

OVER VIEW OF ELECTROMAGNETIC BRAKING SYSTEM

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Abstract: *Electromagnetic braking system is based on the principle of electromagnetism to achieve friction less braking in which applying brakes using electronic and magnetic power. This increases the lifecycle and trustworthiness of brakes since no friction leads to less wearing out of brakes. This is imminent of braking systems. It is smaller in size compared to the traditional braking systems. when magnetic flux passed in a perpendicular direction to the rotating wheel, an eddy current flow in a reverse to the rotational direction of the wheel. This produces an opposing force to the rotation of wheel and in turn reduces the speed of wheel rotation. It develops a torque and finally the vehicle comes to rest. This braking system can be combined in heavy vehicles as an auxiliary brake. It can be used in commercial vehicles by monitoring the current supplied to generate the magnetic flux. As per the requirement of vehicle pilot a required torque can be generate to slow down the vehicle. This new braking system minimize the road accident now a days. This paper is focused on basic summarized version of electromagnetic braking system including types, component, construction, working principal, application and it's future scope of application and modification.*

Key word: *Electromagnetism, Eddy current flow, Friction less, Magnetic flux*

1. INTRODUCTION

There are Different experimental setups are used for the investigation and in particular a short section of overhead line and a full-scale pantograph have been assembled in a shielded chamber and finally get a measurement campaign aimed at investigating electromagnetic emissions in sliding contacts are presented [1]. A spherical design of electromagnetic brake is presented for haptic application, to exploits model of coulomb friction to generate fully controllable braking in 3-DOF rotational motion. The brake design is optimized for maximizing the force to input power ratio with help of the analytical models of magnetic force and friction moment [2]. In electromagnetic braking system the uses of magnetic strength to minimize or stop the rotation of wheel speed. Electromagnetic braking comes with the merits and demerits of stresses in calipers and dissipation of heat [3]. Magnetic braking system is a rising system in automobile system to increase efficiency of traditional braking system. Ferromagnetic material is attached rear wheel axle, surrounded by a magnetic coil. With the help of electricity magnetic coils generate repulsive force against rotation of rear axial [4]. Brushless tubular permanent magnet actuator with a passive spring plays an important role in electromagnetic suspension system [5]. An electromagnetic brake is a combination of electro-mechanical concept. It aims to reduce the road accidents. This system used on any vehicle with minor amendments to the transmission and electrical systems [6].

TYPES OF BRAKE

Drum Brake It consists brake drum which is concentric to the axle hub, on the axle casing is mounted a back plate. The back plate is made up of pressed steel sheet and it provide support for the expander, anchor, and brake shoes.



Figure 1: Drum Brake

Disc Brake Disc brakes work using the same basic principle as the brakes on a bicycle as the caliper pinches the wheel with pads on both sides, it slows the vehicle

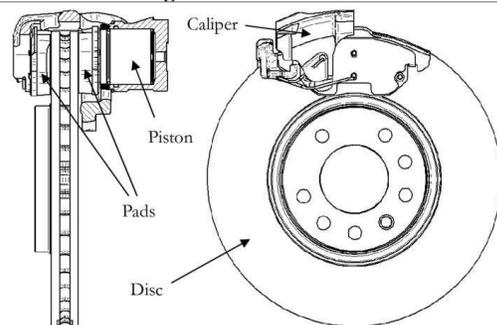


Figure 2: Disc Brake

Air Brake Air brakes use standard hydraulic brake system components such as braking lines, wheel cylinders and a slave cylinder similar to a master cylinder to transmit the air-pressure-produced braking energy to the wheel brakes. Air brakes are used frequently when greater braking capacity is required

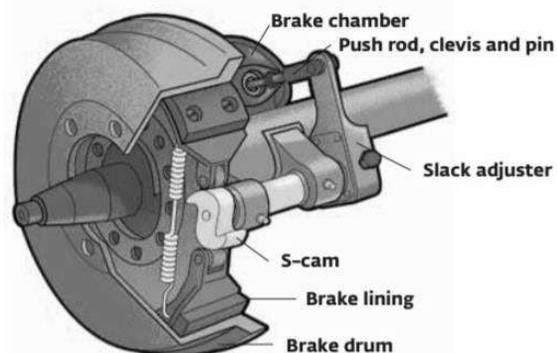


Figure 3: Air Brake

TYPE OF MAGNETS

Permanent Magnet: A permanent magnet is an article produced using a material that is charged and makes it shown steady attractive field. An ordinary model is a fridge magnet used to hold notes on a cooler entry way. Materials that can be polarized, which are additionally the ones that are unequivocally pulled in to a magnet, are called ferromagnetic (or ferro-magnetic).

Ferromagnetic materials can be separated in to attractively "delicate" materials like toughened iron, which can be charged however don't will in general remain polarized, and attractively "hard" materials, which do. Lasting magnets are produced using "hard" ferromagnetic materials, for example, alnico and ferrite that are exposed to extra ordinary preparing in a solid attractive field amid production to adjust their inward microcrystal line structure, making them exceptionally difficult to demagnetize. To demagnetize a soaked magnet, a specific attractive field must be connected, and this edge relies upon coercively of the separate material. "Hard" materials have high coercively, though "delicate" materials have low coercively. The general quality of a magnet is estimated by its attractive minute or, then again, the all-out attractive motion it produces. The nearby quality of attraction in a material is estimated by its charge.

Electromagnet: An electromagnet, in its most straightforward structure, is a wire that has been snaked in to at least one circles, known as a solenoid. At the point when electric flow courses through the wire, an attractive field is created. It is thought close (and particularly inside) the curl, and its field lines are fundamentally the same as those of a magnet. The introduction of this viable magnet is dictated by the correct hand rule. The attractive minute and the attractive field of the electromagnet are relative to the quantity of circles of wire, to the cross-segment to fetch circle, and to present going through the wire. On the off chance that the loop of wire is folded over a material with noun common attractive properties (e.g., cardboard), it will in general produce an exceptionally feeble field. Be that as it may, on the off chance that it is folded over a delicate ferromagnetic material, for example, an iron nail, at that point the net field created can result in a few hundred-to thousand folds in cement of field quality. Utilizations for electromagnets incorporate molecule quickening agents, electric engines, junkyard cranes, and attractive reverberation imaging machines. A few applications include arrangements in excess of a straightforward attractive dipole; for instance, quadruple and sextuple magnets are utilized to center molecule shafts. In arithmetic and material science, the right-hand rule is a typical mental helper for understanding introduction of to Mohawks in three-dimensional space. The electromagnetic braking system is one kind of a technological revolution where the prototype model of it shows a closer look to its design where the model consists of: Disc, DC Motor, Chain, Wheel, Battery, Frame, Electromagnet.

2. MAJOR COMPONENTS

Disc: The brake disc is the component of a disc brake against which the brake pads are applied. The material is typically grey iron a form of cast iron. The design of the disc varies somewhat. Some are simply solid, but others are hollowed out with fins or vanes joining together the disc's two contact surface (usually included as part of a casting process).

DC Motor: DC motor is an electric motor converts electrical energy into mechanical Motion. The reverse task that of converting mechanical motion into electrical Energy, is accomplished by a generator or dynamo. In many cases the two Devices are identical except for their application and minor construction details.

Chain: A chain drive is a mechanism for transferring mechanical power between two places, and is common means of location in bicycles and motorcycles. It is also motive source for many different types of machinery. Chain drives have existed as a technology science. Third century BC and have remained the same in their basic design Since that time.

Wheel: The wheel is a circular component that rotates on an axle bearing where it is one of the key components of the braking system with a radius of 90cm.

Battery: Battery is a device that converts chemical energy directly to electrical energy where it is used to power up the whole system especially to the circuits. It consists of a number of voltaic cells; each voltaic cell consists of two half cells connected in series by a conductive electrolyte containing anions and cations.

Frame: The frame is the structural system which supports components of the physical construction such as the axel, wheel, clamps connecting the electromagnet and the automated circuit board holder. Vertical steel columns and horizontal beams, constructed in a rectangular grid that even balances the vibrations which is occurred by the movement of the wheel and even the ability to handle the stopping force of the wheel by the electromagnets.

Electromagnet: Since the name itself says “Electromagnetic braking system” and the main component required is the electromagnet, whereas the e.m.f. rule states that the metal is completely winded and it is being enclosed so that it can be ready to use anytime. When the current is passed the coils inside are excited and the magnetic field is produced from the electromagnet. The electromagnets work in the base of induction. Where the process induction causes electrical field to produce magnetic field thus the electromagnet uses the source of power from the electrical field in to the magnetic field. The strength of the magnetic field from the magnet is a static property of the electromagnet. Hence the electromagnet works by a source of power which a magnet naturally produces.

3. CONSTRUCTION

A horse shoe magnet (A-1) has a North and South Pole. If a piece of Iron contacts both poles, a magnetic circuit is created. In an electromagnetic brake, the North and South Pole is created by a coil shell and a wound coil. In a brake, the armature is being pulled against the brake field. (A-3) The frictional contact, which is being controlled by the strength of the magnetic field, is what causes the rotational motion to stop. All of the torque comes from the magnetic attraction and coefficient of friction between the steel of the armature and the steel of the brake field. Example, if the brake was required to have an extended time to stop or slip time, a low coefficient material can be used.

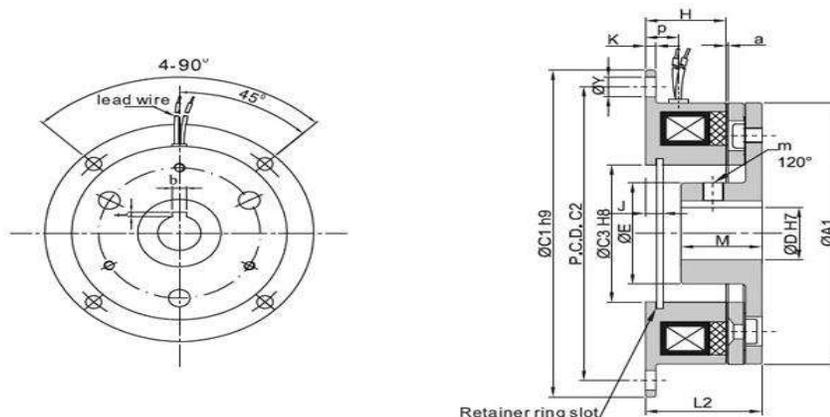


Figure 4: Final Structure

4. WORKING PRINCIPLE

Electromagnetism: Electromagnetism is one of the four major collaborations in nature. The other three are the solid collaboration, the powerless connection and attractive energy. Electromagnetism is the power that causes the collaboration between electrically charged particles; the zones in which this happens are called electromagnetic fields.

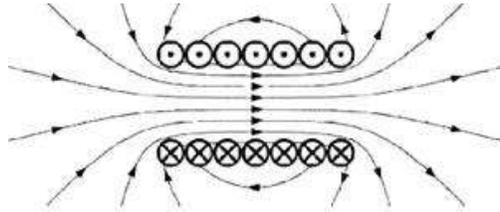


Figure 5: Magnetic field lines

Magnetic Effect of Current: The articulation "Magnetic effect of current" suggests that "a present streaming in a wire conveys a magnetic field around it". The magnetic impact of current was found by Oersted in 1820. Oersted found that a wire conveying a current had the ability to stay away from a magnetic needle.

Electromagnet: An electric flow can be utilized for making impermanent magnets known as electromagnets. An electromagnet chips away at the magnetic impact of current. It has been discovered that in the event that a delicate iron pole called center is put inside a solenoid, at that point the quality of the magnetic field turns out to be exceptionally extensive on the grounds that the iron metal is charged by enlistment

The quality of an electromagnet is:

- Directly proportional to the quantity of turns in the loop.
- Directly proportional to the presents reaming in the loop.
- Inversely proportional to the length of air hole between the shafts.

When all is said in done, an electromagnet is frequently viewed as superior to a change less magnet since it can deliver solid magnetic fields and its quality can be constrained by shifting the quantity of turns in its curl or by changing the current moving through the loop.

Electromagnetic Brakes: Electromagnetic brakes work electrically, however transmit torque precisely. This is the reason they used to be alluded to as electro-mechanical brakes. Throughout the years, EM brakes ended up known as electromagnetic, alluding to their in citation technique. The assortment to fuses and brake structures has expanded significantly, however the fundamental activity continues as before. Single face electromagnetic brakes make up roughly 80% of the majority of the power connected brake applications.

Characteristics of Electromagnetic Brakes: It was discovered that electromagnetic brakes can build up a dative power which speaks to about double the most extreme power yield of a run of the mill motor, and somewhere around multiple times the braking intensity of a fumes brake. These exhibitions of electromagnetic brakes make them significantly more aggressive contender for elective hindrance hard ware's contrasted and different retarders. The brake linings would last impressively longer before requiring support, and the possibly "brake blur" issue could be dodged.

In research directed by at rack producer, it was demonstrated that the electromagnetic brake expected 80 level of the obligation which would some way or another have been requested of the customary administration brake. Besides, the electromagnetic brake anticipates the perils that can emerge from the delayed utilization of brakes past their capacity to scatter heat. This is destined to happen while a vehicle plunging along slope at fast.

5. APPLICATION

- This rendition of the standard is utilized in two correlative uses of Ampère's circuital law:
- An electric flow goes through a solenoid, bringing about an attractive field. When folding the correct hand over the solenoid with the fingers toward the traditional current, the thumb focuses toward the attractive north post.
- An electric flow goes through a straight wire. Snatching the wire focuses the thumb toward the ordinary current (from positive to negative), while the fingers point toward the attractive transition lines. The heading of the attractive field (counter clockwise rather than clockwise when seen from the tip of the thumb) is a consequence of this show and not a hidden physical wonder. The thumb focuses heading of current and fingers point bearing of attractive lines of power.

6. CONCLUSION

A revolutionary invention is made in the field of automobile as well as brake. Regenerative braking system can be equipped with the Electromagnetic brakes. Electromagnetic braking system is more reliable as compared to other braking systems where in oil braking system or air braking system has a tendency of leakage may lead to complete failure of brakes. In electromagnetic braking system as four-disc plates, coils and firing circuits are attached individually on each wheel, even any coil fails, remaining coils work properly. The electromagnetic system required minimum maintenance. Electromagnetic brakes have been used as additional equipment in addition to the regular friction brakes on heavy vehicles.

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