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A Review on Braking System in Automobiles

Dharmananda Barik [1*], Prasanta Kumar Nayak [2]
[1*]Assistant Professor, Department of Mechanical Engineering, Nalanda Institute of Technology, Bhubaneswar, Odisha, India
[2] Assistant Professor, Department of Mechanical Engineering, Nalanda Institute of Technology, Bhubaneswar, Odisha, India
*Corresponding author e-mail: dharmanandabarik@thenalanda.com

ABSTRACT

The most important system in an automobile is the braking system. If the brake fails, there will be a collision, which could result in injuries or even fatalities. Friction brakes are found on every automobile. The control unit presses brake shoes, or pads, against the rotating brake drums or discs at the wheel when a driver applies the brakes. The wheel slows or stops due to friction between the shoes and the drums or discs, which slows or stops the vehicle. Reviewing the braking system in cars and enhancing its mechanical and electrical components are the paper's key goals. The purpose of this study is to educate readers on vehicle brake systems and to examine some basic maintenance procedures. To maintain personal safety, the driver must have a fundamental grasp of the braking system and regularly check the brake to make sure it is in excellent working order.

This article also provides some forecasts for the possible development of the brake market in addition to a description of the current commercial environment.

KEYWORDS:
ABS, Anti Lock Brakes, Anti Lock Braking system, Safety, Slip Factor, Advance Braking System, Vehicle Stability Control, Braking system.

INTRODUCTION

The majority of people today are aware of the value and necessity of having brakes on their vehicles. In order to aid drivers in understanding vehicle braking systems, this paper outlines their fundamental principles, makeup, and functions. Yet, applying the brake results in greater pollution. Just a few examples include resource waste, air pollution, and noise pollution. In order to conserve resources and cut pollution, we shouldn't use the brakes excessively. We are all aware of how disastrous the results are if the brakes fail. To make sure the brakes are in good operating order, drivers must regularly inspect and repair damaged or severely degraded braking components.

ANTI-LOCK BRAKING SYSTEM STUDIES

Kartik Bhasin (2018) With the advancement in technology, the security problems that are associated with vehicles and automation have been significantly reduced; one such technology is the Anti-lock braking system, also known as ABS. The number of accidents is reduced as a result of the use of this technology. This form, however, will no longer be effective in obstructing street conditions. To overcome this limitation, the vehicle industry developed new technologies such as EBFD, ECS, and TCS[1].

Dineshkumar C (2017) The signal from the IR sensor is routed through the control unit to the stepper motor, which activates the braking mechanism to control the situation. The vehicle's speed is sensed by the speed sensor, and the stepper motor is triggered based on the vehicle's speed. Programming in the control unit activates the braking.The stepper motor drags the brake cord, which is attached to both the front and back wheels, at different speeds. Infrared sensor, stepper motor, control unit, and speed sensor are some of the terms used in this paper[2].

Sagar B. Pawar *et al* (2018)The system will be installed on a four-wheeler vehicle and will be based on an intelligent electronically controlled automatic bumper activation system called "Automatic Braking with Pneumatic Bumper System Using Proximity Sensor." The automatic braking system and the pneumatic bumper system are the two mechanisms that make up this system in general. The Infrared Sensor is used in automatic braking (IR) The sensor then sends a signal to the engine's relay, which causes the engine to shut down. During the operation of the Automatic Braking System, the vehicle's driver will also attempt to stop the vehicle by pressing the brake pedal.[3].

Towoju.O.A (2019) This study is being conducted to mathematically evaluate the impacts of multiple braking structures on temperature growth that could relate to brake fade in a braking

system for a 2200 kg car travelling at 40 m/s and whose speed is supposed to be decreased to 4 m/s upon 5 seconds with two matches of the brake for a seconds' duration.[4].

Irshad A. Zariye *et al* (2016) Electronic circuits such as sensor, relay, control system, microcontroller, signal transmitter and signal receiver, and Peripheral Interface Circuit will be used in the speed control and automatic braking system (PIC).The strategic management of a collision involving cars was the philosophy behind the implementation of the speed control and automatic braking mechanism.We'll use an ultrasonic sensor to identify the barrier and an infrared sensor to activate the automatic braking system. The device would be designed to keep the driver and passengers safe inside the car[5].

R.Sangeeth Kumar *et al* (2007) When the vehicle's speed exceeds a predetermined safety distance, the microcontroller-based device activates an actuating function to reduce the vehicle's speed to a reasonable level, reducing the likelihood of an accident. If a crash is unavoidable, an Automatic Braking Mechanism (ABS) incorporates Advanced Driver Assist systems with Electronic Stability Control to delay the car and theoretically mitigate the severity of the effect. The advantages of AEBS over traditional braking systems are discussed, as well as potential future advances in this area[6].

Yair wiseman (2018) Anti-lock Braking System (ABS) is a vehicle control system designed to prevent vehicle wheels from locking up during emergency braking. The vehicle wheels can become locked, resulting in poor steering capability, increased stopping distance, and substantial tire wear.By unlocking the wheels, a successful Anti-lock Braking System device will solve these issues[7].

Ayman A *et al* (2011) For ABS systems, a variety of control methods have been developed. Theoretically, these approaches vary, as does their success under changing road conditions. The current study is part of a larger project called "Intelligent Antilock Brake System Design for Saudi Arabian Road Surfaces." The techniques used in the design of ABS systems are discussed in this article.This highlight the most pressing issues and review recent advancements in their management techniques. ABS can make use of intelligent control mechanisms such as fuzzy control[8].

Irene Isaksson-Hellman *et al* (2006) Rear-end crashes account for a significant portion of all road fatalities involving passenger vehicles, and the majority of them happen at low speeds. Auto Brake is a technology that has recently been included in a number of passenger car models.City Safety is a system that automatically brakes the car to help the driver prevent, and in some cases stop, rear-end crashes at low speeds[9].

Ayman *et al* (2011) For ABS systems, a variety of control methods have been developed. Theoretically, the approaches vary, as does their success under changing road conditions. Fuzzy control schemes, for example, can be used in ABS control to mimic the contextual dimensions of human intelligence, with many benefits such as robustness, universal approximation theorem, and rule-based algorithms[10].

Astrid Linder *et al* (2007) Statistical assessment, testing, and driver behavior were all addressed. According to the literature review, mathematical approaches focused on odds ratios were used in particular to test the traffic safety impact. Several research methods are listed in this study to assess the impact of ESC in physical testing.Surveys of vehicle owners have been used to estimate the consequences of driver behavior. Experiments in the field and in a simulator have also been recorded in the literature[11].

BRAKING PADS REVIEW

Augsburg K *et al* (2008) The factors influencing hysteresis pressure losses in a hydraulic brake system are investigated experimentally in this paper.The brake pedal stroke velocity, the distances between the brake pads and the brake disc, and the brake device configuration are all being investigated[12].

Akshay Kumar S *et al* (2014) A prototype model is fabricated and studied in this research work with the aim of improving the braking system in automobiles. The electromagnetic brake is clearly an essential addition to the safe braking of heavy vehicles.Its aim is to prevent road accidents by reducing brake failure. It also lowers the cost of braking system repair.Its aim is to prevent road accidents by reducing brake failure. It also lowers the cost of braking system repair[13].

Rajan Parmar *et al* (2021) The majority of braking systems use friction forces to convert a moving body's kinetic energy into heat, which is then dissipated by the braking pads.As friction-type braking systems are overused, the temperature of the braking pads rises, decreasing the system's effectiveness.The eddy-current is formed when a magnet and a metal (or alloy) conductor move in opposite directions[14].

Likun Xia *et al* (2014) For the AEB system, this study provides a car detection method employing a single camera. Background subtraction, thresholding, and inverted U-shape back wheel detection are the three essential processes of the approach[15].

Jonathan I Miller *et al* (2012) When compared to other vehicles, heavy freight vehicles have poor braking performance in emergency situations.By installing high-bandwidth, binary-actuated valves directly on the brake chambers, conventional brake actuators are improved.Furthermore, air usage during an anti-lock brake stop on a low friction, smooth surface determines the overall air reservoir capacity necessary on a heavy goods vehicle.As a result, it shows the potential reduction in reservoir size that the new system could achieve[16].

Sonya A *et al* (2019) The conventional braking system never prevents a collision in a critical circumstance involving abrupt braking, and the car is more likely to collide.Today, autonomous braking systems serve an important role in preventing accidents, but they are only found in high-end vehicles.The proposed concept and system can be used in low-end vehicles to minimise mortality rates by connecting a mechanical actuator to the brake pedal and compressing it if the IR sensor detects an item[17].

Krunal Prajapati *et al* (2017) The electromagnetic braking system is employed in LMV and HMV vehicles such as jeeps, buses, cars, trucks, trains, and motorcycles. Electromagnetic brakes are sometimes known as electro-mechanical brakes.To utilise in the future, highly manufactured accidents This braking mechanism is designed to prevent accidents. In electricity, the power source is utilised.The magnetic field in the armature coil is created by the electric power given to the magnetic coil, which attracts the electromagnet aluminium disc.To use the brakes and bring the road wheel and vehicle to a complete stop[18].

Shubham Narang *et al* (2015) Accidents are becoming more common these days, thus safety has become a top focus. One of the causes of accidents is improper brake use. The goal of the project is to increase the brake safety parameters.Sudden recognition of any object in front of the driver causes panic, and in this scenario, normal drivers fail to use brakes properly, resulting in an accident. By taking the driver's reaction time into consideration, we will strive to aid the driver in avoiding accidents and thereby increasing safety[19].

Hitesh Kumar S P,Jayanth H (2002) Vehicles are a vital form of transportation for people in today's society, and car brakes are an essential component that can save or kill lives. So, using a Microcontroller and ultrasonic sensors, we created the intelligent reverse braking system. This ultrasonic sensor detects obstacles and immediately brakes, preventing accidents and saving the car's occupants' lives[20].

Regenerative and Electromagnetic braking system

HE Ren *et al* (2003) The principle of automotive regenerative braking energy is explained. There are three different types of regenerative braking systems. This type of regenerative braking system has a number of benefits, including recuperating braking energy,

generating electricity, starting the engine, and helping acceleration. When driving in the city, you can save anywhere from 10% to 30% on gas[21].

Gopal P *et al* (2014) The author exclaims about One of the most important considerations for a race car, especially a solar electric car, is weight reduction. Instead of employing a large hat type disc rotor, it was chosen to use the disc rotor and callipers from a bike to reduce the weight of the brake system. Calculations and thermal analyses prove that utilising a bike's rotor is safe [22].

Shaikh Mohd Yousuf *et al* (2015) The author explains about safety. One can prevent many road accidents by employing intelligent braking systems. For example, if someone is driving a car without paying attention and a person or an animal suddenly appears in front of the vehicle, the photo-electric sensor detects the object in front of the car and sends a signal to the relay, which then opens or closes the solenoid wall to apply brakes depending to the situation[23].

Ravi Gupta *et al* (2017) The author explains about a vacuum pump, is used to create vacuum in the brake pipe. This vacuum reservoir is used by the braking cylinder to apply the brakes. The vacuum-assisted hydraulic braking system in light vehicles uses vacuum created by the engine to minimise the driver's exertion on the foot pedal[24].

Shubham Narang *et al* (2018) The goal of the project is to increase the brake safety parameters. Sudden detection of any obstacle next to the driver causes panic, and in this scenario, regular drivers fail to use brakes properly, resulting in an accident. By taking the driver's reaction rate into consideration, we will strive to aid the driver in avoiding accidents and thereby increasing safety[25].

Shugen Hu,Yucheng Liu (2017) This model was built to examine the effects of braking variables such as disc rotating speed and braking tension on brake noise. The complicated eigenvectors of the system were also taken into account when determining the brake model's longevity under varied braking conditions. The accelerating linear static charts and phases charts were created by solving the program's formulas.[26].

Naresh Babu AR *et al* (2014) The car currently includes an alert system to keep a safe gap between moving vehicles. When the car gets too close to an object, the alarm goes off, alerting the driver to the presence of the object. Our goal is to create a system that can prevent accidents when reversing heavy-duty vehicles such as trucks, buses, and other vehicles[27].

Megan Bayly *et al* (2007) ITS are transportation-related technologies that can improve mobility, efficiency, and safety, among other things. The potential for ITS to improve road user safety has been extensively investigated, and this study summarises what is currently known about the effectiveness of safety-relevant ITS[28].

SHIRISH VASANTRAO GADEWAR, A. M. JAIN (2017) Conversion of electrical energy to mechanical energy is done by rotating electrical machines. The electric motors in EVs and HEVs can be controlled to operate as generators to Convert the kinetic or potential energy of the vehicle mass into electric energy that can be stored in the energy storage and Reused[29].

Yogesh Abhale,Prateek Nigam(2015) Conversion of electrical energy to mechanical energy is done by rotating electrical machines. The electric motors in EVs and HEVs can be controlled to operate as generators to Convert the kinetic or potential energy of the vehicle mass into electric energy that can be stored in the energy storage and Reused[30].

Liang Chu *et al* (2011)The development of a new integrated braking control unit is being investigated. The system's effects, such as energy recovery and braking performance, are validated by modelling findings based on the ADVISOR and the HIL test bench[31].

Zuowu Ding *et al* (2007) The research investigates an electric car's regenerative braking. Matlab is used to simulate the vehicle performance, speed, and the total pressure of the hydraulic aggregate. Because the hydraulic capacitor can absorb and store every one of the braking energy, the electric car engine can start with a minimal current[32].

Rakesh Chandmal Sharma *et al* (2015) The numerous braking mechanisms used in vehicular traffic are discussed in this study. This research also takes into account train electrodynamic and electromechanical braking, which is very important in high-speed trains. This research provides a method for calculating the stopping distance of a railway vehicle[33].

Luca Pugi *et al* (2019) Regenerative braking has an impact on various areas of electric vehicle quality and implementation. Modern electric drives have improved performance, which can be used to increase opportunity efficiency, stability, and environmental impact. The braking system is used to not only stop the vehicle but also to activate a number of onboard safety features[34].

R. Vignesh *et al* (2020) Regenerative braking is a technique for driving a vehicle more efficiently and effectively. For deceleration, electric ATV vehicles employ a mechanical brake to increase the wheel's roughness. In terms of energy conservation, the mechanical brake wastes a large amount of energy, whereas the kinetic energy of an electric vehicle is converted into thermal energy[35].

Qiping Chena *et al* (2018) This study examines nonlinear friction caused by the deceleration mechanism in a motor-driven EHB system. In addition, depending on the opening and closing properties of a limit switch, this research develops a fuzzy-PI maintained for the EHB system's cylinder hydrostatic fluid[36].

Shriram Pawar *et al* (2020) Instead of using air brakes, the proposed model uses exhaust gas to actuate the brake lever. The hydraulic actuator and brake lever are both operated by the combustion compressed gas. To charge the air tank, the system uses a non-return valve. This research can be expanded to include both diesel and gasoline engines[37].

De Gruyter (2020) The study examines the options for assessing braking conditions during the introduction of a braking system during an inspection of trucks under Slovak Republic settings. The braking effectiveness of the vehicle is assessed using a roller brake tester to measure braking forces. The findings of practical testing of braking efficiency measurement of a cat truck are discussed in this study.The outcomes of practical lessons of braking quality evaluation of a truck of categorization presented in this study[38].

Jianqiang Gong *et al* (2014) An automobile braking system is used to calibrate the model, and the components of the braking are compared and studied. The enhanced ABC categorization approach reduces the proportion of major and main components, according to the findings. This strategy can increase the efficiency of maintenance operations by focusing on the most crucial components and lowering administrative costs for businesses[39].

Xiangmo Zhao *et al* (2018) The principal component analysis (PCA) is used. The back-propagation (BP) neural network classifier is used to automatically evaluate ABS using the processed PCA data as an input. Experiments showed that the novel method accurately simulates a variety of road braking circumstances[40].

Susan Rebecca Cikanek, Kathleen Ellen Bailey (2001) This research outlines regenerative braking for a paralleled hybrid vehicle that generates regenerative power based on the vehicle variables, resulting in improved performance, economy, and durability at a reasonable cost.[41].

Yimin Gao, Mehrdad Ehsani (2001) has determined the amount of braking energy that can be recovered in a typical driving cycle. The brake system's anti lock performance was tested. The findings indicate that a large quantity of energy can be recovered, and the vehicle's braking performance is flawless[42].

Tarun Kumar Bera *et al* (2011) This paper investigates an antilock braking system that employs a on–off management method to keep wheel slip within a predetermined range. The vehicle dynamics model must be included into the controller design. Only steady normal loading on the wheels is considered in a single wheel or bicycle vehicle model[43].

Yimin Gao *et al* (2007) There are now two hybrid braking systems on the market. The parallel hybrid braking system, for example, has a straightforward structure and control. The other is a hybrid braking system that is entirely controlled. For this system, two standard control strategies have been established. The first focuses on ideal braking performance, while the second focuses on optimal braking energy recovery[44].

Xiaohong Nian *et al* (2014) The simulation findings are presented in this work by assessing the battery state of charge, braking force, and dc bus current in the MATLAB and Simulink environments. The simulation findings show that with fuzzy logic and PID control, EVs may achieve regenerative braking and extend their driving range while maintaining braking quality[45].

Georg F Mauer *et al* (1995) The design requirements, as well as the control system's decision and rule structure, are described in this study. The simulation results show how the system performs on various types of roads and in rapidly changing road conditions[46].

Ali Belhocine *et al* (2020) The linked thermomechanical model's resolution allows us to see additional key findings from this study, such as the disc deformations and corresponding Von Mises stresses, as well as the contact pressure distribution on the brake pads. A number of inferences can be drawn based on the findings of this inquiry[47].

MK Yoong *et al* (2010) The working concept and brake controller for regenerative braking have been investigated in this research in order to improve the efficiency and realise energy savings in electric vehicles[48].

Dong Peng *et al* (2008) Once emergency brakes are required, the regenerative braking system works in tandem to ensure great regenerative image and better steering, even on roads with low adhesion coefficient. The experiment and simulation show that the proposed braking control approach is stable and effective[49].

Zhongshi Zhang *et al* (2017) On the suggested test bench, the loading and motion of the automobile EBS during different braking situations may be accurately replicated, and the dependable test results allow the EBS to be investigated safely, inexpensively, and quickly in the field[50].

CONCLUSION

Nowadays, the majority of people recognise the value and necessity of having brakes on their cars. The brake system is used in a wide range of vehicles besides cars, such as bicycles and aeroplanes. Brake system technology will advance in the future. Therefore, it is advantageous for drivers to comprehend the fundamental concepts, components, and architecture of an automotive brake system. Each type of brake and brake pad has a unique mix of advantages and disadvantages. When choosing these components, drivers must take into account the actual driving circumstances and choose the components that are a good match. Future product development will focus on lowering wear particles and noise. Possibly a larger portion of the auto industry will be occupied by electric vehicles.

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