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Weaving Machine Design of Cam and Follower Mechanism and Manufacturing

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ABSTRACT :

In this research, we delved into the mechanisms responsible for opening sheds in weaving machines, focusing on both the shed opening systems such as cam and follower mechanisms utilized in dobby systems. Our aim was to devise a novel cam and follower system that is not only cost-effective but also simple to manufacture and maintain, drawing inspiration from the principles underlying dobby mechanisms. Specifically, we aimed to develop a system capable of producing fabrics with minimal tension in warp threads. Following the completion of the cam and follower design phase, we proceeded to fabricate and assemble the drive, selection, and motion transmission mechanisms onto the frames. Upon meticulous adjustment of these mechanisms, they were set to operate automatically at various speeds.

Keywords: *Weaving, Cam, Desing, Mechanism.*

Dokuma Makinası Kam ve İzleyci Tasarım ve İmalatı

ÖZET

Bu araştırmamızda dokuma makinelerinde ağızlık açmadan sorumlu mekanizmaları derinlemesine inceleyerek, armür sistemlerinde kullanılan kam gibi ağızlık açma sistemlerine ve takipçi mekanizmalarına odaklandık. Amacımız, armür mekanizmalarının altında yatan ilkelerden ilham alarak, yalnızca uygun maliyetli değil, aynı zamanda üretimi ve bakımı da basit olan yeni bir kam ve takipçi sistemi tasarlamaktı. Özellikle çözgü ipliklerinde minimum gerginlikle kumaş üretebilen bir sistem geliştirmeyi hedefledik. Kam ve takipçi tasarım aşamasının tamamlanmasının ardından tahrik, seçme ve hareket aktarma mekanizmalarını üretip çerçevelere monte etmeye başladık. Bu mekanizmalar titizlikle ayarlandıktan sonra otomatik olarak çeşitli hızlarda çalışacak şekilde ayarlandı.

Anahtar Kelimeler: *Dokuma, Kam, Tasarım, Mekanizma.*

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1. INTRODUCTION

The efficiency of weaving machines and the fabric quality they produce are influenced significantly by several pivotal factors, notably shed geometry, shed formation, and the movement of warps within the shed. Prior to the introduction of the weft in weaving machines, it is imperative for the warp threads to undergo a process of segregation into two layers, ultimately forming a triangular tunnel, commonly referred to as a mouthpiece, through which the weft is threaded. Various systems, known as shedding mechanisms, have been devised to facilitate this separation of warp threads during shed formation. These mechanisms are typically classified into three primary groups based on their operational principles[1-4].

In our investigation, we have undertaken the design and fabrication of the cam and follower mechanism, a fundamental shed opening device utilized in weaving machines to orchestrate the movement of frames for shed creation. The cam and follower system developed in this study is purpose-built, featuring unique designs and manufacturing techniques. Distinguishing itself from research conducted in other institutions globally, this cam mechanism, in conjunction with its tracker, boasts significant advancements, particularly in its drive, selection, and motion transmission mechanisms tailored to the frames [5-8].

Moreover, our research has yielded a revolutionary weaving machine pattern mechanism, supplanting conventional commercial patterns restricted by cam and tracer systems. This innovative mechanism facilitates the adaptation of diverse and intricate patterns on weaving machines, liberating fabric design from previous constraints[9-11]. By transcending these limitations, we have successfully pioneered the development of a proficient dobby mechanism for the mechanical dobby production of woven fabrics within our country [12, 13].

Lima et al. They compared several common methods used for the appropriate design of cam mechanisms and realized the production of cam mechanisms [14,15]. Podgornyj et al. Design analysis of cam mechanisms shows that the laws of motion are established by a standard set of acceleration curves. It is designed to suggest the most efficient equipment for the follower mechanism for the contact point between the comb and the fabric edge [16]. Hamza et al. More geometric parameter design problems are solved to improve the optimum design quality of the cam mechanism [17]. Yousuf, et al. The contact between the cam and the follower was examined in terms of the periodicity of the follower during the movement [18]. Abderazek et al. Formulated for maximum strength resistance for optimum cam design. The effect of choosing the follower motion law on the optimal design of the mechanism was investigated [19]. Rao et al. It shows different prediction performances at different preloads and different cam rotation speeds to predict the change in friction coefficient and friction force depending on the cam rotation angle [20]. As a result of the literature research, shedding systems in weaving machines produced with different methods attract attention. When the literature is examined, the deficiency in shedding in weaving machines draws attention. Therefore, in this study, unlike the literature, a new cam and follower system design that is not only cost-effective but also simple in production and maintenance was examined.

2. MATERIAL AND METHOD

To develop the new cam design as outlined in this study, an initial step involved conducting thorough analysis and calculations of the parameters influencing the design [7-9]. Key parameters integral to the design of shedding mechanisms employed in weaving looms include the number of frames, inter-frame distance, shed width, shed angle, frame displacement height, and warp thread tension forces during weaving. The determination of the number of frames is contingent upon the fabric type intended for weaving on the looms.

$\boldsymbol{\alpha = 30^o}$; $\mathbf{n_k = 200\,\frac{rev.}{min.}}$. $\boldsymbol{\varphi_{height} = 270^o}$; $\boldsymbol{\varphi_{üb} = 90^o}$; $\boldsymbol{\beta = 22^o}$; $\mathbf{l = 70\ mm}$; $\mathbf{r_o = 42\ mm}$;

Following the theoretical exploration of design parameters, the process of designing the cam mechanism commenced. Through the investigations conducted in this study, it was observed that by imparting oscillating motion to the main shaft within the program mechanism, significant simplification of the mechanism, and subsequently the dobby, could be achieved. This approach also allowed for the utilization of standard machine elements and bearings, leading to the realization of a novel dobby design capable of implementing this principle [10].

A specialized research-oriented dobby has been developed, affording full parameter interference and entirely designed and manufactured using domestic resources. Notably, a system has been devised to produce fabrics with minimized tensions in warp threads [11]. Furthermore, a foundational support framework has been established for future dobby device manufacturers in our country. This initiative not only mitigates reliance on expensive imported machinery but also enables the production of domestically manufactured dobbies of superior quality at reduced costs. Additionally, a unique mechanical pattern system has been devised to regulate woven fabric manufacturing processes with desired precision and quality [12]. The creation of the cam profile employs the method of motion transformation.

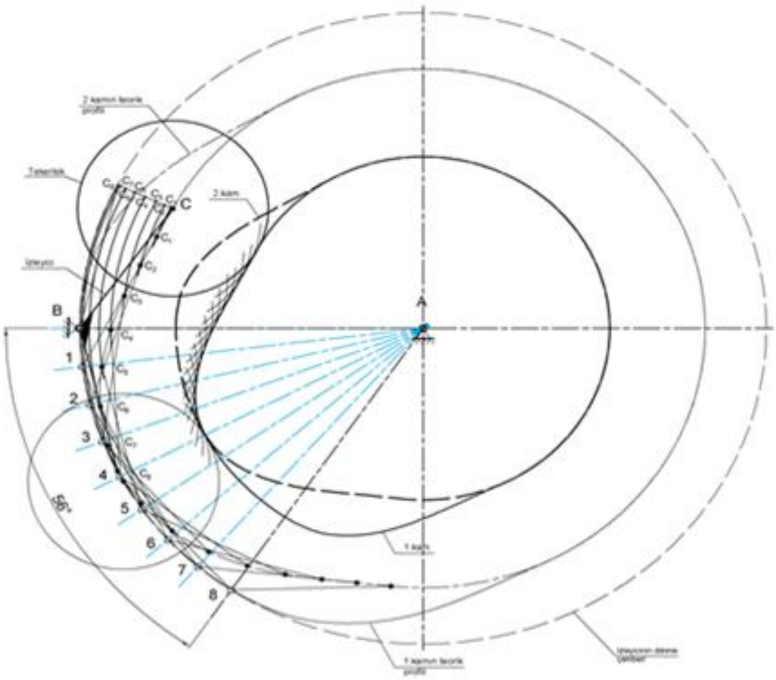

Figure 1. Design of double cam profile

Figure 1 illustrates the cam profile depicted by a solid line and the profile of the second cam by a dashed line. In positive systems, these cams transmit motion to the followers, which are linked to the frame legs. Followers operate with eccentrics, either with or without channels, depending on their construction. Non-channel eccentrics feature the ball of the foot situated on the eccentric, whereas channeled eccentrics have the ball of the foot positioned within the channel

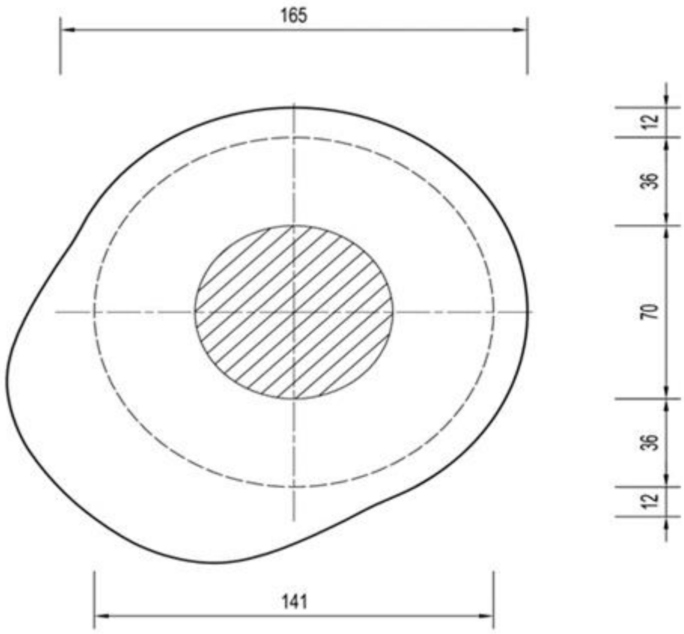

Figure 2. The technical drawing of the dobby cam mechanism is shown

In the figures below, the technical drawing of the arms, their unprocessed and machined dobby mounting conditions are shown.

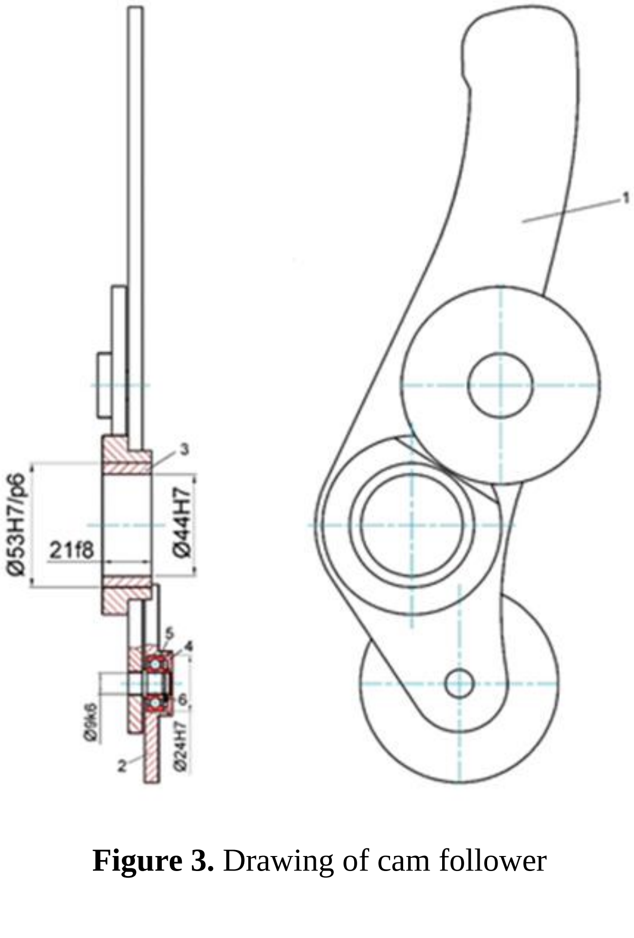

Figure 3. Drawing of cam follower

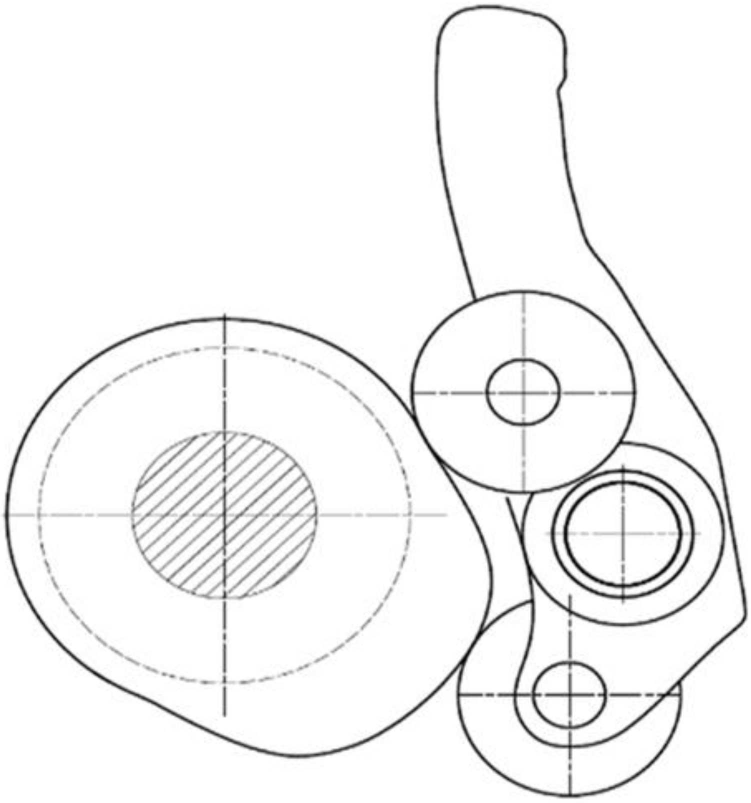

Figure 4. Assembly drawing states of cam and follower mechanism

Figure 5. Example of cam follower

3. RESULT AND DISCUSSION

Figure 6. Manufacturer of the audience

The purpose is to shift the cam body, which is affixed to the dobby, along the axis of the shaft. To ease the movement of the cam, the cylinder is installed on the cam mechanism body.

Figure 7. Cam follower

Figure 8. Dobby cam mechanism

Figure 9. Assembly of cam and follower mechanism

When dealing with intricate or frequently changing knitting patterns, traditional shedding mechanisms prove inadequate, necessitating the development of a programmable shedding mechanism. A dobby system comprises three interlinked mechanisms: the drive mechanism, the selection mechanism, and the motion transmission mechanism to the frames. However, in the proposed system, traditional drive mechanisms and motion transmission components such as gears, chains, or belts that relay motion from the main shaft to the dobby are omitted.

Rotary dobby systems expend considerable energy to counteract warp tension, frame weight, and spring traction. Over time, fatigue in the return springs can lead to uneven lowering of frames during nozzle opening, resulting in irregular shed formation. Additionally, the weight of frames and spring assemblies restricts the operating speed of weaving machines equipped with rotary dobby systems, limiting them to the production of medium or lightweight fabrics.

4. CONCLUSION AND RECOMMENDATIONS

In the developed cam mechanism, specifically designed cams for the program reading unit allow for their manipulation and retention based on signals received from the program reading unit. This unique feature sets apart the cam mechanism from classical dobby systems that rely on electromagnets and electronic operation.

Upon completion of the study, a comparison was drawn between the produced cam mechanism and those available on the market, assessing their alignment with existing literature and identifying distinctive characteristics. The cam mechanism exhibited superior mechanical and design properties compared to literature benchmarks, thereby introducing novel contributions to the field.

A noteworthy aspect of this study is the creation of an experimental model, which was then compared with theoretical models found in the literature. This comparative analysis facilitated the realistic determination of optimal cam parameters, ultimately aiming to mitigate warp yarn breakage.

The introduction of this device is expected to catalyze the initiation of innovative and fruitful projects across our nation, particularly in areas such as product and material development, parameter optimization, weaving technology enhancement, and flexible control strategies. This initiative is particularly significant in a landscape where the availability of universities and research centers is limited, necessitating the importation of expensive cam mechanisms from abroad.

Çıkar Çatışması Beyanı

Yazarlar arasında çıkar çatışması yoktur.

Araştırma ve Yayın Etiği Beyanı

Çalışma, araştırma ve yayın etiğine uygundur.

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