A REVIEW ON MAGLEV TRAIN

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ABSTRACT

The standard transportation system is not adequate today because of the rising demand for transportation brought on by a growing population and expanding cities. We can enhance the transportation resources, such as the MAGLEV trains. Reviewing and summarising Maglev train technologies from an electrical engineering point of view, this paper discusses the design, hardware, application, and potential future usage of "Magnetic levitation trains." The maglev transportation system is more reliable, swifter, more cost-effective. The transportation services are expected to significantly enhance thanks to the Maglev trains.

Keyword : -
Superconducting Electromagnet , Linear induction motor , Linear Synchronous Motor , Electro Dynamic Suspension (EDS) , Electro Magnatic Suspension (EMS)

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1. Introduction:

Normal trains like passenger's , good 's , Bullet trains are moving with wheels. But this type of train travel without wheels. i.e by using Super magnets . That type of trains are called MAGLEV TRAIN. Normally the max speed of the train is 380KMPH. But this Maglev reaches the speed upto 608KMPH. This technology was developed by American professor and inventor Robert Goddard and French-born American engineer Emile Bachelet and have been in commercial use since 1984. James Powell and Gordon Danby was taking the first patent of the maglev train. MAGLEV the world means MAGNETIC LEVITATION. There are two types of maglev trains are available. i.e.

1.Electro Dynamic Suspension (EDS)
2.Electro Magnatic Suspension (EMS)

The difference between the two types of trains is varying magnetic field. And in this train's Linear motors are used. i.e

1. Linear Induction Motor (LIM)
2. Linear Synchronous Motor (LSM)

2. SUPERCONDUCTING ELECTROMAGNET :

The levitating trains require a powerful super conducting electromagnets. Normal magnets does't achive the speed so we are using SUPERCONDUCTING ELECTROMAGNETS. This magnets will produce the huge amount of current i.e 700KA .And the magnets are more powerful and more efficient.The challange is to keep the coil in superconducting stage for this purpose an onboard LIQUID HELIUM refrigeration system is used. The Niobium-titanium(Nb-Ti) alloy is used in sc electromagnet. The cricital temperature of this alloy is 10Kelvins. When temperature of helium is less than critical temperature the helium is evaporate. And it goes back to initial stage i.e HELIUM COMPRESSOR and refrigeration unit is used. The refrigeration unit is work's on the principle of Gifford-McMahon REFRIGERATION CYCLE . The magnets observe the heat from out side in the form of radiation. To prevent this radiation RADIATION SHIELD is used. However in the operation of maglev eddycurrent & heating issues are occur in the shield. To decrease the heating and eddy current's in shield it require cooling system. For this purpose LIQUID NITROGEN unit is used. A vacuum is provided inside the shield for the passing the nitrogen into the shield

The following objectives required to achieve the max speed MAGLEV i.e

1. LEVITATE
2. PROPEL
3. GUIDANCE

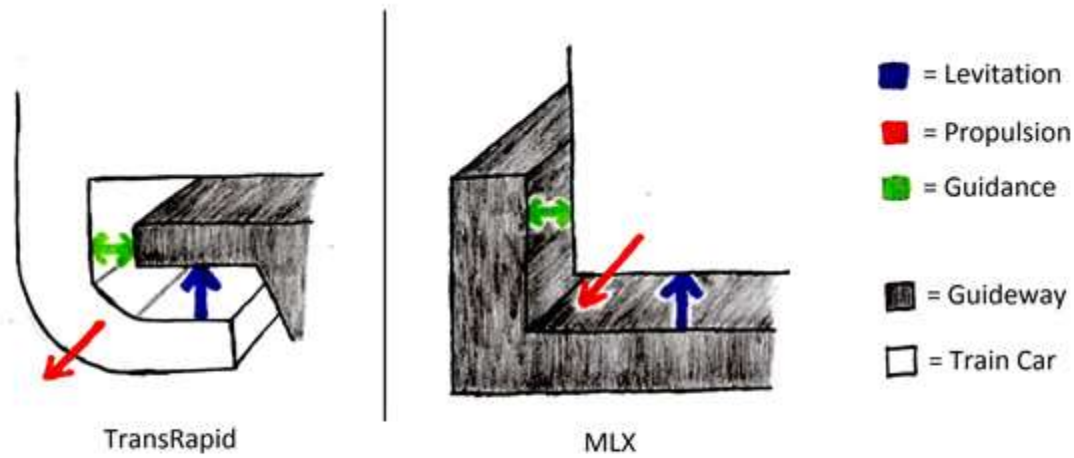

Fig -1 : Maglev Train

2.1 LEVITATION:

Installed on the guiding way's sides are levitation coils. These coils create an electric current when the onboard superconducting magnets travel by at a high speed a few millimetres below the centre of them, briefly acting as electromagnets. Consequently, there are forces that pull and push the superconducting magnet upwards at the same time, levitating the Maglev vehicle.

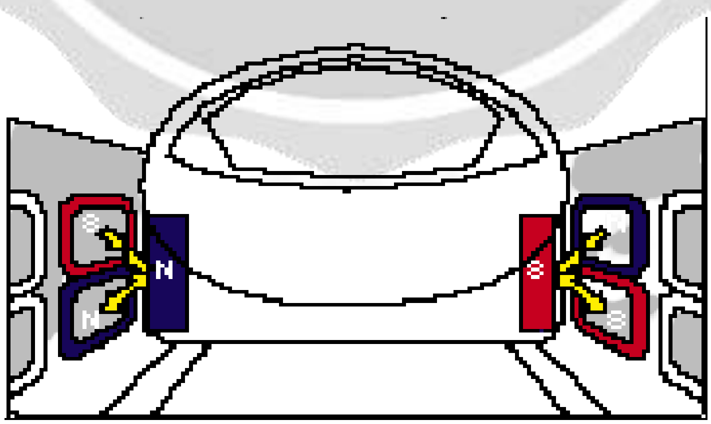

Fig - 2 : Levitation

2.2 GUIDANCE:

The levitation coils that are facing one another are linked together beneath the guide path to form a loop. An electric current is induced in the loop when a running Maglev vehicle, which is a superconducting magnet, displaces laterally. This causes a repulsive force to act on the levitation coils on the side closest to the car and an attractive force to act on the levitation coils on the side farther apart from the car. As a result, the middle of the guide path is constantly occupied by a running automobile**.**

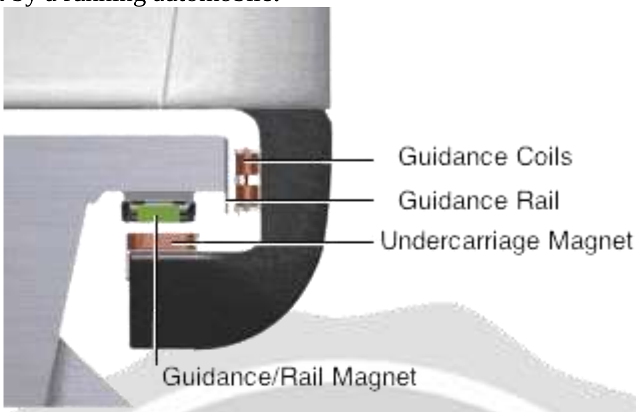

Fig - 3 : Guidance

2.3 PROPULSION:

The force that propels the train forward is called propulsion. Maglev achieves propulsion through the use of an electric linear motor. Magnetism is used in a typical electric rotary motor to produce torque and spin an axle. It has a stator, which is a piece that is stationary, surrounding a rotor, which is a revolving element. In order to produce a spinning magnetic field, the stator is used. The rotor spins as a result of the rotational force this field produces. An unrolled version of this figure is all that a linear motor is. The rotor is positioned above the flattened stator. The stator produces a field that runs the length of it rather than a spinning magnetic field. Similarly, the rotor encounters a linear force that pulls it downward rather than a rotational force.A linear force acting on the rotor pulls it down toward the stator. A straight line is thus produced immediately by an electric linear motor. But only when the rotor is above the stator can this motor generate a force. The rotor comes to a stop when it reaches its conclusion.

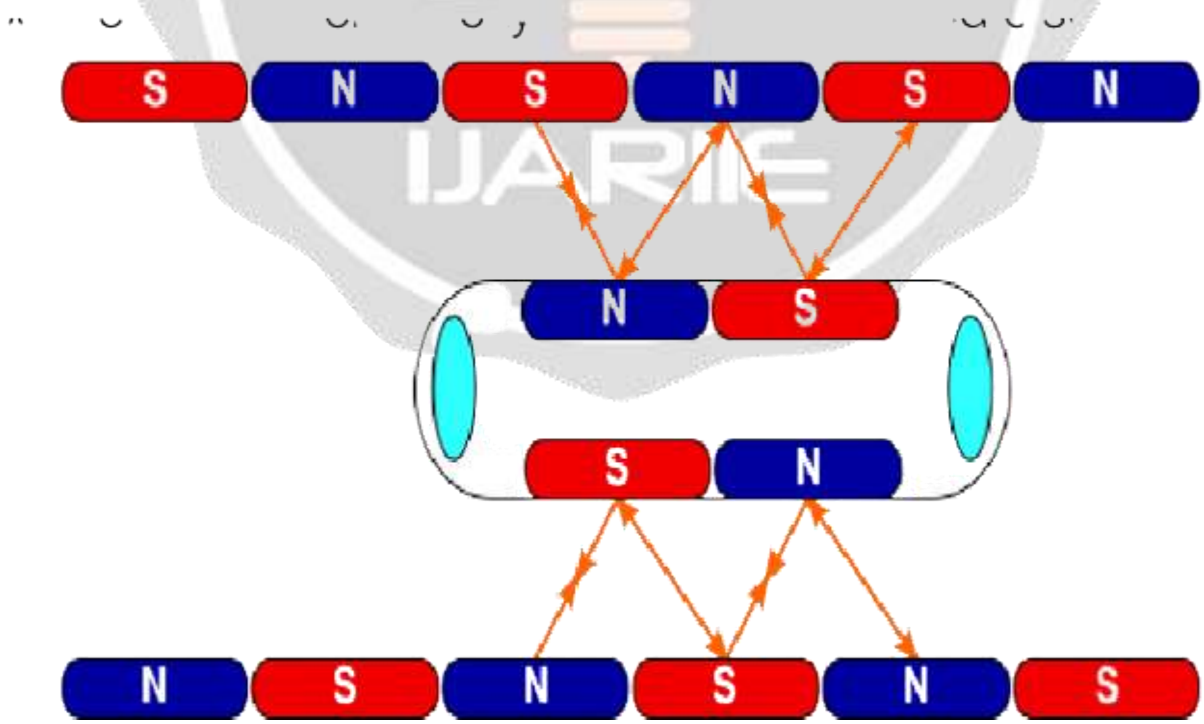

Fig - 4 : Propulsion

3. ELECTRO MAGNETIC SUSPENSION: (EMS)

Levitation is accomplished by EMS using the attracting force of electromagnets positioned on the track and the train. The advantages of this approach are that it maintains levitation at zero speed and is easier to execute than electrodynamic suspension (described below). The system's inherent instability is one of its downsides. Maintaining the proper space between the train and the guideway at high speeds becomes challenging. The train will fail to levitate and come to a grinding halt if this distance cannot be maintained. Complex feedback-control systems are needed by EMS to take this into account and ensure the train is constantly stable (Lee, 2006).

Fig -5 : Electro Magnetic Suspension

4. ELECTRO DYNAMIC SUSPENSION: (EDS)

Levitation is accomplished by EDS using the repulsive force of (superconducting) magnets mounted on the track and the train. While the train is moving, the magnets pass one another force. This approach has the advantage of being highly stable at high speeds. It is not a worry to maintain the proper spacing between the train and the guideway (Lee, 2006). The disadvantages include the requirement for a train to reach a certain speed before it can even begin to levitate. This approach is also a lot more difficult to implement and expensive. Electro dynamic suspension can also occur when an electro magnetic drive by an AC electrical source produces the changing magnetic field, in some cases, a linear inductor motor generates the field. south and north poles where down poles will pushes and top poles will attract , Singles large magnets by changing polarity train will moves.Repulsive system have a major downside as well. at slow speeds, the current induced in these coils by the slow change in magnetic flux with respect to time is not large enough to produce a repulsive electromagnetics forces sufficient to support the weight of the train. Moreover the energy efficiency for EDS at low speed is low for this reason the train must have wheels or some other form of landing gear to support the train until it reaches a speed that can sustain levitation.

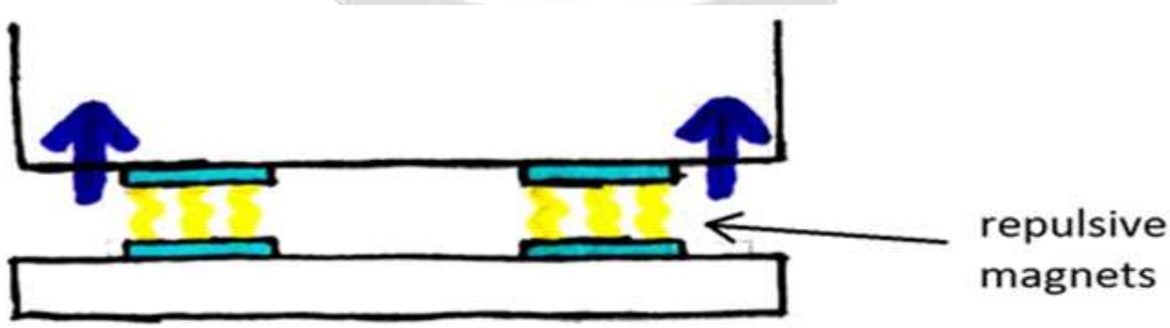

Fig – 6: Electro Dynamic Suspension

5. LINEAR MOTOR'S:

There are two linear motor types that are appropriate for maglev propulsion: linear synchronous motors and linear induction motors (LSM). For each type, there are two different ways to supply multiphase electric power: to "active guidway" windings on the guidway. Although it operates on the same fundamental principles as other induction motors, a linear induction motor (LIM) is an alternating current (AC), asynchronous linear motor that is often made to produce motion directly in a straight line. In contrast to traditional induction motors, which are set up in an infinite loop, linear induction motors typically have a finite primary or secondary length that produces end-effects. A linear motor known as a linear synchronous motor (LSM) has mechanical motion that is synchronised with the magnetic field, or mechanical speed is the same as the magnetic field's travel speed. High-speed, low-acceleration, high-power motors are typically designed with linear synchronous motors. The magnets number two. They are electromagnets and permanent magnets, with an array of pole magnets on one side and an air gap on the other.

$$V_s = 2t\ f_s \text{ m/sec}$$

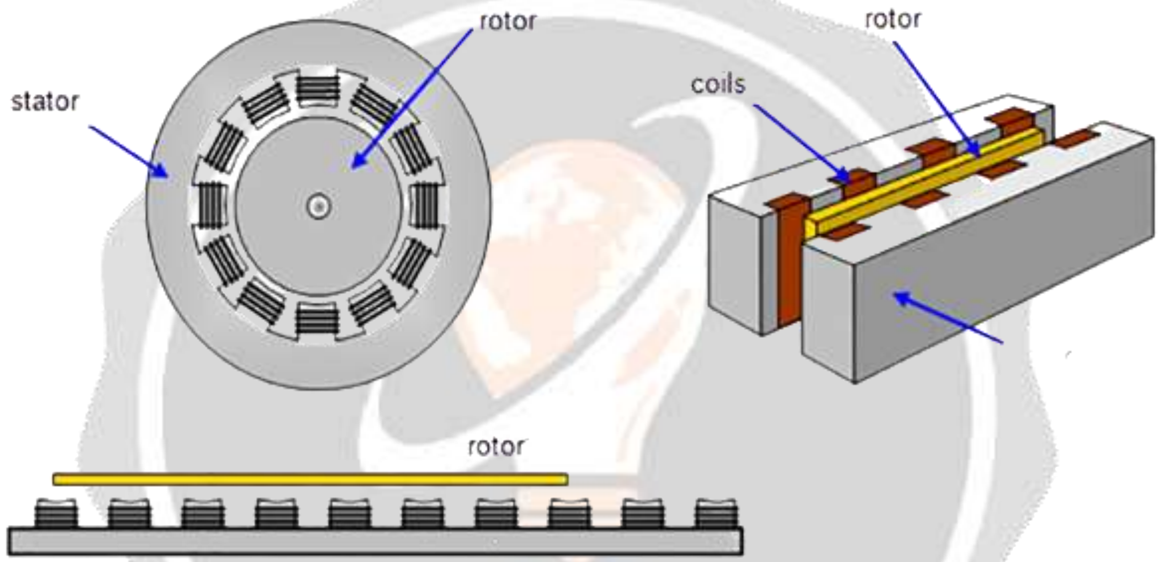

Fig -7 : Linear Induction Motor

6. ADVANTAGES:

1. In maglev trains there is no maintenance.
2. maglev trains using less energy up to 30percent then compare to normal trains.
3. extremely fast speed 400to600/km per/hour
4. in this maglev train there is no air pollution and also no sound pollution
5. extremely fast speed 400to600/km per/hour

7. DISADVANTAGES:

1. Expensive to build, not least because it's a new and largely untried technology.
2. Expensive to operate, both to maintain the new technology and because the energy consumption is quite high.
3. Not necessarily any faster than a high speed wheel on rail.
4. Not necessarily quieter than high speed wheel on rail (noise is an issue for high speed rail)

8. CONCLUSION:

Both intercity and urban transportation networks are taking into account the Maglev train. The operation schedule is shorter in the low-medium speed Maglev train than it is in the high-speed train. Therefore, from the perspective of building costs, EMS technology and LIM are recommended. EDS technology and LSM, however, are favoured in high-speed operations due to their controllability and dependability. In addition, stronger magnetic energy that is more cost-effective will be employed for the Maglev train together with the development of the high temperature superconductor and new kind of permanent magnets. The authors are certain that this technique can be used to satellite launching systems in addition to railway applications.

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