CONTACTLESS ELECTROMAGNETIC BRAKING SYSTEM

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ABSTRACT

This principle of braking road vehicles in the conversion of kinetic energy into heat. This high energy conversion therefore demands an appropriate rate of heat dissipation if reasonable temperature and performance stability are to be maintained. While the design construction, and location features severely limit the heat dissipation function of the friction

Brake, electromagnetic brakes work in a relatively cool condition and avoid problems that friction brakes faced by using a totally different working principle and installation location. By using the electromagnetic brakes as supplementary retardation equipment, the frictions brakes can be used less frequently and therefore practically never reach high temperatures. The brake linings thus have a longer life span, and the potential 'brake fade' problem can be avoided. It is apparent that the electromagnetic brake is an essential complement to the safe braking of heavy vehicles.

KEYWORDS: Electromagnet, Brake, contactless braking, Frictionless, Eddy Current.

I. INTRODUCTION

1.1. Brake

A vehicle brake is used to slow down a vehicle by converting its kinetic energy into heat. Most commonly brakes use friction between two surfaces pressed together to convert the kinetic energy of the moving object 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. Other methods convert kinetic energy into potential energy in such stored forms as Eddy current brakes use magnetic fields to convert kinetic energy into electric current in the brake disc, fin, or rail, which is converted into heat. Still other braking methods even transform kinetic energy into different forms, for example by transferring the energy to a rotating flywheel.

Types of Brakes:
1. Friction Brake
2. Electromagnetic Brake

1.2 Friction Brake

A friction brake is a type of automotive brake that slows or stops a vehicle by converting kinetic energy into heat energy, via friction. The heat energy is then dissipated into the atmosphere. In most systems, the brake acts on the vehicles
Wheel hubs, but some vehicles use brakes which act on the axles or transmission.

There are two types of Friction Brake

1. Drum Type

A drum brake is a vehicle brake in which the friction is caused by a set of brake shoes that press against the inner surface of a rotating drum. The drum is connected to the rotating road wheel hub.

2. Disc Type

The disc brake is a device for slowing or stopping the rotation of a road wheel. A brake disc usually made of cast iron or ceramic, is connected to the wheel or the axle. To stop the wheel, friction material in the form of brake pads (mounted in a device called a brake caliper) is forced mechanically, hydraulically, pneumatically or electromagnetically against both sides of the disc. Friction causes the disc and attached wheel to slow or stop.

1.2. Electromagnetic Brake

Electromagnetic brakes slow an object through electromagnetic induction, which creates resistance and in turn either heat or electricity. Friction brakes apply pressure on two separate objects to slow the vehicle in a controlled manner. In locomotives, a mechanical linkage transmits torque to an electromagnetic braking component. Trains use electromagnetic track brakes where the braking element is pressed by magnetic force to the rail. They are distinguished from mechanical track brakes, where the braking element is mechanically pressed on the rail. Electric motors in industrial and robotic applications also employ electromagnetic brakes. Recent design innovations have led to the application of electromagnetic brakes to aircraft applications. In this application, a

combination motor/generator is used first as a motor to spin the tires up to speed prior to touchdown, thus reducing wear on the tires, and then as a generator to provide regenerative braking.

II. PROBLEM STATEMENT

The conventional brake system consists of a lot of moving parts and is based on the principle of friction thus a lot of forces dissipated in the form of heat due to friction and the links involved. 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. Drum brakes consist of a heavy flat-topped cylinder, which is sandwiched between the wheel rim and the wheel hub. The inside surface of the drum is acted upon by the linings of the brake shoes. 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. All the above mentioned convectional brakes have two chief problems one is the wear and tear and other is unnecessary excessive temperature in the service is attained. Excessive heating of brakes can result in fade, it causes temporary changes in the friction as they get hotter. Normally efficiency is regained when they cool again Brake pads and linings also wear away faster at higher temperatures.

III. COMPONENTS OF SYSTEM

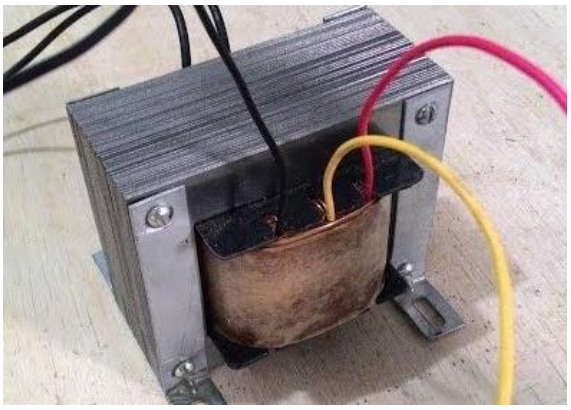
DC MOTOR

A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills.

ELECTROMAGNET

An electromagnet is a type of magnet in which the magnetic field is produced by an electric current. Electromagnets usually consist of wire wound into a coil. A current through the wire creates a magnetic field which is concentrated in the hole, denoting the center of the coil. The magnetic field disappears when the current is turned off. The wire turns are often wound around a magnetic core made from a Ferro magnet or ferromagnetic material such as iron; the magnetic core concentrates the magnetic flux and makes a more powerful magnet. The main advantage of an electromagnet over a permanent magnet is that the magnetic field can be quickly changed by controlling the amount of electric current in the winding. However, unlike a permanent magnet that needs no power, an electromagnet requires a continuous supply of current to maintain the magnetic field. Electromagnets are widely used as components of other electrical devices, such as motors, generator, electromechanical solenoid, relays, loudspeakers, hard disks, MRI machines, scientific instruments, and magnetic separation equipment. Electromagnets are also employed in industry for picking up and moving heavy iron objects such as scrap iron and steel.

TRANSFORMER



A transformer is a passive electrical device that transfers electrical energy from one electrical circuit to another, or multiple circuits. A varying current in any one coil of the transformer produces a varying magnetic flux in the transformer's core, which induces a varying electromotive force across any other coils wound around the same core. Electrical energy can be transferred between separate coils without a metallic (conductive) connection between the two circuits. Faraday's law of induction, discovered in 1831, describes the induced voltage effect in any coil due to a changing magnetic flux encircled by the coil. Transformers are most commonly used for increasing

low AC voltages at high current (a step-up transformer) or decreasing high AC voltages at low current (a step-down transformer) in electric power applications, and for coupling the stages of signal processing circuits. Transformers can also be used for isolation, where the voltage in equals the voltage out, with separate coils not electrically bonded to one another. Since the invention of the first constant-potential transformer in 1885, transformers have become essential for the transmission, distribution, and utilization of alternating current electric power. A wide range of transformer designs is encountered in electronic and electric power applications. Transformers range in size from RF transformers less than a cubic centimeter in volume, to units weighing hundreds of tons used to interconnect the power grid.

IV. CONSTRUSTION

There are three parts to an electromagnetic brake: field, armature, and hub (which is the input on a brake). Usually the magnetic field is bolted to the machine frame (or uses a torque arm that can handle the torque of the brake). 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. This can happen very fast (1-3sec). Disengagement is very simple. Once the field starts to degrade flux falls rapidly and the armature separates. A spring hold the armature away from its corresponding contact surface at a predetermined air gap.

V. WORKING

A. Electromagnetism

Electromagnetism is one of the four fundamental interactions in nature. The other three are the strong interaction, the weak interaction and gravitation. Electromagnetism is the force that causes the interaction between electrically charged particles; the areas in which this happens are called electromagnetic fields.

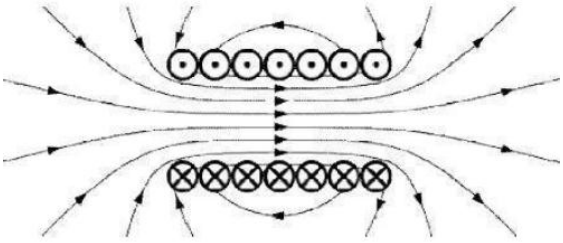


Fig-1 Working principle of Electromagnetism

B. Magnetic Effect of Current

The term "Magnetic effect of current" means that "a current flowing in a wire produces a magnetic field around it". The magnetic effect of current was discovered by Oersted in 1820. Oersted found that a wire carrying a current was able to deflect a magnetic needle.

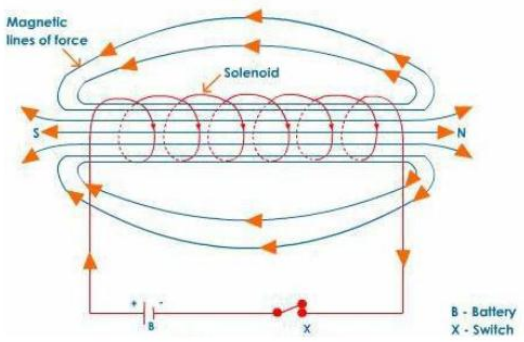


Fig-2 Magnetic Field Lines through and around the current carrying solenoid

C. Electromagnet

An electric current can be used for making temporary magnets known as electromagnets. An electromagnet works on the magnetic effect of current. It has been found that if a soft iron rod called core is placed inside a solenoid, then the strength of the magnetic field becomes very large because the iron ore is magnetized by induction

In general, an electromagnet is often considered better than a permanent magnet because it can produce very strong magnetic fields and its strength can be controlled by varying the number of turns in its coil or by changing the current flowing through the coil. Electromagnetic brakes operate electrically, but transmit torque mechanically. This is why they used to be referred to as electro-mechanical brakes. Over the years, EM brakes became known as electromagnetic, referring to their actuation method. The variety of applications and brake designs has increased dramatically, but the basic operation remains the same. Single face electromagnetic brakes make up approximately 80% of all of the power applied brake applications. It was found that electromagnetic brakes can develop a negative power which represents nearly twice the maximum power output of a typical engine, and at least three times the braking power of an exhaust brake..

VI. CONCLUSION

In electromagnetic braking system as four disc plates, coils and firing circuits are attached individually on each wheel, even any coil fails the brake does not completely fails remaining three coil works properly. It is found that electromagnetic brakes make up approximately 80% of all of the power applied brake applications. This enhanced braking system not only helps in effective braking but also helps in avoiding the accidents and reducing the frequency of accidents to a minimum. Furthermore, the electromagnetic brakes prevent the danger that can arise from the prolonged use of brake beyond their capability to dissipate heat. These electromagnetic brakes can be used as an auxiliary braking system along with the friction braking system to avoid overheating and brake failure. ABS usage can be neglected by simply using a micro controlled electromagnetic disk brake system. 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. Hence the braking force produced in this is less than the disc brakes.

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