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PROTOTYPE MODEL OF ELECTRICAL LOCOMOTIVE

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Abstract - *Electrical locomotive is driven by DC series motor of 12V and 10A. The torque produced by motors is used to move the locomotive. The main supply to the motor is given through pantographs. The total length of path is 5m approximately. The other main equipment are relays, rectifiers, signal controllers. Rectifier is used for conversion of alternating current to direct current. The relays and the signal control system are connected together to trace the location of the locomotive. The final outcome of our project is to design a traction-based locomotive equipped with sensor along with the automatic signal system to alert the driver during obstructions on the path. The railway is one of the largest and oldest methods of the transportation in our country serving many people in many ways. The major problem in railways is derailing and obstruction to the locomotive in different ways. Traction is basically two types, electrical traction and non-electric traction. Electric traction is most advantageous and economical with less maintenance when compared to other.*

***Key Words*: DC series Motor, traction system, pantograph, Locomotive, DC servo motor.**

1.INTRODUCTION

Indian Railways has a rich history and operates the fourth-largest network in the world, covering more than 1.2 million kilometres nationwide. The Indian Railway primarily offers three different services to the general public: express trains, mail express trains, and passenger trains. Passenger trains have the lowest fares when it comes to fares, whereas Mail Express trains have the highest fares. Express train fares, however, fall somewhere in the middle. In 1832, the idea of setting up a railway system in British India was first proposed. At that time, rail travel was still in its infancy in Britain, but the East India Company knew the allowed to establish a rail system by Lord Harding, the Governor-General of India in 1844. By the year 1845, the "East Indian Railway Company" and the "Great Indian Peninsula Railway" had been established. The first train in India was scheduled to travel approximately 34 kilometres between Thane and Bori Bunder in Bombay (now Mumbai) on April 16, 1853.

Around the three major port cities of Bombay, Madras, and Calcutta, a network of around 14,500 km was created in 1880.The Department of Trade and Industry provided oversight for the establishment of the Railway Board in 1901.Yet, the Viceroy was still given the authority. Look at the timeline of Indian railroads. In our college, we created this prototype model of an electric locomotive. The electric locomotive is driven by DC series motor of 12V. The torque produced by motors is used to move the locomotive. The main supply to the motor is given through pantographs. The main motive To Design AC Traction System used for Practical Applications. And the other main equipment are relays, rectifiers, signal controllers. Rectifier is used for conversion of alternating current to direct current. The relays and the signal control system are connected together to trace the location of the locomotive. There are different methods are used in tractions systems such as AC traction & DC tractions

There are three primary categories of electric traction systems:

Composite system, Direct Current (DC), and Alternating Current (AC) electrification systems.

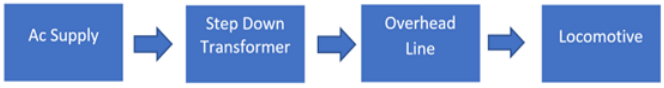

Fig no. 1 Block Diagram Electric locomotive

Electric locomotive that are completely power by electricity, electric locomotive is faster than other types of locomotives. but how electric converted an engine work, in this project we will learn the working function of an electric locomotive. the electricity is supplied to the locomotive through overhead cable which carry alternating current AC these cables are connected to a power station that produced the required electricity The first stage is transformer which is converted 230 volts to 24-volt AC in overhead line and this alternating current which is carry pantograph, pantograph which touch in overhead line and collect electricity it run over busbar on the roof of locomotive through circuit breaker, this device is used to protect the locomotive form short circuit and over load current. A single-phase ac converted and engine work the output current from the circuit breaker transfer to rectifier where it is converted to direct current dc further the dc is used to regulate the traction motor connecter to the wheel as the motor rotates the wheel are driven the traction motor.

2. METHODOLOGY

The electric locomotive is driven by DC series motor of 12V. The torque produced by motors is used to move the locomotive. The main supply to the motor is given through pantographs. The main motive To Design AC Traction System used for Practical Applications. And the other main equipment are relays, rectifiers, signal controllers. Rectifier is used for conversion of alternating current to direct current. The relays and the signal control system are connected together to trace the location of the locomotive. There are different methods are used in tractions systems such as AC traction & DC tractions

1. Step down Transformer- the incoming 230 volts ac supply are connected in primary side of transformer i.e., called as input supply voltage. The transformer converts into 230 volts to 24volts AC, 50hz. & The secondary side of transformer is called as output is 24 volts Ac supply the output supply are also connected in overhead line

2. DC series Motor - The electric locomotive which is used DC series motor because of their high torque and good speed control. Compared to AC motors, DC motors can provide industry applications with a fine balance of strong starting torque and controllable speed for seamless yet precise performance. Trains are a large-scale application; therefore, a DC motor can effectively and safely move the heavy load forward. The DC series Motor is such dc motor that used in such applications where a high quantity of torque needed. Its construction is such that armature windings and field windings are linked in series combination. Such configuration helps to generate a large quantity of torque.

3. DC servo - DC servo motors have a high ratio of starting torque to inertia and therefore they have a faster dynamic response. DC motors are constructed using rare earth permanent magnets which have high residual flux density and high coercively. As no field winding is used, the field copper losses am zero and hence, the overall efficiency of the motor is high. The speed torque characteristic of this motor is flat over a wide range, as the armature reaction is negligible. Moreover, speed in directly proportional to the armature voltage for a given torque. Armature of a DC servo motor is specially designed to have low inertia. In DC servo motors are used with magnetic flux produced by field windings.

4. Battery Charger Signaling Relay- This relay is provided across battery charger and indicates the working of the charger. This Relay is Electric make picks up below 24 V DC.

Construction –

The D.C series motor is consisting of a rotor (armature), commutator, stator, axle, field windings, and brushes. The fixed component of the motor is the stator and is constructed with two or more electromagnet pole parts. The rotor consists of the armature and windings at the associated core for the armature. The power source in the brush array associated with the commutator can be connected to the armature winding. The rotor includes a central axle for rotating, and due to a large amount of current in the entire winding the field winding should be able to hold the higher current, the larger will be the torque produced with the motor.

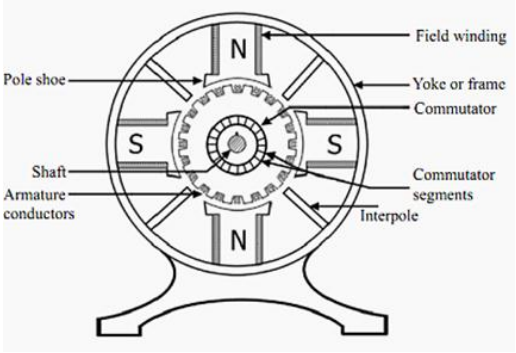

Fig. no. 2 DC Series motor

The stator and rotor of the servo motor are both wound twice. The stator winding, also known as the motor's field winding, is wound on the stationary portion of the machine. The rotor winding, also known as the motor's armature winding, is wound on the component that rotates. For the shaft's free movement, the motor has two bearings on the front and back. The encoder features a rough sensor for calculating the motor's rotational speed and revolutions per minute.

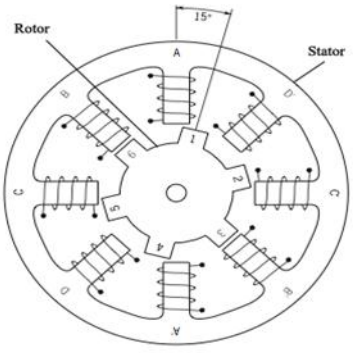

Fig. no. 3 DC Servo motor

Table -1: Comparison chart

SN	Points	AC System Traction	DC System Traction
01	Supply given to O/H condition	1-ph, 25KV, AC 25 Hz	600/750V-Tromways 1500/300V urban/suburban
02	Type of drive used	1-ph, AC series motor	DC series motor for tramways. DC compound motor
03	Weight of traction motor	1.5 times more than d.c series motor.	1.5 times less then a.c series motor
04	Starting torque acceleration and retardation	Less starting torque	High starting torque
05	Acceleration and retardation	Less than d.c series motor	High
06	Overhead capacity	Less than d.c series motor	High
07	Method of speed control	Simple and smooth	Limited, except chopper method
08	Efficiency	More	Less
09	Regenerative braking	Easy	Difficult
10	Cost track electrification	Less	More
11	Cross section of conductor	Less	More
12	Design of supporting structure	Light	Heavy
13	Distance between two substations	More	Less
14	No.of substation required	Less	More
15	Applications	Main line services	Urban and suburban area

A) Mechanical Properties or characteristics:

It should be robust in construction & simple in design to withstand against continuous vibrations. Weight of motor per HP should be minimum in order to increase pay load capacity. It must be small in overall dimensions, especially in overall diameter. It must have totally enclosed type enclosure to provide protection against entry of dirt, dust in drive. 5) When motors are running in parallel, they should share almost equal load. (Even where there is unequal wear & tear of wheels)

B) Electrical Properties or characteristics:

It should be having starting torque. It should possess high rate of acceleration & retardation 8) It should be variable speed motor. Its speed-torque characteristics should such that as torque increases speed decreases, due to this characteristic motor is protected against overload. Motor must be capable of taking excessive overload in case of emergency. It should have simple speed control methods. Electrical braking system should be reliable, easy to operate and control, especially regenerative braking is possible. Motor should draw low inrush (Starting current) current It should withstand for voltage fluctuation without affecting its performance.

C) General Properties or characteristics:

It should have less maintenance cost. It should have high efficiency. Long life. Low initial cost.

3. DETAIL OF IMPLEMENTATION

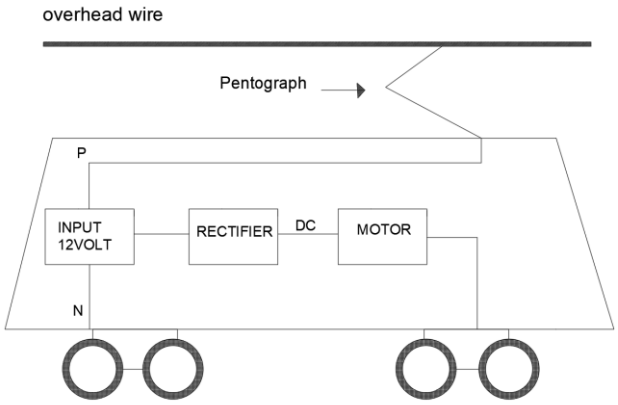

Fig. No. 4 Prototype Model of Electric Locomotive

Above This AC Traction System block diagram. information on each individual block in our effort for a prototype electrical locomotive. Pantograph, Step Down Transformer, motor controller, DC Series Motor, Rectifier Unit, etc. are all included in it. Electric locomotives are quicker than other types of locomotives since they are entirely powered by electricity. But in this project, we'll find out how an engine that has been modified to run on electricity works. The

locomotive receives energy through overhead cables carrying AC (alternating current). The power station that generated the necessary electricity is where these wires are attached. The pantograph, which touches the overhead line and collects electricity, is powered by an alternating current that is converted in the first stage by a transformer from 230 volts to 24 volts in the overhead line. A circuit breaker is used to protect the locomotive from short circuits and overloaded currents. A single-phase ac engine is converted, and the output current is transferred from the circuit breaker to a rectifier, where it is converted to direct current (DC). The DC is then used to control the traction motor connecter to the wheel, which is powered by the traction motor while the motor turns.

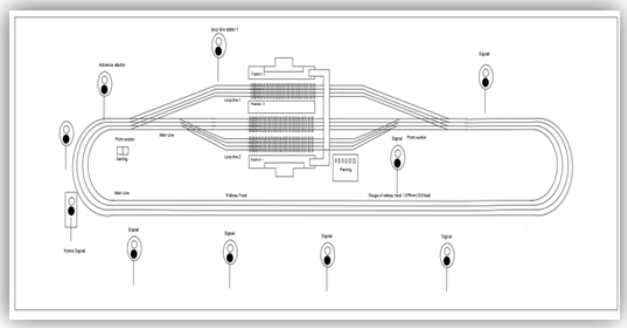

Fig. No. 5 Layout of Prototype Model

The above layout shows arrangement of traction system. There are one main line & two loop lines, signals, flyover, Two Platform, two crossing points. When train starts run from platform 1 to station. In second platform we are decide where to train stop platform 1 or platform 2 With the help of crossing point which is operates automatically. In station There is three which is operate manually and main line signal operate automatically with the help of relay.

4. CONCLUSIONS

In real life we cannot visit to a railway traction system. Because it is very dangerous and we don't get permission to visit the system. The prototypes model of electric traction system helps to study the traction systems. This project understands how the electric traction system works. The Electric locomotive are playing a vital Role in railway system till now. Basically, the traction system is divided into two parts such as AC traction and DC traction. Both systems are its own advantages and disadvantage. This prototype model helps us to study the working of electric traction system.

5. FUTURE SCOPE

This prototype model can be upgraded in future. In this we can add an automation system like if a big object falls on the track it will detect and send danger signal to the station and another system when station is coming the train will adjust their speed and stop on station if required. We can also add the feature of automatic opening and closing the train door when the train is at the station, also we can implement fault detection system for electrical lines fault or track fault. Can add 2 more trains. We can make a station signal that will work automatically. In trains we can add various braking system like emergency braking, Electropneumatic breaks Air Brakes. We can add railway track crossing point which is used by people and vehicles and also control this point automatically

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