International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

Introduction to Electromagnetic Braking System

Shreya Bharti[1], Mrinal Anand[2]

[1]*Shreya Bharti, B.Tech (ECE), Amity University, Uttar Pradesh, India*
[2]*SMrinal Anand, B.Tech (ME), Amity University, Uttar Pradesh, India*

Abstract - *This paper go-round the use of electromagnetic scope to stop or hold the motion of the vehicle. An Electromagnetic Braking system make use of magnetic force and current to stop the motion, the applied voltage or current creates magnetic force which draw in the brakes which further stop the motion of the vehicle that is the rotatory motion. Major number of electromagnetic brakes makes use of single friction surface while there are multiple disc designs also which functions in a similar manner as the single friction surface brakes does. The prime elements of it consist of field coil, armature and hub. As told earlier the electromagnetic brake works over electric whim but torque is produced mechanically, whenever the voltage and current is applied on the brakes the coil becomes electromagnet and produces magnetic lines of flux, these flux lines travel through small gap between field coil and armature and thus it magnetically pulls the armature against the hub which holds the brake. When the current and voltage is removed from the brakes the spring holds back the armature from hub surface creating a small air gap. Electromagnetic brakes participated in considerable vehicles and auto as an associate brake. The electromagnetic brakes can be used as a touch of business vehicles by controlling the current accommodated make the connecting with improvement. Causing a couple of redesigns in the brakes it to can be used as a piece of vehicles in future.*

***Key Words*: Electromagnetic, friction, flux, torque, armature, hub.**

1. INTRODUCTION

Latest advancements are arriving everyday or other. Various ventures got benefitted in light of these new developments such as vehicle industry or food and packaging industry. As brake is a basic bit of vehicle advancement, there are improvements in brakes also. The large used brakes in vehicles are drum and circle brakes. Various sorts of easing back instrument used are pressure driven, pneumatic, etc. Electromagnetic braking is an inventive advancement and moreover outlines the reason of creating development. The two imperative sorts of brake are frictional and electromagnetic retarder. The brake is a mechanical tool which ends the movement of vehicle in a development. While braking power is associated by brake to upset the development of vehicle lots of engine essentialness is dispersed as warmth imperativeness. Fundamental limit of Brakes is to direct the speed of a vehicle in a short range paying little heed to speed. In this way, the brakes are required to have the option to making high torque and fascinating imperativeness at to extraordinary degree high rates for brief time allotments. The repeat of incidents is at present a-days extending as a result of inefficient halting instrument. Hereafter halting instrument ought to be improved for ground-breaking and profitable braking.

2. PARTS OF EM BRAKES

There are three imperative parts of EM brakes field coil, an armature and hub.

The coil has north and south post. In the event that a bit of iron reached the two poles and magnetic connection is made. At the point when power is applied a magnetic field is made this field (motion) defeats the air hole among field and the armature. This magnetic fascination pulls the armature in contact with the brake field face. The erosion and the quality that is strength of the magnetic field, is the thing that makes the rotational movement stop. Practically the entirety of the torque originates from the magnetic force and coefficient of friction between the steel of the armature and the steel of the rotor or brake field. The material is for the most part used to help decline the wear rate. Be that as it may, various kinds of material can likewise be utilized to change the coefficient of erosion for exceptional applications. Copper (in some cases aluminum) magnet wire used to make the loop/coil which is held in the shell either by a bobbin or by glue. For most modern brakes, friction material is then set over the loop and is set between the inward and external poles. The material is flush with the outside of the brake since you need to have metal to metal contact between the coil shell and the armature.

Fig-1: EM brake front view

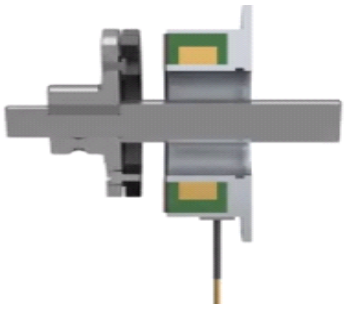

Fig-2: EM brake side cross-sectional view

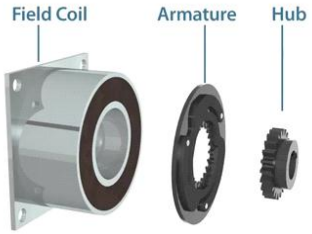

Fig-3

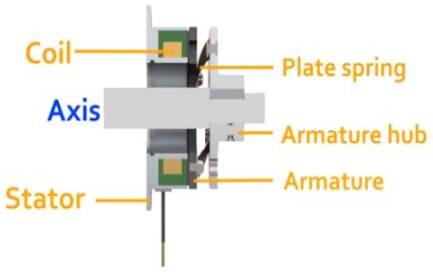

Fig-4

Fig-3, 4: Parts of brake

2.1 Working

The major number of EM brakes use single phase friction plate to stop movement. The EM brakes operates over electric actuation but produce torque mechanically, when voltage and current (power) is applied to the brake the loop becomes electromagnet and produces magnetic lines of flux this flux travels through the air gap between field coil and armature magnetically pulling the armature towards against the hub and creating a holding force to hold the brakes. When current and voltage (power) is expelled from the brakes, the spring holds the armature away from hub surface creating a small air gap in between. In outdoor use friction material is not used while in industrial applications friction material is used to help hinder wear in clutch or brakes, the friction material is flush with steel poles the single phase design allows a very quick action thus suited for high cycle applications. The EM brakes found in various applications, uses are in processing and food packaging machinery, medical equipments, servo motors, robotics and elevators and escalators.

2.2 Calculation of torque

1. Maximum braking force is given by:

FL = Mdal × *g* × *Ur*
FL = possible braking force on axle
Mdal = dynamic axle load
g = acceleration due to gravity
Ur = coefficient of friction between road and tire

2. Braking torque require to stop wheel

T = BF × R/*r*
BF = Braking force
T = brake torque
R = radius of tire
r = speed ratio between the wheel and brake

3. ADVANTAGES

- Less wear of portions
- Electronically controlled
- No compelling need to change the brake oils reliably.
- Longer life of EM brakes in comparison to normal brakes.
- Uncomplicated design
- Less noise
- Large degree of safety

4. NEW CONCEPT

If we increase the magnitude of current in the current carrying wire then according to the Ampere's law of magnetic field can be derived by:-

➢ Integration of B (vector).ds (vector)=Uo.I(Enclosed)

Therefore the surface area of a current carrying wire is:

Integration of B (vector). (2.pi.r)=Uo.I (enclosed)

$$B = \frac{\mu_0 I}{2\pi r}$$

Fig- 5: Equation of Biot-Savart Law

B (vector) = (Uo.I.r)/ (2.pi.R^2)

Therefore we can see as I increases then B increases or B is proportional to I.

Where,

B= Magnetic field,

Uo=permeability of free space,

I=current,

U=Radius distance,

R= radius of wire (outer)

In this relation we get,

B ∝ I ---------- eqn (1)

Now with the help of this equation 1, we are going to proof the increase in Magnetic force due to small increase in the magnitude of Magnetic field.

Here we go,

With the help of Lorentz's Law,

But we know that,

F=BILsin (theta)

For maximum magnetic force,

Fmax= BIL

Or

Fmax=B [B (2.pi.r^2)/Uor^2]

Fmax=B^2 .2.pi.R^2/(Uor)

If 2.pi.R^2/ (Uor)=constant=K

Therefore Fmax=B^2.K

Which means Fmax is proportional to B^2

- Therefore if there is a small change in magnetic field then the magnetic force increases as a square of magnetic field.
- Here this relation clearly shows us with the small change in magnetic field the magnetic forces will become the square of the magnitude of magnetic field.
- Therefore, small change in magnetic field will leads to a large change in magnetic force.
- So that in this way we will able to generate more powerful Electromagnetic Brakes.

5. APPLICATION IN TODAY'S SENARIO

In today's time the more we need speed we also need the powerful brakes to control the speed at the same time. EM brakes are an efficient system to control the speed and the movements. Its application is vast, can be used in various sectors of technology such as

- It can be used in Railways to stop or control the speed of trains.
- It can be used in Manufacturing and packaging industries to control the motion of products on the conveyer.
- It can be used in Automobile industries to control motion of cars.
- It can be used in Medical equipments.
- It can be used in robotics.

6. CONCLUSION

Electromagnetic brakes have various inclinations over frictional component. This brake can be used as halting instrument in vehicle. It can very well used as a piece of rail coaches to decelerate the segment moving in quick. Blend of these brakes extends the brake life and act like totally stacked brakes. These brakes can be used as a piece of wet condition, so there is no use of against slipping instrument. It is totally electrically controlled which achieves less disasters. The braking power conveyed right now not as much as the plate brakes. Thusly, it tends to be used as a helper or emergency easing back instrument in the cars.

REFERENCES

[1] EM brakes how works from site: 'https://www.electric-brake.com'.

[2] IRJET (International Research Journal of Engineering and Technology) Volume5 issue 4.