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Onloom Twist Impart for Multi Pick Insertion in Airjet Loom

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***Abstract*: This paper explores a novel method for enhancing fabric quality in textile manufacturing by integrating an onloom twist impart device within airjet looms for multi-pick insertion. This innovation eliminates the need for separate twist application processes, significantly reducing production time and costs while improving fabric strength and overall quality. The study provides a detailed analysis of the device's design, implementation, and the resulting improvements in fabric characteristics, offering a potential shift in how high-quality textiles are produced.**

***Keywords*: onloom twist, multi-pick insertion, airjet loom, textile innovation, fabric quality.**

1. Introduction

Traditional textile manufacturing processes often involve multiple stages, with twist application being a separate and labor-intensive step that adds complexity, time, and cost to fabric production. This separation can lead to inefficiencies, such as inconsistent yarn quality and increased resource consumption, which negatively impact the overall production process. The problem is further exacerbated by the need for multiple passes through machinery, each requiring careful monitoring and adjustment. To address these challenges, this study aims to develop and integrate an innovative onloom twist impart device directly into airjet looms, enabling multi-pick insertion during the weaving process. This integration is designed to enhance fabric strength and quality while simultaneously optimizing the manufacturing process by eliminating the need for a separate twisting stage. The significance of this innovation lies in its potential to revolutionize textile manufacturing by reducing production costs, improving fabric quality, and significantly increasing production speed, thereby offering a more efficient and sustainable approach to fabric production.

2. Literature Review

The literature on textile manufacturing has extensively documented the evolution of fabric production techniques, highlighting the critical role of twist application in enhancing yarn strength, fabric integrity, and overall durability. Traditionally, twisting is performed as a separate process before weaving, requiring additional machinery, operational steps, and skilled labor, which contribute to higher production costs and extended processing times. Research has explored various methods to integrate twisting more seamlessly with weaving, but these efforts have often faced limitations in scalability, effectiveness, and compatibility, particularly in high-speed manufacturing environments like airjet looms. Recent advancements have focused on the automation, real-time application, and precise control of twist during weaving, aiming to streamline the process and reduce the resource burden. However, while these innovations have shown promise, they have yet to be widely adopted due to technical challenges, cost constraints, and the need for further refinement. This study builds on the existing body of work by proposing a novel onloom twist impart device specifically designed for multi-pick insertion in airjet looms, offering a potentially transformative solution to the longstanding challenges in the textile industry, with a focus on efficiency and fabric quality.

3. Methodology

A. Design and Development of the Onloom Twist Impart Device

1) Device Specifications

The development of the onloom twist impart device was centered around creating a mechanism capable of applying real-time twists to the yarn during the weaving process, specifically designed for integration with airjet looms. The device is equipped with a twisting mechanism that synchronizes with the loom's existing operations, ensuring that each yarn is twisted consistently as it is woven into the fabric. This mechanism involves a series of rotating elements that grip and twist the yarn at precise intervals, controlled by an advanced microcontroller system. The twist impart device was designed to be adaptable to various airjet loom configurations, with adjustable settings for twist levels to accommodate different yarn types and fabric specifications. Integration with the loom required careful consideration of the device's footprint and compatibility with existing loom components, ensuring that it could be installed without significant modifications to the loom's structure. Control systems were implemented to allow for real-time adjustments during the weaving process, providing flexibility to adapt to varying production requirements.

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2) Implementation Process

The integration of the onloom twist impart device into existing airjet loom setups followed a systematic approach to ensure seamless operation. Initially, the loom's existing configuration was analyzed to identify potential interference points and areas that would require modifications. The twist impart device was then mounted onto the loom, ensuring that the rotating elements were aligned with the yarn paths. This alignment was critical to maintain the precision of the twist application. Once mounted, the device was connected to the loom's control system, enabling synchronization between the twisting mechanism and the loom's operations. The installation process also involved calibrating the device to match the specific operational parameters of the loom, such as the speed of yarn insertion and the tension levels. Any necessary adjustments were made to the loom's software to accommodate the new device, ensuring that the entire system operated cohesively. Following installation, the device underwent a series of tests to verify its functionality and compatibility with the loom, making adjustments as needed to optimize performance.

B. Experimental Setup

1) Materials

The study utilized specific types of yarn and other materials to evaluate the effectiveness of the onloom twist impart device. The yarns selected included a range of cotton and synthetic fibers, chosen for their common use in commercial textile manufacturing and their responsiveness to twisting. Each yarn was characterized by its linear density (measured in tex or denier), strength, and elasticity, ensuring a representative sample for testing. Additionally, the study incorporated various weaving accessories, such as reeds and healds, compatible with the airjet loom and the twist impart device. The materials were chosen to simulate real-world manufacturing conditions and to provide a reliable assessment of the device's performance across different fabric types.

2) Operational Parameters

The weaving conditions for the experimental setup were carefully controlled to evaluate the performance of the onloom twist impart device under varying operational scenarios. Key parameters included the air pressure used in the airjet loom, which directly influences the speed and force of yarn insertion, and the twist levels imparted by the device, which were adjustable depending on the desired fabric characteristics. The pick insertion rate, or the speed at which the weft yarns are inserted into the fabric, was another critical parameter, with settings optimized to balance production speed with the quality of the twist application. Other variables, such as yarn tension and loom speed, were monitored and adjusted as necessary to maintain consistent weaving conditions across all test samples. These parameters were documented meticulously to ensure repeatability and to provide a comprehensive dataset for analysis.

3) Fabric Testing

The fabrics produced using the onloom twist impart device were subjected to a series of rigorous tests to assess the impact of the twist application on their physical properties. The primary tests included assessments of fabric strength, where the tensile strength of the fabric was measured to determine its resistance to breaking under tension. Thickness measurements were also conducted to evaluate how the twist application affected the overall density and bulk of the fabric. Additionally, other relevant characteristics such as the fabric's elongation, tear resistance, and surface texture were examined to provide a holistic view of the device's impact. Each test was performed according to standard textile testing protocols, ensuring that the results were accurate and comparable to industry benchmarks. The data collected from these tests were analyzed to identify trends and correlations between the operational parameters of the twist impart device and the resulting fabric properties, providing insights into the optimal settings for various fabric types.

C. Simultaneous Twist Application Devices

The device which gives twist to the yarn of weft which is simultaneous action of twisting while weaving. The weft pulled up by the weft insertion medium of Airjet loom, which unwinding the weft yarn from multi-plied yarn packages and Two-for-one twisting system impart to the yarn.

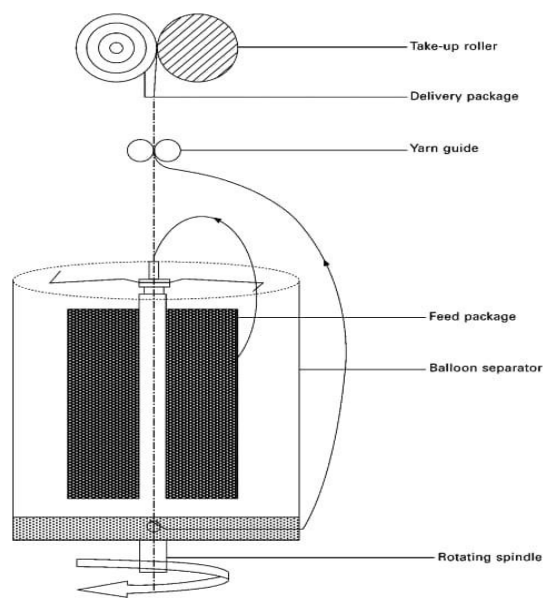

Fig. 1.

4. Results and Discussion

A. Performance Evaluation of the Onloom Twist Impart Device

1) Fabric Strength and Quality

Presentation of data showing improvements in fabric strength, thickness, and overall quality compared to fabrics produced with traditional methods.

2) Efficiency Gains

The integration of the onloom twist impart device into airjet looms significantly reduces production time and costs by streamlining the fabric manufacturing process. By combining twisting and weaving into a single operation, the need for separate machinery and handling steps is eliminated, leading to faster production cycles and lower labor requirements. Additionally, this integrated approach reduces energy consumption and machine maintenance, contributing to long-term cost savings. Overall, the efficiency gains from this innovation result in increased production capacity and profitability for textile manufacturers.

B. Comparative Analysis

1) Comparison with Traditional Methods

A detailed comparison of the results obtained with the onloom twist impart device against traditional twisting and weaving methods.

2) Discussion on Innovation and Impact

Insights into how this innovation could shift industry practices, including potential challenges in adoption and scalability.

5. Conclusion

The integration of the onloom twist impart device into airjet looms represents a significant advancement in textile manufacturing, offering a transformative solution to some of the most persistent challenges in the industry. This innovation eliminates the need for separate twist application processes, thereby streamlining production, reducing operational complexity, and enhancing the overall efficiency of fabric manufacturing. By combining the twisting and weaving steps into a single, continuous operation, manufacturers can achieve considerable reductions in production time, labor, and energy consumption. These improvements not only lower production costs but also contribute to a more sustainable manufacturing process by reducing waste and energy use.

Moreover, the onloom twist impart device has been shown to significantly enhance the physical properties of the fabric, particularly in terms of strength and durability. The ability to apply precise and consistent twists during the weaving process results in a higher quality fabric, which is better suited to meet the growing demand for durable and high-performance textiles. This improvement in fabric quality, coupled with the increased production efficiency, positions the onloom twist impart device as a key innovation that could reshape the textile industry.

In summary, the onloom twist impart device offers a comprehensive solution that addresses both the technical and economic challenges of traditional textile manufacturing. By improving fabric quality, optimizing production processes, and reducing costs, this innovation has the potential to significantly impact the textile industry, driving it towards more efficient, sustainable, and profitable manufacturing practices. Future research could further refine this technology, exploring its application across a wider range of fabric types and production environments, thereby extending its benefits even further within the industry.

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