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REDESIGN AND CREATION OF THE CROCKING MACHINE FABRIC LOCK FOR MORE ACCURATE CROCKING

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Abstract: This study aims to redesign the fabric locking system on a crocking machine to address the main problem, namely how to create a more stable and accurate locking system in the fabric colorfastness testing process. The research methods include literature study, design, prototype creation, and experiential testing. The results show that the old locking system with 2 bolts requires an average of 28 seconds for installation, testing, and removal, but produces less stable clamping and the fabric tends to wrinkle. Meanwhile, the new locking system with 4 bolts requires 46 seconds, but is able to provide a stronger, more stable, and more accurate clamping without causing wrinkling. Tests on various types of fabrics such as cotton combed 24s, poly span rib, and DTY brush light weight can prove that the new design is more consistent in maintaining fabric stability during testing. Although it requires longer installation and removal times, the new locking system is proven to improve test results, improve fabric clamping quality, and reduce the risk of machine damage. This design is recommended for application in the textile industry to improve the quality of colorfastness testing and product quality consistency.

Keywords: crocking machine, damage, design, textile

1. INTRODUCTION

Clothing and food are considered primary or basic needs, which are fundamental and absolute for human survival. Clothing serves to protect the body from extreme weather and maintain comfort. Over time, clothing has also become a form of identity and self-representation (Qorib et al., 2023). The increasing functionality of clothing has led to the development of mass-produced ready-to-wear clothing, known as garments. Garment production requires structured quality control to achieve high quality (Fathia et al., 2023).

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Figure 1 Crocking Machine

One of the tools used in the quality control process in the garment industry is a fabric crocking machine, which is used to test the colorfastness of fabric to friction or color transfer that can occur due to direct contact with other surfaces. This process is known as the crocking test, which is a standard testing method in the textile industry (Tripratama et al., 2024). The colorfastness to friction/crocking test measures the resistance of a fabric to color transfer when rubbed. The rubbing test determines the colorfastness of a color or dye in a fabric. Fastness to friction also determines how well a fabric resists stains (https://id.darongtester.com/insights-to-colorfastness-to-rubbing-crocking-test/).

Figure 2. Crocking machine fabric locking bolt

Crocking Machine

The crocking machine consists of a fabric clamp, abrasive, a drive, and a counter, as shown in Figure 1 (https://fyitester.com/id/crockmeter).

Figure 1. Crocking machine (https://fyitester.com/id/crockmeter)

Locking system

The locking system on a fabric crocking machine serves to hold the fabric in a stable position during the testing process, ensuring accurate test results. The locking system used in this machine must be able to hold the fabric firmly without causing shifting that could disrupt the testing process. Chaudhary & Singh explain that one common

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problem is inefficiency in the locking system (Ikhwan, 2024). Weak or poorly installed locks can cause the fabric to move during operation, thus affecting test results. In many cases, improvements or modifications to the locking mechanism can improve the accuracy and effectiveness of the testing process.

Modifications to the Machine's Locking System

Modifications or improvements to the locking system of fabric crocing machines have been explored in several previous studies. The use of stronger materials for the locking components or changes to the design of the locking mechanism have increased its effectiveness. (Kurniawan et al., 2015).

Research Objectives

This research aims to modify the locking system on a fabric crocking machine, which was previously inefficient (Figure 2), to improve fabric stability and colorfastness testing accuracy. The research design includes systematic steps, from planning to analysis of results.

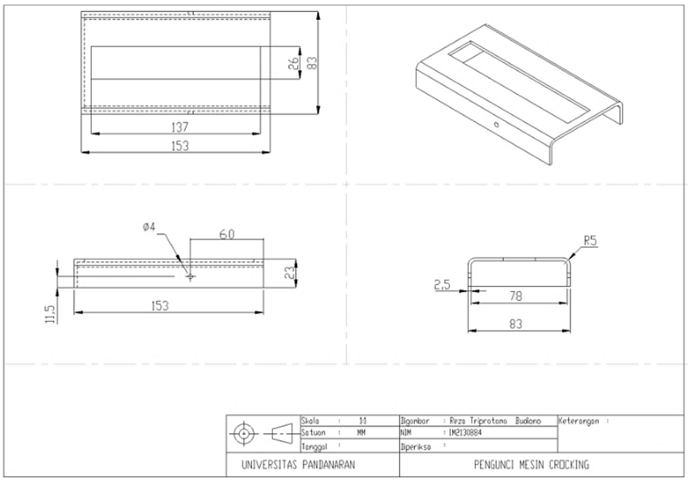

Figure 2 Fabric lock before modification

2. METHOD

This research follows a systematic and structured approach to redesign and improve the fabric locking system on a crocking machine. The methodology includes several stages: literature study, design using Onshape software, prototype creation, and experiential testing. Below is a breakdown of the key steps involved in this study:

1. **Literature Study**:
   The first step in the methodology was to conduct a thorough literature review to understand the existing problems with the fabric locking system in crocking machines. This included examining previous studies, articles, and design approaches to identify areas for improvement in fabric locking mechanisms and to explore possible solutions.
2. **Design Using Software**:
   After identifying the issues with the current system, the next step was to design a more efficient and stable fabric locking system. a cloud-based 3D design software, was used to create both 2D and 3D models of the new locking components. The design process considered factors such as material strength, ease of maintenance, and space efficiency within the machine. The locking mechanism, supports, and pressure regulators were all designed with the aim of improving resistance to friction and wear during machine operation.
3. **Prototype Creation**:
   Once the design was completed, the next step was to manufacture the prototype of the new locking system based on the detailed specifications created in the design phase. The components were fabricated with high-quality materials selected for their durability and resistance to wear. The components were then assembled using welding and plate bending machines to ensure the locking system was robust and functional.

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4. **Experiential Testing**:
   After assembling the prototype, the next phase involved conducting operational tests to evaluate the performance of the new fabric locking system. The tests involved fabric samples such as cotton combed 24s, poly span rib, and DTY brush light weight. These fabrics were subjected to a crocking test to assess the effectiveness of the new locking system in maintaining fabric stability. The tests measured factors such as installation time, testing time, removal time, and the ability of the fabric to stay in position during the testing process.
5. **Comparison of Results**:
   The performance of the newly designed locking system was compared to the old system. Key metrics such as clamping strength, fabric stability, and test results were recorded and analyzed. The results showed that the new system provided better fabric stability and more accurate test results, despite requiring more time for installation and removal.
6. **Evaluation and Final Adjustments**:
   After the initial tests, the results were analyzed, and any necessary adjustments were made to the locking system to improve its efficiency. This included optimizing the number of bolts, pressure settings, and material choices to ensure maximum stability and minimal fabric movement during testing.

By following this methodology, the research aimed to design a fabric locking system that would provide more accurate and stable results during colourfastness testing, ultimately improving the quality control process in textile manufacturing.

3. RESULT AND DISCUSSION

Fabrication and installation

The fabric locker design was carried out to address the main problem with crocking machines, namely the fabric still moving during operation due to insufficient position and number of locking points. The first step was to analyze the existing fabric locker design, followed by identifying the existing problems. The new fabric locker design, as shown in Figure 3, allows for the creation of technical drawings with a high degree of accuracy and precision.

The locking component design was created in 2D and 3D to facilitate visualization and accurate dimensional calculations. Several factors were considered in this design, including material strength, ease of maintenance, and space efficiency on the machine. The locking components, including the locking mechanism, support, and pressure regulator, were designed with resistance to friction and wear during machine use in mind.

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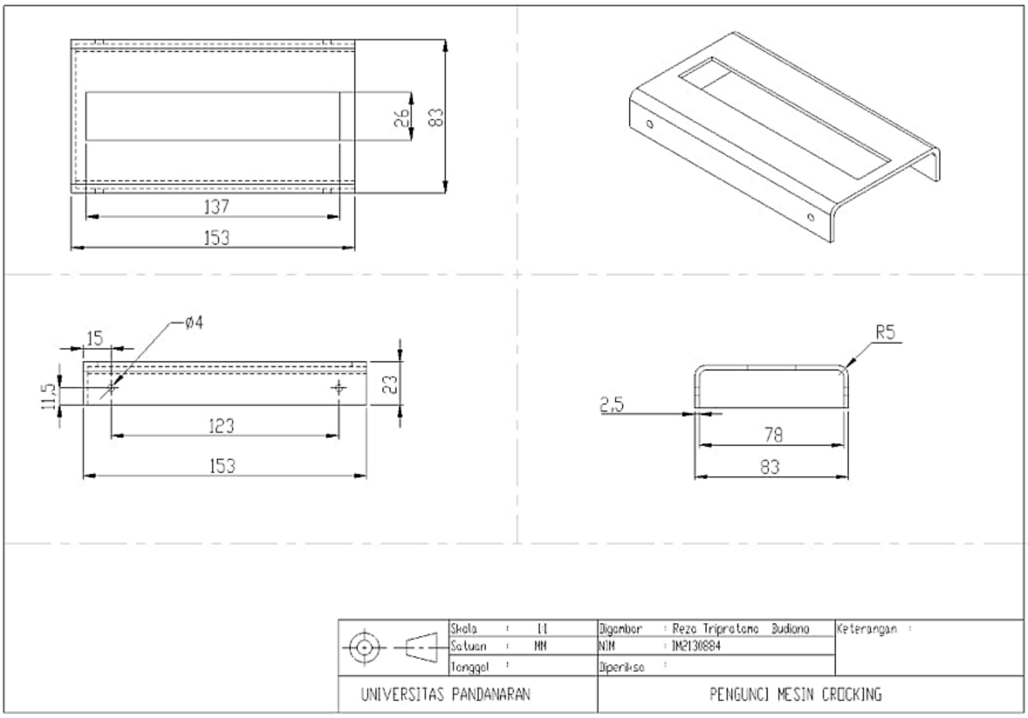

Figure 3 Lock Modification

The fabric lock manufacturing process begins with the fabrication of the lock components according to the predetermined design. The components are manufactured with careful consideration of the quality of the materials used, as well as a dimensional check process to ensure precise dimensions.

After the lock components are manufactured, the next stage is assembly using welding and a plate bending machine. Careful installation is carried out to ensure the lock system functions properly and can withstand fabric movement during machine operation. This process also involves initial testing to evaluate the performance of the installed fabric lock.

How it Works

The modified machine's operating procedure follows the correct operating steps to ensure optimal fabric lock function. Machine users must carefully follow the operational steps in accordance with the SOP, which includes setting machine parameters, such as motion speed or fabric lock pressure, according to the specifications established during the design stage.

Furthermore, the fabric lock is monitored to ensure that the fabric does not move during the crocking process. If any discrepancies or problems are found in operation, parameter adjustments or repairs are made to maintain machine performance.

This design focuses on increasing locking strength by optimizing the shape and size of the components involved in the locking system.

Before and after comparison

In this new design, the fabric lock consists of several key components, such as an adjustable pressure-based locking mechanism, a stable support system, and the use of more durable materials to prevent wear. The design results in Figure 4 show the more precise placement of the locking components, which allows the machine to perform more optimally in holding the fabric in place during the crocking process.

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Figure 4: Locking Fabrication

After the fabric locking design was completed, the manufacturing phase was carried out, taking into account the established specifications. This involved increasing the number of locking bolts from the previous 2 to 4 (Figure 5). The fabric locking was manufactured according to the design validated during the design phase. The manufacturing results demonstrated that the locking components could be accurately manufactured to the specified dimensions. The fabrication process used materials selected for their strength against friction and wear resistance. After checking the component quality, the fabric locking was installed on the crocking machine.

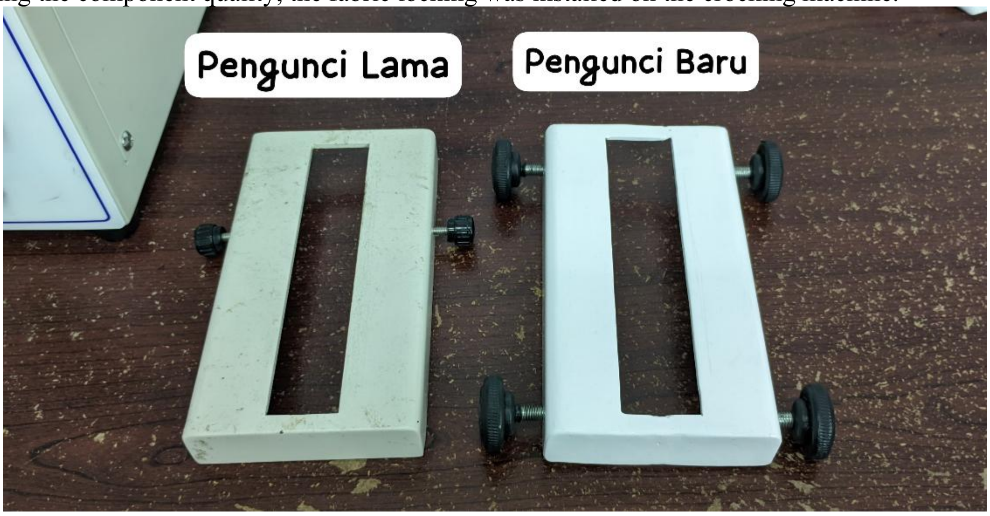

Figure 5: Comparison of the old and new locking system.

Initial testing of the fabric locking system demonstrated improved locking strength, with the fabric being more firmly and stably locked during machine operation. No visible fabric movement was observed during operation with the new fabric locking system, indicating that this locking system is more effective than the previous design.

After the modified fabric locking system in Figure 6 was tested during machine operation, meeting the applicable standard of 10 strokes. The results of the operational trials on 24s combed cotton fabric showed that the new fabric locking system could smoothly withstand 10 strokes without any ripples appearing. Meanwhile, the old fabric locking system showed ripples appearing on the second stroke, and by the 10th stroke, the ripples had worsened.

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Figure 6. New Lock

By using the modified lock, the machine can operate more efficiently without unwanted fabric movement. The fabric remains still and stable throughout the entire machine operation. The new fabric lock securely locks the fabric, ensuring that it doesn't move or shift, which often occurs with the old lock design. This not only improves product quality but also reduces the possibility of fabric damage due to uncontrolled movement.
Furthermore, the fabric pressure and lock settings can be adjusted more easily according to production needs. The machine can operate more consistently without interference from fabric movement. Overall, operating the machine with the modified fabric lock provides more stable and optimal results.

Advantages and Disadvantages
Installation: The old lock only had two bolts, resulting in only two locking points, while the new lock has four locking points, allowing for adjustable fabric tension.
Time: The old lock was quicker to install due to its two locking bolts, but it performed less well and was prone to fabric snagging. The new lock has four bolts, but it produces better results.
For clarity, see tables 1, 2 and 3.

Table 1. Comparison of operating times on 24s combed cotton fabric types

Old Locking						
Fabric Type	Sample No.	Installation (seconds)	Testing Process (seconds)	Removal (seconds)	Total Time (seconds)	Clamping Results
Cotton Combed	1	11	10	6	27	Shrinking
	2	9	10	6	25	Shrinking
	3	10	10	6	26	Shrinking
	4	11	10	6	27	Shrinking
	5	9	10	6	25	Shrinking
Average		10	10	6	26	

New Locking

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Fabric Type	Sample No.	Installation (seconds)	Testing Process (seconds)	Removal (seconds)	Total Time (seconds)	Clamping Results
Cotton Combed	1	20	10	15	45	Good
	2	19	10	14	43	Good
	3	20	10	15	45	Good
	4	18	10	14	42	Good
	5	19	10	15	44	Good
Average		19,2	10	14,6	43,8	

Table 2. Comparison of operating times on 2x1 poly span rib fabric types

Old Locking						
Fabric Type	Sample No.	Installation (seconds)	Testing Process (seconds)	Removal (seconds)	Total Time (seconds)	Clamping Results
2x1 Poly Span rib	1	12	10	6	28	Shrinking
	2	11	10	7	28	Shrinking
	3	10	10	6	26	Shrinking
	4	10	10	7	27	Shrinking
	5	12	10	7	29	Shrinking
Rata-Rata		11	10	6,6	27,6	

New Locking						
Fabric Type	Sample No.	Installation (seconds)	Testing Process (seconds)	Removal (seconds)	Total Time (seconds)	Clamping Results
2x1 Poly Span rib	1	21	10	15	46	Good
	2	19	10	15	44	Good
	3	20	10	16	46	Good
	4	21	10	16	47	Good
	5	20	10	15	45	Good
Average		20,2	10	15,4	45,6	

Table 3. Comparison of operating times on light weight dty brush fabric types

Old Locking

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Fabric Type	Sample No.	Installation (seconds)	Testing Process (seconds)	Removal (seconds)	Total Time (seconds)	Clamping Results
DTY Brush Light Weight	1	13	10	6	29	Shrinking
	2	12	10	6	28	Shrinking
	3	11	10	6	27	Shrinking
	4	11	10	5	26	Shrinking
	5	13	10	7	30	Shrinking
Average		12	10	6	28	

New Locking						
Fabric Type	Sample No.	Installation (seconds)	Testing Process (seconds)	Removal (seconds)	Total Time (seconds)	Clamping Results
DTY Brush Light Weight	1	22	10	15	47	Good
	2	21	10	15	46	Good
	3	22	10	16	48	Good
	4	22	10	16	48	Good
	5	20	10	15	45	Good
Average		21,4	10	15,4	46,8	Good

Based on the analysis, the old lock was faster to use, with an average time of approximately 28 seconds, while the new lock took longer, approximately 46 seconds. However, the new lock provided better locking quality, high accuracy, and maximized test results, making it more suitable for testing standards requiring precision. The time difference, particularly during the installation and removal processes, was due to the new lock's more stable design, which reduces errors and improves result consistency.

Therefore, although the new lock requires additional time, its superior test quality makes it more recommended for use in fabric testing processes, especially for applications that emphasize accuracy and data reliability.

Safety: The old lock was prone to the actuator catching on the fabric due to fabric waves, which could force the machine to stop. The new lock is safer due to the minimal, or almost no, fabric waves that could cause the actuator to catch on the fabric. Operation results: The old lock gave less accurate results due to minimal friction during the rubbing process so that the fabric followed the movement of the driver which triggered the fabric waves, and in some cases did not give results because the machine stopped suddenly because it was caught in the fabric. The new fabric lock gave more accurate results, because when the driver was working the fabric tension condition was stable and did not cause the fabric to be wavy.

4. CONCLUSION

Based on the results of research and testing on the modified fabric locker on the crocking machine, the following conclusions can be drawn: The modified fabric locker design has resulted in a more effective and efficient design than the previous design. This new design improves locking strength, stability, and resistance to friction and pressure during machine operation. The fabric locker manufacturing process followed design specifications. The resulting components exhibit a high level of accuracy and utilize materials that meet the requirements for wear resistance. Test results showed a significant increase in fabric locking strength and stability during machine operation. Machine operation with the modified fabric locker proved more optimal. The fabric was firmly locked without shifting during the crocking process, improving the quality of test results and reducing

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the risk of fabric damage. Maintenance of the modified fabric locker was easier and more efficient. Components showed no significant wear during the test period and required less maintenance compared to the previous system. This resulted in reduced maintenance costs and increased production efficiency.

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