SYNOPSIS

DEVELOPING NEW SYSTEM OF YARN WARPING

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(Area of Work: Textile Warping – Direct & Indirect)

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, 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.

Warping has been defined as "Warping comprises winding parts of the warp yarns, normally from bobbins, on a warping beam, whereby sequential parts are wound next to each other until the full weaving width is covered. The warping beam is then normally in a next step of warp preparation used for beaming." Whereas beaming is defined as "Beaming comprises winding the full width of the warp yarns in a single winding operation on the weaving beam (i.e. the beam which is to be placed on the loom). The warp yarns can be wound from a creel or a warping beam". (1)

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 the creel used.

1.0 Introduction

There are two most popular methods of carrying out the warping process as below: (2, 3, 4).

1. Direct warping
2. Sectional warping

1.1 Direct warping

Direct warping is used mainly for producing beams containing mono colored 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 (5). 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 re-beaming 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. So 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.

1.2 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 (6), 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 process.

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 later on, 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.

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 of warp 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 very high 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 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. As written in previous section, 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.

As seen in earlier part there have been many attempts to provide solution to the problem of requirement of two systems of warping. There were few attempts which addressed the problem directly but not solving problem in total. The question of adjustment of section width is still not addressed anywhere.

An attempt has been made in this thesis to offer the solution to the problem by a novel design (Patent Applied) of a beam which is to be used on a direct warper and at the same time one will be able to wind the sections of the threads in a limited width like sectional warping. If one wants to prepare the beam containing mono-colored warp, then normal beam as used regularly on a direct warper is to be used. The novel designed beam (patent applied) is to be used when it is required to warp multicolor warp with complicated design.

2.0 Literature Review

As mentioned earlier not much work has been reported in the books or journals regarding the attempts made at unifying two systems of warping. Most of the work is reported in to patents. In the literature review most of the patents available in English language and the ones which can be translated in to

English have been reported. Mainly the patents offering some solution to unifying the design have been studied and reported upon in the literature review (7 – 20).

3. Development of New system of yarn Warping

A new design for the warp beam has been developed along with all detailing of the entire assembly. Also included is the mechanism for adjustment of the section width for the entire warp width. The beam design is useful to work patterned warp on to a direct warping machine with a small retrofitting of section adjustment rail as available on sectional warping. All necessary drawings of the design were prepared using dedicated mechanical design software. A 3-D simulation has also been developed to verify the working of the design.

4. Validation of the Design

The design which has been developed has been filed for registration of the patent. A prototype of the design has been developed using 3-D printer system. The model shows all parts, as developed in the design, in working condition. It is also possible to carry out section width adjustments with the prototype.

5. Conclusion

The conclusion summarizes the work done and provides direction for the future work.

References

1) CPC-Cooperative Patent Classification, D02H – Warping, Beaming or Leasing, Available at: http://www.cooperativepatentclassification.org/cpc/definition/D/definition-D02H.pdf. accessed on 18.08.2015

2) Lord, P.R. & Mohamed, M.H.(1982). Weaving: Conversion of Yarn to Fabric. Durham, England: Merrow Publishing Co. Ltd.

3) Gandhi, K. L. (2012). Woven textiles Principles, developments and applications. Cambridge: Woodhead Publishing Limited *in association with* The Textile Institute.

4) Dorgham, M.E. (2013). Warping Parameters Influence on Warp Yarns Properties: Part 1: Warping Speed and Warp Yarn Tension. Journal of Textile Science and Engineering, 3(2).

5) Adanur, S. (2001). Handbook of Weaving. Boca Raton, USA: Taylor & Francis (CRC Press).

6) Dr.Majumdar, A. (2014). Fabric Manufacture I. (MHRD, GOI) Available at: http://nptel.ac.in/courses/116102005/ Accessed on 31.08.2015

7) Loncteaux, H. J., Norton, J.F. & Griffis L.W. (1935). USPatent No. 2017008.

8) Harris, S.A. (1960). GB Patent 838364.

9) Erwin, P. (1978). US Patent No. 4083513.

10) Scholze, G. (1974). German Patent DE19702046995.

11) Colson, W.B., Fogarty, D.M., & Hartman, D.P. (2003). US Patent No. 20030233744.

12) Agnihotri, K. (2008). Patent No. WO2008044241

13) Fuhr, M. (2009, 4 7). Patent No. JP 2010043398.

14) Fuhr, M. (2012, 11 14). Patent No. CN 101649520B.

15) KI, K. S., KIM, C. S., & PARK, Y. B. (2008, Dec). Patent No. KR1020060106974.

16) KI, K. S., KIM, C. S., PARK, Y. B., & KIM. (2008, Dec). Patent No. KR100871902(B1).

17) Fuhr M. (2010, Feb). Patent No. EP2154277A1.

18) SHI YIMAN, W. Q., & MAOMING, L. (2009, Oct). Patent No. CN 101565872.

19) TAN WEIFENG, TIAN ZHUAN, WANG YUN, LI XIBEI, ZHAO XIAOBING, ZHAO QINGNAN, & SHAOFEN, W. (2016, Nov). Patent No. CN205711169U.

20) ZHANG CHENGXIANG, CHENG SIHUI, CHENG HONGKE, LI CHENGGANG, LI KUIXIANG, LIU SONGTAO, & HAITAO, Z. (2017, Jan). Patent No. CN205856725.