MAJOR PROJECT REPORT

ON

"DESIGN AND FABRICATION OF ELECTROMAGNETIC BRAKES AND ITS CONVERSION TO TWO STEP BRAKING SYSTEM"

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Of

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In

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THESIS COMPLETION CERTIFICATE

This is to certify that the thesis on **"DESIGN AND FABRICATION OF ELECTROMAGNETIC BRAKES AND ITS CONVERSION TO TWO STEP BRAKING SYSTEM "** by **"Honey Chaudhary", "Rajat Singh Bisht", "Shivam Kumar"** in Partial completion of the requirements for the award of the Degree of bachelor of technology is an original work carried out by them under our joint supervision and guidance.

It is certified that the work has not been submitted anywhere else for the award of any other diploma or degree of this or any other University.

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INTERNAL GUIDE

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ACKNOWLEDGEMENT

First and foremost, we wish to thank University of petroleum and energy studies, Dehradun which gave us an opportunity to carry out a research work of this magnitude. We would like to take this opportunity to thank them all.

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We thank **to Dr. Mukesh Saxena** (Head Of Department, mechanical department) UPES, Dehradun, for their enthusiastic support and encouragement in completing our project.

Finally, we are also thankful to those respondents who directly and indirectly help us and spared their valuable time.

ABSTRACT

Braking is the use of friction to slow the motion of body, bring it to a halt, or hold it in a standing position. Braking action on wheeled vehicles is the use of a controlled force to hold, stop, or reduce the speed of vehicle.

The use of friction for braking results in noise, particulate emissions and the use of higher force. But if we can use a system which is frictionless then noise, emissions and forces required to apply brakes can be reduced. In order to do this, we are using a electromagnetic braking system to get the improved results.

The main aim of this project is to replace conventional Braking system with Electromagnetic braking system. The main objective of replacing conventional braking system with Electromagnetic braking System is less cost and increased & improved & improved performance. Moreover there is no need of Maintenance and replacement of braking system.

Furthermore our project also aims to develop a two step braking system in which electromagnet braking system and mechanical braking system will work together one after other. First the electromagnetic system will reduce the speed of the vehicle and then mechanical brakes will be applied to stop and hold the vehicle at standing position.

So combined effect of both electromagnetic braking system and mechanical braking system will help in stopping the vehicle with ease as the speed will be reduced and the friction of brake pads with wheels will reduce while using the mechanical system.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

1.1.1 GENERAL

Braking is the use of friction to slow the motion of body, bring it to a halt, or hold it in a standing position. Braking action on wheeled vehicles is the use of a controlled force to hold, stop, or reduce the speed of vehicle. Fig shows the friction and heat is generated during braking.

Brakes on early motor vehicles were nothing more than modified wagon brakes used on horse-drawn wagons. These were a hand-operated, mechanical, lever-type brakes that forced a piece of wood against one or more of the wheels. This caused friction or a drag on the wheel or wheels. Many factors must be considered when designing the braking system for an automotive item. The vehicle weight, size of tires, and type of suspension are but a few that influence the design of a system.

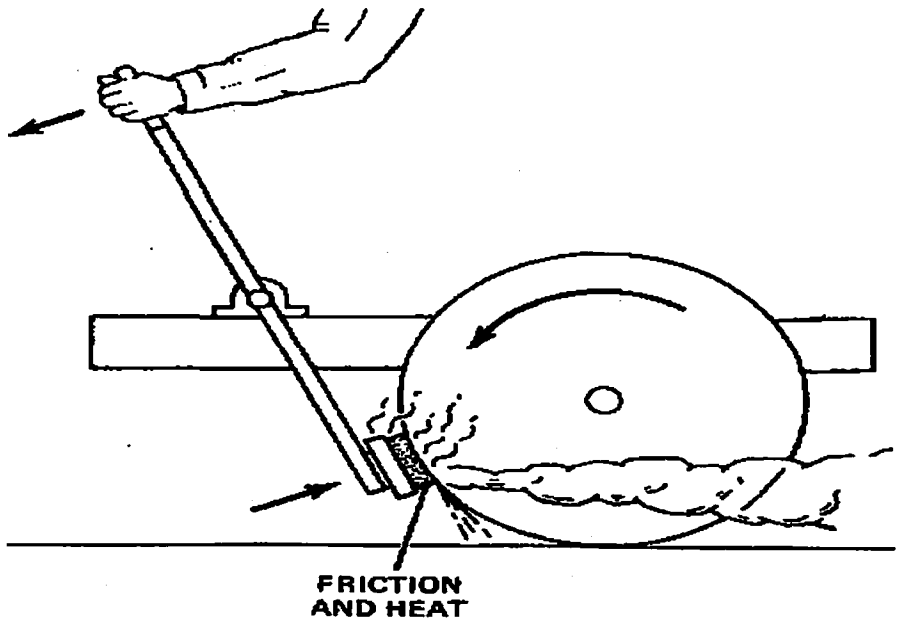

Fig 1.1

Concept Of Friction

A brake is a mechanical device which inhibits motion. Its opposite component is a clutch. Rest of this article is dedicated to various types of vehicular brakes A braking device consisting of a combination of interacting parts that work to slow a motor vehicle.

1.2 FUNCTIONS OF VEHICLE BRAKING

There are two main functions of brakes:

(a) To control the speed of vehicle at turns and also at the time of driving down on a hill slope.

(b) To slow down or stop the vehicle in the shortest possible time at the time of need.

1.3 CLASSIFICATION OF BRAKES

On the Basis of Method of Actuation

(a) Foot brake (also called service brake) operated by foot pedal.

(b) Hand brake – it is also called parking brake operated by hand.

On the Basis of Action on Front or Rear Wheels

(a) Front wheel brakes-Brakes Mounted on Front wheels front wheel Brakes

(b) Rear wheel brakes-Brakes mounted on rear wheel are Rear wheel brakes

On the Basis of Method of Application of Braking Contact

(a)Internally expanding brakes- Brakes which expand on the Internal side of drum are known as internally expanding Brakes

(b) Externally contracting brakes-Brakes Contracting from outside of the tire are known as externally contracting brakes.

On the Basis of Mode of Operation

(a) Mechanical brakes

(b) Hydraulic brakes

€ Air brakes

(d) Vacuum brakes

€ Electric brakes

1.4 TYPES OF BRAKING SYSTEM

Hydraulic brakes:

Hydraulic Brake is an arrangement of braking mechanism which uses brake fluid, typically containing ethylene glycol, to transfer pressure from the controlling unit, which is usually near the operator of the vehicle, to the actual brake mechanism, which is usually at or near the wheel of the vehicle.

Mechanical brakes:

Internal expanding shoe brakes are most common, to transfer pressure from the controlling unit, which is usually near the operator of the vehicle, to the actual brake mechanism, which is usually at or near the wheel of the vehicle only used in automobiles. In an automobile, the wheel is fitted on a wheel drum. The brake shoes come in contact with inner surface of this drum to apply brakes. This type of brakes is mostly used in two wheelers vehicle like scooters and motor bike etc.

Air brakes:

Air brakes are applied by the pressure of compressed air. Air pressure applies force on brakes shoes through suitable linkages to operate brakes. An air compressor is used to compress air. This compressor is run by engine power.

Vacuum Brakes:

Vacuum brakes are a piston or a diaphragm operating in a cylinder. For application of brakes one side of piston is subjected to atmospheric pressure while the other is applied vacuum by exhausting air from this side. A force

acts on the piston due to difference of pressure. This force is used to operate brake through suitable linkages.

Electric Brakes:

In electrical brakes an electromagnet is used to actuate a cam to expand the brake shoes. The electromagnet is energized by the current flowing from the battery. When flow of current is stopped the cam and brake shoes return to their original position and brakes are disengaged. Electric brakes are not used in automobiles as service brakes.

CHAPTER 2
PROJECT OBJECTIVE

2.1 OBJECTIVE AND AIMS

The primary objective of this project is to replace conventional Braking system with Electromagnetic braking system. The primary objective of replacing conventional braking system with Electromagnetic braking System is less cost and increased & improved performance. Moreover there is no need of Maintenance and replacement.

Furthermore our project also aims to develop a two step braking system in which electromagnet braking system and mechanical braking system will work together one after other. First the electromagnetic system will reduce the speed of the vehicle and then mechanical brakes will be applied to stop and hold the vehicle at standing position.

So combined effect of both electromagnetic braking system and mechanical braking system will help in stopping the vehicle with ease as the speed will be reduced and the friction of brake pads with wheels will reduce while using the mechanical system.

2.2 DETAILS OF PROJECT IDEA

In Electromagnetic System, the passing of current in electromagnet led to the generation of magnetic field. The generation of Eddy current in the metal oppose the rotation of tyre. The opposing of tyre can be used as a braking device. It is a non frictional braking system.

There is no direct contact of the electromagnet and the tyre .the generation of eddy currents in the tyre lead to the braking action.

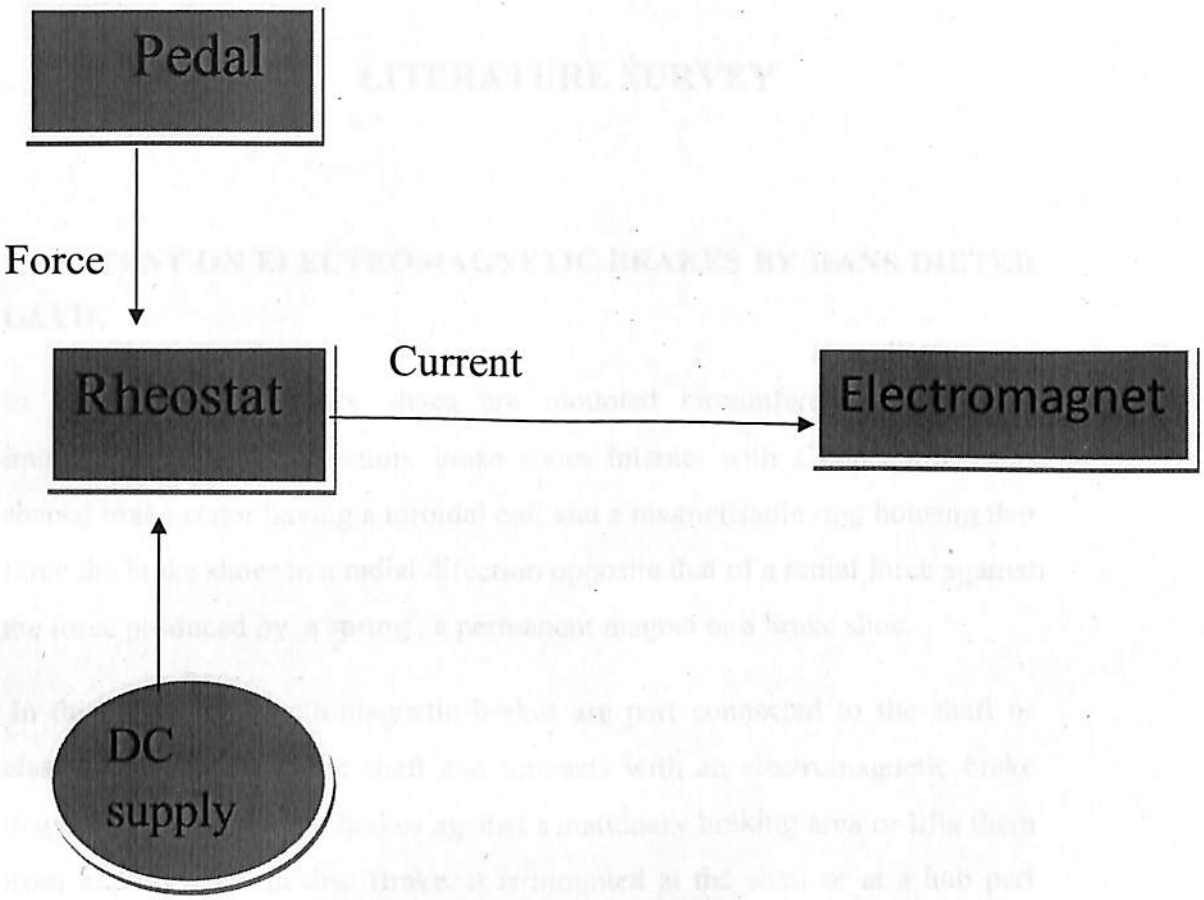

Fig 2.1

Flow Diagram

CHAPTER 3

LITERATURE SURVEY

3.1 PATENT ON ELECTROMAGNETIC BRAKES BY HANS DIETER LAYH.

In this patent the brake shoes are mounted circumferentially but are immovable in radial direction. Brake shoes interact with a concentric ring-shaped brake stator having a toroidal coil and a magnetisable ring housing that force the brake shoes in a radial direction opposite that of a radial force against the force produced by a spring , a permanent magnet or a brake shoe.

In this invention electromagnetic brakes are part connected to the shaft or elastically attached to the shaft and interacts with an electromagnetic brake magnet which forces the brakes against a stationary braking area or lifts them from braking area. In disc Brake, it is mounted at the shaft or at a hub part arranged on the shaft by spring elements to move in an axial direction but fixed so as to essentially not be rotated relative to the shaft. Leaf springs are manufactured with large tolerances and so adjusting device is necessary to ensure a sufficiently reproducible position of the brake disk when the brake is not actuated. But if it is necessary, the manufacturing tolerances can be reduced if the brake disk is guided axially on the shaft or the hub part by interacting grooves and recesses. But This type of arrangements generate noise. But in Cases tolerances that are too low and when the brake is not actuated ,it may cause the brake disks to grind at the brake magnet or at the stationary braking area.

In shoe type of brakes, An Electromagnet is transversely arranged in the arrangement and brake shoes are pressed from the inside and thus the braking

action is achieved, so to suit the need, the brake shoes that are curved in axial view of the brake drum at one end are disposed to be pivot able around an axis parallel to the axis of the drum. electromagnet is applied at theo the end of the brake shoes. Adjustment are needed to be made in this type of arrangement so as to work in a condition that brake shoes wear with time adjustment are needed to be made. The adjusting is necessary because the adjusting forces generated by the electromagnet also depend on the adjusting path that becomes continuously longer because of the wear of the brake shoes.

In this patent objective is achieved by a brake stator or brake magnet having two ring-shaped pole pieces that are arranged concentrically to the axis of the shaft and can be oppositely magnetized, and brake segments being arranged radically adjacent or concentric to the pole pieces with radial mobility at the shaft or at a hub part or the like and connected with said shaft are acted upon by springs that force the brake segments from the pole pieces and towards stops on the shaft or on the hub part.

Since the brake segments, when the brake is not actuated, take up a fixed, constructively indicated position, any precise adjusting in this case is not required. In addition, the braking force is extensively independent of the wear of the brake segments. The reason is that in the position when the brake is in effect, the brake segments are magnetically attracted by the ring-shaped pole parts and will close the gap between the pole parts irrespective of the wear. The magnetic forces between the brake segments and the pole parts are most extensively independent of the material thickness of the brake segments.

3.2 PATENT ON MAGNETIC BRAKE AND ELECTROMAGNETIC DEVICE WITH A MAGNETIC BRAKE BY OATHMER BOOZ AND GEORG KEOPFF

The invention is preferably a bi-stable magnetic brake, which is intended in particular for locking an actuating device of an electromechanical wheel braking device in its braking position at a given time. To enable releasing the magnetic brake even in the event of a defect, the invention proposes embodying the magnetic brake with two redundant electromagnets for its actuation.

The invention relates to an magnetic brake and more particularly to an improved electromechanical braking device especially useful for motor vehicles.

Description of the Prior Art

One such magnetic brake is known from U.S. Pat. No. 5,185,542. The known magnetic brake has one rotatable part and one rotationally fixed part, which are in frictional or positive engagement with one another in a braking position of the magnetic brake, so that the rotatable part is held or at least braked by the rotationally fixed part, and which in a released position of the magnetic brake are free of one another, so that the rotatable part is freely rotatable. For actuation, the known magnetic brake has a spring element, which presses the rotationally fixed part or the rotatable part against the respectively other part, as well as an electromagnet, which by being supplied with current disconnects the rotatable part and the rotationally fixed part from one another counter to the force of a spring element; that is, the spring element puts the magnetic brake in its braking position and keeps it there, and the magnetic brake can be released by means of the electromagnet. It is equally possible to put a magnetic brake into the braking position by supplying current to the electromagnet, while conversely a spring element releases the magnetic brake.

The magnetic brake has the disadvantage that in the event of a defect, or in other words if its electromagnet or its power supply fails, it cannot be actuated.

3.3 PATENT ON FLOATING ELECTROMAGNETIC BRAKES BY WILLIAM FRANK BORCHERS, ABRAHM SHOWKEE FARAG.

An electromagnetic brake system includes a motor having a rotor with a rotatable disk fixed to the rotor and an electromagnetic brake disposed about the disk to selectively prevent rotation of the rotor. The electromagnetic brake is carried on a resilient element so that it is suspended relative to the disk and isolated from the remainder of the system reducing the propagation of structural and airborne noise generated by actuation of the electromagnetic brake.

An electromagnetic brake system comprising:

- a motor having a rotor carried in a housing with a shaft extending from the housing and being rotatable with the rotor.

- a disk carried by the shaft and being fixed to the shaft to rotate in concert therewith.

- an electromagnetic brake disposed about the disk including a body, a coil carried by the body and a plunger disposed between the coil and the disk.

- at least one resilient element interposed between the housing and the body wherein the body is suspended on the housing by the resilient element so that the electromagnetic brake floats on the resilient element relative to the housing and the disk.

3.4 RETARDERS USED BY FRENCH COMPANY TELMA, ASSOCIATED WITH ROUL SHARAZIN, ON THE PRINCIPLE DERIVED BY REVERDIN.

Electromagnetic brakes work in a relatively cool condition and satisfy all the energy requirements of braking at high speeds, completely without the use of friction. Due to its specific installation location (transmission line of rigid vehicles), electromagnetic brakes have better heat dissipation capability to avoid problems that friction brakes face as we mentioned before. Typically, electromagnetic brakes have been mounted in the transmission line of vehicles. The propeller shaft is divided and fitted with a sliding universal joint and is connected to the coupling flange on the brake. The brake is fitted into the chassis of the vehicle by means of anti-vibration mounting. The practical location of the retarder within the vehicle prevents the direct impingement of air on the retarder caused by the motion of the vehicle. Any air flow movement within the chassis of the vehicle is found to have a relatively insignificant effect on the air flow around tire areas and hence on the temperature of both front and rear discs. So the application of the retarder does not affect the temperature of the regular brakes. In that way, the retarders help to extend the life span of the regular brakes and keep the regular brakes cool for emergency situation.

Working Principle

The working principle of the electric retarder is based on the creation of eddy currents within a metal disc rotating between two electromagnets, which sets up a force opposing the rotation of the disc. If the electromagnet is not energized, the rotation of the disc is free and accelerates uniformly under the action of the weight to which its shaft is connected. When the electromagnet is energized, the rotation of the disc is retarded and the energy absorbed appears

as heating of the disc. If the current exciting the electromagnet is varied by a rheostat, the braking torque varies in direct proportion to the value of the current. It was the Frenchman Raoul Sarazin who made the first vehicle application of eddy current brakes. The development of this invention began when the French company Telma, associated with Raoul Sarazin, developed and marketed several generations of electric brakes based on the functioning principles described above (Reverdin, 1974).

CHAPTER 4

GENRAL PRINCIPLE OF ELECTROMAGNETIC BRAKES

4.1 INTRODUCTION

Electromagnet have been used as an supplementary retardation equipment in addition to the general friction Brakes on a Vehicle. Here we try to outline the general outline of regular brakes and several alternate retardation systems.

4.2 WHAT IS AN ELECTROMAGNET?

An Electromagnet is a Non-Permanent Magnet that runs on Electricity. The strength of an electromagnet depends on the amount of current supplied to it.

As we know current passed in a wire produces a magnetic field around it. Current passed in a wire produce circles around it. The magnetic field can be concentrated inside the loop, if the current passing inside the wire can be formed into the loops. if an electromagnet is wrapped around a core ,its strength can be increased even more. Atoms in metal acts like tiny magnets these magnets tend to cancel each other's magnetic field. However if wire wrapped around a core point the field, the number of aligned atom increases in one direction and make a strong field in one direction.

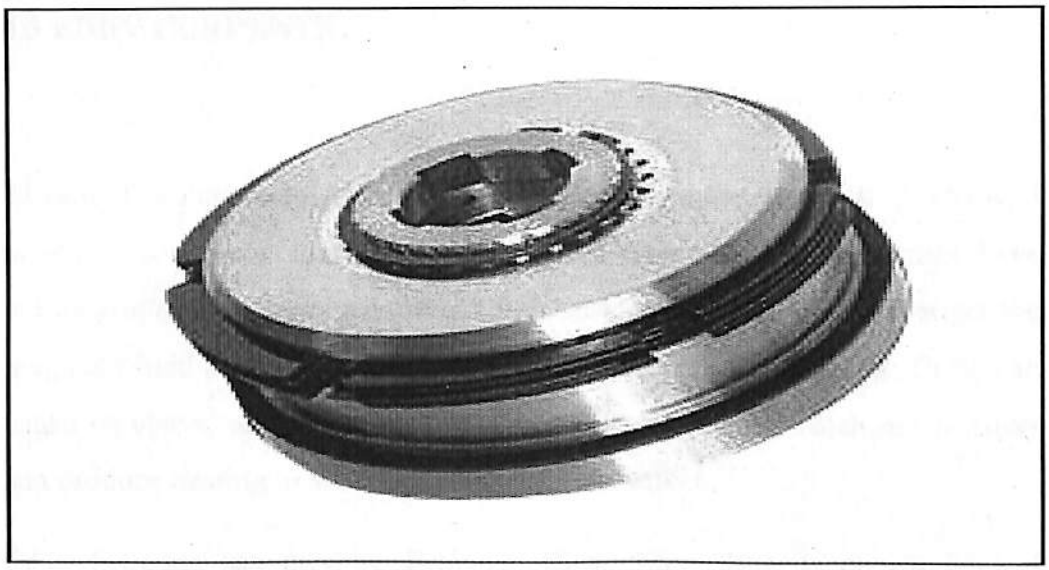

Fig 4.1

Electromagnet

1)Magnetic filed in Anti clockwise direction when current is coming in a direction out of paper.

2)Magnetic field in clockwise direction when current is coming in a direction into the paper.

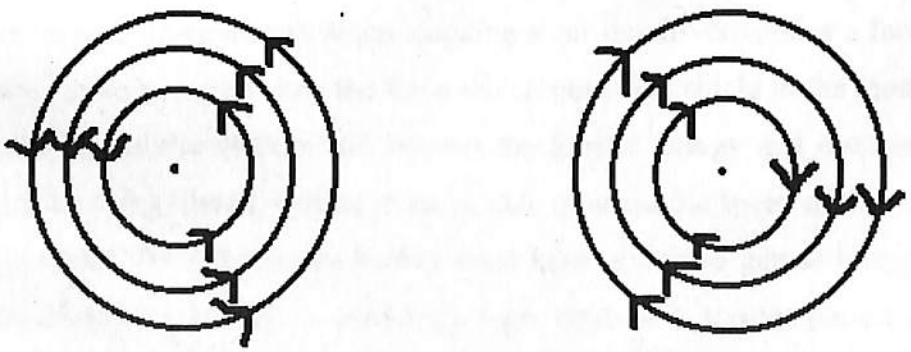

Fig 4.2

Basic Principle

4.3 EDDY CURRENTS

Electric Currents induced in a conductor when magnetic field is changed inside a conductor these are called eddy currents. Eddy currents have inductance and thus produce electric field inside a conductor. The stronger the magnetic field or greater the conductivity, greater are the currents .These can cause repulsive, attractive, heating, Drag Effects. Metals which are resisters can produce heating as well as electromagnetic effect.

Eddy Currents can produce Braking effect. Since there is no mechanical contact with brake shoe or drum there is no mechanical wear. Due to the drag produced by the eddy currents, it causes the braking effect. But they cannot produce a holding torque, so they are generally used in combination with mechanical brakes. The main reason for braking is the development of electric resistance within the plates.

4.4 GENERAL PRINCIPLE OF BRAKE SYSTEM

The General principle of Brake system is the conversion of kinetic energy into the thermal energy(heat).When stopping a car the driver applies a force many times more powerful than the force which puts the vehicle in the motion. The brakes stops the vehicle and convert the kinetic energy and dissipates it as thermal energy(heat). Brakes must be able to arrest the speed of the vehicle at any speed .As a result ,the brakes must have ability to generate high torque and absorbing energy at extremely high rates at a shorter period of time. Brakes may be applied for prolonged period of time in application such as Heavy vehicles descending a long Gradient at high Speed. Brakes have to have the mechanism to keep the heat absorption capability for a prolonged period of time.

4.5 CONVENTIONAL FRICTION BRAKES

The conventional friction brakes consist of the following Basic Components.:
1.Master Cylinder-Which is directly connected to the Brake pedal and directly increases the pedal force many times. This force is applied to Brake fluid and hydraulic pressure is developed.

2.Brake Hoses –The Brake hoses connect the master cylinder to slave cylinder at the wheel.

3.Brake fluid-This system is filled with brake fluid and it is designed to work in extreme temperature conditions.

4.Brake shoes- Slave cylinder pushes the Brakes against the rotor or drum which develops drags and slow down the car.

Two Major type of brakes are disc Brakes And drum Brakes:-

Disc Brakes use the clamping action to produce friction between the rotor and the pads mounted in the calliper attached to the suspension members disc brake uses the same principle as that in a bicycle.

Disc brake consist of cylinder which is sandwiched between wheel rim and wheel hub.when force is applied brake shoes comes in contact with the drum of wheel to slow down the rotation of the vehicle.

Air Brakes uses the simple hydraulic brakes components such as brake linings Master cylinder Slave cylinder to transmit Air Pressure produced braking energy to the wheel Brakes. Air Brake is used when greater Braking energy is required.

4.6 BRAKE FADING EFFECT

The conventional friction brakes can absorb and produce enormous energy values, but only if temperature of material is controlled. This high energy conversion therefore demands an appropriate rate of heat dissipation if a reasonable temperature and performance stability are to be maintained. Unfortunately, design, construction, and location features all severely limit the heat dissipation function of the friction brake to short and intermittent periods of application. This could lead to a 'brake fade' problem (reduction of the coefficient of friction, less friction force generated) due to the high temperature caused by heavy brake demands. The main reasons why conventional friction brakes fail to dissipate heat rapidly are as follows:

- poor ventilation due to encapsulation in the road wheels,
- diameter restriction due to tire dimensions,
- width restrictions imposed by the vehicle spring designer;
- problems of drum distortion at widely varying temperatures.

It is common for friction-brake drums to exceed 500 °C surface temperatures when subject to heavy braking demands, and at temperatures of this order, a reduction in the coefficient of friction ('brake fade') suddenly occurs (Grimm, 1985). The potential hazard of tire deterioration and bursts is perhaps also serious due to the close proximity of overheated brake drums to the inner diameter of the tire.

4.7 RETARDERS

Retarders are means of overcoming the above problems augmenting a vehicle's foundation brakes with a device capable of opposing vehicle motion at relatively low levels of power dissipation for long periods.

There are several retarder technologies currently available. Two major kinds are the hydrokinetic brake and the exhaust brake. Hydrokinetic brake 7 uses fluid as the working medium to oppose rotary motion and absorb energy. Hydrodynamic brakes are often built into hydrodynamic transmission. Exhaust brakes use a valve which is fitted into the exhaust pipe between the exhaust manifold and silencer. When this valve is closed air is compressed against it through the open exhaust valve by the piston rising on the exhaust stroke. In that way the engine becomes a low pressure single stage compressor driven by the vehicle's momentum, resulting in a retarding effect being transmitted through the transmission to the driving road wheels. The power-producing engine is converted into a power absorbing air compressor .This approach could put a lot of stress on the cylinder and exhaust system. So it may require extra engineering efforts to implement this system. As a brake applied to the engine, exhaust brakes can only absorb as much power as the engine can deliver. But the power absorbed in braking is usually greater than the power absorbed in driving.

Compared with these retarders, electromagnetic brakes have greater power capability, simplicity of installation and controllability.

4.8 GENERAL PRINCIPLES OF ELECTROMAGNETIC BRAKES:

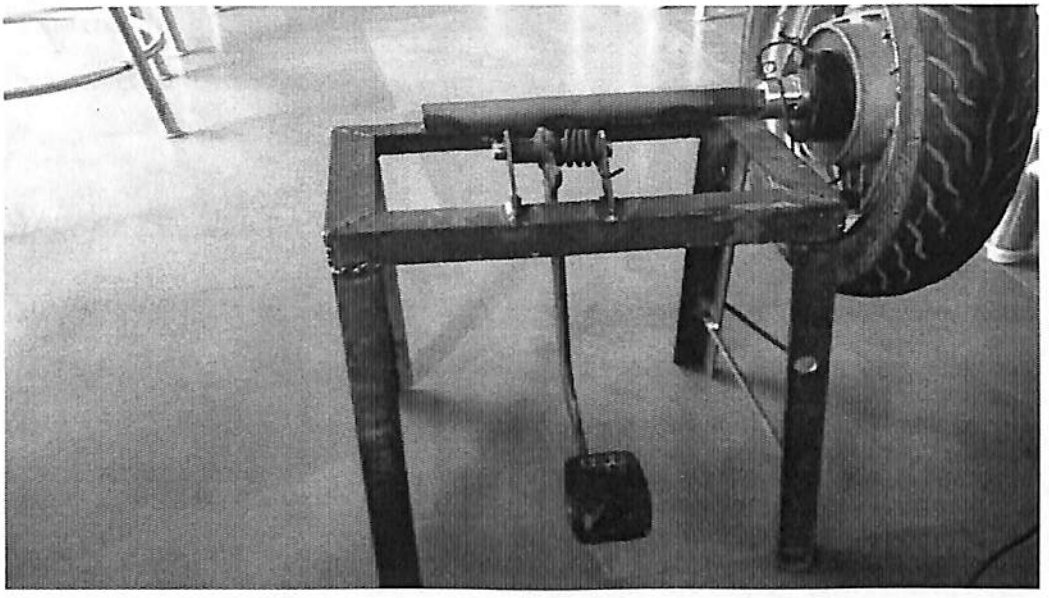

Fig 4.3

Use Of Electromagnet In Brakes

Installation location

Electromagnetic brakes work in a relatively cool condition and satisfy all the energy requirements of braking at high speeds, completely without the use of friction. Due to its specific installation location electromagnetic brakes have better heat dissipation capability to avoid problems that friction brakes face as we mentioned before. electromagnetic brakes have been mounted on the chassis of the vehicle.

The brake is fitted into the chassis of the vehicle by means of anti-vibration mounting.

The practical location of the retarder within the vehicle prevents the direct impingement of air on the retarder caused by the motion of the vehicle. Any air flow movement within the chassis of the vehicle is found to have a

relatively insignificant effect on the air flow around tire areas and hence on the temperature of both front and rear discs. So the application of the retarder does not affect the temperature of the regular brakes. In that way, the retarders help to extend the life span of the regular brakes and keep the regular brakes cool for emergency situation.

Working Principle:

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A typical retarder consists of stator and rotor. A stator consists of induction coils which work as current passes through them. The coil is made up of copper. The electromagnetic brakes are mounted on the chassis of the vehicle.

Electric circuit of the Electromagnetic Brakes

Electromagnet is connected by a rheostat to the DC power supply. Rheostat is directly connected to the DC power supply. As the pedal is pressed the resistance passing through the rheostat as the pedal is pressed resistance is varied from its highest value and as the pedal is pressed more so the system is direct and it offers 0 resistance highest current flows to the electromagnet in this situation. In this way the Resistance is varied and so the current is varied and thus the electromagnetic effect or the production of eddy currents is varied and thus the braking force keeps on varying.

4.9 CHARACTERISTICS OF ELECTROMAGNETIC BRAKES

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. These performances of electromagnetic brakes make them much more competitive candidate for alternative retardation equipments compared with other retarders. By using the electromagnetic brake as supplementary retardation equipment, the friction brakes can be used less frequently and therefore practically never reach high temperatures. The brake linings would last considerably longer before requiring maintenance, and the potentially "brake fade" problem could be avoided. In research conducted by a truck manufacturer, it was proved that the electromagnetic brake assumed 80 percent of the duty which would otherwise have been demanded of the regular service brake. Furthermore, the electromagnetic brake prevents the dangers that can arise from the prolonged use of brakes beyond their capability to dissipate heat. This is most likely to occur while a vehicle descending a long gradient at high speed. It can exceed the requirements of continuous uninterrupted braking, leaving the friction brakes cool and ready for emergency braking in total safety.

It does not need a subsidiary cooling system. It does not rely on the efficiency of engine components for its use, as do exhaust and hydrokinetic brakes. The electromagnetic brake also has better controllability. The exhaust brake is an on/off device and hydrokinetic brakes have very complex control system. The electromagnetic brake control system is an electric switching system which gives it superior controllability.

CHAPTER 5

DESIGN AND CALCULATIONS

As we know the design of an electromagnetic brake simply includes a electromagnet which is connected to a shaft directly mounted on a chassis which is near to the vehicles. We have to mount electromagnet on all 4 wheels as it is an additional retarder and cannot work singly on all 4 wheels.

Here in the designing section we will design a electromagnet which can stop a Maruti 800 car.

1.) We will try to calculate the number of turns which an electromagnet need choosing a wire of suitable gauge.

2) The calculations of a Rheostat needed to vary the Current in the Electromagnet.

3) The Stopping Distance of car after applying the above electromagnet.

1) First of all we will design a electromagnet which can stop a Maruti800.

Solution :–

weight of car =1000kg

Weight of passenger=100kg.

Seating capacity =4

Total weight=1000+100*4=1400kg

But considering a weight increment of +200 kg, we will design brakes for car weighing 1600kg.

As we know a car has 4 wheels,

so weight on each wheel = 1600/4=400kg.

We will design an electromagnet with a weight of 400kg on each wheel.

Now, Battery of Maruti800 12V

Current value =30 Ampere.

Diameter of Wire=21 gauge.

Diameter of wire=21 gauge(5.33*10^(-6))

Force =400 kgf (4000N)

Area=pi/4 D^2

= (3.14/4)*(5.33*10 ^ (-6)) ^ 2

=89.24* 10 ^ (-12) m

K=constant.

K=4 * pi * 10 ^ (-7)

G= 0.2cm

N=?

Formula:

Weight = ((N*I) ^ 2 * K * A)/2 * G ^ 2

4000= ((N*30) ^2 * 4*Pi*10^(-7)*8.924 *10 ^ (-11))/2*(0.002) ^ 2

4000= ((N*30)^2*4*3.14*10^(-7)*8.924*10 ^ (-11))/(.004)^2

On solving the above equation,

The value of N comes out to be around 900

N~900

The number of turns required for stopping a wheel of weight 400kg would be around 900.

An electromagnet with a wire of diameter around 21 gauge and at a distance of around .2 cm from the metal plate with 900 turns is enough to stop a maruti800 car.

A rheostat is needed to vary the current passed into the electromagnet. The current passed into the electromagnet comes from a 30V constant DC supply. But to vary the braking force through the electromagnet the current passed into the magnet should be varied. This is achieved through a rheostat as current through it is varied by varying the resistance.

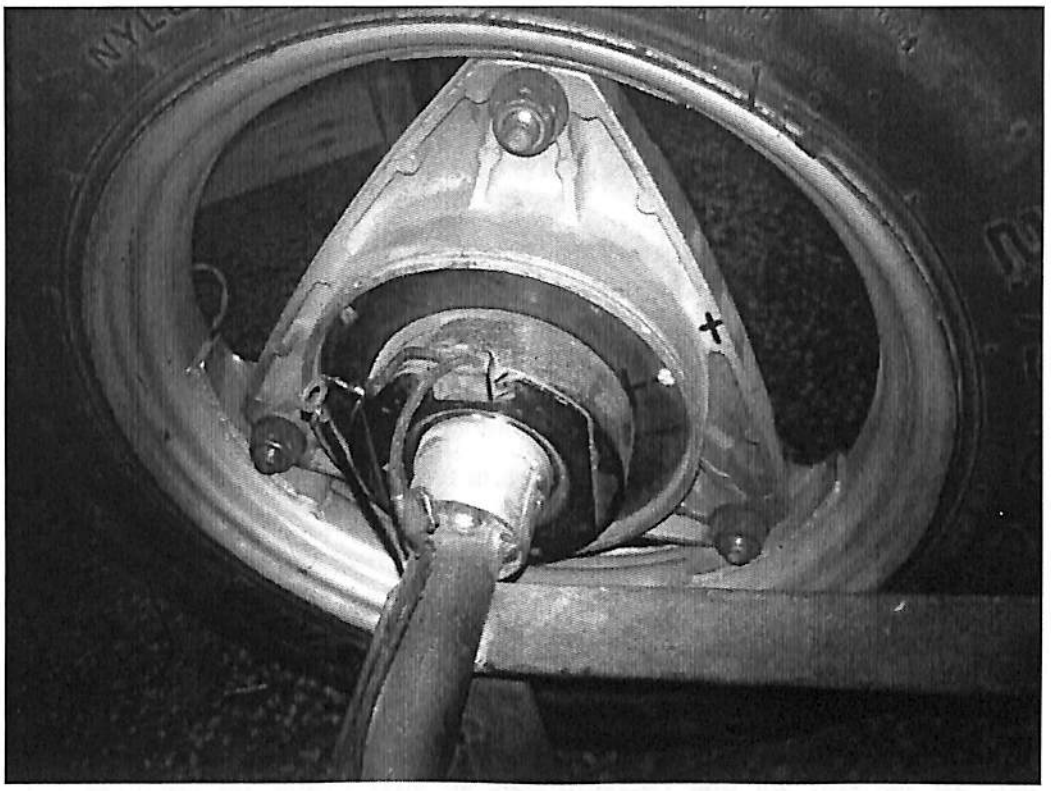

Fig 5.1

Model

2) Calculation of Rheostat.

As we know we need to vary the current in an electromagnet according to the pedal force applied but if the value of the resistance is large then the current passed in electromagnet would be negligible and so the braking force.

We will try to vary the current from 6 ampere to 30ampere.

So the resistance required would be.

V=IR

R=V/I

R=30/6 = 5 ohm .

So we design a rheostat at which the resistance varies from 5 ohm at the minimum pedal force to 0 ohm at the highest pedal force applied.

We have used nichrome wire for the above purpose.

(Nichrome is an alloy of nickel and chromium commonly used for heating.

Nichrome generally consist of around 80 % nickel and 20% chromium by weight. Nichrome is grey in colour and generally have high melting point.)

Out of Many metals we have choose to go with nichrome wire because of its high resistive properties and high melting point.

We calculated the resistance using the ohmmeter of the rheostat.

After applying the above type of electromagnet and the rheostat we will hereby try to calculate the stopping distance of the car by installing the above brakes.

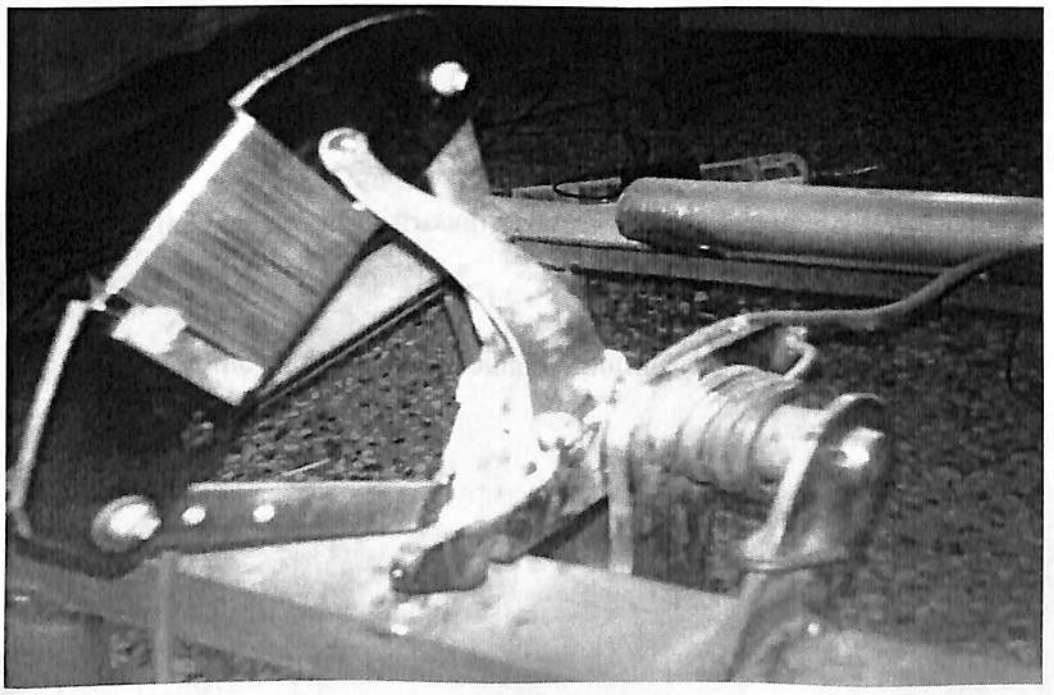

Fig 5.2

Rheostat

3) Calculation of the Braking distance of a car.

Braking distance of car refers to the distance the vehicle will travel from the point where brakes are fully applied to the point where vehicle comes to a complete stop. It is affected by the speed of the vehicle, the reaction time of the rider and the coefficient of friction between the tires and the road surface.

The theoretical Braking distance of car can be determined by determining the work required to dissipate the vehicle's kinetic energy.

The kinetic energy of the vehicle is given by the equation.

$E=1/2\ mv^2$

Where

m=mass of the vehicle.

v= velocity of the vehicle.

The work done by braking is given by

$W=umgd$

Where u is the coefficient of friction between tires and road,g is the gravity of the earth, d is the distance travelled.

The distance of the vehicle can be found by putting the W=E.

$d=v^2/2*u*g$

suppose a speed of 90km/hr.

Then the speed in m/sec would be.

$90*5/18=25m/s$

Considering u=0.25

And $g=10m/sec^2$

Now the stopping distance would be,

d=(25^2)/2*0.25*10=125m.

Now if the speed of the vehicle is 60km/hr.

Then v=60*5/18

=16.67m/sec

The stopping distance would be around

d=(16.67)^2/2*0.25*10=56m

The stopping distance at a speed of 60km/hr would be 56m.

The stopping distance at speed of 90km/hr and 60/hr are significant.

CHAPTER 6

CONCLUSION

We have replaced conventional braking system with Electromagnetic Braking System. An Electromagnet which is installed on the chassis near tyre and is connected to the battery through a Rheostat.

Fig 6.1

Complete Model

Thus using electromagnetic brakes we have tried to concluded the following thing.

1) Electromagnetic brakes can work in a relatively cool condition and could satisfy all the energy requirements of braking at high speeds, completely without the use of friction.

2) Particulate emission can be decreased.

3) Noiseless – as electromagnetic brakes have no frictional contact, they are noise less in nature.

4) As there is no contact is there with the tire and electromagnet can last longer, thus Brake fade problem can be avoided and the problem of regular replacement can be avoided.

5) The brake linings would last considerably longer before requiring maintenance if used.

6) Electromagnetic Braking System can be used in automatic braking with the use of sensors.

7) They can be easily used for regeneration of energy.

8) They have High degree of safety. as the braking performance is same all over the time thus they have high degree of safety.

9) They have Very high response. As the braking action start as soon as the current passes through the brakes thus they have very high response.

10) They have Constant performance. As nothing does damage with time and so the performance of electromagnetic brakes have constant performance all over the time.

CHAPTER 7

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