

# Electromagnetic Braking System

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**Abstract**— In this paper we had develop the electromagnetic braking system. Braking System should ensure the safety and comfort of the passenger, driver and other road user. The brake must be strong enough to stop the vehicle during emergency within shortest distance. The congenital braking system are bulky and power to weight ratio is low. Electromagnetic braking system is high-tech braking system find its use in small & heavy vehicle like car, jeep, truck, busses etc. This paper represent about minimizing the brake failure in order to avoid the accident. It also reduces the maintenance of braking system. The effectiveness of brake should remain constant. The proper cooling of brake gives anti fade character and efficient operation of brake. Proper lubrication and maintenance must be done to operate brake safe, effective and progressive with minimum fatigue to driver. This system provides better response time for emergency situations and in general keeps the friction brake working longer and safer.

**Keywords:** Brake, Electromagnetism, Brake power, Torque

## I. INTRODUCTION

Electromagnetic brakes have been used as supplementary retardation equipment in addition to the regular friction brakes on heavy vehicles. We outline the general principles of regular brakes and several alternative retardation techniques in this section. The working principle and characteristics of electromagnetic brakes are then highlighted. 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 have to 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 [1-4]. 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, electro magnet 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 plate 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. The recent studies on solar system are presented [5-11].

## II. CONSTRUCTION

The electromagnet brake has two sections primarily; they are calliper and specially crafted rotor made of aluminium. Electromagnet and neodymium lasting magnets are set on callipers and rotor separately. Current is given to electromagnet through current source. Electromagnets in calliper and rotor can be settled by blasting, riveting or by high quality pastes (cyanoacrylates, polyurethane). In rotor changeless magnet are fitted in its fringe surface at a point. The electromagnets in caliper which are confronting opposite to electromagnets in rotor. There is additionally one all the more exceptionally solid electromagnet which is utilized for creating swirl current in aluminum rotor.



Fig. 1: Wheel with electromagnetic brakes



Fig. 2: Electromagnetic braking arrangement

### III. WORKING

Electromagnetic brake chips away at the rule of electromagnetism. They are absolutely contact less. Because of this they have longer life expectancy and solid. Less upkeep is required in these brakes. It can be utilized as supplementary brakes and can likewise use to quits turning shafts of high-rev machines in enterprises.

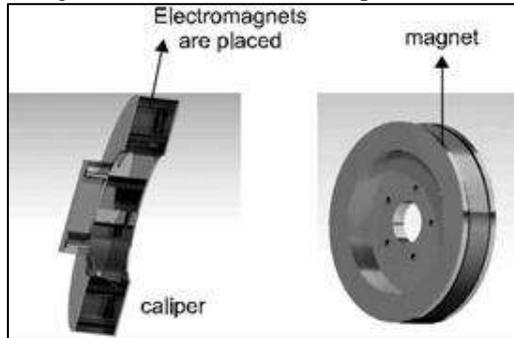


Fig. 3: Electromagnetic braking disc

This brake utilizes both swirl current and fascination power of magnet to stop vehicle. Swirl current is utilized to hinder the vehicle while attractive power is accustomed to convey vehicle to rest. This braking depends on fascination property of magnets. So when the rotor moves between the caliper, the electromagnets in the caliper pull in the lasting magnet in rotor. Since, electromagnets in caliper are settled; they endeavour to turn the rotor inverse way i.e. decelerating it. The deceleration is finished by expanding attractive field by expanding current supply to the electromagnets. The present supply for electromagnets in calliper is finished by wiring through calliper to battery. The centre segment of rotor has structure like round thick plate and solid electromagnet is put before it. The leeway between rotor center part and electromagnet is less. While driving an auto, solid electromagnet situated before rotor center bit is turned on, along these lines shaping an attractive motion. This attractive motion is oppositely brought into rotor. A vortex current is in this manner incited in the tweaked rotor because of the Faraday's law. A Lorentz compel is created by the relative activity between the swirl current and the attractive transition, in this manner framing a braking torque. Vortex current does not decelerate vehicle at low speed. That's why anticipated brake is blend of both attractive power and swirl current.

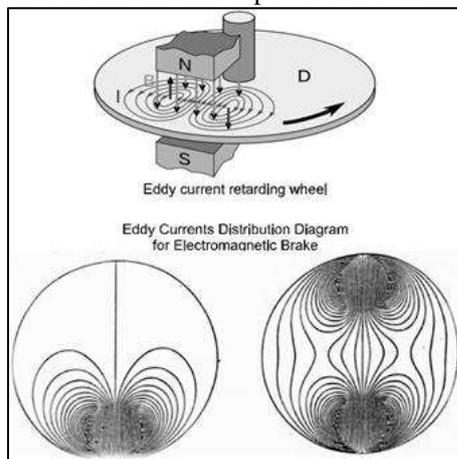


Fig. 4: Eddy current retarding wheel and eddy current distribution

### IV. CALCULATIONS

A. Force at wheel lock or maximum braking force can be calculated by following:

$$FL = Mdal \times g \times ur$$

FL = possible braking force on axle

Mdal = dynamic axle load

g = acceleration due to gravity

ur = coefficient of friction between road and tire

B. Braking torque require to stop wheel

$$T = BF \times R/r$$

BF = Braking force

T = brake torque

R = radius of tire

r = speed ratio between the wheel and brake

C. Braking force obtained by eddy current

$$Fe = \pi \times D^2 \times d \times B0^2 \times c \times v/4\rho$$

$$c = \frac{1}{2} [1 - (1/4) * 1/(1 + r/A)^2 (A - r/D)^2]$$

Fe = braking force (N)

D = diameter of soft iron pole (m)

d = disk thickness

B0 = air gap induction at 0 speed (T)

A = disk radius (m)

c = proportionality factor, ratio of total disk contour (outward curve) resistance to resistance of disk contour (outward curve) part under pole.

v = tangential speed of the rotating disk

$\rho$  = specific resistance of disc material.

### V. ADVANTAGES

- No grating misfortune.
- Less warmth misfortune.
- Less wear of segments.
- Fully electronically controlled.
- Great braking proficiency potential to recover vitality lost in braking.
- Potential to recapture vitality lost in braking.
- Potential danger of tire crumbling and blasts because of grinding is disposed of.
- No need to change brake oils consistently.
- No oil spillage.
- Problem of brake liquid vaporization and solidifying is dispensed with.
- Less support cost.
- Longer life traverse contrasted with ordinary brakes.
- Can be utilized as a part of industry to stop or decelerate turning parts.
- No need of abs.

### VI. CONCLUSION

As we discussed about the limitations of drum brakes, hydraulic brakes and pneumatic brakes electromagnetic brake is a better and reliable solution. Electromagnetic brake control system is an electric switching system which gives it superior controllability. The installation of an electromagnetic brake is not very difficult. From the foregoing, it is apparent that the electromagnetic brake is an attractive complement to the safe braking of heavy vehicles.

Good results with current design, a larger budget would improve performance.

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