Design and Development of Electrical Bicycle Using Electro Magenetic Brake

G.Rajesh
Assistant Professor
Department of Mechanical Engineering
SRM Valliammai Engineering College
chennai, India
Email: rajeshg.mech@srmvalliammai.ac.in & rajeshmech1984@gmail.com

Abstract-An electromagnetic brake may be a new and revolutionary concept. These are totally friction less. Electromagnetic brakes are the brakes engaged on the electrical power & magnetic power. An Electromagnetic Braking system uses attractive force to interact the brake, but the facility required for braking is transmitted manually. Electromagnetic braking system could be a modern technology braking system employed in electrical vehicles, light motor vehicles & heavy cars. The frequency of accidents is now-a-days increasing to inefficient braking system. It's apparent that the electromagnetic brake is a vital complement to the safe braking of light and heavy vehicles. It aims to reduce the breakdown to avoid the road accidents. It also reduces the upkeep of braking system. The plus of this technique is that it is often used on any vehicle with minor modifications to the transmission and electrical systems. An Electromagnetic Braking system uses attraction to have interaction the brake, but the facility required for braking is transmitted manually. The disc is connected to a hub motor of the electrical bicycle and therefore the electromagnet is mounted on the rear wheel frame. When electricity is applied to the coil a field is developed across the armature due to the present flowing across the coil and causes armature to induce attracted towards the coil, as a result, it develops a torque and eventually the vehicle involves rest. These brakes are often incorporated in heavy vehicles as an auxiliary brake. The electromagnetic brakes are employed in electrical bicycle by controlling this supplied to provide the magnetic flux. Making some improvements within the brakes it is often employed in automobiles in future.

Keywords-Electromagnetic brake, friction less.

INTRODUCTION

Electromagnetic brakes are used as supplementary retardation equipment additionally to the regular friction brakes on heavy vehicles. We outline the overall principles of standard brakes and several other alternative retardation techniques during this section. The working rule and characteristics of electromagnetic brakes are then highlighted. The principle of braking in road vehicles involves the conversion of mechanical energy into thermal energy (heat). When stepping on the brakes, the motive force commands a stopping force several times as powerful because the force that puts the car in motion and dissipates the associated mechanical energy as heat. Brakes must be able to arrest the speed of a

vehicle during a short period of your time regardless how briskly the speed is. As a result, the brakes are required to own the flexibility to generating high torque and absorbing energy at extremely high rates for brief periods of your time. Brakes could also be applied for a chronic period of your time in some applications like an important vehicle descending an extended gradient at high speed. Brakes must have the mechanism to stay the warmth absorption capability for prolonged periods of your time. within the electromagnetic brake, the coil or solenoid attracts a steel disc. The steel disc presses a brake disc product of sintered or asbestos material between itself and a stationary steel disc. The torque is thus 'grounded' and braking action takes place. this kind of brake is employed in machines like lathes, presses etc. In electro-magnetic braking system electro-magnetic property is employed thanks to this action of braking are going to be done. during this system, electro magnet iron plate, liners, tension spring, stud, hydraulic brakes plate are used. The brake liners are attached with electro- magnet and iron plate individually and both plate insert the disc plate and this plate rigidly attached with wheels. The battery of minimum 24 volts is employed for external power supply. Electromagnet consists of wire wound over a soft iron core. When current is more experienced the coil, it produces a force field which magnetizes the core into the magnet with the polarities. Strong flux is obtained by high currents of huge self-induction. High currents don't seem to be always feasible, which is why a high self-induction is obtained by making a loop of wire within the shape of a coil, a so-called solenoid. More current and more turns produce a stronger field which ends in stronger electromagnet. When current is converted field disappears and also the iron core not a magnet. This ability of an electromagnet provides a powerful magnetic force of attraction. Shape geometry and material used in construction of electromagnet decide the shape and strength of magnetic field produced by it.

COMPONENTS

Electromagnetic coil

An electromagnetic coil is an electrical conductor like a wire within the shape of a coil, spiral or helix. Electromagnetic coils are employed in EE, in applications where electric currents interact with magnetic fields, in devices like electric motors, generators, inductors, electromagnets, transformers, and sensor coils. Either an electrical current is seasoned the wire of the coil to come up with a flux, or conversely, an external time-varying force field through the inside of the coil generates an EMF (voltage) within the conductor. A current through any conductor creates a circular force field round the conductor thanks to Ampere's law. The advantage of using the coil shape is that it increases the strength of the magnetic flux produced by a given current. The magnetic fields generated by the separate turns of wire all suffer the middle of the coil and add (superpose) to provide a robust field there. The more turns of wire, the stronger the sphere produced. Conversely, a changing external magnetic flux induces a voltage in an exceedingly conductor like a wire, thanks to Faraday's law of induction. The induced

voltage is often increased by winding the wire into a coil because the sphere lines intersect the circuit multiple times. The direction of the force field produced by a coil are often determined by the proper hand grip rule. If the fingers of the correct hand are wrapped round the core of a coil within the direction of conventional current through the wire, the thumb will point within the direction the force field lines tolerate the coil. the tip of a core from which the sphere lines emerge is defined to be the North Pole. There are many alternative varieties of coils utilized in electric and equipment.

Fig.1 Electromagnetic coil

DC Electrical Switch

In engineering science, a switch is an electrical component which will disconnect or connect the conducting path in an electrical device, interrupting the electrical current or diverting it from one conductor to a different. The foremost common variety of switch is an mechanical device consisting of 1 or more sets of movable electrical contacts connected to external circuits. When a pair of contacts is touching current can pass between them, while when the contacts are separated no current can flow.

Fig.2 DC Electrical Switch

Lead acid battery

The lead–acid battery could be a style of rechargeable battery first invented in 1859 by French physicist Gaston Planté. it's the primary sort of rechargeable battery ever created. Compared to modern rechargeable batteries, lead–acid batteries have relatively low energy density. Despite this, their ability

to provide high surge currents means the cells have a comparatively large power-to-weight ratio. These features, together with their low cost, make them attractive to be used in automobiles to produce the high current required by starter motors. As they're inexpensive compared to newer technologies, lead–acid batteries are widely used even when surge current isn't important and other designs could provide higher energy densities. In 1999 lead–acid battery sales accounted for 40–50% of the worth from batteries sold worldwide (excluding China and Russia), comparable to a producing market price of about $15 billion. Large-format lead–acid designs are widely used for storage in backup power supplies in mobile phone towers, high-availability settings like hospitals, and stand-alone power systems. For these roles, modified versions of the quality cell could also be accustomed improve storage times and reduce maintenance requirements. Gel-cells and absorbed glass-mat batteries are common in these roles, collectively referred to as VRLA (valve-regulated lead–acid) batteries.

In the charged state, the energy of the battery is stored within the voltage between the pure lead at the negative side and therefore the PbO2 on the positive side, plus the aqueous oil of vitriol. The electricity produced by a discharging lead–acid battery is attributed to the energy released when the strong chemical bonds of water (H2O) molecules are formed from H+ ions of the acid and O2− ions of PbO2. Conversely, during charging, the battery acts as a water-splitting device.

Fig.3 12v and 18 amps lead acid Battery

Disc Plate

Brake rotors of disc brakes rotate with the wheels, and brake pads using electromagnetic coil, which are fitted to the brake calipers, clamp on these rotors to stop or decelerate the wheels. The brake pads pushing against the rotors generate frictionless, which transforms kinetic energy into a thermal energy.

Fig.4 MS Disc Plate

Electrical bicycle

An electric bicycle may be a motorized bicycle with an integrated motor accustomed assist propulsion. Many sorts of e-bikes are available worldwide, but they often fall under two broad categories: bikes that assist the rider's pedal-power (i.e. pedelecs) and bikes that add a throttle, integrating moped-style functionality. Both retain the flexibility to be pedaled by the rider and are therefore not electric motorcycles. E-bikes use rechargeable batteries and typically travel up to 25 to 40 km/h. High-powered varieties can often travel over 40 km/h. In Germany as of 2013, they're gaining in popularity and taking some market share far from conventional bicycles, while in others, like China as of 2010, they're replacing fossil fuel-powered mopeds and little motorcycles.

Depending on local laws, many e-bikes (e.g., pedelecs) are legally classified as bicycles instead of mopeds or motorcycles. This exempts them from the more stringent laws regarding the certification and operation of more powerful two-wheelers which are often classed as electric motorcycles. E-bikes may also be defined separately and treated under distinct electric bicycle laws. E-bikes are the electrical motor-powered versions of motorized bicycles, which are in use since the late 19th century. Some bicycle-sharing systems use them.

Fig.5 Electromagnetic e-bicycle

CONSTRUCTION AND WORKING PRINCIPLE

This electrical bicycle has a 350W & 48V hub motor with a control unit. It gives the motion for the electrical bicycle movement to three different speeds, at 25 km/h, 30 km/h and 40 km/h. These corresponding speeds mainly draw back, appealing to the appalling break to this device and controlling the speed of this bicycle. So we are implementing an electromagnetic breaking system to control this electrical bicycle. In this system we are using two electric coils to the specification of 60 kg with 24v capacity. The total break force is 120 kg for the two different places in the front wheel setup. This electromagnet breaks to control the entire bicycle's speed with the help of an electrical switch. To activate the electrical switch, the electrical coil is magnetic and applies force to the disc without friction to stop the bicycle. An electromagnet is simply a coil of wire. It is usually wound around an iron core. However, it could be wound around an air core, in which case it is called a solenoid. When connected to a DC voltage or current source, the electromagnet becomes energized, creating a magnetic field just like a permanent magnet. The magnetic flux density is proportional to the magnitude of the current flowing in the wire of the electromagnet.

The polarity of the electromagnet is determined by the direction of the current. The north pole of the electromagnet is determined by using your right hand. Wrap your fingers around the coil in the same direction as the current is flowing (conventional current flows from + to -). The direction your thumb is pointing in the direction of the magnetic field so north would come out of the electromagnet in the direction of your thumb. DC electromagnets are principally used to hold break disc.

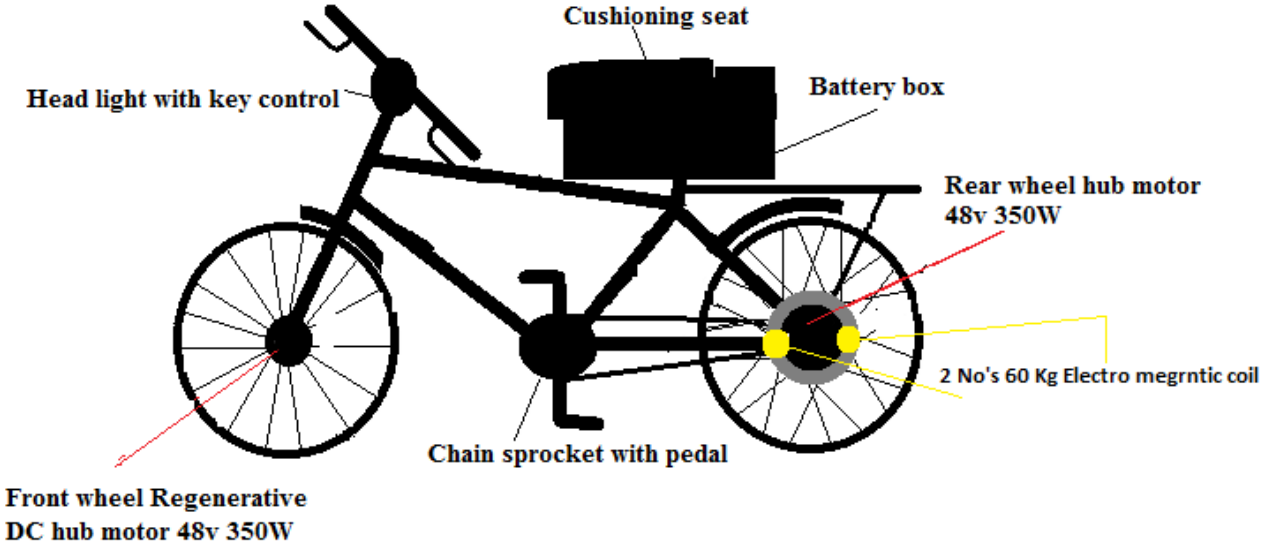

Fig.6 Design of Electromagnetic e-bicycle

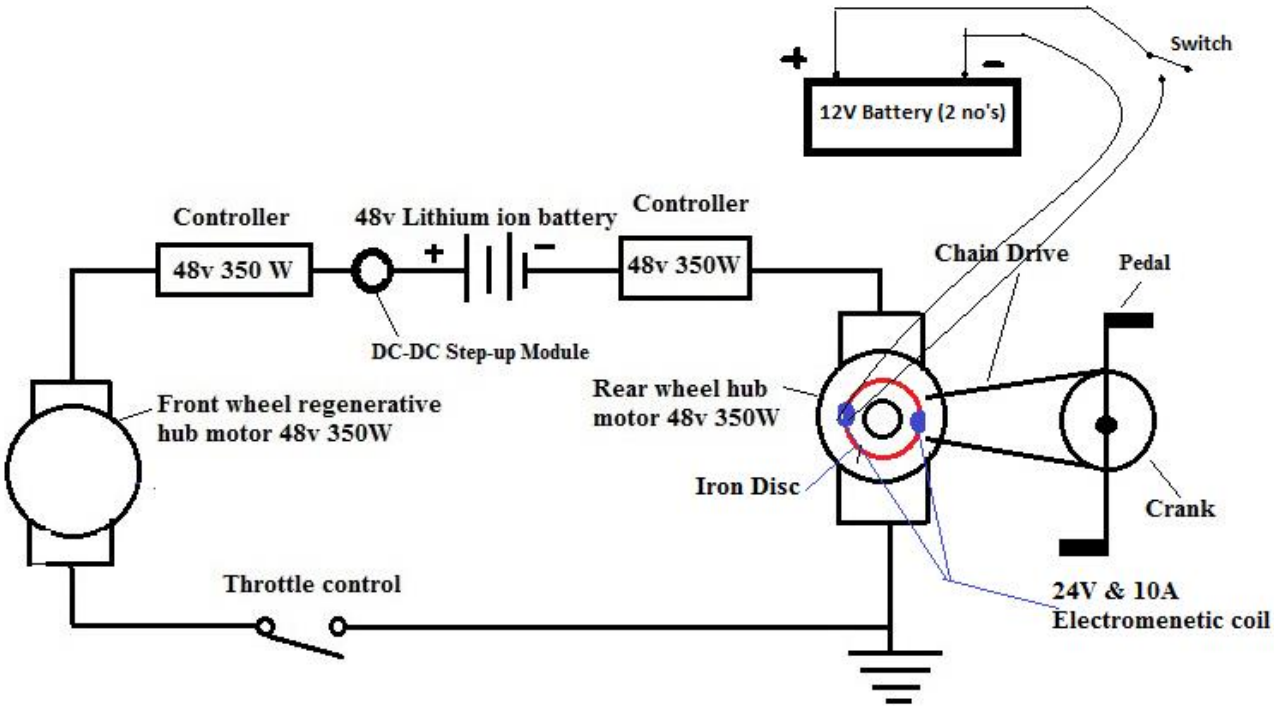

Fig.7 Circuit Diagram

SPECIFICATION

S.No	Specification	Front wheel	Rear wheel
1	Rated Voltage of DC Motor	-	48 V
2	Rated Power of DC Motor	-	960W
3	Continuous Current of DC Motor	-	~15.7A
4	Torque on DC Motor	-	8.277 N-m
5	Lithium-ion battery for DC hub motor	-	48v & 20A
6	Lead acid Battery for break	12v & 18A (2 no's)	-
7	HOLDING/ SUCTION FORCE (KG)	60 kg (2 No's)	-
8	OPERATING VOLTAGE (VDC)	24v	-
9	Power Consumption (watt)	15 V	-
10	Outer core	40 mm x 40 mm.	-
11	Inner Core	25 mm x 25 mm.	-
12	No. of turns on electromagnet (N)	800, (24 gauge wire)	-
13	Dia of electromagnet (L)	25 mm	-

CONCULUSION

Electro-magnetic system is to be more reliable than the present braking system. In disc braking system or wire and shoe braking system, there are chances of equipment failure While in electromagnetic braking system as two electromagnets are placed round the MS plate a having small air gap between them, just in case any electromagnet brake fails the brake dose not completely fails remaining one electromagnet work properly. And this method required very low maintenance. this sort of braking system not only helps in effective braking but also helps in reducing the frequency of accidents to a minimum. From the benefits of electromagnetic brake over friction brake it may be used on electrical vehicles where the brake fading problem exists. supported this same concept is developed for application on lighter vehicles. Electromagnetic braking could be a non contact form of braking system. electromagnetic brake may be used as auxiliary braking system with friction braking system to avoid overheating. Electromagnetic braking system is cheaper than other braking system.