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DESIGN, DEVELOPMENT AND ANALYSIS OF TOGGLE LEVER CALIPER CABLE TROLLEY BRAKE FOR FAIL SAFE OPERATION

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ABSTRACT

Present cable trolley brakes used in material transfer or overhead trolley transport systems uses twin shoe caliper brakes operated by solenoid. These brakes are not fail safe, means that slip occurs between cable and brake caliper. Sometimes overloading leads to wear of brake shoe material. The failure of brake system may increase the chances to loss of life of occupant. These conventional caliper brakes are replaced by self-locking toggle lever operated caliper brakes. More over change in friction material as copper wire reinforced brake liner material with better coefficient of friction, better heat dissipation ability make the brake fail safe in operation.

Keywords:-self-locking toggle lever, Caliper Brakes, brake liner material, brake fail safe in operation, friction lining.

1. INTRODUCTION

1.1. Introduction to Conventional Braking System

Conventional cable trolley brake systems comprise caliper brakes operated by solenoid. These systems are prone to failure hence there is a need of developing a cable trolley braking mechanism that will provide reliable locking. Cable trolley braking requirements lead to choose the brake caliper mounted directly to a secondary cable as the top level design for this project. Reliability is given the most weightage in the decision making process, and the concept chosen should be highly reliable due to the simplicity of the concept. Other important constraints met by the caliper on cable concept are listed below

• The system is completely mechanical.

• The system operates in a non-destructive manner with major system components.

• Installation and maintenance costs are low.

• The tram cart is captured to the track by a secondary cable.

This concept also allowed for a relatively simple and manual override the final design of the product utilizes a secondary cable stretched from the top to the bottom of the tramway. The secondary cable passes through a mechanical brake caliper which is attached to the tram cart. A linkage set connects the winch pull cable to the caliper, and a spring is utilized to apply braking force to the caliper in the event of an emergency. Figures 1 provide models of the complete braking system. The braking system features three distinct subunits: the caliper assembly, the caliper activation assembly, and the cable guides.

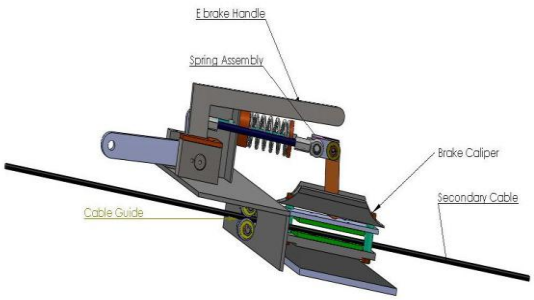

Figure 1.Models of the complete Braking System

1.2 Introduction to friction material

A. Asbestos

Asbestos become the major material for friction material composition. Asbestos were from Greek word which mean "inextinguishable". This asbestos dry friction material is hazardous to human life as it becomes wearied during operation.

B. Kevlar or Aramid

The use of non-metallic friction material seems to become the solution forth asbestos friction material. Friction material made from Kevlar or aramid fiber.

2. LITERATURE REVIEW

Sivarao et.al [1] have carried out work on braking system to ensure the safety of users and vehicle. The good condition of brake lining is very crucial to ensure the efficiency of the braking systems. The worn off brake lining not only endangers life but also damages the entire brake associated parts such as hub, disk, shaft, etc. The special spot on the brake pad which evaluates thickness, hardness, layer properties and critical region of wear. The wear sensing micro switch function embedding techniques were tried which detects lining wear safety limit by touching the rotor disk just before exceeding the brake pad lining limit. The sensor used suits well with the design of an existing pad, this modification done did not disturb the original function and purpose and can be installed into brake housing as usual. This is simple, cheap solution of detecting the lining wear safety limit by alerting user.

Otterson et.al [2] have mentioned the braking system is to operate automatically in the event of a pull cable or winch gearbox malfunction. The braking system should either stop the tram cart, or allow the cart to descend to the bottom of the tramway at a controlled velocity of no more than 2 ft./sec. The braking system must be reliable, mechanical (non-electrical), and operate without the destruction of major braking system components. The brake is automatically engaged when the handle of the cart is released. The brake is fully contained within the rear wheel of the cart. One advantage is that the brake mechanism will automatically engage when the cart is left unattended. This enhances the overall safety of the cart. Another advantage is that the brake fits inside the profile of the rear wheel. As a result, brake action is not affected by wheel and wear does not damage on the tire tread.

Daniel Brair Boren et.al [3] have carried out work on a friction shoe may be mounted on the trolley between the pulleys to contact the upper portion of the cable between the pulleys to provide braking force. Thus, when the rider is suspended from the plate of the trolley, the weight of the rider forces the biased pulley upward relative to the plate, allowing the shoe to be forced against the cable. This friction of the shoe against the cable provides the braking force. The study of various material properties and characteristics may be considered when selecting a material for a friction shoe in accordance with the present invention. For example, one material may have excellent Wear resistance, but its coefficient of friction against a cable may vary greatly depending on whether the cable is dry. Accordingly, the material may be suitable for dry conditions, yet be hazardous for Wet conditions.

Okon D. et.al [4] has demonstrated the application of analysis in the caliper seal groove design. In this, the mechanics of rubber deformation within the prescribed boundaries of the seal groove are established. Predictions on the forces acting on the rubber seal during application of brakes are also made. The spring like behavior of the caliper housing and lining as well as the hyper elastic behavior of the seal in the seal groove are beneficial to the system. The analysis models incorporate all the salient design parameters of a caliper system, and offer complimentary predictions regarding the caliper performance. The ability to optimize the performance of the caliper groove seal early in the design when only the design variables are known, i.e. before prototypes are made.

Amit Gavhad et.al [5] have mentioned vehicle's braking system must be capable of locking all four wheels on a dry surface. Ease of manufacturability, performance and simplicity are a few important criteria considered for the selection of the braking system involving the designing of hydraulic disc brake system. The ideal braking system is the one of that will allow the driver to bring a vehicle to a stop in shortest possible distance. To be able to do this it should have an enough power to lock up and skid all tyres while stopping on clean, dry pavement

3. PROBLEM STATEMENT

a) Present cable trolley brakes used in material transfer or overhead trolley transport system uses twin shoe caliper brakes operated by solenoid. These brakes are not fail safe i.e. the slip occurs between cable and caliper system due to overloading. The overload leads to slippage of cable which enhances possibility to the failure of braking system.
b) The friction material used in brake lining also gets worn out, brake lining is very crucial to ensure the efficiency of the braking system, where the worn off brake lining not only endangers life but also damages the entire brake associated parts such as hub, disk, shaft, etc.

4. SUGGESTED SOLUTION

a) These conventional caliper brakes are replaced by self-locking toggle lever operated caliper brakes.
b) Change in friction material as copper wire reinforced brake liner material with better coefficient of friction, better heat dissipation ability make the brake fail safe in operation

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