MECHANISM DESIGN OF MAGNETORHEOLOGICAL BASED ANTILOCK BRAKING SYSTEM

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I admit that I have read this report and it has followed the scope and quality in partial fulfillment of requirement for the Bachelor of Mechanical Engineering (Automotive)

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"I admit that this report is from my own work and idea except for the summary and a few sections which were extracted from other resources as being mention".

Signature: …….....

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To my lovely mother and father, brothers and sisters, who give me spirit and inducement towards the success in my study and my future. To all my lecturers and friends, thank you for all the support and guidance given to me for all this while.

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ABSTRAK

Penulisan kertas ini adalah bertujuan untuk merekabentuk dan menghasilkan sistem elektrik mekanikal brek yang baru menggunakan cecair Magnetorheological. Brek Magnetorheological mengandungi sepasang cakera yang terendam di dalam cecair Magnetorheological di dalam drum atau perumah yang berputar. Unsur di dalam cecair magnetorheological boleh berubah dari cecair ke separuh pepejal apabila terdedah kepada medan magnet. Tekanan yang di hasilkan oleh cecair Magnetorheological berubah sebagai fungsi medan magnet. Oleh yang demikian, kuasa brek boleh di kawal dengan tepat dengan hanya menukar arus yang di kenakan terhadap electromagnet. Untuk menghasilkan atau mendapatkan kuasa untuk membrek yang di kehendaki, rekabentuk Magnetorheological brek harus di teliti dengan menggunakan pelbagai parameter antaranya adalah rekabentuk litar magnet, berat, dimensi, kegunaan, mudah dihasilkan, ketahanan dan jumlah permukaan yang bersentuhan. Pelbagai konsep rekabentuk dihasilkan berdasarkan parameter yang di beri. Setiap konsep rekabentuk telah di bincangkan berdasarkan parameter dan konsep pemarkahan matrik telah di gunakan bagi memilih rekabentuk yang terbaik. Rekabentuk konsep yang terpilih akan dianalisa dengan menggunakn perisian simulasi magnet, ANSOFT MAXWELL. Keputusan dari analisa akan diperincikan untuk mencari rekabentuk terbaik bagi sistem Magnetorheological brek. Rekabentuk terperinci akan dihasilkan dengan menggunakan perisian 3 dimensi, CATIA V5R19. Analisa terhadap struktur komponen yang kritikal dalam Magnetorheological brek dilaksanakan dengan menggunakan perisian 3 dimensi, CATIA V5R19. Geometri serta konfigurasi magnetorheological brek apabila dipasangkan pada motorsikal dipaparkan dalam bahagian 4 kertas ini.

ABSTRACT

The purpose of this report is to design and develop the new electromechanical brake system using Magnetorheological fluid (MR fluid). Magnetorheological brake (MR brake) consists of discs immersed in Magnetoreheological fluid (MR fluid) inside rotating housing or drum. The properties of MR fluid can be change from fluid to semi solid when exposed to magnetic field. The yield stress of the MR fluid varies as a function of the electromagnet. Hence, the braking torque can be precisely controlled by simply changing the current applied to the electromagnet. In order to generate maximum or desired torque for braking, the design is optimized using various parameters such as magnetic circuit design, weight constraints, dimensions, feasibility, ease of manufacture, durability and number of contact surface. Various concept designs are produced based on the given parameters. Each concept design is evaluate according to the parameters and concept scoring matrix is use to select the best design. The selected concept design is analyze using magnetic simulation software, ANSOFT MAXWELL. The result from the analysis is optimize to find the optimum design for the MR brake. Detail design of the optimum design is draw using 3D modeling software, CATIA V5R19. Analysis on the critical part of the MR brake is done using CATIA V5R19. The MR brake geometry and configuration when installing to the motorcycle drum brake is shown in the chapter 4 of this report.

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CHAPTER 1

INTRODUCTION

1.1 Background

The purpose of this project is to design and develop the mechanism of magneto-rheological brake (MR brake) based on antilock braking system (ABS) for motorcycle. Braking system is very important for a vehicle. Brake will help drivers to be able to control their vehicle by slowing down or stopping the vehicle when needed. For over centuries, design and material used for a brake has been optimized to improve the safety and the comfort to the driver s and passengers. Nowadays, there are 2 types of brakes commonly used on motorcycle, drum brake and disc brake. Both types of brakes are using the same application which is to apply force against the friction of the road, thus slowing down or stopping the motion of the vehicle, alternatively devices to restrain the vehicle from starting to move again. MR brake has advantages over the conventional brake as it is electronically controlled brake systems.

According to E.J. Park et al, (2006), the properties and behavior of the brake will be easy to adapt by simply changing software parameters and electrical outputs instead

of adjusting mechanical components. This also allows easier integration of existing and new control features such as anti-lock braking system (ABS).The other advantages are the wiring will be simplified as less mechanical components are used and no brake fluids are used, thus prevent water pollution caused by the brake fluids. The MR brake consists of a rotating disk immersed in a MR fluid, enclosed in an electromagnet. When current is applied, the magnetic field produced, will cause the MR fluid to become semi solid, thus cause friction between discs brake and plates inside MR brake. In principle, the brake torque can be controlled by changing the DC current applied to the electromagnet, thus with some suitable methods are used, we can actually prevent the tires from locking up while braking (anti-lock braking system).

1.2 Problem statement

Conventional brake use both mechanical and hydraulic system. Hence, it involves a lot of mechanical system that is needed to be replaced or adjusted mechanically over a period of time or when necessary depend on driving behavior and road condition. Brake oil or hydraulic oil will cause pollution when it is improperly dispose. Magneto-rheological brake (MR brake) is controlled by current, hence it uses no hydraulic oil and the system is simple compared to mechanical system. MR brake contains controllable fluids call magneto-rheological fluid (MR fluid) that can change their properties when exposed to magnetic fields. By controlling the current applied to an electromagnetic coil inside the disc brake of the MR brake, the MR fluid's viscosity can be changed. Adjustment takes place by varying the amount of current and suitable methods are used to identify the desired braking torque.

1.3 Objectives

1) To conceptually design of magneto-rheological brake (MR brake) with anti lock braking system (ABS) and to select the optimum design of MR brake.
2) To detail design of MR brake with ABS based on magnetic field analysis software.
3) To fabricate and install MR brake into motorcycle.

1.4 Scopes

Conceptual designs and detail design of Magneto-rheological brake (MR brake). Fabricate and install Magneto-rheological brake (MR brake) on motorcycle. Characterization of torque current behavior of Magneto-rheological brake (MR brake).

1.5 Project Overview

CHAPTER 1

This chapter is an introduction and it covered background, problem statement, objective and scope.

CHAPTER 2

This chapter is literature review consist of introduction of automotive braking system, antilock braking system, magneto-rheological brake (MR brake), analytical modeling of MR brake and magneto-rheological fluid (MR fluid).

CHAPTER 3

This chapter is methodology and it is consist of flowchart, conceptual design overview, conceptual design generation, conceptual design criteria, concept scoring matrix and design consideration for installing MR brake to the motorcycle.

CHAPTER 4

This chapter is result of the project. It is consist of concept design of MR brake, magnetic analysis, detail design, structural analysis and design optimization.

CHAPTER 5

This chapter is discussion. It consists of graph of braking torque against time and graph of slip against time.

CHAPTER 6

This is final chapter which is conclusion and recommendation.