Enhancement of Electro Magnetic Brakes in Automobiles

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ABSTRCT: The traditional way to change a car's tire is to loosen the lug nuts one by one with the help of wheel spanner. However, it is exhausting and time consuming in car service centers and workshops. Hence, in this project to we are incorporating sun and planetary gear mechanism to remove all 4 lug nuts of the care wheel simultaneously with the help of primary power source. An adjustable Multi-nut remover or tighter for car tire is designed to change a car's wheel by driving a planetary gear mechanism with a single motor in which all 4 lug nuts can be simultaneously be loosened or tightened, the pitch circle diameter for different model and variants of car is adjusted by Four-jaw self centering chuck mechanism. The machine can be used for tightening or loosening of lug nuts of 3 different models of car by using a keypad remote. The machine is expected to be 40% more efficient than the traditional method of loosening or tightening of the lug nuts.

1. INTRODUCTION

Electromagnetic brakes have been used as supplementary retardation equipment in addition to the regular friction brakes on heavy vehicles. The principle of braking in road vehicles involves the conversion of kinetic energy into thermal energy (heat). When stepping on the brakes, the driver commands a stopping force several times as powerful as the force that puts the car in motion and dissipates the associated kinetic energy as heat. Brakes must be able to arrest the speed of a vehicle in a short period of time regardless how fast the speed is. As a result, the brakes are required to have the ability to generating high torque and absorbing energy at extremely high rates for short periods of time. Brakes may be applied for a prolonged period of time in some applications such as a heavy vehicle descending a long gradient at high speed. Brakes must have the mechanism to keep the heat absorption capability for prolonged periods of time. In the electromagnetic brake, the coil or solenoid attracts a steel disc. The steel disc presses a brake disc made of sintered or asbestos material between itself and a stationary steel disc. The torque is thus 'grounded' and braking action takes place. This type of brake is used in machines like lathes, presses etc.

In electro-magnetic braking system electro-magnetic property is used due to this action of braking will be done. In this system, electromagnet iron plate, liners, tension spring, stud, disc brake plate are used. The brake liners are attached with electro-magnet and iron plate individually and both plates insert the disc plate and this plate rigidly attached with wheels. The battery of minimum 12 volt is used for external power supply. Electromagnet consists of wire wound over a soft iron core. When current is passed through the coil, it produces a magnetic field which magnetizes the core into the bar magnet with the polarities. Strong magnetic field is obtained by high currents of large self-induction. High currents are not always feasible, which is why a high self-induction is obtained by making a loop of wire in the shape of a coil, a so-called solenoid. More current and more turns produce a stronger magnetic field which results in stronger electromagnet. When current is switched OFF field disappears and the iron core no longer a magnet. This ability of an electromagnet provides a strong magnetic force of attraction. Shape geometry and material used in construction of electromagnet decide the shape and strength of magnetic field produced by it.

A brake is a device which inhibits motion. Its opposite component is a clutch. Most commonly brakes use friction to convert kinetic energy into heat, though other methods of energy conversion may be employed. For example, regenerative braking converts much of the energy to electrical energy, which may be stored for later use. The brakes are different to use in stopped the reciprocating parts and motion automobile vehicles. The automobile industry is also developed new braking system like to drum brake, disc brake, hydraulic brake, pneumatic brake, air brake and electromagnetic brake. The different brakes are working on different principle operation (1-4). The main principle of electromagnetic brake to induced kinetic energy into heat energy and this type brake mainly working principle is one rotating metal disc in between the two magnets to apply the brake to induced electric current in circuit to induced magnetic field in armature to attract the magnet to the rotating metal disc and stopped the rotation in several time while applied brake. When certain amount of current is passed through a round conductor then it produces magnetic field which is uniform all over the conductor. The magnetic field strength depends on the current flowing 0through conductor and the no of turns and higher the current flowing through conductor higher the magnetic field gets created. Solenoid is the coil having more no of turns and it is used to produce high strength magnetic field which is used in this Electromagnetic Braking.

The main objective of our project is to design and enhance an Electromagnetic Braking in automobiles. Besides the main objective, following are our secondary objectives:

1. To understand project planning and execution.

2. To understand the fabrication techniques in a mechanical workshop.

3. To understand the usage of various mechanical machine tools and also measuring tools.

4. To make day to day human life easier by proper use of technology.

2. METHODOLGOY

The electromagnetic brake is a relatively primitive mechanism, yet it employs complex electromagnetic and thermal phenomena. As a result, the calculation of brake torque is a complex task. The case study of electromagnetic brake is done, and literature survey has been studied. Aluminium and Copper are the preferred materials for the disc due to their electric, thermal, and magnetic properties. 3d CAD model is prepared based on the required dimensions. Different electromagnets and different air gaps for the electromagnets were taken for purpose of comparison and design of experimentation. Maximum Braking torque, Maximum Braking force and Stopping Distance were calculated. Design of electromagnetic braking system is done based on the calculations.

2.1 Materials Selection:

The material of the rotor disc must also be optimized to minimize the time constant, τ and minimize the disc's moment of inertia, I. There are two strong candidates in our selection of material which are copper and aluminium. This evaluation is based on the qualitative result of Equation. To minimize the time constant, we must choose the smallest ratio of density, ρ to conductivity, σ from all the materials available. We have evaluated the ratios for a few possible commercial materials. We find that copper and aluminium rank top.

2.2 Selection of Disc Thickness

The thickness of the rotor disc, d, must also be optimized in order to minimize the time constant, τ and minimize the disc's moment of inertia, I. The inertia of the disc is linearly proportional to the thickness, so minimizing the disk radius minimizes the disk inertia. The time constant does not depend on the disc thickness. Thus, the optimization problem reduces to minimizing disc thickness while maintaining enough structural rigidity (4).

Flow Chart

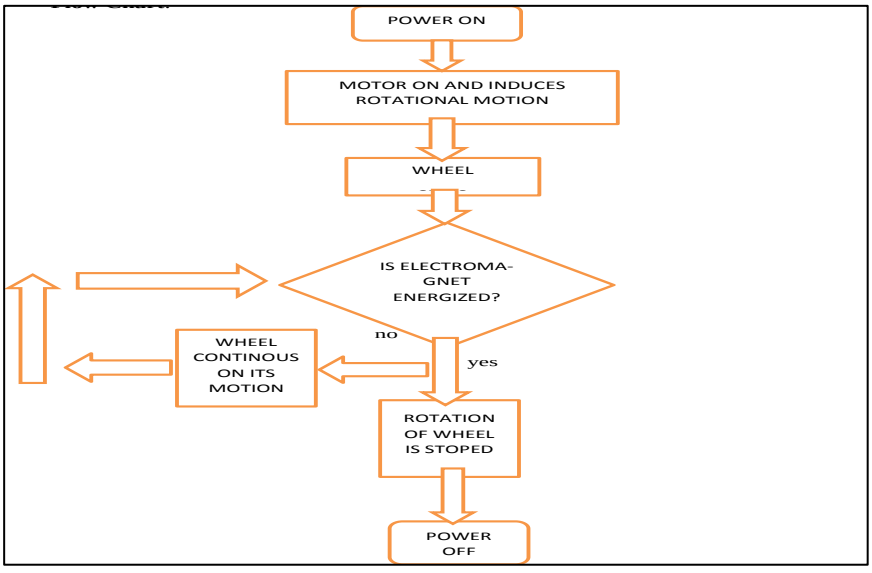

Figure1. Flow Chart for Working of Electro Magnetic Brakes

Disc Radius

The radius of the rotor disc, R, must also be optimized to minimize the time constant, τ and minimize the disc's moment of inertia, I. The inertia of the disc is proportional to the radius to the fourth power, so minimizing the disk radius minimizes

the disk inertia. The functionality of the time constant on the disc radius is not as clear. Equation that the time constant is proportional to the radius squared, however the magnetic flux, ϕ(R), is also a function of the disc radius because the larger the radius the more magnets can be mounted and thus the stronger the magnetic field. This functionality of the magnetic field on the disc radius is unknown and may only be evaluated experimentally (4).

Figure2. Disc

Components Required:

The components required are

- Electric Motor
- Power supply
- Wheel
- Electromagnet
- Disc Plate
- Bearing
- Spring
- Solenoid Coil

Spring

A coil spring, also known as a helical spring, is a mechanical device which is typically used to store energy and subsequently release it, to absorb shock, or to maintain a force between contacting surfaces. : Two compression springs are used to push back the brake shoe back in its position.

Figure 3. Spring

Bearing

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves this by using at least three races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly (e.g., a hub or shaft). As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling they have a much lower coefficient of friction than if two flat surfaces were sliding against each other.

Figure 4. Bearing

Electromagnet

An electromagnet is a type of magnet in which the magnetic field is produced by an electric current. Electromagnets usually consist of wire wound into a coil. A current through the wire creates a magnetic field which is concentrated in the hole in the center of the coil. The magnetic field disappears when the current is turned off. The wire turns are often wound around a magnetic core made from ferromagnetic or ferrimagnetic material such as iron; the magnetic core concentrates the magnetic flux and makes a more powerful magnet. The main advantage of an electromagnet over a permanent magnet is that the magnetic field can be quickly changed by controlling the amount of electric current in the winding. However, unlike a permanent magnet that needs no power, an electromagnet requires a continuous supply of current to maintain the magnetic field.

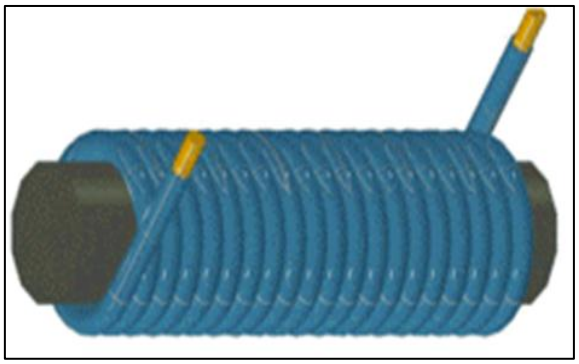

Figure 5. Electromagnet

Electric Motor

An Electric motor is an electrical device that converts electrical energy into mechanical energy. In normal motoring mode, most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. Electric motors may be classified by electric power source type, internal construction, application, type of motion output, and so on.

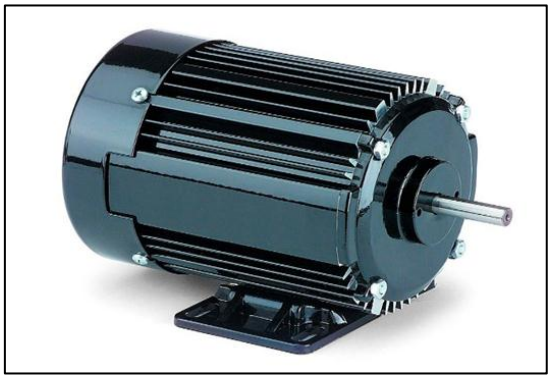

Figure 6. Motor

Wheel

Wheel gets in motion with the help of running motor. Both motor and wheel is connected with the help of connecting chain and chain ring.

Power control

This division consists of power supply to whole system and a separate power control system to control the motion of motion.

3D CAM Model

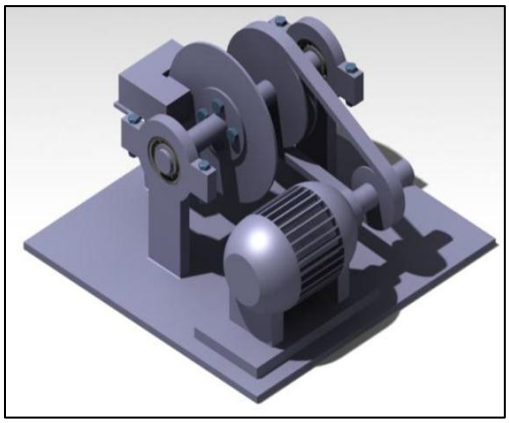

Figure 7. 3D Model

Calculations

Breaking Torque

$V = \Pi * d * N/60$ (m/sec)

$A = (v-u)/t$ (m/sec^2)

$F = m*A$ (N)

Braking force

$T = (Fx\ 0.5d)/R$ (NM)

Breaking Power:

$KE = 0.5 \times m \times v^2$

3. RESULTS

By using the electromagnetic brake as supplementary retardation equipment, the friction brakes can be used less frequently, and therefore practically never reach high temperatures. The brake linings would last considerably longer before requiring maintenance, and the potentially "brake fade" problem could be avoided. In research conducted by a truck manufacturer, it was proved that the electromagnetic brake assumed 80 percent of the duty which would otherwise have been demanded of the regular service brake (Reverdin 1974). Furthermore, the electromagnetic brake prevents the dangers that can arise from the prolonged use of brakes beyond their capability to dissipate heat. This is most likely to occur while a vehicle descending a long gradient at high speed. The installation of an electromagnetic brake is not very difficult. It does not need a subsidiary cooling system. It does not effect on the efficiency of engine. Electromagnetic brake also has better controllability. Thermal stability of the electromagnetic brakes is achieved by means of the convection and radiation of the heat energy at high temperature. The electromagnetic brakes have excellent heat dissipation efficiency. Electromagnetic brakes have better thermal dynamic performance than regular friction brakes.

This report presents the performance of an electromagnetic braking system which includes various components with its cost effectiveness and efficient methodologies to utilize the supplied energy.

With the application of the effective and strong electromagnet we can have greater efficient braking system.

In addition, it is found that electromagnetic brakes make up approximately 80% of all of the power applied brake applications.

4. DISCUSSION AND CONCLUSION

Electromagnetic braking system is found to be more reliable as compared to other braking systems. In oil braking system or air braking system even, a small leakage may lead to complete failure of brakes. While in electromagnetic braking coils and firing circuits are attached individually on each wheel, even any coil fails the brake does not completely fails remaining three coil works properly. And this system needs very little of maintenance. In addition, it is found that electromagnetic brakes make up approximately 80% of all of the power applied brake applications. Electromagnetic brakes have been used as supplementary retardation equipment in addition to the regular friction brakes on heavy vehicles. The frictions brakes can be used less frequently and therefore practically never reach high temperatures. The brake linings would last considerably longer before requiring maintenance and the potentially ―brake fade problem could be avoided. This enhanced braking system not only helps in effective braking but also helps in avoiding the accidents and reducing the frequency of accidents to a minimum. Furthermore, the electromagnetic brakes prevent the danger that can arise from the prolonged use of brake beyond their capability to dissipate heat.

Electromagnetic brakes have numerous preferences over frictional slowing mechanism. The blend of swirl present and attractive powers makes this brake more successful. This brake can be utilized as assistant stopping mechanism in vehicle. The utilization of abs can be dismissed by utilizing a smaller scale controlled electromagnetic framework. It can be utilized as a part of rail mentors to decelerate the prepare moving in fast. Mix of these brakes expands the brake life and act like completely stacked brakes. These brakes can be utilized as a part of wet condition, so there is no utilization of against slipping instrument. It is completely electrically controlled which brings about less mishaps. The braking power delivered in this brake is not as much as the plate brakes. Subsequently, it can be utilized as an auxiliary or crisis slowing mechanism in the autos.

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