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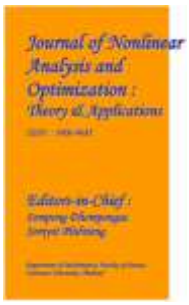

AUTOMATIC ELECTROMAGNETIC BRAKING SYSTEM

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ABSTRACT

An electromagnet braking system using a tilt sensor for vehicles. The system is designed to prevent accidents caused by loss of control or reckless driving. The tilt sensor measures the angle of the vehicle and sends a signal to the control unit, which then activates the electromagnet brake. The system provides rapid

and reliable braking for various vehicles, including construction equipment, agricultural machinery, and recreational vehicles. The system is simple, reliable, and cost-effective, making it an attractive solution for various applications. The system has the potential to reduce accidents and improve vehicle safety, increasing driver confidence and providing a sense of security and control. The system consists of an electromagnet brake, a tilt sensor, and a control unit. The electromagnet brake is designed to provide rapid and reliable braking, while the tilt sensor measures the angle of the vehicle and sends a signal to the control unit. The control unit processes the signal from the tilt sensor and activates the electromagnet brake. The system is designed to be versatile and can be used in various applications, including construction equipment, agricultural machinery, and recreational vehicles. The system has the potential to save lives and prevent injuries, making it an important development in the field of vehicle safety. The system is also designed to be easy to install and maintain, making it an attractive solution for various applications. The system has the potential to improve vehicle safety and reduce accidents, making it an important development in the field of vehicle safety.

The system is designed to be simple and easy to use, making it an attractive solution for various applications. The system can be used in various vehicles, including cars, trucks, and buses. The system is designed to be reliable and efficient, providing rapid and reliable braking for various vehicles. The system has the potential to save lives and prevent injuries, making it an important development in the field of vehicle safety. The system is also designed to be cost-effective, making it an attractive solution for various applications. The system can be used in various industries, including construction, agriculture, and transportation. The system is designed to be durable and long-lasting, withstanding the rigors of various applications. The system is also designed to be compact and lightweight, making it easy to install in various vehicles. The system has the potential to improve vehicle safety and reduce accidents, making it an important development in the field of vehicle safety. The system is designed to be simple and easy to use, making it an attractive solution for various applications. The system can be used in various vehicles, including cars, trucks, and buses. The system is designed to be reliable and efficient, providing rapid and reliable braking for various vehicles. The system has the potential to save lives and prevent injuries, making it an important development in the field of vehicle safety. The system is also designed to be cost- effective, making it an attractive solution for various applications. The system can be used in various industries, including construction, agriculture, and transportation. The system is designed to be durable and long-lasting, withstanding the rigors of various applications.

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I. INTRODUCTION

1.1 Brake Definition and Background

A brake is a that inhibits motion by absorbing energy from a moving system. It is used for slowing or stopping a moving vehicle, wheel, axle, or to prevent its motion, most often accomplished by means of friction. Brakes may be broadly described as using friction, pumping, or electromagnetic. One brake may use several principles: for example, a pump may pass fluid through an orifice to create friction.

Most brakes commonly 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 pressurized air or pressurized oil. 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.

Brakes are generally applied to rotating axles or wheels, but may also take other forms such as the surface of a moving fluid (flaps deployed into water or air). Some vehicles use a combination of braking mechanisms, such as drag racing cars with both wheel brakes and a parachute, or airplanes with both wheel brakes and drag flaps raised into the air during landing.

Since kinetic energy increases quadratically with velocity (KE=1/2 mv2), an object moving at 10 m/s has 100 times as much energy as one of the same mass moving at 1 m/s, and consequently the theoretical braking distance, when braking at the traction limit, is 100 times as long. In practice, fast vehicles usually have significant air drag, and energy lost to air drag rises quickly with speed.

Almost all wheeled vehicles have a brake of some sort. Even baggage carts and shopping carts may have them for use on a moving ramp. Most fixed-wing aircraft are fitted with wheel brakes on the undercarriage. Some aircraft also feature air brakes designed to reduce their speed in flight.

Notable examples include gliders and some World War II-era aircraft, primarily some fighter aircraft and many dive bombers of the era. These allow the aircraft to maintain a safe speed in a steep descent. The Saab B 17 dive bomber and Vought F4U Corsair fighter used the deployed undercarriage as an air brake.

Friction brakes on automobiles store braking heat in the drum brake or disc brake while braking then conduct it to the air gradually. When traveling downhill some vehicles can use their engines to brake. When the brake pedal of a modern vehicle with hydraulic brakes is pushed against the master cylinder, ultimately a piston pushes the brake pad against the brake disc which slows the wheel down. On the brake drum it is similar as the cylinder pushes the

brake shoes against the drum which also slows the wheel dow.

1.2 Types Of Brakes

1.2.1 On the Basis of Power Source

The power source which carries the pedal force applied by the driver on brake pedal to the final brake drum or brake disc in order to de accelerate or stop the vehicle the braking systems are of 6 types-

1 Mechanical brakes
2 Hydraulic brakes
3 Air or pneumatic brakes
4 Vacuum brakes`
5 Magnetic brakes
6 Electric brakes

1.2.2 On the Basis of Frictional Braking Contact

On the basis of the final friction contact made between the rotating brake components i.e. brake drum or disc rotor and the brake shoe the braking systems are of 2 types-

1. Internal expanding brakes (e.g.- drum brakes)
2. External contracting brakes(e.g. disc brakes)

1.2.3 On the Basis of Application

On the basis of method of applying brakes, braking systems are of 2 types-

1. Foot or service brakes
2. Hand or parking brakes

1.2.4 On the Basis of Brake Force Distribution

1. Single acting brakes
2. Dual acting brakes

1.2.1. On the basis of power source

i. Mechanical Brakes

It is the type of braking system in which the brake force applied by the driver on the brake pedal is transferred to the final brake drum or disc rotor through the various mechanical linkages like cylindrical rods, fulcrums, springs etc. In order to de accelerate or stop the vehicle.

Mechanical brakes were used in various old automobile vehicles but they are obsolete now days due to their less effectiveness.

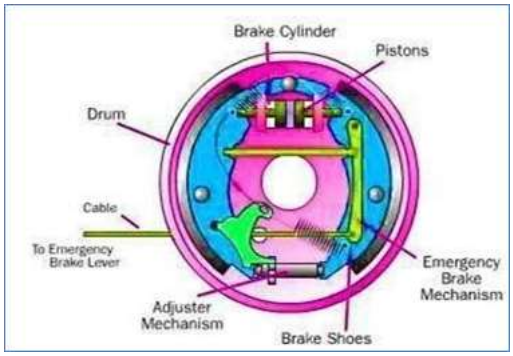


Fig.no 1.1 : MECHANICAL BRAKES

ii. Hydraulic brakes

It is the type of braking system in which the brake force applied by the driver on brake pedal is first converted into hydraulic pressure by Master Cylinder (for reference read article on master cylinder) than this hydraulic pressure from master cylinder is transferred to the final brake drum or disc rotor through brake lines.

Instead of mechanical linkages, brake fluid is used in hydraulic brakes for the transmission of brake pedal force in order to stop or de accelerates the vehicle.

Almost all the bikes and cars on the road today are equipped with the hydraulic braking system due to it high effectiveness and high brake force generating capability.

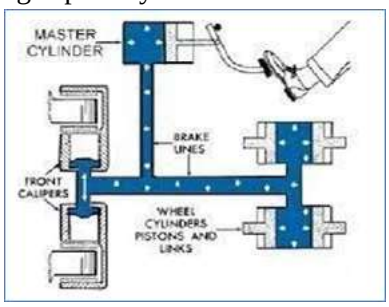


Fig.no 1.2: Hydralic brakes

iii. Air or Pneumatic Brakes

It is the types of braking system in which atmospheric air through compressors and valves is used to transmit brake pedal force from brake pedal to the final drum or disc rotor.

Air brakes are mainly used in heavy vehicles like busses and trucks because hydraulic brakes fails to transmit high brake force through greater distance and also pneumatic brakes generates higher brake force than hydraulic brake which is the need of the heavy vehicle.

The chances of brake failure is less in case of pneumatic brakes as they are usually equipped with a reserve air tank which comes in action when there is a brake failure due to leakage in brake lines.

323High end cars these days are using air brakes system due to its effectiveness and fail proof ability.

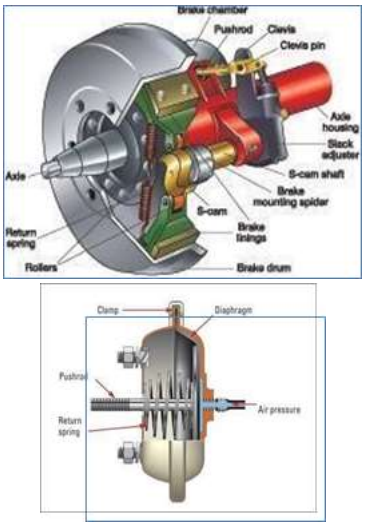


Fig.no1.3: air or pneumatic brakes

iv. Vacuum Brakes

It is the conventional type of braking system in which vacuum inside the brake lines cause are brake pads to move which in turn finally stops or de accelerate the vehicle.

Exhauster, main cylinder, brake lines, valves along with disc rotor or drum are the main components that combines together to make a vacuum braking system

Vacuum brakes were used in old or conventional trains and are replaced with air brakes now days because of its less effectiveness and slow braking.vacuum brakes are cheaper than air brakes but are less safe than air brakes.

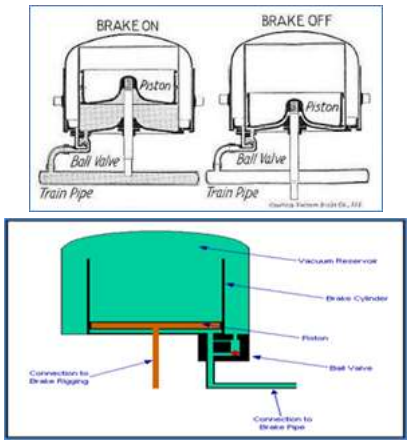


Fig .no1.4: Vacuum Brakes

v. Magnetic Brakes.

In this types of braking system, the magnetic field generated by permanent magnets is used to cause the braking of the vehicle.

- It works on the principle that when we pass a magnet through a cooper tube, eddy current is generated and the magnetic field generated by this eddy current provide magnetic braking.
- This is the friction less braking system thus there is less or no wear and tear.
- This is the advanced technology in which no pressure is needed to cause braking.
- The response to the braking in this is quite quick as compared to other braking systems.

Fig .no1.5: Magnetic Brakes

1.3 Principle of Braking System

The principle of braking in road vehicles involves the conversion of kinetic energy into thermal energy (heat). When stepping on the brakes, the driver commands a stopping force several times as powerful as the force that puts the car in motion and dissipates the associated kinetic energy as heat. Brakes must be able to arrest the speed of a vehicle in short periods of

time regardless how fast the speed is. As a result, the brakes are required to have the ability to generating high torque and absorbing energy at extremely high rates for short periods of time.

1.4 Types of Braking System

(i) Electromagnetic Brake System

A rising style of brake system, electromagnetic brakes use an electric motor that is included in the automobile which help the vehicle come to a stop. These types of brakes are in most hybrid vehicles and use an electric motor to charge the batteries and regenerative brakes. On occasion, some buses will use it as a secondary retarder brake.

(ii) Frictional Brake System

A frictional brake system is found in many automobiles. They are service brakes, and typically found in two forms; pads and shoes. As the name implies, these brakes use friction to stop the automobile from moving. They typically include a rotating device with a stationary pad and a rotating weather surface. On most band brakes the shoe will constrict and rub against the outside of the rotating drum, alternatively on a drum brake, a rotating drum with shoes will expand and rub against the inside of the drum.

(iii) Hydraulic Brake System

A hydraulic brake system is composed of a master cylinder that is fed by a reservoir of hydraulic braking fluid. This is connected by an assortment of metal pipes and rubber fittings which are attached to the cylinders of the wheels. The wheels contain two opposite pistons which are located on the band or drum brakes which pressure to push the pistons apart forcing the brake pads into the cylinders, thus causing the wheel to stop moving.

1.5 Objective

Primary Objective

The main objective of our project is to design and fabricate an Electromagnetic Braking System model.

Secondary Objective

- Besides the main objective, following are our secondary objectives:
- To understand project planning and execution
- To understand the fabrication techniques in a mechanical workshop
- To understand the usage of various mechanical machine tools and also measuring tools
- To make day to day human life more easier by proper use of technology

1.6 Significance and Scope

- Electromagnetic brakes satisfy all the energy requirements of braking without the use of friction. They have better heat dissipation capability to avoid problems that friction brakes faces times.
- They can also be used as supplementary retardation equipment in addition to the regular friction brakes on heavy vehicles.
- These brakes's component cost is less so these brakes are cheap.
- They can be used as an alternative method for the future crisis of the crude oils.

LITERATURE SURVEY

The following are the few journals in which the study was on electromagnetic braking system with different modifications

Innovative Electro Magnetic Braking System by Sevvel P and S Mukesh published in International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Volume-3 in April 2014, Second National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2014) at Sri Krishna College of Engineering & Technology, Kuniamuthur, Coimbatore,Tamilnadu, India . Mr. Sevvel P and S Mukesh Et al find that the 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.

When these brakes are combined with mechanical brakes, it increases the life of brake and act like fully loaded brakes. These electromagnetic brakes can be used in wet conditions which eliminate the anti skidding equipment. Hence, the braking force produced in this is less than the disc brakes if can be used as a secondary or emergency braking system in the automobiles.

Design & Fabrication of Eddy Current Braking System by Oscar Rodrigues, Omkar Taskar, Shrutika Sawardekar, Henderson Clemente, Girish Dalvi published in International Research Journal of Engineering and Technology (IRJET). The purpose of the study was to perform a comparative study of theoretical and practical braking time and establish a practical air gap limit beyond which the electromagnetic brakes lose their effectiveness. From theoretical calculations and experimented braking time values, a maximum reduction in braking time 23.97% is found and max air gap limit of 3 mm is obtained beyond with electromagnetic brakes are found to be ineffective. Further, a magnet of higher magnetic flux density can be used to minimize the braking time. Also, magnets can be positioned at different locations around the disc in radial arrangement to get better breaking torque distribution.

'Modeling and control of electromagnetic brakes for enhanced braking capabilities or automated highway systems' by M. Qian, and P. Kachroo, University of Nevada, LasVegas, IEEE Conference on Intelligent Transportation Systems, pp. 391396, January, 1997. A modified mathematical model is developed for electromagnetic brakes, is proposed to describe their static characteristics i.e. angular speed versus brake torque. This paper describes electromagnetic brakes as a supplementary system for regular friction brakes. This system provides better response time for emergency situations, and in general keeps the friction brake working longer and safer.

To control the brakes, a robust sliding mode controller is designed to maintain the wheel slip at a given value. Simulations show that the controller designed is capable of controlling the vehicle with parameter deviations and disturbances.

Design and fabrication of electromagnetic braking system published International Review of Mechanical Engineering (I.RE.M.E.) by M.Z.Baharom, M. Z. Nuawi, S. M. Haris.

The behaviour of electromagnetic braking using eddy current was studied.Start edwith preliminary study investigating 3 difference materials of aluminum, copper and zinc to choose the best material as brake disc. It also looks on effects of increasing current induced into electromagnet. From the experiment that has been conducted, it can be concluded that aluminum is the best material compared to copper and zinc to be use as the disc brake for eddy current braking using electromagnetic. Besides that, we may conclude that A16061 is better than A17075 to be uses as the brake disc material for our electromagnetic braking system using eddy current project. Thicker disc will generate high torque which will approach the motor torque in order to stop the disc rotation which in this study disc of 5 mm is better than 4mm of thickness. Smaller air gap will produce high braking torque and give better performance to the electromagnetic braking which air gap of 1mm shows the best result compared to 3mm and 5mm is better than 4mm of thickness. Smaller air gap will produce high braking torque and give better performance. To the electromotive braking which air-gap of 1mm shows the best result compared to 3mm and 5mm gap. A16061 which has higher electrical conductivity than A17075 shows great performance of braking torque produced in the study. Therefore, finding of mentioned parameters from this study are parallel; with the theory and will be the guidance to extend this project for any potential application.

3. ELECTROMAGNETIC BRAKING SYSTEM

3.1 Background and Rational

Electromagnetic brakes (also called electro-mechanical brakes or EM brakes) slow or stop motion using electromagnetic force to apply mechanical resistance (friction). The original name was "electro- mechanical brakes" but over the years the name changed to "electromagnetic brakes", referring to their actuation method. Since becoming popular in the mid-20th century especially in trains and trams, the variety of applications and brake designs has increased dramatically, but the basic operation remains the same. Electromagnetic brakes are the brakes working on the electric power & magnetic power. They work on the principle of electromagnetism. These brakes are an excellent replacement on the convectional brakes due to their many advantages. The reason for implementing this brake in automobiles is to reduce wear in brakes as it frictionless. Electromagnetic brakes are of today's automobiles. The working principle of this system is based on faradays first law of electromagnetic induction i.e when a magnetic flux linking with a conductor changes an emf is induced in the coil. An additional current is supplied to the coils so that it creates an opposing torque. This results in the rotating wheel or rotor comes to rest/ neutral.

3.2 Components of Electro-Magnetic Braking System

The electro-magnetic braking system consists of mainly the following parts. They are:-

- Base frame
- Shaft
- Chain and sprockets
- Dc- motor
- Electromagnetics
- Tire(or) wheel
- Bearings
- Battery
- Tilt sensor
- Aurduino
- Relay
- Display

3.2.1 Base Frame.

The components require support during the operation. The base frame facilitates necessary support for this purpose.

3.2.2 Shaft

A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power. The various members such as pulleys and gears are mounted on it.

One end of the shaft is connected to motor with the help of pulley and belts and the other end is connected to wheel so that it helps in transmitting motion from motor to wheel.

Types

They are mainly classified into two types.

- Transmission shafts are used to transmit power between the source and the machine absorbing power; e.g. counter shafts and line shafts.
- Machine shafts are the integral part of the machine itself; e.g. crankshaft.

Fig .no3.1:Types of shaft

3.2.3 CHAIN SPROCKETS:

Chain sprockets (also called chainrings or gears) are key components in the bike's drivetrain system. They work in conjunction with the chain to transfer power from the pedals to the rear wheel, enabling the bicycle to move. Chain sprockets come in various sizes and configurations, and they play a critical role in

determining how easy or difficult it is to pedal, as well as the bike's speed.

Fig .no3.2: chain sprockets

3.2.4 BLDC-Motor:

A BLDC motor is any of a class of rotary electrical machines 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 flow in part of the motor. DC motors were the first type widely used, since 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 used in propulsion of electric vehicles, elevator and hoists, or in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

Fig.No 3.3 Bldc motor

3.2.4 Electromagnetic Brakes:

Electromagnets can be used in electromagnetic brakes, which are a type of braking system that utilizes the force of magnetism to create friction and slow down or stop the motion of a moving object, such as a vehicle or machinery. These types of brakes offer several advantages, including precision, low wear, and the ability to be easily controlled by electrical signals. Here's a breakdown of how electromagnets work in brakes.

Fig .no3.4: Electromagnetic Brakes

3.2.5 Tire or Wheel

A wheel is a circular block of a hard and durable material at whose center has been bored a circular hole through which is placed an axle bearing about which the wheel rotates when a moment is applied by gravity or torque to the wheel about its axis, thereby making together one of the six simple machines.

Fig.No 3.6 Wheel

4. RESULTS AND DISCUSSION

The Theoretical braking time is obtained from the formulas mentioned in the previous chapter at suitable speeds by taking some assumptions. The experimental braking time is calculated by taking readings from fabricated model using stop watch at required speeds. These experimental and theoretical values are compared in this experiment.

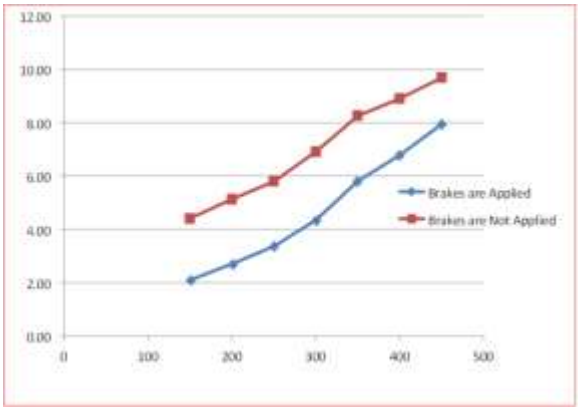
The values of time taken by the wheel to stop when brakes are applied, when brakes are not applied and also theoretically are shown in the table. And graphs are plotted for speed of the wheel and theoretical experimental braking time, speed of the wheel and time taken by the wheel to stop and when brakes are applied , when brakes are not applied as shown in the graph

The value variation between speed of the wheel and braking time are observed in XY plane which shows that the time taken by the wheel to stop increases within increase in speed of the wheel.

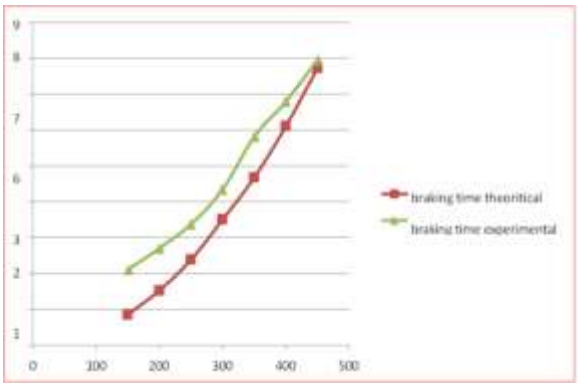
From the graph it is shown that these brakes are most effective at high speeds.

Sl.No.	Speed	Experimental Time taken when		Theoretical Time taken
		Brakes are applied	Brakes are not applied	
1.	150	2.10	4.41	0.85
2.	200	2.70	5.13	1.52
3.	250	3.37	5.80	2.38
4.	300	4.34	6.91	3.50
5.	350	5.81	8.26	4.67
6.	400	6.79	8.91	6.10
7.	450	7.95	9.69	7.72

Table 4.1: Experimental and Theoretical braking time varying with speed of the wheel.



Graph no:4.1:SPEED VS TIME APPLYING BRAKES



Graph no: 4.2: SPEED VS TIME THEORITICALLY AND EXPERIMENRALLY

5. CONCLUSIONS AND FUTURE SCOPE

5.1 CONCLUSION

The electromagnet braking system using a tilt sensor for vehicles is a revolutionary development in the field of vehicle safety. The system is designed to prevent accidents caused by loss of control or reckless driving, and it has the potential to save lives and prevent injuries. The system is simple, reliable, and cost-effective, making it an attractive solution for various applications.

The system consists of an electromagnet brake, a tilt sensor, and a control unit. The electromagnet brake is designed to provide rapid and reliable braking, while the tilt sensor measures the angle of the vehicle and sends a signal to the control unit. The control unit processes the signal from the tilt sensor and activates the electromagnet brake.

The system is designed to be versatile and can be used in various applications, including construction equipment, agricultural machinery, and recreational vehicles. The system is also designed to be easy to install and maintain, making it an attractive solution for various applications.

The system has the potential to improve vehicle safety and reduce accidents, making it an important development in the field of vehicle safety. The system is designed to be simple and easy to use, making it an attractive solution for

various applications. The system can be used in various vehicles, including cars, trucks, and buses.

The system is designed to be reliable and efficient, providing rapid and reliable braking for various vehicles. The system has the potential to save lives and prevent injuries, making it an important development in the field of vehicle safety. The system is also designed to be cost-effective, making it an attractive solution for various applications.

5.2 Future scope

The proposed winding model should be verified and its validity with respect to frequency and model parameter settings investigated.

- In the core model the static hysteresis model should be improved, especially regarding the modelling of minor loops. E.g., the distribution function of the pseudo particles and the relation between reversible and irreversible processes should be studied more in detail.
- In the dynamic magnetization model the optimization of the Cover circuit sections and the frequency and amplitude dependency of the parameter V0 could be studied. If it is possible to find that dependency for a class of material, this would make this model a very useful tool. Then the only necessary adapting step would be to fit the static curve to the measured static curve.
- The composite transformer model should also be validated in other operation modes like transient overvoltage.
- A more detailed reluctance network model of the transformer including three dimensional flux paths in tank and construction details should be developed and verified.
- A static magnetization model that takes B as input and returns H should be developed.

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