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Design and development of Electro Magnetic Braking System

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***Abstract*: An Electromagnetic Braking system utilizes Magnetic drive to connect with the brake, however the power required for braking is transmitted physically. The disc is associated with a shaft and the electromagnet is mounted on the edge .When power is connected to the curl(coil) a magnetic field is produced over the armature as a result of the present streaming over the loop and makes armature get pulled in towards the coil. Thus it builds up a torque and in the end the vehicle stops. In this venture the upside of utilizing the electromagnetic stopping mechanism in car is considered. These brakes can be consolidated in substantial vehicles as an assistant brake. The electromagnetic brakes can be utilized as a part of business vehicles by controlling the current provided to deliver the attractive flux. Making a few enhancements in the brakes it can be utilized as a part of automobiles in future.**

Keywords: Peak Force, Fade, Drag, Flux, Electro Magnet

I. INTRODUCTION

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.

II. PRINCIPLE OF BRAKING SYSTEM

A brake is a gadget which represses movement. Its inverse part is a clutch. Most usually brakes utilize friction to change over active kinetic energy into heat, however different strategies for energy transformation might be utilized. For instance regenerative braking changes over a significant part of the energy to electrical energy, which might be put away for later utilize.

III. EXISTING CONDITION

A. Brake fading impact:

The regular rubbing brake can ingest and change over gigantic energy values (25h.p. without self-obliteration for a 5-pivot truck, Reverdin1974), yet just if the temperature ascent of the friction contacts materials is controlled. This high energy transformation along these lines requests a fitting rate of heat dispersal if a sensible temperature and execution soundness are to be kept up.

B. Brake liquid leakage

In the event that your vehicle has worn brake pads or brake shoes, the liquid level in your brake liquid repository will be low. Be that as it may, suppose you have moderately new brake pads and you as of late finished off your brake repository just to see a couple days after the fact that the liquid level has dropped detectable. If that's the case that is the situation, it's a decent wagered you have a break some place in your slowing mechanism - which implies that you likely have greater brake issues than something as basic as worn brake cushions.

C. Other real problems

Furthermore, different issues incorporate the brake liquid vaporization and brake liquid solidifying however vaporization happens just in uncommon cases. Solidifying is very regular in colder spots like Scandinavian nations and Russia and so on… … where the temperature comes to as low as - 50°C to−65°C, in such cases there is a requirement for some hostile to solidifying specialists and builds the multifaceted nature and cost of the system.

IV. WORKING PRINCIPLE

A. Electromagnetism

Electromagnetism is one of the four principal collaborations in nature. The other three are the solid cooperation, the frail association and attraction. Electromagnetism is the constrain that causes the communication between electrically charged particles; the zones in which this happens are called electromagnetic fields

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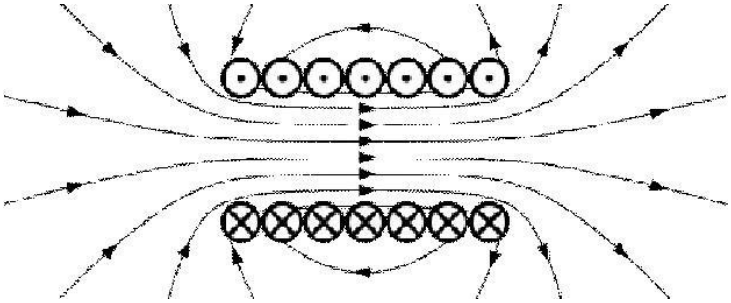

Fig. 1 Magnetic Field Line

B. Magnetic Effect of Current

The expression "Magnetic effect of current" implies that "a current flowing in a wire delivers an Magnetic field around it". The Magnetic impact of current was found by Oersted in 1820. Oersted found that a wire conveying a current could avoid an Magnetic needle

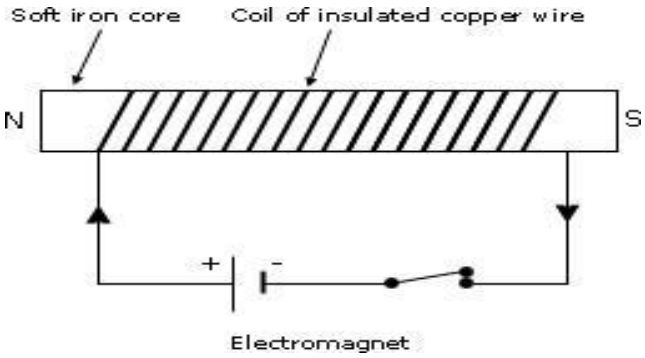

Fig. 2 Magnetic Field Lines

C. Factors affecting strength of an Electromagnet

The nature of an electromagnet is:

- Directly corresponding to the quantity of turns in the loop.
- Directly proportional to the current flowing in the coil.
- Inversely proportional to the length of air gap between

By and large, an electromagnet is frequently viewed as superior to a perpetual magnet since it can create exceptionally solid attractive fields and its quality can be controlled by fluctuating the quantity of turns in its curl or by changing the present moving through the loop.

V. CONSTRUCTION

The parts of Electromagnetic Disc Brake are:

- AC Motor
- Disc
- Frame
- Electromagnet
- Pulleys & Belt
- shaft

A. AC MOTOR

An AC motor is an electric motor driven by an alternating current. It commonly consists of two basic parts, an outside stationary stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft that is given a torque by the rotating field. Where speed stability is important, some AC motors (such as some past motors) have the stator on the inside and the rotor on the outside to optimize inertia and cooling

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Fig.3 Photographic View of an AC Motor

Fig .4 electromagnetic

B. FRAME

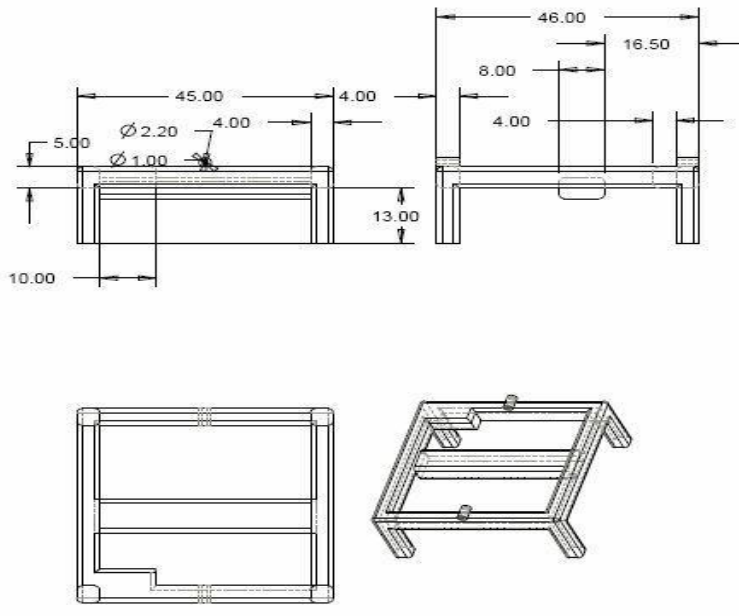

Fig.5 Diagrammatic Representation of the Frame using Pro E Software

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C. Electromagnet

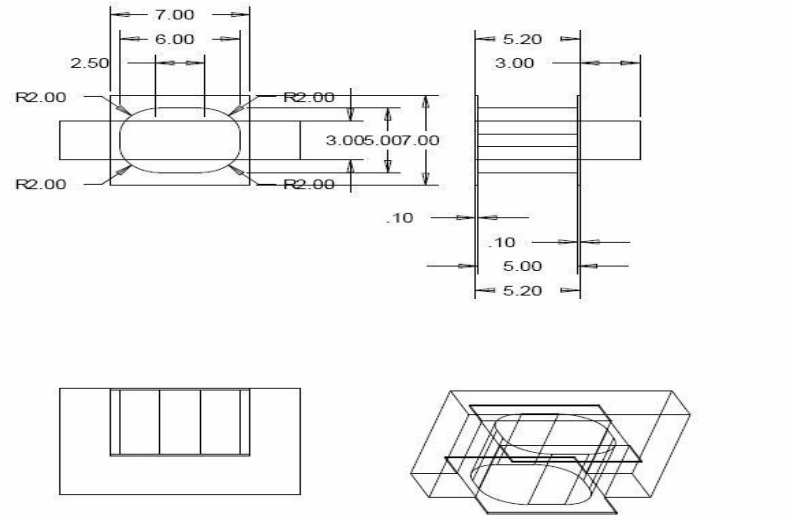

Fig.6 Diagrammatic Representation of the Electro Magnet using Pro E Software

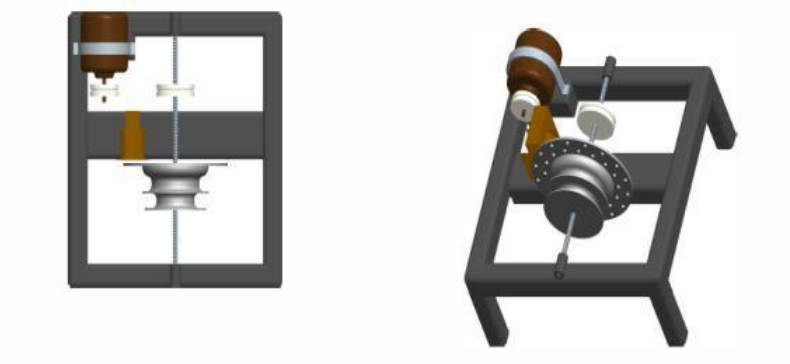

Fig.7 Assembled View of the Electro Magnetic Braking System using Pro E Software

VI. DESIGN CALCULATIONS

Centre distance between the pulleys= .24 m=C
Diameter of the driving pulley = .085 m=d
Diameter of the driven pulley = .05 m=D
Speed of the driving pulley = 1800 rpm=N1
Material of the belt = fabric
Material of the pulley = plastic

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A. Determination of speed of the driven pulley

$n_1 d = n_2 D$

$$i = \frac{n1}{n2} = \frac{D}{d}$$

$$N2 = \frac{D}{d} * N1$$

$$N2 = \frac{.085}{.05} * 1800$$

$$= 3060 \text{ rpm}$$

B. Checking for centre distance:

"The centre distance between the two pulleys must be greater than the average value of the diameters of both the pulleys."

$$C \geq \frac{D+d}{2}$$

$$\frac{D+d}{2} = \frac{.085+.05}{2} = .07\text{m}$$

$$C = .24 \text{ m}$$

Therefore $C \geq \frac{D+d}{2}$

C. Arc of Contact:

$$\text{Arc of contact} = 180^0 - \frac{D-d}{C} X\ 60^o$$

$$= 180^0 - \frac{.085-.05}{.24} X\ 60^o$$

$$= 172^0$$

D. Length of the Belt:

$$L_o = 2C + \frac{\pi}{2}(D+d) + \frac{(D-d)^2}{4C} \text{ (opendrive)}$$

$$= 2 * .24 + \frac{\pi}{2}(.085 + .05) + \frac{(.085 - .05)^2}{4 * .24}$$

$$= .6933 \text{ m/s}$$

E. Actual Length of the Belt:

$$= L - [1\% \text{ of } L]$$

$$= .6933 - [.01 * .6933] = .6240 \text{ m}$$

VII. THERMAL DYNAMICS

Thermal stability of the electromagnetic brakes is accomplished by methods for the convection and radiation of the heat energy at high temperature. The estimation of the energy disseminated by the fan can be figured by the accompanying expression:

$$Q\ MCp = Dq$$

Where M = Mass of air circulated;
Cp = Calorific value of air;
Dq = Difference in temperature between the air entering and the air leaving the fan;

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VIII. WORKING OF ELECTROMAGNETIC DISC BRAKE

The electromagnet is stimulated by the AC supply where the magnetic field delivered is utilized to give the braking system. At the point when the electromagnet is not stimulated, the pivot of the disc is free and quickens consistently under the activity of weight to which the shaft is associated. When the electromagnet is energized, magnetic field is produced thereby applying brake by retarding the rotation of the disc and the energy absorbed is appeared as heating of the disc. So when the armature is attracted to the field the stopping torque is transferred into the field housing and into the machine frame decelerating the load. The AC engine makes the disc to pivot through the shaft by methods for pulleys associated with the shaft.

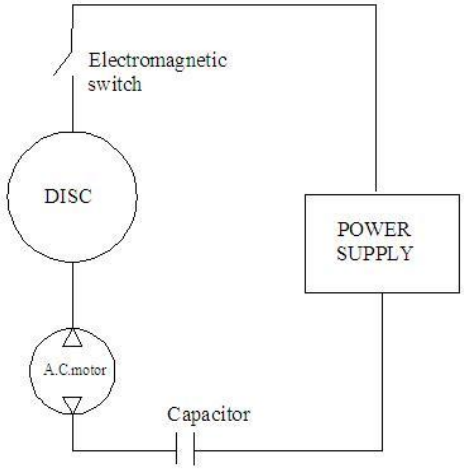

Fig.8 Working of Electro Magnetic Disc Brake

A. Engagement Time

There are really two engagement times to consider in an electromagnetic brake. The first is the time it takes for a loop to build up an magnetic field, sufficiently solid to pull in an armature. The second one is air hole, which is the space between the armature and the loop shell. Computer aided design systems can consequently figure part latency, however the way to measuring a brake is ascertaining how much inertia is reflected back to the brake.

To do this, engineers use the formula: $T = (WK2 \times \Delta N) / (308 \times t)$ Where T = required torque in lb-ft, WK2 = total inertia in lb-ft2, ΔN = change in the rotational speed in rpm, and t = time during which the acceleration or deceleration must take place.

B. ASSEMBLED MODEL

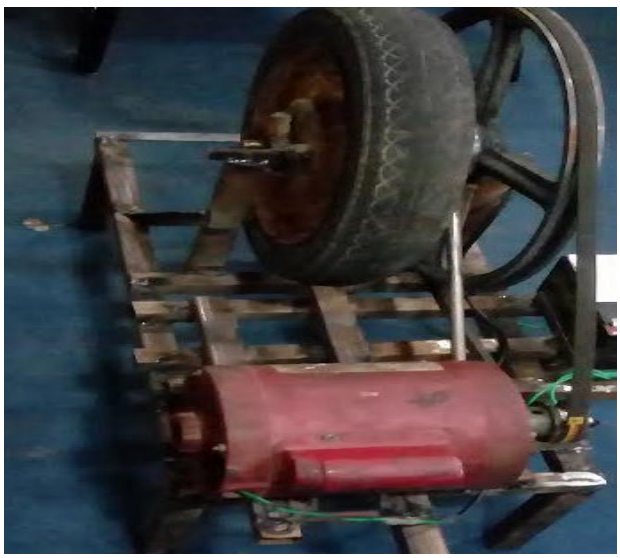

Fig 9 Front View of the Fabricated Brake System

Fig 10 .Top view of the Fabricated Brake System

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IX. CONCLUSION

With every one of the upsides of electromagnetic brakes over grating brakes, they have been generally utilized on overwhelming vehicles where the 'brake fading' issue exists. A similar idea is being created for application on lighter vehicles. The concept designed by us is just a prototype and needs to be more developed. These electromagnetic brakes can be used as an auxiliary braking system along with the friction braking system to avoid overheating and brake failure. ABS use can be ignored by just utilizing a smaller scale controlled electromagnetic plate slowing mechanism .These find endless applications in overwhelming vehicles where high warmth (heat) dissemination is required. In rail mentors it can utilized as a part of mix of plate brake to acquire the trains moving rapid. When these brakes are combined it increases the life of brake and act like fully loaded brakes. These electromagnetic brakes can be used in wet conditions which eliminate the anti-skidding equipment, and cost of these brake are cheaper than the other types. Consequently the braking power created in this is not as much as the plate brakes if can be utilized as an optional or crisis slowing mechanism in the vehicles.

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