

Electromagnetic Braking System

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Abstract - This paper centers around utilization of electromagnetic power to stop vehicle. An Electromagnetic Braking structure uses Magnetic power and what's more turn current to attract the brake, however the power required for braking is transmitted through current source. The circle (rotor) is associated with a pole and the electromagnet is mounted on the caliper and lasting magnet is intertwined or mounted on plate at an edge. Exactly when control is associated with the twist an appealing field is created over the armature because of the present gushing over the circle and influences armature to get pulled in towards the twist. Because of fascination between magnets in calipers and circle, it builds up a torque which restricts the movement of rotor and in the long run the vehicle stops and furthermore, whirlpool current is produced on the plate when exceptionally quality magnet is set close to the moving circle. Swirl current created in the plate build up their own attractive field which contradicts the connected attractive field. In this manner, rotor or circle stops by torque created because of resistance of attractive field i.e. (of provided and vortex current's attractive field). Along these lines, this brake utilizes both attractive power and also whirlpool current to connect with brake. These brakes can be joined in substantial vehicles and auto as an assistant brake. The electromagnetic brakes can be utilized as a bit of business vehicles by controlling the current provided for make the engaging development. Making a few upgrades in the brakes it can be utilized as a part of vehicles in future.

Keywords:- Electromagnet, auxillary brake , contact less braking, Friction, Eddy Current.

1. INTRODUCTION

New advances are landing in this world. Numerous enterprises got profited because of the entry of these new innovations. A vehicle industry is one of them. As brake is an essential piece of car innovation, there are developments in brakes as well. The generally utilized brakes in cars are drum and circle brakes. Different sorts of slowing mechanism utilized are pressure driven, pneumatic and so forth. Electromagnetic braking is an imaginative innovation and furthermore frames the premise of developing innovation. Slowing mechanism is for the most part grouped by their strategy for task. The two noteworthy kinds of brake are frictional and electromagnetic retarder. The brake

is a mechanical gadget which includes the change of dynamic vitality into warm vitality (warm) by halting vehicle in a movement. While braking power is connected by brake to hinder the movement of vehicle bunches of motor vitality is disseminated as warmth vitality. Essential capacity of Brakes is to moderate the speed of a vehicle in a brief span regardless of speed. Therefore, the brakes are required to be able to creating high torque and engrossing vitality at to a great degree high rates for brief timeframes. Brakes might be connected for a more extended timeframes in a few applications, for example, an overwhelming vehicle dropping in an incline at rapid. Brakes must have the capacity to keep the warmth retention for delayed timeframes. The recurrence of mischances is currently a-days expanding because of wasteful stopping mechanism. Henceforth stopping mechanism should be improved for powerful and productive braking.

Electromagnetic brake is as new idea. It is discovered that electromagnetic brakes can build up a power which is almost double the most extreme power yield of a normal motor, and no less than three times the braking energy of a fumes brake to stop vehicle. These exhibitions of electromagnetic brakes make them substantially more focused possibility for elective hindrance hardware's contrasted and different retarders. This examination work expects to limit the brake inability to stay away from the street mischances. It additionally diminishes the support of stopping mechanism. Preference of this framework is that it can be utilized on any vehicle and is grating less method of braking.

2. CONSTRUCTION

The electromagnet brake has two sections primarily; they are caliper and specially crafted rotor made of aluminum. Electromagnet and neodymium lasting magnets are set on calipers and rotor separately. Current is given to electromagnet through current source. Electromagnets in caliper 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

3. 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-review machines in enterprises.

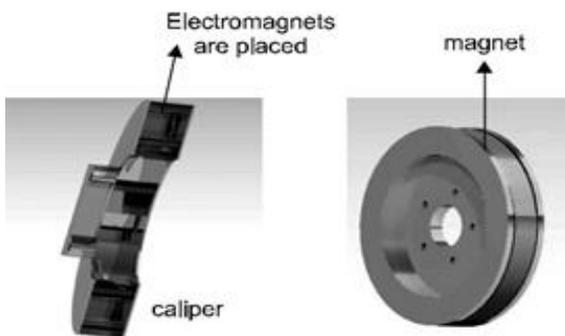


Fig-3: Electromagnetic braking disc

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 endeavor 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 caliper is finished by wiring through caliper to battery. The center 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.

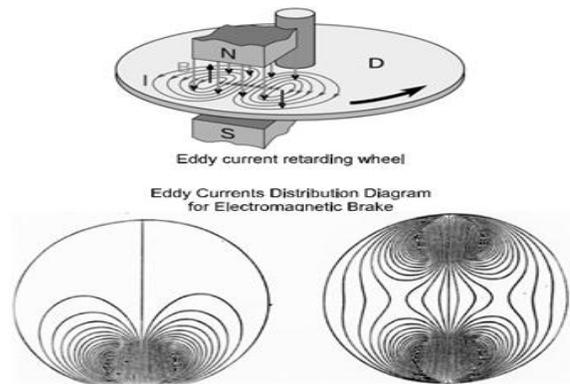


Fig-4: Eddy current retarding wheel and eddy current distribution

4. CALCULATIONS

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

$$F_L = M_{dal} \times g \times u_r$$

F_L = possible braking force on axle

M_{dal} = dynamic axle load

g = acceleration due to gravity

u_r = coefficient of friction between road and tire

2. Braking torque require to stop wheel

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

B_F = Braking force

T = brake torque

R = radius of tire

r = speed ratio between the wheel and brake

3. Braking force obtained by eddy current

$$F_e = \pi e \times D^2 \times d \times B_0^2 \times c \times v/4\rho$$

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

F_e = braking force (N)

D = diameter of soft iron pole (m)

d = disk thickness

B_0 = 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

ρ = specific resistance of disc material.

5. 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.

6. CONCLUSION & FUTURE SCOPE

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.

7. REFERENCES

- Schmid, Hamrock and Jacobson, "Fundamental of Machine Elements , 3rd Edition" chapter 18.
- Ming Qian Pushkin Kachroo, Modeling and control of electromagnetic brakes for enhanced braking capabilities for automated highway systems.
- Akshyakumar S.Puttewar¹, Nagnath U. Kakde², Huzaifa A. Fidvi³, Bhushan Nandeshwar⁴, "Enhancement of Braking System in Automobile Using Electromagnetic Braking".
- Sevvell P1, Nirmal Kannan V2, Mars Mukesh S3, "Innovative Electro Magnetic Braking System".
- G.L. Anantha Krishna, K.M. Sathish Kumar, "Investigation on Eddy Current Braking Systems – A Review", Applied Mechanics and Materials, Vols 592-594, pp. 1089-1093, Jul. 2014.
- SUN Jingting, SHI Shicai ,CHEN Hong, LIU Hong (State Key Laboratory of Robotics and System, Harbin Institute of Technology, Harbin 150080,China).