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MANUFACTURING OF MRF PROTOTYPE BRAKE

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ABSTRACT

This paper is about a new magnetorheological (MR) brake prototype which was designed, fabricated and tested. Initially, the rheological properties of MR fluids, in particular the dynamic yield stress, were experimentally investigated based on a Bingham plastic model. The further working principles of the MR brake were then analysed and discussed. Also the equations for transmitted torque were derived and used to evaluate the disc-shaped MR brake. The finite element analysis was used to analyse the electromagnet. Following the manufacturing and fabrication of a brake prototype, the mechanical performance of the MR brake was experimentally evaluated with a specially designed test rig. The effects of magnetic field and rotary speed on the transmitted torque were addressed, and an amplifying factor was introduced to evaluate the brake performance. It was found that brake torque increased steadily with the increment of magnetic field or rotary speed. The amplifying factor showed an increasing trend with the magnetic field but a decreasing.

Keywords: *magnetorheological fluid, finite element analysis, Bingham plastic, dynamic yield stress*

I. INTRODUCTION

In today's world of advanced technology each and every technology used in an automobile is based on modern inventions right from tyre grip on the road to the fuel injection or combustion processes in the engine all have been changed in order to increase the efficiency of working. The only conventional things still used in an automobile is the braking system. Few changing have occurred over the period but the basic principle of working is same. Hence the expected efficiency required for this system has not been achieved yet.

The problems related to the brake force and its effective application are still being faced. This problem can be effectively solved by using magnetorheological fluid. Magnetorheological fluid is such a fluid whose properties can be instantly changed by applying magnetic field. Hence due to this reason the MR fluids can be used for clutches as well as brakes

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II. LITERATURE SURVEY

A.G.Olabi, A. Grunwald [1] conducted research on Magneto-rheological fluid (MRF) technology and found that it is an old ‘‘newcomers’’ coming to the market at high speed. Various industries including the automotive industry are full of potential MRF applications. Magneto-rheological fluid technology has been successfully employed already in various low and high volume applications. A structure based on MRF might be the next generation in design for products where power density, accuracy and dynamic performance are the key features. This paper presents the state of the art of an actuator with a control arrangement based on MRF technology. The study shows that excellent features like fast response, simple interface between electrical power input and the mechanical power output, and controllability make MRF the next technology of choice for many applications.

Edward J. Park , Dilian Stoikov [2] also studied on MRF system,The aim of this work is to develop a magnetorheological brake (MRB) system that has performance advantages over the conventional hydraulic brake system. The propoimmersed in a MR fluid and enclosed in an electromagnet, which the yield stress of the fluid varies as a function of the magnetic field applied by the electromagnet. The controllable yield stress causes friction on the rotating disk surfaces, thus generating a retarding brake torque. The braking torque can be precisely controlled by changing the current applied to the electromagnet. In this paper, an optimum MRB design with two rotating disks is proposed based on a design optimization procedure using simulated annealing combined with finite element simulations involving magnetostatics, fluid flow and heat transfer analysis.

Kerem Karakoc, Edward J. Park [3] also did research and in this paper, design considerations for building an automotive magnetorheological (MR) brake are discussed. The proposed brake consists of multiple rotating disks immersed in a MR fluid and an enclosed electromagnet. When current is applied to the electromagnet, the MR fluid solidifies as its yield stress varies as a function of the magnetic field applied. This controllable yield stress produces shear friction on the rotating disks, generating the braking torque.

III. CONTENTS OF MR FLUID

Metal powder - Carbonyl iron particles (45%)

Base fluid - Synthetic oil (50%)

Sub additives – Grease and oleate acid (3-5%)

IV. CONSTRUCTION

As per seen in fig. assembly there is a steel rod with 20 mm diameter on which our whole Brake prototype assembly are mounted. There is “c” type face turned circular disc present with 9 mm deep face turn inside having 9 mm, a cover disc present with 1 mm of inside face turn whose thickness same as like “c” type disc i.e 9 mm.

The area available between two disc are 10 mm in which a break disc are placed with a 6 mm thickness and 124 mm diameter. Diameter of outer c-type disc and cover plate 148 mm attached with each other by allen screw of having 5 mm internal thread drilling. These two plates are mounted on steel rod with the help of 41mm outer diameter oil sealed bearing.

Internal rotating brake disc are slotted with 10 mm at 120 degree to each other to improving effect of MR fluid on disc and it also reduced a weight of assembly. Also on side plate there is two small holes are added, one is for filling the oil and other to remove the air from assembly at same time.

Copper winding is placed on outer diameter of circular disc to generate electromagnetic effect inside the disc. We are using 31 gauge copper wire with 2000 number of turns.

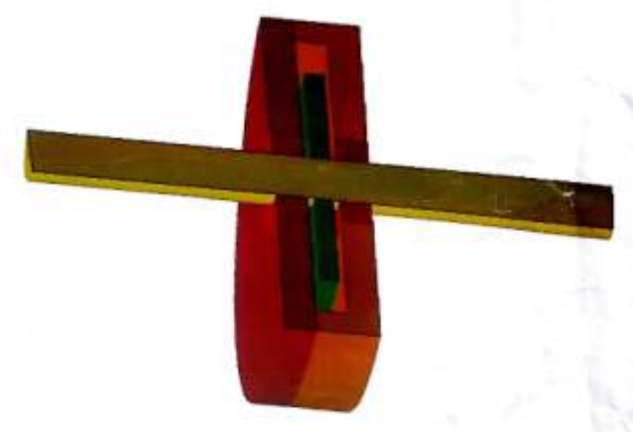

Fig. no.1. Cross-sectional view of the MR brake.

V. WORKING

As per shown in fig. after completing whole assembly we added a M.R. fluid inside a disc with the help of injections and removed air at the same time.

After inserting a fluid inside, we place a brake prototype on a test rig to test how actually it works. As we provide a electric current to winding, a electromagnetic flux are created in between disc and it acts like a electromagnet. This electromagnet make our M.R. fluid semi-solid within a 0.8 to 0.10 Sec. and chain like structure formed which oppose rotary motion of the disc.

When we remove a electrical supply, MR fluid again comes to liquid state and electromagnetic effect get stopped and disc again start to rotate at regular speed.

As effect it create a hurdle to rotate a inside rotating disc because it converts into semisolid and reduce its speed. As speed of rotating disc get reduced, our aim i.e. slower down the rotating disc is completed.

Fig. no 2. MR fluid effect

VI. CONCLUSION

By provision of slots on inside rotating disc we improve the effect of MR fluid on brake. As like conventional brakes there is no any mechanical moving parts like linkages, connecting rods etc. therefore frictional losses get reduced. MR Fluid having excellent features like fast response, simple interference between electrical power input and mechanical power output and controllability make MR fluid the next technology of choice for brake application.

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