DESIGN OF ELECTRONICALLY CONTROLLED JACQUARD MACHINE FOR MULTI-SHED WEAVING MACHINES

ARSOY RAŞIT[1*] AND ASLAN SELÇUK[2]

[1] Kafkas University, Faculty of fine arts, Department of Textile and Fashion Design, Kars 36000, Turkey
[2] Kafkas University, Fine Arts Vocational School, Department of Design, Kars 36000, Turkey

ABSTRACT

The Jacquard shed opening system, which makes it possible to open the shed by controlling the warp threads in groups and obtain different designs and shapes, differs from other shed opening systems in that each group of warp threads and each of them can be controlled as needed. The various warp movements, which are limited by the number of frames in other shedding systems, are limited by the number of sinkers in the Jacquard system. Since all known Jacquard shedding systems are designed for operation with single shed weaving machines, they cannot be used for shedding on multiple weaving machines. In this study, a new electronically controlled jacquard machine for multiple shed weaving machines was developed, which eliminates this problem and enables the opening of the weaving compartments by controlling the warp threads individually in multiple shed weaving machines, thus allowing the weaving of all known jacquard fabric patterns.

The technological and kinematic schemes of the jacquard machine were prepared taking into account the type of fabric to be produced, the operating principles of the weft insertion and shedding mechanisms to be used in the machine to be developed, and the expectations for improving the technical and economic indicators of the machine.

The electronically controlled pattern reading system, which consists of modules in the machine, converts the electronic data into mechanical data to ensure shedding. In the cam shedding mechanism, which transmits motion to the knives in the form of a stepped shaft in the multiple weaving machine, the warp threads are placed on the knives so that they can move vertically. They are controlled by specially structured sinkers which, in contact with the blades, move from the lower to the upper state with the help of the blades and from the upper to the lower state with the help of springs. When the warp threads are to remain in the upper position according to the pattern, the sinkers are interlocked by electromagnets to form an undulating nozzle corresponding to the fabric pattern.

By arranging the interlocking projections along the sinker, it is possible to match the density of the sinker to the density of the warp threads.

Since the machine allows weaving of all known jacquard fabrics, the problem of not being able to produce weaves other than the rag foot weave, which is considered one of the major drawbacks of multiple shed weaving machines, has been solved.

KEYWORDS

Jacquard; Shed; Weaving; Plate; Thread.

* **Corresponding author:** Arsoy R., e-mail: rasitarsoy@gmail.com

INTRODUCTION

The Jacquard shed opening system, which makes it possible to open the shed by controlling the warp threads in groups and obtain different designs and shapes, differs from other shed opening systems in that each group of warp threads and each of them can be controlled as needed [1, 2, 3, 11]. The various warp movements, which are limited by the number of frames in other shedding systems, are limited by the number of sinkers in the Jacquard system.

According to motion control systems, Jacquard machines can be mechanically and electronically controlled. Today, electronic control systems are used in all Jacquard machines.

To enable the production of more complex patterns, research is being carried out into the design of Jacquard machines that allow individual control of the warp threads.

In the invention of Jonathan F. McIntyre, information is given on the construction of an electronically controlled device that can control the warp threads individually [7].

Walter Keim and Kurt Jhile did the work on an electromagnetic basis. A common electromagnet between the hooks is used to control the shed in a certain position according to the scheme. The electromagnet is attached to the case so that it can be tilted or pivoted about an axis. In the pattern reading position, each hook moves mechanically to approach the pole of the electromagnet, especially to lean against it [9].

Chi Zhang introduced the basic design technologies of jacquard knitting integrated control system, the structure of integrated control system. The results of this project provided some theoretical and practical implications for the development of electronic jacquard control system [4].

M. Kaplan's project involved the manufacture, development and improvement of a prototype pattern loom using a Jacquard shedding machine. It was found that a more complex pattern could be produced by individual manipulation of the warp threads using the Jacquard mechanism [6].

Since all known Jacquard shedding systems are designed to operate on single shed weaving machines, they cannot be used for shedding on multiple shed weaving machines.

In this paper, information is given on the design structure of a new Jacquard machine for multiple shed weaving machines, developed by me, which eliminates this problem and enables shedding by controlling the warp threads one by one on multiple shed weaving machines, allowing all known Jacquard fabric patterns to be woven.

MATERIALS AND METHODS

The development of a new Jacquard machine requires in-depth knowledge of fabric theory and extensive knowledge of existing designs of known Jacquard machines and mechanisms. Due to the necessity of performing these operations and the complexity of the Jacquard machine design, care was taken to ensure that the design steps listed below were fully implemented in the design [11, 21]:

1. For the design of the Jacquard machine, the technological task was developed. At the same time, the characteristics of the technological process were carefully studied and the mechanical properties of the new machine were critically evaluated;

The design structures of existing Jacquard machines were studied, patents and technical literature were studied to determine the functionality of the machine to be designed, the main directions of its production perspective and the development prospects;

2. The technological and kinematic schemes of the jacquard machine were prepared taking into account the type of fabric to be produced, the operating principles of the weft insertion and shedding mechanisms to be used in the machine to be developed, and the expectations for improving the technical and economic indicators of the machine;

Figure 1 shows the technology diagram of the wave shed fabric forming system [21]. The shuttle 9 carrying the weft 10 moves at constant speed in the direction shown in the figure in a nozzle A which opens in front of it and closes behind it in a wave-like manner. The number of sheds depends on the dimensions of the shuttle and the width of the fabric. The fabric forming process is realized by compressing the weft threads introduced into the shed to the fabric line with the help of the special weaving blade number 11 in wave motion.

It is not so easy to transfer the movement to the shuttles in the closed shed. Many methods have been proposed for this purpose. One of the methods is to use the weight of the shuttle as the force that stabilizes the shuttle in the shed. When the teeth of the weaving blade number 11 move from left to right, the shuttles move in the horizontal direction at a certain speed under the influence of the friction force.

The main technical scheme of the machine is similar to the known technical schemes. The warp yarns No. 2 opening from the warp beam No. 1 pass through the warp bridge No.3, the warp control system No. 6 and the shafts No. 4, 6, through the eyelets of the reeds No. 8 attached to the frames No. 7 of the shedding mechanism and through the comb teeth No. 11 and reach the fabric forming zone. After the finished fabric has passed the fabric tension shaft No. 12, it is wound onto the fabric beam No. 13.

The motion on the frames is transmitted by the shed forming mechanism No. 15 and the motion on the card teeth No. 11 is transmitted by the weaving blade mechanism No. 14.

When forming a shed, several frames are used to form the shed in the shape of a wave and to allow wave-like movement of the shed along the width of the warp threads.

The main advantages of this technology are that the fabric formation is similar to the classical methods, the machine works at low speeds and has a high efficiency.

The main disadvantage of this technology is that it can be used only for the production of one type of fabrics, namely rag fabrics [1, 21, 24].

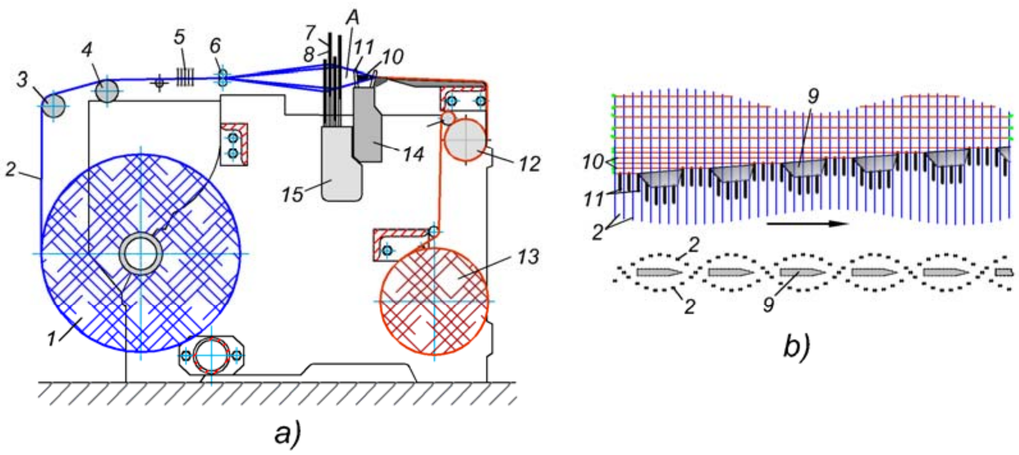


Figure 1. Technological scheme of the multiphase weaving machine with wave shed: a) technological scheme; b) threading the weft threads through the shed.

Presentation of the newly developed machine.

In this study, a new electronically controlled Jacquard machine for multiple shed weaving machines was designed by analyzing the design structures of existing Jacquard machines, patents on the design of shedding systems of multiple shed weaving machines, technical literature and publications on this subject in technical journals [10-22, 24].

In order to make the working principle of the designed Jacquard machine easy to understand, the machine is presented with seven technical drawings:

Fig. 2 - General view of the Jacquard machine mounted on the weaving machine and B-B cross-section of the machine in the front view plane;

Fig. 3 - A-A cross-section of the Jacquard machine in the left view plane;

Fig. 4 - Schematic describing the operation of the electronically controlled interlock mechanism;

Fig. 5 - Cross-section C-C illustrating the assembly and guiding of the sinkers;

Fig. 6- Scheme explaining the formation of the wavy nozzle on the machine;

Fig. 7 - Three-dimensional view of the Jacquard machine explaining its structure and operation;

Fig. 8 - Three-dimensional view of the sinker.

The movement to the Jacquard machine is transmitted from the main shaft of the weaving machine through a 17-18 bevel gear. The machine consists of a computerized electronically controlled pattern reading system, a cam mechanism numbered 4-5 that transmits a wave-like motion to the knives, and a system that transmits motion from the knives to the warp threads according to the pattern.

In the shedding mechanism with cams No. 4-5 transmitting a stepped wave-like motion to the drop wires No. 6, the warp threads No. 1 are placed on the drop wires in such a way that they can move vertically from the lower to the upper layer of the drop wires with the help of the springs 16, in the opposite direction, from the upper layer to the lower layer, they are guided by the specially structured sinkers 8 in contact with the drop wires 6.

The design structure of the sinkers, which transmit the movement to the warp threads depending on the pattern, is shown in Figure 8. The plate, made of thin steel bar, has a locking projection E at the lower end and a slot D at the other end, through which the knives can move freely when the sinkers are locked.

The electronically controlled pattern reading system consists of No. 9 modules. The task of the modules in the machine is to convert the electronic data into mechanical data (the pattern in the computer into a mechanical movement) to ensure the formation of the nozzle. This operation is performed by the electromagnet No. 11 with the latches No. 10. When the warp threads are to remain in the upper position according to the pattern, a magnetic field is generated with the help of the given electric current, and the latches are mobilized. The end of the latch 10, which is pulled and rotated during magnetization, enters the slot E opened on the board and ensures that it is locked and the warp threads remain in the upper position. When the warp threads are to be lowered, the power supply to the module is interrupted. In this case, the end of the pawl rotating in the negative direction comes out of the slot with the help of the spring 12 and the sinker is released and moves together with the knife to the lower position. Lowering of the sinker together with the knife is ensured by the spring 16 connected to the sinker by the thread No. 15.

The number of electronic control modules corresponds to the number of sinkers used in the machine. Since the width of the modules is greater than the thickness of the blanks, the modules are arranged in several rows. The number of rows is specified in the pattern.

Figure 6 shows that a stepped, corrugated nozzle is formed in the machine. The number of stages of the nozzle depends on the number of blades that form the nozzle. It is recommended that this number is above 8.

In cross-section A-A in the left view plane of the machine, the number of blades is indicated as six, and in Figure 7, which explains the three-dimensional view of the machine, the number of blades is indicated as four to make the figure understandable.

To ensure a high density of platinum, two blades are attached to each arm. Thus, if the sinker thickness is 0.25 mm and the distance between the sinkers is 0.5 mm, the warp density is assumed to be 40 per 1 cm.

The eccentrics No. 4 mounted on the spindle No. 23, driven by the main spindle of the loom in a ratio of 1:1, perform a rotational movement and transmit a displacement in the vertical direction corresponding to the height of the shed to the blades 6 arranged at the ends of the arms 5 (Fig. 2).

In order to obtain a mountain-shaped nozzle, the eccentrics No. 4 are arranged on the shaft at equal angles according to the number of blades forming the stepped nozzle. If we express the number of blades with n, the insertion angle of the eccentrics results from the equation $\phi = 360o/n$.

The infinite wave-like movement of the blades is transmitted to the warp threads via the sinkers (8) and the threads 15, which connect the warp threads to the sinkers.

The positions of the shuttles No. 20 and the warp threads in the shaft nozzle are shown in Figures 6 and 7.

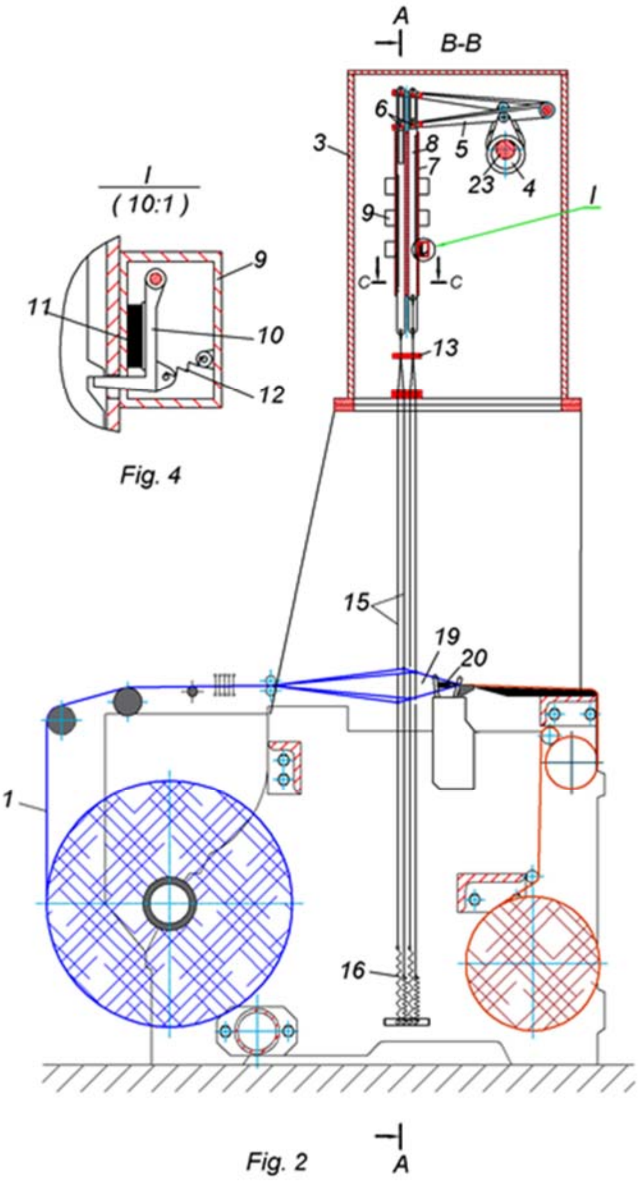


Fig. 4

Fig. 2

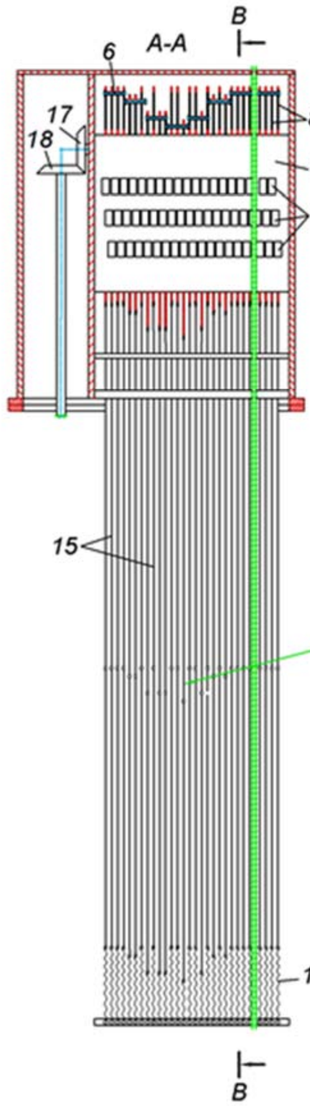
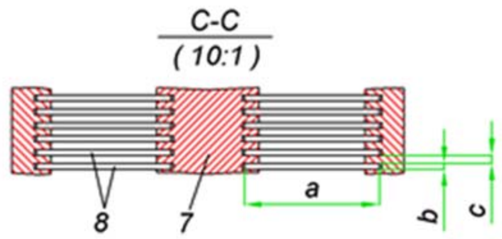


Fig. 3

Fig. 5



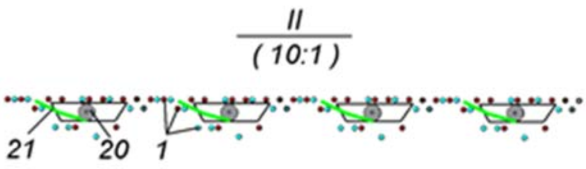


Fig. 6

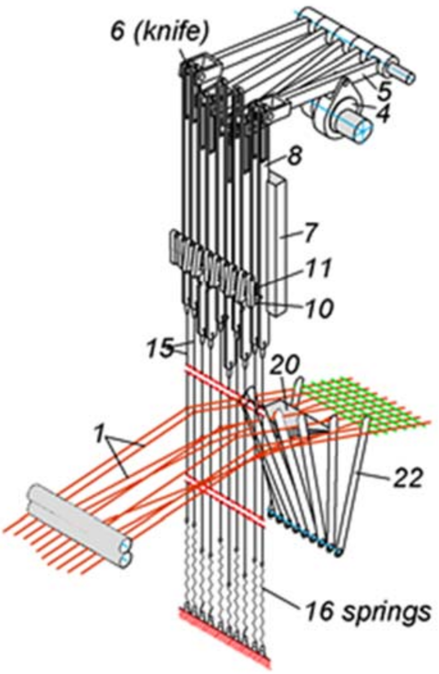


Fig. 7

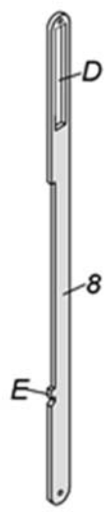


Fig. 8

RESULTS

1. In the cam shedding mechanism (4,5), which transmits motion to the knives (6) in the form of a stepped shaft in the multiple weaving machine, the warp threads (1) are placed on the knives so that they can move vertically. They are controlled by specially structured sinkers (8) which, in contact with the blades, move from the lower to the upper state with the help of the blades (6) and from the upper to the lower state with the help of springs (16). When the warp threads are to remain in the upper position according to the pattern, the sinkers are interlocked by electromagnets (10, 11) to form an undulating nozzle corresponding to the fabric pattern.

2. By arranging the interlocking projections (E) along the sinker, it is possible to match the density of the sinker to the density of the warp threads.

3. Since the machine allows weaving of all known jacquard fabrics, the problem of not being able to produce weaves other than the rag foot weave, which is considered one of the major drawbacks of multiple shed weaving machines, has been solved.

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