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Research Article

DESIGN AND MANUFACTURING OF PNEU-MECHANIC DOBBY MACHINERY

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Keywords
Design, Pneu-mechanic, Manufacturing, Weaving, Dobby Machinery.

Abstract
The contents of the shed opening frames used in the weaving machines and the pneumatic connections used in the dobby mechanisms of the shedding cost were made. As a result of the weaving, a new dobby with low cost, easy to manufacture and maintain was designed and produced in weaving machines. In particular, you can run a system that can manufacture fabrics with minimized tensions in warp threads. After executing the cam and tracking design, the drive, select, and motion acquisition to the frames were fabricated and assembled. After seeing the precise adjustments of the mechanisms, they were automatically operated at different speeds. Optimum results have been achieved in the incoming tension values in the warp with the new generation pneu-mechanical dobby machine, which is one of the shedding devices used to create sheds in Bizim Study weaving machines and provides the movements of frames for this purpose. The average warp tension during the weaving process was 34.6 cN.

PNÖ-MEKANİK ARMÜR MAKİNASININ TASARIM VE İMALATI

Anahtar Kelimeler
Tasarım, Pnö-mekanik, İmalat, Dokuma, Armür Makinası.

Öz
Bu çalışmada, dokuma makinelerinde kullanılan ağızlık açma mekanizmalarının incelenmesi ve ağızlık açma sistemlerinden armürlü mekanizmalarda kullanılan pnömatik mekanizmalarının araştırılması yapılmıştır. Yapılan araştırmalar sonucu dokuma makinelerinde kullanılabilecek maliyeti düşük, üretimi ve bakımı kolay yeni bir armür tasarlanıp üretilmiştir. Özellikle çözgü iplerindeki gerilmeleri en aza indirilmiş kumaş imalatı yapabilecek bir sistem geliştirilmiştir. Kam ve izleyici tasarımı tamamlandıktan sonra tahrik, seçim ve çerçevelere hareket iletim mekanizmalarının üretimi ve montajı yapılmıştır. Mekanizmaların hassas ayarlamaları da tamamlandıktan sonra farklı hızlarda otomatik olarak çalıştırılması sağlanmıştır. Çalışmamızda dokuma makinelerinde ağızlık oluşturmak için kullanılan, bu amaçla çerçevelerin hareketlerini sağlayan ağızlık açma tertibatlarından birisi olan yeni nesil pnö-mekanik armür makinesi ile çözgüde meydana gelen gerilim değerlerinde optimum sonuçlara ulaşılmıştır. Dokuma işlemi boyunca ortalama çözgü gerilimi 34,6 cN olarak gerçekleşmiştir.

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Highlights

- Drive, selection and motion transmission mechanisms to the frames are important.
- All kinds of complex patterns can be changed on the weaving machine.
- Will be able to manufacture fabrics with minimized tensions in warp threads.

Graphical Abstract

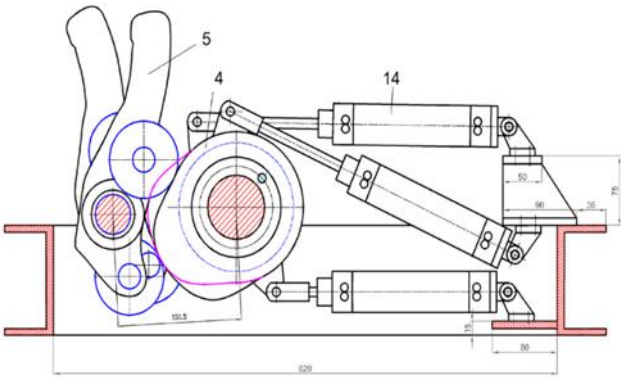

Figure. Technical Drawing of the Dobby

Purpose and Scope

By examining the working principles of dobby shed opening edges used in weaving machines, a new dobby is designed and tested on low cost in weaving machines, easy to manufacture and maintain.

Design/methodology/approach

Aim; is to create a qualified research-purpose pneu-mechanical dobby device, which can be intervened in all parameters, designed and manufactured with completely domestic means. In particular, a system will be developed that can manufacture fabrics with minimized tensions in warp threads. In addition, basic research support infrastructure will be established for the companies that will make dobby devices in our country in the future.

Findings

The cam, pneumatic system, engines, frames used in the dobby have been produced to have the qualities required by the design. The formation of the moving cam levers and blades in the dobby body was designed in a unique way by examining the related studies. A unique mechanical pattern system has been developed that can control the woven fabric manufacturing processes with the desired quality and precision.

Originality

In particular, a system has been developed that can manufacture fabrics with minimized tensions in warp threads. Instead of the machines imported by paying a high price, it has been possible to manufacture national pneumatic dobby with higher quality and lower cost. The design and manufacture of the mechanism belongs to Murat Kodaloğlu et al.

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1. Introduction

Design Parameters For the design of the new pneu-mechanical dobby to be developed in the study, first of all, the analysis and calculations of the parameters affecting the design were made. The main parameters used in the design of shedding mechanisms used in weaving looms; the number of frames, the distance between the frames, the width of the shed, the shed angle, the displacement height of the frames and the tension forces of the warp threads during weaving. The number of frames is determined according to the type of fabric to be woven on the weaving looms (Abdulla, 2001, 2002, 2006).

After the theoretical investigation of the design parameters, the design processes of the pneu-mechanical dobby were started (Marks, 1976). In this study, the feasibility of a new dobby design that can oscillate the main shaft in the dobby mechanism, thus simplifying the mechanism significantly, using standard machine elements and bearings, and applying this principle has been demonstrated (Eren, 2000, 2005, 2008).

A qualified research purpose pneu-mechanical dobby has been created, which can be intervened in all its parameters and is designed and manufactured with completely domestic means (Adanur, 2001, 2020). In particular, a system has been developed that can manufacture fabrics with minimized tensions in warp threads (Fimtextile, 2018). In addition, it has established a basic research support infrastructure for companies that will make dobby devices in our country in the future (Hasçelik, 2008). Instead of the machines imported by paying a high price, it has been possible to manufacture national pneumatic dobby with higher quality and lower cost (Gandhi, 2020). A unique mechanical pattern system has been developed that can control the woven fabric manufacturing processes with the desired quality and precision (Djuraev, 2020, 2021).

2. Material and Method

2.1. Design Of Dobby Construction

Based on the analysis and synthesis results of the mechanisms that make up the dobby, the construction design of the dobby was carried out. Accordingly, cam mechanism and pneumatic pistons are used in the selection mechanism providing oscillating motion in the driving mechanism of the dobby. In addition, three selection mechanisms were used in the design and each selection mechanism was envisaged to control 7 frames. Thus, the dobby is designed as a pneu-mechanical dobby with a 21 frame capacity and an open shedding. Below is the technical drawing showing the construction of the dobby. Figure 1 shows the front view of the dobby and the cross-sectional view of the main shaft (Kodaloglu, 2019).

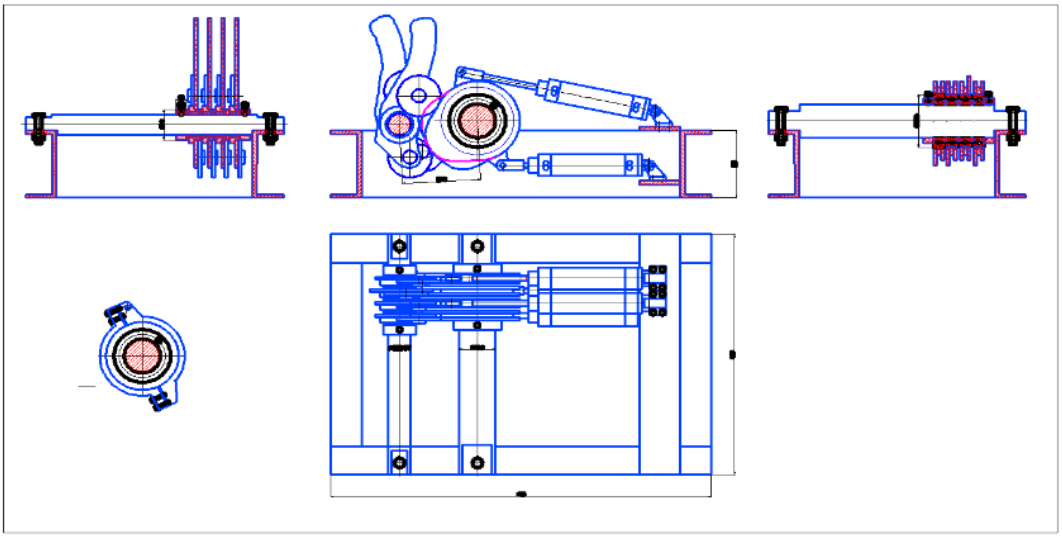

Figure 1. General View Technical Drawing of the Pneu-mechanical Dobby

First of all, the main body of the newly developed dobby was designed and produced. The main body of the dobby is designed and manufactured in such a way that it can carry all the bearings, bearings, shafts and the dobby drive, selection and motion transmission mechanisms to the frames. The main body is made of durable and light materials against all forces that may occur during assembly and operation of the dobby (Kodaloglu, 2019).

2.2. Positioning The Dobby Selection Mechanism Cams

After the design of the cams, which is the most important element of the selection mechanism, was completed and produced, their fixed assembly was made. The adjustments of the cams have been made precisely by taking into account the waiting angles and times of the drive mechanism. For these adjustments, the cams are manually rotated and positioned at the angles where the main shaft rests, and fixed mounting with clamping screws. Figure 2 shows the assembly status of the cams. After the design of the cams, which is the most important element of the selection mechanism, was completed and produced, their fixed assembly was made. The adjustments of the cams have been made precisely by taking into account the waiting angles and times of the drive mechanism. For these adjustments, the cams are manually rotated and positioned at the angles where the main shaft rests, and fixed mounting with clamping screws. Figure 3 shows the mounting status of the cams (Kodaloglu, 2019).

Figure 2. Fixed Shedding Status of Cams

The cam located on the shaft in the mechanism body is designed. Although the mechanism was designed to accommodate twelve cams, only 3 cams were placed and three of them were connected to the pneumatic piston in order to ensure the adequacy of the project support. The placement of the cam and pistons in the mechanism is designed in such a way that they do not oppose each other and prevent the operation.

The duty of the pneumatic piston on the dobby is to move the cam body to which it is attached along the shaft axis. The pneumatic piston provides the movement of the cam to which it is connected by the air coming from the valve. In order to facilitate the movement of the cam, the pneumatic cylinder is mounted on the cam mechanism body. Figure 3. shows the pneumatic pistons and their mounting situations (Kodaloglu, 2019).

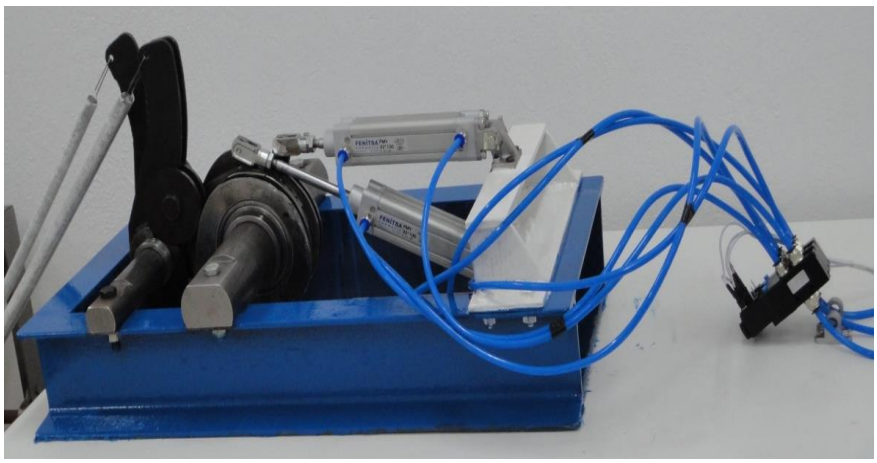

Figure 3. Installation Status of the Dobby

The pattern wheel is a mechanism on which insulating bands (regions) are placed according to the pattern to be woven, its circumference is divided into 16 equal parts, and it receives the rotational movement by means of a belt.

While the dobby pattern wheel is rotating, the wire system in contact with the wheel generates electrical signals for the operation of the pneumatic pistons and electronic valves when it comes into contact with a region outside the insulated areas placed on the pattern wheel according to the dobby pattern plan. There is 12 volt electrical energy in the pattern wheel. After the fixed assembly of the program reading unit, the automatic operation of the selection levers was observed (Kodaloglu, 2019).

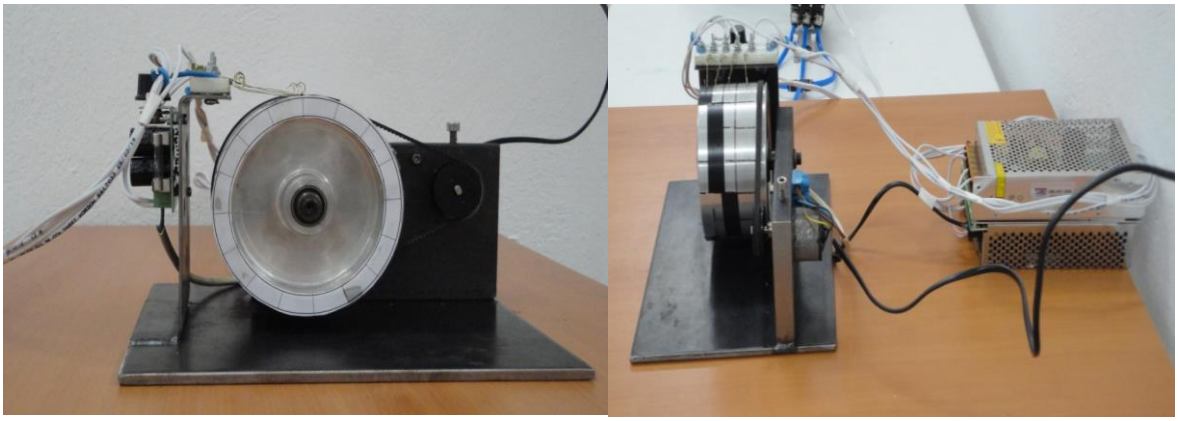

Figure 4. Programming Disk (Pattern Wheel) Fixed Shedding Status

It may be desirable for the knitting pattern to be large and complex, or for the pattern to be woven to be changed frequently. Since cam shedding mechanisms cannot meet these conditions, a programmable shedding mechanism was needed. The structure of pneu-mechanical dobby shedding mechanisms is as simple as cam mechanisms, and the patterning capacity is higher. The general view of the experimental set is given in Figure 5 (Kodaloglu, 2019).

Figure 5. The Experimental Set

3. Results and Discussion

A dobby consists of a combination of three mechanisms. This system; are the drivetrains of motion to the drive, pick and frames. In the proposed system, there is no drive mechanism and gears, chain or belt mechanisms that transmit motion from the main shaft to the dobby. Rotary dobbies consume a lot of energy to overcome the warp tension, frame weight and traction of the springs. In addition, due to the fatigue of the return springs in the system over time, the springs do not lower the frames to the lowest position during the opening of the nozzle, causing uneven nozzles to open. In addition to these disadvantages, due to both the weight of the frames and the spring assemblies, the speed of the weaving machines with this dobby must be low and the fabrics produced must be of medium or lightweight. For these reasons, a new pneu-mechanical dobby construction has been developed for both lifting and lowering of the frames. Warp tensions were measured at 5, 10, 15, 20 bar pressure values. The tension values taken over the warp yarns were determined as the maximum warp tension of 47 cN under 5 bar pressure, the initial tension of weaving (minimum tension) as 21 cN, 53 cN under 20 bar pressure, and 23 cN of weaving initial tension (minimum tension). The average warp tension during the weaving process was 34.6 cN.

The cam follower is placed on the cam that moves in the axial direction of the cam. The cam followers are connected to the mechanism body by a shaft connection. It is designed to provide the movements of the follower frames in the up and down positions, which are in contact with the cam driven by the pneumatic piston.

4. Conclusions and Recommendations

It has been determined that the pneumatic pistons and the air delivery time are suitable for the nozzle opening process in the new construction and there is no reason for the mechanism to not work. Within the scope of this study, which allows the medium and low speed weaving looms used in today's market to be reused in the textile industry, the fact that old looms can be revised and a great saving will be achieved for the sector emerges.

In the selection mechanism of the developed dobby, the program reading unit consists of a mechanical pattern wheel working with electrical signals, specially designed cams for timely operation, and pneumatic pistons that help the cams to be pushed and held according to the signals coming from the program reading unit. Because of these mechanisms, the selection mechanism of the pneu-mechanical dobby developed in this study differs from the classical dobbies with electromagnets and electronically operating.

As a result of the study, the dobby machine produced and the dobby machines in the market were compared, and their compatibility with the literature and their different points were determined. Better mechanical and design properties were obtained than the literature values, thus bringing new and original values to the literature. Another unique aspect of the study is that the experimental model was created and compared with the theoretical models in the literature. This result enabled the determination of the most suitable dobby parameters realistically, and warp yarn breaks in the final product could be prevented. Warp tensions were measured at 5, 10, 15, 20 bar pressure values. The tension values taken over the warp yarns were determined as the maximum warp tension of 47 cN under 5 bar pressure, the initial tension of weaving (minimum tension) as 21 cN, 53 cN under 20 bar pressure, and 23 cN of weaving initial tension (minimum tension). The average warp tension during the weaving process was 34.6 cN. With this study, a qualified dobby was designed and manufactured for research purposes in our country. With this device, researchers across our country will trigger new and productive projects in areas such as product development, material development, parameter optimization, development of weaving technology, flexible control of strategy, technology development, especially in the field of textiles. Dobby devices imported from abroad at very high prices are used in a limited number of universities and research centers in our country.

Conflict of Interest

No conflict of interest was declared by the authors.

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