Journal for Re Attach Therapy and Developmental Diversities
eISSN: 2589-7799
2023 February; 6 (2s): 305-309

Application of Electromagnetic Braking System in the Mechanical Industry and its Impact on Humanities

Dr. Kuldeep Panwar[1], Sapna Pandey[2], Dr. Vikas Sengar[3]

1Department of Mechanical Engineering, Shivalik College of Engineering, Dehradun
2 College of Pharmacy, Shivalik, Dehradun
3Shivalik Institute of Professional Studies, Dehradun
Drkuldeep.panwar@sce.org.in

Received: 29-November-2022
Revised: 08-January-2023
Accepted: 12-February-2023

ABSTRACT: The braking system should ensure the driver's, passenger's, and some other road users' comfort and safety . An electromagnetic brake is a novel and ground-breaking innovation that can stop a car quickly and forcefully in an emergency. Modern technology brakes like electromagnetic brakes are utilized in light and heavy motor vehicles including cars, trucks, buses, and jeeps. The issue arises Given the increasing frequency of accidents in today's society as a result of ineffective braking systems, it is clear that the electro - magnetic brake is a critical inclusion to the secure stopping of large vehicles. Hence author focusses on the electromagnetic braking system and its application which uses principal of the brake is engaged by a magnetic force, but the power needed for braking is delivered manually. It concluded that the danger that can result from using brakes for a longer period of time than they can effectively disperse heat is avoided with electromagnetic brakes. It may be employed not just in the automobile industry but also in the aerospace industry. As a consequence, the electromagnetic braking system may represent a more significant technical advance in the future.

Keywords: Automobiles, Electromagnetic Braking System, Machine, Friction, Vehicle.

1. INTRODUCTION

Electromechanical brakes, also known as EM brakes, are another term for electromagnetic brakes. They construct mechanical properties, or friction, by using electromagnetic force to slow or stop motion. A braking coil's current produces a magnetic field powerful enough just to push an armature toward and away from one magnetic face. They are not to be confused with eddy current braking, which produces resistance by applying magnetic force. Numerous brake applications and designs have evolved a lot since they were initially widely used in the mid-twentieth century, particularly in trains and tramways, but their fundamental function has not changed [1],[2]. The history of electro - magnetic brakes, including their development, numerous variations, and distinctions from eddy current brakes [3][4]. A brake is a device that stops movement. It is well understood that friction is employed by brakes to convert kinetic energy into heat. Electromagnetic brakes, in place of conventional friction brakes, have been used on large vehicles as a basis for formulating of retardation apparatus.

They work on the basis of electromagnetic theory. When a magnetic force is applied perpendicular to a revolving wheel or rotor, eddy current to flow in the opposite way [5],[6]. Though friction brakes used less frequently, when the electro - magnetic braking system is used as an additional component for retardation, increases in temperature are almost never reached. In this study, a prototype model is developed and tested with the goal of improving the brake system method in automobiles. It minimizes brake failure in order to avoid road accidents [7],[8]. It also reduces the need for brake system maintenance. This system has the advantage of being able to adapt to any vehicle with only minor transmitting and electrical system modifications. Magnetic brakes are electrically powered yet mechanically transmit torque. For this reason, they were once known as electro-mechanical braking. Due to its actuation technique, EM brakes have come to be characterized as electromagnetic over time. Although there are now a vast array of uses and brake types since brakes first gained popularity more than 60 years ago, the fundamental function has not changed. Exactly 80% of all power applied brake applications are electromagnetic brakes. On big trucks and in some cars, electromagnetic brakes have indeed been utilized as retardation equipment as addition to conventional friction brakes.

1.1. History of the Electromagnetic Brake:

Granville Tailer Woods became the first African-American innovator after the Civil War. He was a self-taught electrical and mechanical engineer. The large portion of his works involved railroad cars, railroad lines, and other transportation methods [9],[10]. The Asynchronous Multiplex Railway Telegraph, a version of the

immersion telegraph that used ambient stationary power supply from existing phone wires to transmit data between railway stations and moving trains, was one of his most notable innovations. In the United States, he owned over sixty patents. 1887 saw the invention of the electromagnetic brake, which was intended for use on trains. Because of how they operated, these were formerly known as electrical brakes, but their name has since been changed to electromagnetic brakes. In the locomotive industry, electromagnetic brakes have a variety of applications, especially for trains and trams. Rail and trams adopted electric and magnetic brakes in the early twentieth century to sustain the effectiveness and safety of their tracks [11]. As emergency braking systems, they have a wide range of applications. They are, however, widely used in the engineering, power tool, robotic systems, and other transportation industries. Due to recent developments, these brakes are now utilised in conveyor system, photocopiers, and the aerospace industry. Other developments involve factory automation, printing equipment, food processing equipment, and packaging equipment.

2. DISCUSSION

Heavy-duty vehicle equipment as addition to the standard friction brakes. In this lesson, we go over the fundamental concepts of conventional brakes as well as a few other methods of retardation. The operation and features of electromagnetic brakes are then emphasized. We are attempting to create a brake system using this project which is applicable in a two-wheeled vehicle at Magnetic brakes have been employed as an additional kind of high-speed, low-maintenance braking. Here, a plunger as well as an electromagnetic coil are being used. The plunger is moved in the direction of braking by an electromagnetic action.

2.1. Working of electromagnetic braking system:

Important to the approach of braking is the converting of kinetic energy to thermal energy. The pressure used to accelerate an automobile or vehicle is released in the form of heat is when brakes are applied, likely to result in a stopping force several times stronger. Regardless of the vehicle's speed, the brake pads reduce speed rapidly. A electro-magnetic brake transmits torque physically, but is electrically activated. The coil ignites is when brake receives power or current, producing a magnetic field. Magnetic lines of flow are produced when the coil becomes an electromagnet due to this field. The armature is drawn to the magnetic flow. Typically, the armature and major port are supported by a rotating shaft. By applying magnetic properties to the armature and hub, the coil quickly stops the shaft. Whenever brake is no longer getting electricity, the stator could spin with the brake's shaft. When most kinds of electromagnetic braking lose power, springs separate the armature from the brake system surface, leaving a small air gap.

2.2. Types of braking system:

The brake is a mechanical device that stops a vehicle from moving forward in a development. While braking force is connected by the brake to disrupt the growth of the vehicle, a lot of engine necessity is distributed as warmth necessity. The primary function of brakes is to control a vehicle's speed over a short distance while paying little attention to speed.

2.2.1. Electromagnetic Brake System:

Electromagnetic brakes, a newer type of braking system, utilize the car's built-in electric motor to assist in stopping the vehicle. Regenerative brakes employ an electric motor to recharge the battery and are found in the majority of hybrid vehicles. Several buses will occasionally utilize it as a backup retarder brake.

2.2.2. Frictional Brake System:

Numerous automobiles employ frictional braking. Commonly detected as pads or shoes, these are service brakes. As the name suggests, these brakes rely on friction to prevent vehicle movement. Typically, a spinning device with a stationary pad and a spinning forecast surface is included. In contrast to the majority of band brakes, where saddle inhibits and rubs against the exterior of the rotating drum, a drum brake's rotating drum containing shoes will broaden and rub against by the interior of the drum.

2.2.3. Hydraulic Brake System:

A hydraulic brake system consists of a master cylinder which receives hydraulic fluid from a reservoir. These components are linked together by a series of metal pipes and rubber fittings connected to the wheel cylinders. The bands or drum brakes on the wheels have two opposing pistons that press against one another under pressure, pushing the disc brakes into the cylinders and wanting to stop the wheel.

2.3. Types of Electromagnetic Brakes:

Electromagnetic brakes come in a variety of designs. The single face shape is the one that is most frequently utilized. Applications as well as brake designs have drastically expanded since electromagnetic brakes first gained popularity.

2.3.1. Single Face Brake:

That used turbulence on a single plate surface, single face braking engages both input and output clutch components. About eighty percent of all power-applied brakes are single-face electromechanical brakes.

2.3.2. Power off Brake:

When electrical power is unintentionally or purposefully withdrawn, power-off brakes halt or hold a load. They often operate near or on an electric motor. To increase torque without expanding the brake, multiple discs can be utilized. Two distinct categories of power-off brakes exist. There is first spring-applied braking. A spring needs to pull against the pressure plate without the use of electricity, trying to retain the friction disc here between internal baseplate and the external cover plate. Attached to a shaft, the wheel receives the friction transfer. Since this sort of brake frequently exhibits considerable backlash, it is better suited for less precise applications in which precise response time is indeed not essential. The permanent magnet brake is the second variety of power-off brake. In this design, the armature is drawn to the permanent magnets by means of springs. The armature may be drawn to the brake housing whenever the brake is applied because the permanent magnets produce lines of electromagnetic flux when the brake is applied. To release the brake and open an air gap, power is given to the coil. This produces an alternative magnetic field that counteracts the magnetic flux produced by the permanent magnets. This kind of electromagnetic brake is more suited for applications that demand precise stopping, including safety features, because it has minimal backlash. The brake would stop immediately when it is applied if there is zero backlash.

2.3.3. Hysteresis Power Brake:

Electrical hysteresis components have a wide range of torque. Due to their remote adjustability, they are suitable for test stand applications requiring torque transformation. These kinds of brakes provide a wide torque range since drag torque is negligible. An internal magnetic flux is produced in the field when electricity is delivered, and this flux is subsequently transported into a hysteresis disk. The braking shaft is connected to the hysteresis disk. The output shaft experiences a continual drag or eventually stops because of a magnetic drag upon that hysteresis disk. Once the power is turned off, the hysteresis disk may spin freely and neither part is subject to any relative force. Thus, bearing drag is the sole torque between both the input and the output.

2.3.4. Particle Brake:

The possible operating torque range for magnetic particle brakes is rather broad. Within the unit's operational RPM range, torque may be adjusted extremely precisely under a magnetic particle brake. These characteristics make these devices perfect for applications requiring tension control, including wire winding, sheet, film, as well as tape tension management. Applications with a high cycle rate, such as magnetic card readers, splitting devices, and labelling machinery, can also benefit from their rapid response. This electric and magnetic brake has a powder chamber filled with magnetic particles. When electricity is supplied to the coil, an attempt is made to bind the above particles together to form a kind of magnetic particle slush. As the voltage rises, the particle binding gets stronger. These bonded particles, which the brake rotor drives through, provide an opposing force which slows and ultimately brakes the output shaft.

2.4. Application of electromagnetic braking system:

They need more speed today, and in order to regulate that speed, we also need strong brakes. An effective technique for regulating speed and speed is EM brakes. It has a wide range of uses in technology, including the ability to halt or regulate the pace of trains on railroads. It may be used to regulate how items travel down conveyors inside the manufacturing as well as packaging sectors. It may be applied to the auto industry to regulate vehicle speed. It can be applied to medical equipment. Robotics can make advantage of it.

3. CONCLUSION

Different electromagnetic brakes have tendencies toward frictional parts. This brake can be utilized as a vehicle braking mechanism. It might very easily be utilized as a component of a rail carriage to slow down a fast-moving portion. Combining these brakes increases brake life and simulates fully stacked brakes. There is no need for a tool to prevent slippage because these brakes may be utilized in wet conditions. Because it is entirely electrically operated, fewer accidents occur. Compared to the plate brakes, the braking force transmitted at this time is less. As a result, it frequently serves as an aid or emergency relaxing back device in automobiles. When compared to alternative braking systems, electromagnetic brakes are shown to be more dependable. Even a minor hole in such an oil or air brake system can cause the brake system to fail completely. Even when one of the four disc plates, coils, or firing circuitry on each wheel fails in the electro - magnetic braking system, the remaining three coils continue to function normally. Furthermore, this system requires very little maintenance. The electro - magnetic brake control system has improved controllability because it is an electric switching system. It's not too difficult to install an electromagnetic brake. It is clear from the above that now the electromagnetic brake is a desirable addition to the secure braking of big trucks. Results are good with the existing design, but performance would be better with more funding. It was argued that whereas traditional brakes operate well at high speeds, electromagnetic brakes are ineffective at low speeds. Thus, when traveling at high speeds, it must be utilized as an auxiliary brake.

REFERENCES:

[1] R. Dhoot, S. Gaikar, N. Kulkarni, and O. Jain, “Design & Theoretical Study of Electromagnetic Braking System,” *IOSR J. Mech. Civ. Eng. e-ISSN*, 2016.

[2] S. Wagh, A. Mahakode, A. Mehta, and V. Pyla, “Electromagnetic Braking System in Automobile,” *Int. J. Trend Res. Dev.*, 2017.

[3] K. Prajpati, R. Vibhandik, D. Baria, and Y. Patel, “Electromagnetic Braking System,” *Int. J. Sci. Res. Eng.*, 2017.

[4] A. S. Puttewar, N. U. Kakde, H. A. Fidvi, and B. Nandeshwar, “Enhancement of Braking System in Automobile Using Electromagnetic Braking,” *IOSR J. Mech. Civ. Eng.* , 2014.

[5] P. Saiteja and S. Jeyanthi, “Fuzzy logic simulation for brake-by-wire control system,” *Lect. Notes Mech. Eng.*, 2017, doi: 10.1007/978-981-10-1771-1_18.

[6] R. Lostado, P. Villanueva Roldán, R. Fernandez Martinez, and B. J. Mac Donald, “Design and optimization of an electromagnetic servo braking system combining finite element analysis and weight-based multi-objective genetic algorithms,” *J. Mech. Sci. Technol.*, 2016, doi: 10.1007/s12206-016-0720-6.

[7] J. Liu, “Study on a new kind of electromagnetic mechanical coupled regenerative braking system for electric vehicles,” *Int. J. Mechatronics Appl. Mech.*, 2017, doi: 10.17683/ijomam.issue1.9.

[8] M. Z. Baharom, M. Z. Nuawi, G. Priyandoko, and S. M. Haris, “Electromagnetic braking system using eddy current for brake disc of Al6061 and Al7075,” *Int. Rev. Mech. Eng.*, 2012.

[9] I. Khan, I. Hussain, M. Z. A. Shah, K. Kazi, and A. A. Patoli, “Design and simulation of anti-lock braking system based on electromagnetic damping phenomena,” 2018. doi: 10.1109/INTELLECT.2017.8277615.

[10] A. A. Adly and S. K. Abd-El-Hafiz, “Speed-range-based optimization of nonlinear electromagnetic braking systems,” *IEEE Trans. Magn.*, 2007, doi: 10.1109/TMAG.2007.893411.

[11] L. Zhang, Z. Zhang, G. Wang, J. Zhao, Y. Zhang, and C. Wang, “Electric vehicles stability control based on electromagnetic-mechanical coupled regenerative braking system,” *Nongye Jixie Xuebao/Transactions Chinese Soc. Agric. Mach.*, 2017, doi: 10.6041/j.issn.1000-1298.2017.01.041.

[12] Panwar, K, Murthy, D, S, “*Analysis of thermal characteristics of the ball packed thermal regenerato*r”, Procedia Engineering, 127, 1118-1125.

[13] Panwar, K, Murthy, D, S, “*Design and evaluation of pebble bed regenerator with small particles*” Materials Today, Proceeding, 3(10), 3784-3791.

[14] Bisht, N, Gope, P, C, Panwar, K, “ Influence of crack offset distance on the interaction of multiple c*racks on the same side in a rectangular plate*”, Frattura ed Integrità Strutturale” 9 (32), 1-12.

[15] Panwar, K, Kesarwani, A, "Unsteady CFD Analysis of Regenerator", *International Journal of Scientific & Engineering Research,* 7(12), 277-280.

[16] Singh, I., Bajpai, P. K., & Panwar, K. "*Advances in Materials Engineering and Manufacturing Processes*