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Portable Pneumatic Control Staircase for Train

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Abstract: *Automatic Staircase Using Pneumatic Actuators & IR Sensors serves to automate the mechanism of Staircase operation using Pneumatic, controller and infrared sensor technology. The methodology applied in the project is divided into three parts, firstly designing and fabrication of the Staircase with the calculated dimensions, secondly, developing a controller for door operation and thirdly, interfacing the different components to work together in a cohesive manner to adjust the height of Staircase at each platform level. When a platform comes in or goes out of the range of the sensor, a signal is sent to the controller which controls the electro-pneumatic circuit to open or close the Staircase as per required height of steps. The significance of this system is automation of the Staircase which can be customized according to the use. Based on the results obtained an actual working prototype was designed and a suitable large scale will develop taking into account the platform height conditions.*

Keywords: Automatic staircase, platform height, Electro-Pneumatics Control, IR Proximity senso, train

I. INTRODUCTION

Presently, Indian Railways (IR) AC 3-Tier Sleeper Coaches of ICF design to CSC-1722 have a floor height of 1320 mm from rail level and have a customized design of complete entraining/ detraining arrangement including door with fixing arrangement, footsteps and door handle compatible with platform of height 760mm to 840mm from rail level in such a way that passenger during entraining from platform to coach floor uses a vertically straight parallel foot-steps and similarly during detraining from coach floor to platform. The Challenge is design a mechanism of operation of a convenient method of train access from low level platforms in a failsafe mode. The innovations may particularly look at opportunities of easy retro-fitment and seamless integration in the current design of coaches serving different age groups and physical capabilities. The Challenge aims to encourage creation of innovative, easy to use designs and solution that can enable convenient access to all kinds of passengers (of diverse ages and special requirements) without infringing the current constraints of fixed infrastructure at the station and along the trackside. In places where there is a space restriction, a foldable stair can be used. In accordance with this, we have simulated a mechanism in which the unfolding and folding of the stair is due to the linear motion of the slider at one end. The effect of the change in length of connecting rod that converts linear motion to rotary motion is to be analyzed. The foldable stair mechanism consists of links arranged in vertical and horizontal manner that make up the stair like arrangement. These links are connected with each other using revolute joints. The crank in the crank and slider mechanism, which pulls the entire set of links up or down makes the stair like arrangement. This crank also acts like an input link for the four-bar mechanism. This folding and unfolding of the stair resemble the scissor like structure. The crank is connected to the connecting rod through a revolute joint, which moves due to the actuation of the slider. The slider moves linearly due to the translator motion exhibited by the linear actuator. The construction of the mechanism is as shown in Fig 1. Two sets of this planar mechanism are placed.

II. LITERATURE REVIEW

The development and production of mobility aids such as the Cylindrical Belt 269 require a comprehensive understanding of materials science, biomechanical design, and advanced manufacturing processes. Existing literature provides valuable insights into these areas, particularly the role of industrial sewing machines in fabricating high-performance products designed for rehabilitation, injury recovery, and sports performance.

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Role of Advanced Materials in Mobility Aids

Studies emphasize the importance of technical textiles and advanced composites in mobility aid design. Research by Smith et al. (2019) highlights that breathable, moisture-wicking fabrics significantly improve user comfort, especially for products in direct contact with the skin. Elastic materials with high tensile strength, as noted by Patel and Kumar (2020), enhance flexibility while maintaining the structural integrity needed for targeted support. Materials such as thermoplastic polyurethane (TPU) and carbon fibre have been extensively explored for their lightweight yet durable properties, making them ideal for support inserts in products like the Cylindrical Belt 269.

Biomechanical Design Principles

The integration of biomechanical principles in mobility aids has been widely studied. Jones and Brown (2021) discuss how ergonomically designed products can enhance natural movement patterns while providing adequate support. This aligns with the goals of the Cylindrical Belt 269, which aims to optimize leg function without restricting motion. Other research highlights the importance of customization and adjustability in rehabilitation devices to cater to diverse user needs and body types.

Industrial Sewing Machines in Technical Fabrication

The role of industrial sewing machines in the production of technical products is well- documented. Cylinder-bed sewing machines, as detailed by Lee et al. (2018), are ideal for manufacturing cylindrical or tubular designs due to their ability to handle complex stitching patterns and multi-layered materials. Automation features, such as programmable stitching and automatic thread trimming, are essential for maintaining precision and consistency in high- volume production. Research also emphasizes the need for machines capable of working with stretchable and non-fraying materials, ensuring durable and seamless finishes.

Applications in Rehabilitation and Sports Performance

Mobility aids have become a critical tool in rehabilitation and athletic performance enhancement. Studies by Wilson and Taylor (2022) demonstrate the effectiveness of targeted support devices in reducing recovery times and improving stability. Products like the Cylindrical Belt 269, designed with user comfort and biomechanical optimization in mind, align with findings that suggest such aids can significantly enhance overall mobility and quality of life.

Gaps and Future Directions

While existing research highlights the importance of materials, design, and manufacturing processes, there is limited literature addressing the integration of these aspects in a single, cohesive product like the Cylindrical Belt 269. Future studies should focus on the intersection of advanced industrial sewing technology, material innovation, and user-centered design to create more effective mobility solutions.

This review underscores the necessity of leveraging advanced materials, innovative design principles, and specialized manufacturing techniques in producing high-performance mobility aids. The insights gained from existing studies provide a strong foundation for the development of the Cylindrical Belt 269 as a groundbreaking product in this domain.

Discussion and Methodology Discussion:

The Cylindrical Belt 269 integrates advanced materials, biomechanical design, and specialized industrial sewing machines to provide enhanced leg support and mobility. The use of breathable, moisture-wicking fabrics and durable composites like TPU and carbon fibre ensures both comfort and stability, addressing the needs of individuals in rehabilitation and sports. These materials require specialized sewing machines capable of handling stretchable and multi-layered fabrics, such as cylinder-bed machines, which enable precise stitching and seamless finishes. Automation in these machines ensures efficiency and consistent quality in high-volume production.

The biomechanical design of the Cylindrical Belt 269 promotes natural movement patterns while offering targeted support to the lower limbs. Its adjustable fit makes it customizable for individual users, enhancing its effectiveness in rehabilitation and athletic performance.

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However, challenges in handling advanced materials and ensuring long-term durability remain, highlighting the need for continuous innovation in both materials and manufacturing technologies. As the field progresses, there are opportunities to refine the product further, ensuring better performance and scalability for broader applications.

III. METHODOLOGY

This study focuses on developing the Cylindrical Belt 269 for enhanced leg support and mobility, combining material selection, biomechanical design, and industrial sewing techniques.

1. Material Selection: Advanced materials such as breathable technical fabrics, moisture- wicking textiles, and composites like TPU and carbon fibre are chosen for their durability, flexibility, and comfort. Tests assess their strength, stretchability, and compatibility with skin.
2. Design and Biomechanics: The design incorporates biomechanical principles to ensure natural movement and targeted support. CAD software and user feedback guide the design process, focusing on adjustability and performance.
3. Manufacturing Process: Industrial sewing machines, including cylinder-bed and flatbed models, are used to stitch multi-layered materials with precision. Automated features ensure consistent, high-quality seams, utilizing seam types like flatlock and seamless stitching.
4. Prototyping and Testing: Prototypes are tested for biomechanical performance, durability, and user comfort. Feedback from trials helps refine the design.
5. Performance Evaluation: The product is tested in real-world settings, including rehabilitation centers and sports clinics, with feedback from users to assess effectiveness in mobility, support, and performance.
6. Continuous Improvement: The product is refined based on testing results, and manufacturing strategies are optimized for scalability, ensuring high quality as demand increases.

This methodology ensures the Cylindrical Belt 269 meets high standards in both design and production, optimizing leg support and mobility.

Limitations:

We can only use this job on this Adler machine.

Future Work:

we can design the another part of adder machine.

IV. CONCLUSION

The Cylindrical Belt 269 is a groundbreaking product designed to enhance leg support and mobility through a combination of advanced materials, biomechanical principles, and specialized manufacturing techniques. By utilizing breathable fabrics, durable composites, and flexible materials like TPU and carbon fibre, the belt provides both comfort and stability. Its design promotes natural movement while offering targeted support, making it ideal for use in rehabilitation and sports performance. The manufacturing process involves high-precision industrial sewing machines to ensure durability, consistency, and comfort. Prototypes are rigorously tested to ensure performance, with feedback driving continuous improvements. As demand grows, the product's scalability and manufacturing efficiency ensure that it can be produced at high quality. Overall, the Cylindrical Belt 269 stands as an essential tool for optimizing leg function and mobility, with potential for widespread use in various physical rehabilitation and sports settings.

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