves use of a creel where the given number of warp bobbins are mounted and from each bobbin the warp thread is taken forward up to head stock and then it is wound on a beam named warper's beam. Due to limitations of accommodating a very large creel, the number of bobbins which can be taken will be limited to 1000 – 1200 only. This number is smaller than the requirement of several thousands of warp threads in the final woven fabric. So, there is one more process after direct warping for agglomerating few of the warper's beams to get the final beam suitable for use on the loom. This final beam is named weaver's beam.

The process can be carried out through sizing operation where a coating of size film is applied on the final warp sheet. Alternatively the beams can be combined by a simple rebeaming process if the sizing is not required to be done.

The process of direct warping is simple but has limitation that only single colored warp can be used. Also the length of yarn to be wound per beam should be sufficiently large as the machine is running at speeds of more than 600 mpm. So direct warping is not a preferred choice for small length production.

Warper's beams have the full width required finally but the number of threads are only few hundreds as mentioned earlier. As the number of threads are less, length of yarn wound on warper's beam can be very large. As many beams are to be combined at a later stage it is very difficult to process warp yarns having patterns. Matching of the patterns will become highly complicated issue and in complex patterns will be impossible.

On the other hand the production of the system is very high so suitable and preferred for producing simple varieties at mass scale.

1.3 Sectional Warping

There are three main parts of this system: the creel, head stock and the beaming system. The creel is more or less same as that used in direct warping. Yarn is taken from creel and is brought up to the head stock in the form of a small width

section. As the winding of the yarn takes place section by section, there is need to support the yarn sheet particularly when the flanges are not there. The head stock consists mainly of a one side conical shaped large drum. The angle of the cone can be fixed or variable depending on the manufacturer. Today most of the machines are sold with fixed cone angle. The yarn is mounted on the flat part of the conical drum. The width occupied by the yarn on drum will be exactly the width the same yarn will occupy on weaver's beam. As the drum starts rotating, the section of the yarn is wound on the drum and at the same time there is provision to traverse section of the yarn in such a way that shifting of the section occurs towards the raised conical part of the drum.

After completion of winding of the required length, the yarn section is cut and the whole section is brought back to a point where second section will start. In similar way the winding of all the sections, as per requirement, will be carried out. So, in the end the entire yarn length is now stored on the drum. Now transferring the yarn stored on the drum to beam is carried out through a separate beaming device - an integral part of the machine. So process occurs as a two-step operation.

In this system all the ends required finally will be wound on the beam so there is no need to agglomerate separate beams like direct warping. As all ends are to be accommodated on the drum, it is possible to use the system for warp having multi colored patterns. Again as all ends have been transferred on the drum and lateron on the beam, there is possibility of using the beam directly on the loom if sizing is not required to be done. Also the process will be highly preferred if small length of warp is to be processed even if mono coloured yarns are to be used.

On the other hand, the system has few problems like only small length of yarn can be accommodated on the drum. So the final beam may not have very large length or many weaver's beams cannot be produced like direct warping. This system may not be suitable for mass production of simple varieties. This particular fact sometimes works in the benefit of weavers if the lot size is small. Cost of the machine is also comparatively higher and is justified only if there is

sufficient requirement of suitable varieties. Lastly the machine is more complex in nature and fine-tuned calculations are required to be done to get the required quality characteristics of weaver's beam.

Both the systems of warping have been used over the decades. Manufacturers find their own solution in selecting either or both systems of warping. It is evident that one is required to select the warping system based on the final fabric to be produced and that there is no single system which provides solution for all kinds of fabric production.

There have been many attempts in earlier time wherein researchers have tried to find the solution to the problem but none have gained commercial success. Though warping is considered as extremely important preparatory process and good warping will make sure that the beam unwinds well either during sizing or during weaving process. Again while going through the published literature, not many attempts have been made to study various process parameters at scientific level. Only few papers talk about mechanical developments of warping machines. Mechanical developments have been carried out mainly by the machinery manufacturers. Much of this work is published as patents. Lately there have been many patents filed in China, Korea, etc. Of late researchers have started addressing the issue of using one system of warping for all kinds of yarn.

In the present thesis an attempt has been made to provide a solution by which all types of yarns, i.e. single colored or multi-colored, can run on a unified warping system.

1.4 Objectives of the Work

The broad objective of the work is to develop a system of warping by which all types of yarns, i.e. single colored or multi-colored, can be warped on the same machine. The specific objectives of the work are as listed below:

(a) Investigation of various attempts (in terms of patents and other literature) made for running:

(i) Multi-colored yarn on direct warping;

(ii) Increasing yarn content on sectional warping system;

(iii) Achieving both objectives, as mentioned above, simultaneously, if any.

(b) Designing a manual and CAD based models for unified approach to warping by which any type of yarn can be warped on the same system. Designing 3D model for virtual motion to study any issue before going for prototyping.

(c) Preparing a prototype model, based on the design developed, with the help of a 3D printer system.

(d) Applying for a patent based on the novel design and the prototype developed.

It was not possible to produce the full scale system of warping machine as it will require huge time and investment. But the patent has been filed for the newly designed system. The conclusions are based on the prototype prepared and the calculations are based on the design attempts made.