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Review& Study Paper of New Technology in Electrical Traction System

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Abstract: **The paper consists of the study about the electrical traction system. First of the major things in train is safety then speed. Afterwards comfort zone. It is automation due to technology. Which improve in day-to-day life? It has the radio frequency system. There different kinds of traction system used in the new generation of INDIA. Today there are different kinds of up gradations also available in the traction system. The maglev train, Tubular train, Bullet train are the different kinds of new technology in traction system, which gives us safety as well as speed. The Maglev train is working on the concept of Magnetic levitation, The new technology of Tubular train also use full for traction system. The operation of the tubular rail is based on electromagnets. The electromagnets are placed in some distance which is of tube shape. The installation of this project is costly the main advantage is that if speeds the life. The paper shows that the different kinds of electrical traction system & new up gradation in the traction system.**

***Index Terms*— Electrical Traction, Electrical Drives, Indian Railway**

I. INTRODUCTION

Electrical traction describes the various types of locomotive and multiple units that are used on electrification systems around the world. The operation of a railway or road vehicle by means of electric motors, which obtain their power from an overhead contact wire or from batteries mounted on the vehicle.

These stations have overhead wires that can be switched from one voltage to another and so the train arrives with one locomotive and then departs with another. A less expensive switching station may have different electrification systems at both exits with no switchable wires. Instead the voltage on the wires changes across a small gap in them near the middle of the station. Another way is to use multi-system locomotives that can operate under several different voltages and current types.

Fig(1) Basic structure of normal rail[11]

The railway is safe transportation system compare to another transportation system. By using railway the shipping cost are reduce. The normal rail is more preferable for middle class persons. We can use different types of coaching in normal rail. In the coaches of the normal are also made by stainless steel.The maintenance cost is low. The speed of normal rail is high compare to the travelling system because the normal rail cannot face the problem of trafficking. The highest speed of normal rail in India is 155km/Hr.

The Tubular Rail concept developed from the observation of the relationship between the balance points of a beam at rest on two points. [1] Tubular rail system provides simple convenient safe efficient and pollution free transportation system. Tubular Rail Technology uses the principle of the cantilever beam - a projection anchored at one end. Since the car is moving within- and is held by the support ring. The effect is to create a cantilever beam. The beam is fixed in its vertical orientation but mobile in its horizontal orientation. Therefore this rolling cylinder is constantly shifting from a cantilever beam on the ends to a post and beam and then back again. The two forces act on tubular train They are rotates on perpendicular direction of the axis. The design of the tubular train is made according to available space area.

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II. TYPES OF TRACTION SYSTEM

(1) DC Traction Units

Direct current (DC) traction units use direct current drawn from either a conductor rail or an overhead line. AC voltage is converted into dc voltage by using rectifier.[6]

(2) AC Traction Units

All alternating current (AC) Traction units draw alternating current from an overhead line.[6]

The aim of tubular rail is to develop a safe and reliable form of transportation offering purchasers and their end users an affordable system [1]. This system would features ease of construction with minimal disruption to existing infrastructure and the environment.

It's certainly a far cry from the industrial revolution when welsh coal miners would remove the product of their labors by loading coal into wooden wheeled wagons and pull it through the mud and out of the shaft.

III. OPERATION OF TRACTION SYSTEM

In the traction system, the traction motors are used for operating and propulsion of electrical locomotive vehicle. Direct-current motors with series field windings were the oldest type of traction motors. [12]These provided a speed-torque useful for propulsion, providing high torque at lower speeds for acceleration of the vehicle, and declining torque as speed increased. By arranging the field winding with multiple taps, the speed could be varied, allowing relatively smooth operator control of acceleration. A further measure of control was provided by using pairs of motors on a vehicle, for heavy loads, two motors could be run in series off the direct current supply. Where higher speed was desired, the motors could be operated in parallel and making a higher voltage available at each and so allowing higher speeds. Parts of a rail system use different voltages, with higher voltages in long runs between stations and lower voltage near stations where slower operation would be useful.

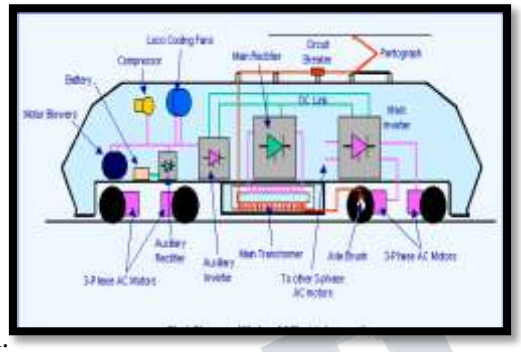

Fig.No.2 Block Diagram of modern AC electrical locomotive[13]

AC induction motors and synchronous motors are simple and low maintenance, but are gawky to apply for traction motors because of their fixed speed characteristic. An AC induction motor only generates useful amounts of power over a narrow speed range determined by its construction and the frequency of the AC power supply. [12] Individual traction motor ratings usually range is 1,600 kW (2,144 hp).

Types of Traction System

(1) Normal Rail
(2) Mono Rail
(3) Tubular Rail

(1) NORMAL RAIL

Working:

The normal rail works on the principle of DC Shunt motor

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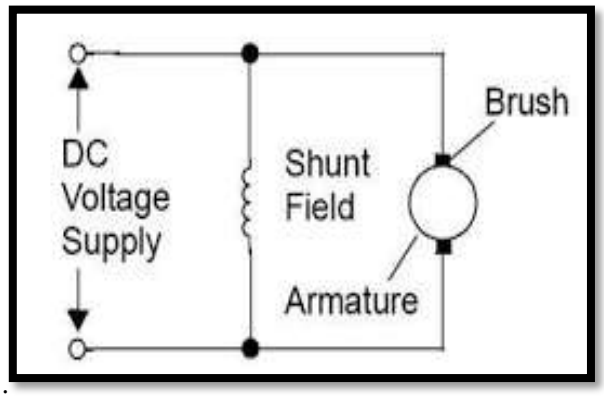

Fig.No.3 Ciircuit Diagram Of DC shunt motor[14]

In DC shunt motorthe field winding is connected in parallelwith the armature. The current through the shunt field winding is not the same as that of the armature current. In DC shunt motor , the shunt field winding resistance is always higher than the armature resistance.

ADVANTAGES:

→Low energy consumption.

→ Cheap mode of transport.

→ It is eco friendly.(runs on electricity).

→ Efficient in terms of space.

→provide automatic train protection system and integrated security systems.

→ Fuel cost saving.

→ Number of vehicles on road reduces.

→ Reduction of emission

***Disadvantages*:**

→the slight congestion on road at the time of construction

→another disadvantage is cost factor, the solution for which is to integrate metros with others systems considering the volume,structure,availability of space and resources for traffic and transportation.

Fig.No.4 Basic structure of Normal Rail[8]

***Application*:**

→Travel one place to another place in short periodic of time.

→ Transportation for cargo and passengers.

CALCULATIONS:

Mathematical description of train operationprocess is the fundamental of studying and analyzing train traction control. As the time is used to the variable, the movement equations of train are shown as follows:

$dv / dt = \xi \cdot c$

$ds/dt=v$

$J=\int_{\circ}^{T} p(t)dt$

Where c—The joint force of train (N/kN).

ξ —Accelerationcoefficient;

r—Gyrating mass coefficient (usually 0.06);

J—Train energy consumption (J);

p(t)—Train energy consumption per unit time (kW);

T—The whole trip operation time (s);

v—The operation speed of train (m/s);

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s—The operation distance of train (m);

t—The operation time of train (s);

Traction Force

(1)The axle traction force of the driving wheel set(fi) which is also called the adhesion traction force. Actually, it is the static frictional force of the driving wheelstand rail.

(2)The axle traction force of the train (F i) which is to produce the torque Tito drive the wheel rolling with the speed v.[9]

$f_i=\mu G_i=\mu Mg$

μ=Theadhension coefficient

$F_i=F_i'=T_i/R_i$

R_i= radius of circle

The Train Operation Resistance Force

(1)The basic resistance force it is produced by the friction and impact between components and parts, the train surface and air, the wheel and rail.[9]

(2) The additional resistance force it is dependent on the steep gradient, the curve radius, and Bridge & Tunnelsituationof the rail line.[9]

$W0=(a + b*v) + (c*v^2) * M * g$

Where,

W0=The basic operation resistance force of train (N)

M=The traction quality (t)

v=The operation speed of train (km/h)

g=The acceleration of gravity (m/s2)

a, b, c=The coefficient being relative with mechanical resistance[9]

The Basic Resistance Force

The unit resistance is generally adopted to represent the train resistance [9]

$\omega_0(v)=W0/M$ (N/t)

(2)**MONO RAIL**

Working Principle Of Mono Rail

Concept of mono rail developed since 1800, first mono rail in Russia in 1820

The concept of monorail is magnetic levitation.

There are different kinds of magnets required to generate field .Superconductive electric magnets in the vehicle to levitate & propel train [16]

An AC is run through electromagnetic coil [16]

That creates a magnetic field that attracts and repels the super conductor magnets [16]

Magneticlevitation requires electromagnetic current to generate the magnetic field.

Fig.no:5 Basic structure of Mono rail[10]

Advantages Of Monorail:

→ Minimum space consumes.

→ faster with less cost.

→ Practically silent while travelling.

→ Eco-friendly environment.

→ No risk of vehicles getting struck in crossing.

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Disadvantages Of Monorail

→ Can't run without electricity.

→ Limited passenger capacity.

→ To replace of track, the entire system needs to be shut down.

→ The capacity to cost ratio is less.

→ In an emergency, immediate exit is not possible

Application Of Monorail

→to travel one place to other place in short period of time.

→to transport cargo and passenger.

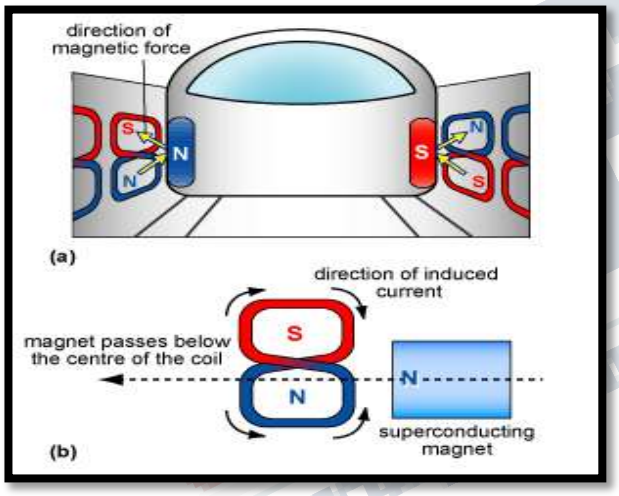

Fig.No:6 basic diagram of magnetic levitation in monorail[15]

***CALCULATIONS OF MONORAIL*:**

Load Factors Load factors are used to account for such items as impact and dynamic lift situations, or to account for unknowns. The load factors discussed below are as defined by the CMAA code; however, these factors can be adjusted to account for the specific design situation being investigated.

Dead Load (DL): The weight of the monorail beam and any other fixed item supported by the beam.

Trolley Load (TL)*:* The weight of the trolley and any other equipment attached to the trolley.

Lifted Load (LL): The weight of the item lifted along with all associated lift devices such as slings, shackles, spreader beams, etc.

Collision Forces (CF) : Loading resulting from the collision with another trolley or bumper stop. The velocity and mass of the objects are required to determine the kinetic energy released during the collision.

Inertia Forces from Drives (IFD)*:* Forces occurring during the acceleration, deceleration, and motions of the monorail.

Operating Wind Load (WLO): The loading on the projected area to the wind. The wind velocity at which a safe lift should be used as specified by the owner specified. The code states that a minimum of 5 psf loading should be used if no information is provided.

Stored Wind Load (WLS): The maximum wind applied to the monorail when the system is not in use.

Forces Due to Skewing (SK): Horizontal forces normal to the beam when wheels roll along the length of the beam. A table provided in the code is used to determine a factor to be applied to the wheel loads.

Dead Load Factor (DLF): This factor covers the dead loads of the trolley hoist and any associated equipment. The factor is based on the travel speed of the trolley and is determined using Equation

DLF = 1.01 < 1.05 + (Travel Speed/2000) < 1.20 ...(1)

The Travel Speed feet per minute (fpm). For a powered trolley, the minimum dead load factor is 1.10. For a trolley that is manually-driven, the travel speed is relatively 321

Low so Equation(1) is not required. A factor of 1.05 to 1.10 should be utilized to account for some unknowns such as mill and weld tolerance.

Note that the Dead Load Factor (DLF) accounts for the dead load of the beam (DL), trolley and associated equipment (TL), while the term Dead Load (DL) introduced in the previous section only refers to the dead load of the beam. It

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is important to note this distinction since the nomenclature can be somewhat confusing.

Hoist Load Factor (HLF): This factor accounts for the motion of the rated load in the vertical direction. The factor also accounts for inertia and mass forces due to sudden impact load during lifting. The factor is also a catchall accounting for all other uncertainties. The HLF factor is determined using Equation (2).

HLF = 1.15 < 1 + 0.55 X Hoist Speed < 1.50 ...(2)

The Hoist Speed is feet per minute (fpm).

For manually-driven trolleys, the load is typically hoisted without the use of power thereby the hoist speed is relatively low. Therefore, Equation (2) may be ignored and a minimum factor of 1.10 to 1.15 can be used. Load Combinations.

The CMAA specification requires that combined stresses be checked for three different stress levels. The three (3) load combinations requiring evaluation are:

Case 1: Monorail in regular use under principle loading (Stress Level 1).

(DL × DLF) + (TL × DLF) + (LL × HLF) + IFD ...(3)

Case 2: Monorail in regular use under principle loading additional loading (Stress Level 2).

(DL × DLF) + (TL × DLF) + (LL × HLF) + IFD +WLO +SK ... (4)

Case 3: Monorail under extraordinary loading (Stress Level 3). There are two conditions evaluated for this case. Monorail not in use and Stored Wind Load DL +TL +WLS ... (5)

(3)TUBULAR RAIL

Working Of Tubular Rail

Tubular train works on magnetic levitation.

The electromagnets can be generate the current. Superconducting electric magnets in the vehicle to levitation and propel the train.

Basic Structure Of Tubular Train **:**

Fig No:6 Basic Structure of Tubular Train[2]

Advantages Of Tubular Train

→ High speed transportation.

→Reduce the traffic problem.

→ Eco-friendly for environment.

→Saving the fuel cost because of using electricity.

Disadvantages Of Tubular Train

→ Produce the losses likes wind age losses , heat losses.

→ Emergency exit quite difficult.

→ Passenger siting capacity is low then other railway.

Analysis Of Tubular Train

The railways system differs greatly to the days when steam trains could be seen chugging around the industrial heatl and of Britain , transporting coal ,iron and wood.

Further change and development have been in the pipeline for some line, with Britain's railways poised to undergo a major programme of development. It has also been reported that Britain's railways undergoing the biggest programme of investment since the Victorian age. The braking system of the Tubular Rail system will rely on the creation of friction between the braking device and the resistance plate on the column. However most routine braking is done by controlling the speed at which the rollers are rotating and when coming into a station the rollers actually serve to regenerate energy back to the grid.[1]

The power is provide by the AC motor.

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The 65-70% cost in tubular rail system are related to the its component used in tubular train.

The tradition rail option solve some important issues but there cost is slightly high.

Fig No:7 Basic Structure of Tubular Train[2]

IV. CONCLUSIONS: -

The papers conclude that the traction system is one of the greatest transportation system .The traction system is useful for each and every person as well as for lower and middle class families.

The traction system is cheap & convenient. The different concept of the traction system can be developed. The mono rail and tubular train are most effective new technology in traction system. The mono rail is most effective because of their consumption of electricity and cheap as compare to tubular train. The tubular train need new path and design structure also. The system design is little beat complicated. The primary cost of tubular is also high .so Mono rail more efficient then tubular.

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