

Design and Fabrication of Electro Magnetic Parking Brake for Handicapped Persons

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Abstract— We all know the function of brake is to reduce the speed of vehicle. To do innovation in the same field, we tried to make parking brake using electromagnetic force. This project mainly focuses on the Fabrication of Electromagnetic parking Brake which is operated by electromagnetic force and is entitled as, "Fabrication of Electro Magnetic Parking Brake for Handicapped Persons". The objective of our project is to come up with an Electromagnetic Braking System with EBD prototype that can be operated by the help of solenoid to provide appropriate amount of brake force to each wheel. As well as calculating the amount of brake force, brake torque, clamp force, and other important parameters to analyze the whole process and try to make it efficient for handicapped person.

Keywords— Brake Force, Brake Heat, Brake Power, Brake Torque, Clamp Force, Parking Brake, Rotational Energy.

I. INTRODUCTION

Most commonly brakes use friction to convert kinetic energy into heat, though other methods of energy conversion may be employed. For an example regenerative braking converts the energy into electrical energy, which can be used for further use.

Electromagnetic brakes slow down or stop the vehicle using electromagnetic force which is used to apply mechanical resistance. This concept is popular in the mid-20th century especially for trains and trams where the variety of applications and brake designs has increased; still the basic operation remains the same. Electromagnetic brakes have been used as supplementary equipment which in addition to the regular friction brakes on heavy vehicles. Electromagnetic brakes are those brakes which are working on the electric & magnetic power. They work on the principle of electromagnetism. The working principle of this system is such as when the magnetic flux passes over and perpendicular to the rotating wheels the eddy current will flow in the opposite direction to the rotating wheel direction. This eddy current will try to stop the rotary motion of wheel or rotor which in result the rotary motion wheel or rotor comes to rest.

II. LITERATURE REVIEW

This project mainly focuses on the analysis and design of electromagnetic brakes when coupled with electronic brake force distributor and one major challenge to check the compatibility of electromagnetic braking with EBD they made a separate ECU as per our design and calculation which in testing phase of their project successfully gave proper brake force distribution among two pair of Electromagnetic Brakes and helped them to know about a new way to use EBD except with ABS. ^[1]

In Electromagnetic Braking system the Magnetic force is used to engage the brake, with help of power which is required is transmitted manually. When applied it develops a torque and eventually the vehicle comes to rest. With all the advantages of electromagnetic brakes with friction brakes, this

brake is being widely used on heavy vehicles where the 'brake fading' problem exists. The same concept can also be used for application on lighter vehicles. The concept is just a prototype and needs to be developed more because of the above mentioned disadvantages. While using friction brakes, Electromagnetic Brakes can be used as an auxiliary system to reduce overheating and failure of brakes. ^[2]

A Parking brake is a backup braking system designed to function even when there is total brake failure. It works through mechanical operation and is independent of the other braking system. During the making of this project "Fabrication of Electromagnetic brake" we got a vast information and knowledge about the brake its construction, working and principle and how the brake action takes place. While doing this project we came across various manufacturing process which we learn in books. But due to project we got actual knowledge about the braking system. ^[3]

It is apparent that the electromagnetic brake is an essential complement to the safe braking of heavy vehicles. By using it helps to minimize the failures of brakes and also to avoid accidents. ^[4]

This project helps us to provide new concept design for the Electromagnetic Parking Brake system which has simple and low-cost characteristics. Safe braking is assured in slopes and hill starts with the help of "HOLD" function. ^[5]

This paper represents about minimizing the brake failure in order to avoid the accident and reduces the maintenance of braking system. They discussed about the limitations of drum brakes, hydraulic brakes and pneumatic brakes electromagnetic brake is a better and reliable solution. ^[6]

This experiment is aimed to see the effects of increasing the current induced into electromagnet which will further produce the drag force and at the end will slow down the vehicle. Advantages and Disadvantages of electromagnetic braking system with conventional braking system is as Electromagnetic brakes have higher performance than frictional brakes in high speeds but this can't be used at low speeds so it should be used as an auxiliary brake on high speeds. ^[7]

III. DESIGN AND CALCULATIONS

- Frame of the model (having 7 bars of diameter 65*35 mm and a plate consist of 1.5 mm thickness)
- Frame material (mild steel)
- Battery (dimensions 16.5 x 12.5 x 17.5 cm, weight 7 Kilograms, voltage 12 volts)
- Cable length (Cable Length: 61-1/2 Inch, Jacket Material: Rubber)
- Drum brake (Hub inner diameter -13cm, outer diameter -15cm)(shoe inner diameter -12cm,outer diameter -14cm)
- Total weight (approximately 50kg)
- Wiring
- Push button
- Solenoid (Standard Testing Condition- Ambient Temperature: $20 \pm 2^{\circ}\text{C}$, Relative Humidity: $65 \pm 5\% \text{RH}$, Rated Voltage- As per specification. Pull Force Testing Position- Load pull method with plunger in the vertical position. Testing Power Supply- DC regulated power supply)
- Wheels (4wheels having wheel size of Front:-10 inch, Rear:-10 inch)

Brake Pedal needs to be pressed to slow down the vehicle which will be operated electrically. Like a normal Braking System. Parking Brake operated through an electromagnetic Plunger which will be operated like a solenoid. In steady condition when the handicapped person wants to apply parking brake. It needs to press a single switch which will just pull down the wiring of parking brake through magnetisation by which the parking brake will be engaged. Similarly to disengage the Parking brake the person needs to press the push button again by which the magnetic force will stop generating and parking brake will be disengaged.

This concept is taken for electromagnetic parking brake system so the vehicle needs to withstand at specific angles which are discussed below. These are the results we got by applying the formulas for Brake Force, Brake Torque, Clamp Force, Rotational Energy, Brake Power and Brake Heat which are plotted in the graph.

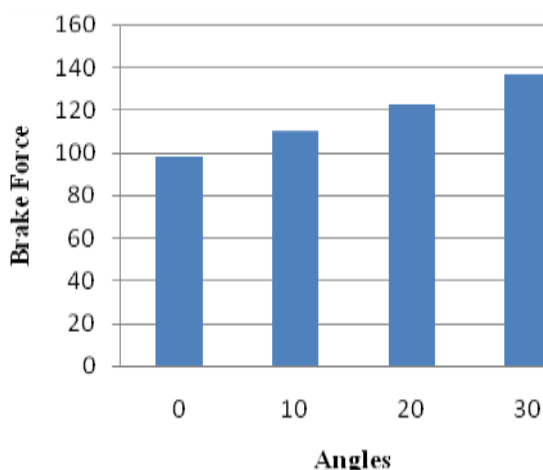


Fig. 3.1. Graph of Brake Force

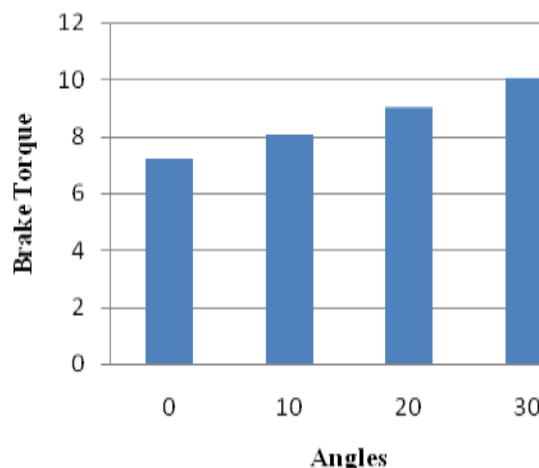


Fig. 3.2. Graph of Brake Torque

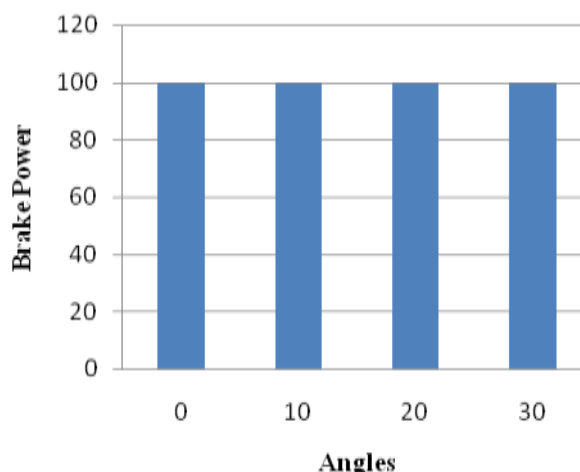


Fig. 3.3. Graph of Brake Power

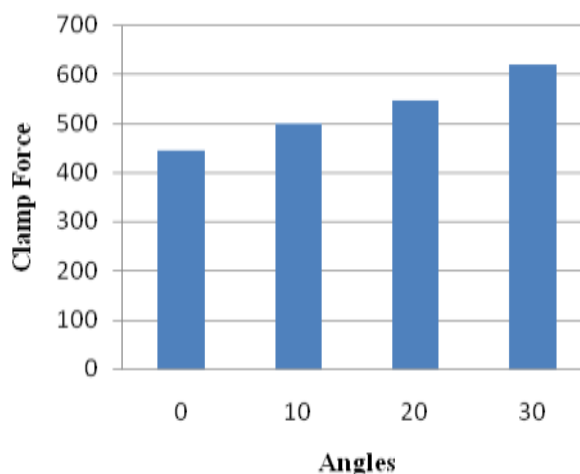


Fig. 3.4. Graph of Clamp Force

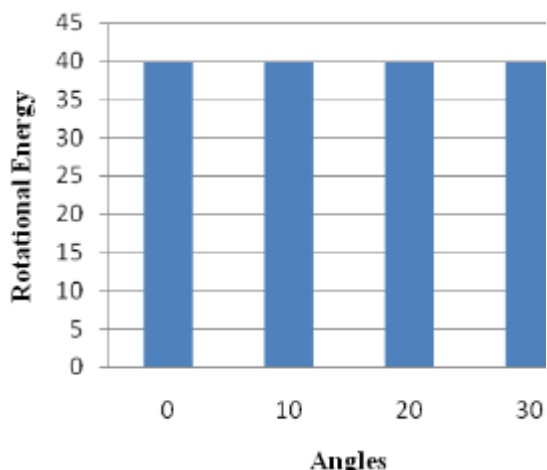


Fig. 3.5. Graph of Rotational Energy

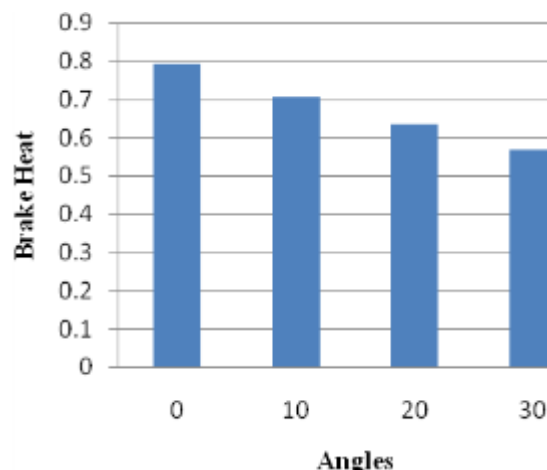


Fig. 3.6. Graph of Brake Heat

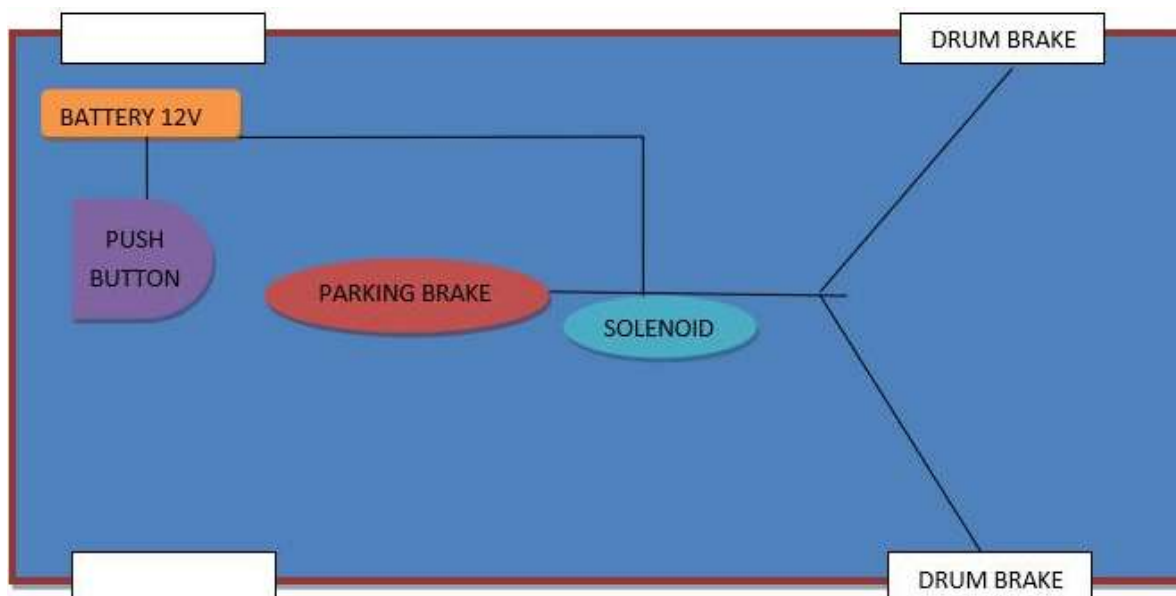


Fig. 3.7. Layout of Electromagnetic Parking Brake for Handicapped Persons

IV. OUTCOME OF THE PROJECT

With all the advantages of electromagnetic parking brakes over friction brakes, they have been widely used on heavy vehicles where the brake fading problem exists. This similar concept has been developed for the application on lighter vehicles. This concept designed by us is just a prototype which needs to be developed more because to solve the above mentioned disadvantages. These electromagnetic parking brakes can be used as an auxiliary braking system along with the friction braking system to avoid overheating and brake failure. The use of these is more in heavy vehicles as on that place heat dissipation is required. Electromagnetic parking brake system is an electric switching system which gives it superior controllability. The installation and construction of an electromagnetic brake is not too difficult. From this, it is apparent that the electromagnetic brake is an attractive complement to the safe braking of light motor vehicles.

V. RESULT AND DISCUSSION

By using the electromagnetic brake as an auxiliary, the use of frictions brakes can be less and therefore it will never reach on high temperatures. The brake linings would also last long, and the potentially “brake fade” problem could be avoided.

In the research which was conducted by a truck manufacturer where this has been proved that the electromagnetic brake assumes 80 percent of the duty which would be demanded for the regular service brake (Reverdin 1974). Moreover, the electromagnetic brake prevents the dangers which can be raised from the continuous use of brakes beyond their capability to dissipate the heat. This mostly happens when a vehicle descending on a long gradient at high speed.

The installation and construction of an electromagnetic brake is not too difficult. It does not need a subsidiary cooling

system. It does not effect the efficiency of the engine. Electromagnetic brake also has better controllability.

Thermal stability of the electromagnetic brakes is being achieved by using the convection and radiation of the heat energy at high temperature. The electromagnetic brakes can dissipate more heat which can increase the life of brakes. Electromagnetic brakes are better than normal frictional brakes as they have high thermal dynamic performance.

Electromagnetic parking brake control system is an electric switching system which gives it superior controllability. The installation of an electromagnetic brake is not too difficult.

From this, it seems clear that the electromagnetic brake is an attractive complement for safe parking brake of vehicles.

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