Linear Induction Motor Based Rapid Human Transportation System

Ankit Vijayvargiya, Abhijeet Singh Naruka(*), Afreen Bee, Arpita Saxena, Dinesh Kumar Tak, Harsh Verma

SKIT jaipur
narukaabhi96@gmail.com

Abstract

Maglev (magnetic levitation vehicle) being created as another transportation implies running at a speed of 500 km/h has different points of interest in mass transportation, less pollution and rapid speed. Although intended primarily, for high speed ground transportation, it has the potential for other applications. Its advantages over conventional trains are higher possible speed, reduced maintenance, less noise and reduced dependence on petroleum. Linear induction motor can give levitation effect. So that, they are used where contact less force is required LIM is an alternating current (AC), asynchronous linear motor that works by the same general principles as other induction motors but is typically designed to directly produce motion in a straight line. Their practical uses include magnetic levitation, linear propulsion, and linear actuators.

Keywords: Linear induction motor, magnetic levitation.

1. Introduction

Linear induction motor is an asynchronous motor, working on the same principle of an induction motor. But, it is designed to produce rectilinear motion, unlike the rotary movement produced by a motor, hence the word linear induction motor.

A linear induction is an advance version of rotary induction motor which gives linear translational motion instead of rotational motion.

2. Principle of Linear Induction Motor

Linear Induction Motors, unlike their rotary counterparts, can give a levitation effect. They are therefore often used where contactless force is required, where low maintenance is desirable. The linear induction motor concept which uses rapidly-pulsed magnetic fields and a segmented reaction rail, as opposed to low-frequency fields and continuous reaction rails found in conventional linear induction motors, these improvements give a high traction. Compact and efficient linear motor that has potential for advanced high speed rail propulsion

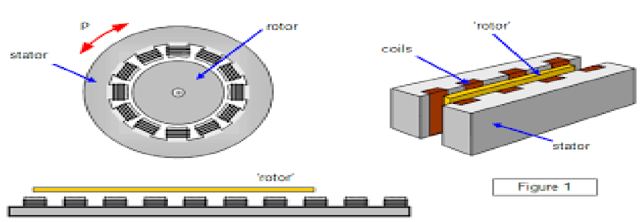

Figure 1-Linear Induction Motor

2.1 Applications of Linear Induction Motor

- The main application of the LIM is in transportation and in electric traction system. The primary is mounted on the vehicle and the secondary is laid on the track.
- It is used in the cranes.
- Pumping of liquid metals.
- Actuators for the movement of doors.
- Used in high voltage circuit breakers and also in accelerators.

3. Principle of Magnetic Levitation

Magnetic levitation is a method by which object is suspended with no support other than magnetic fields. Magnetic force is used to counteract the effects of the gravitational acceleration. The two primary issues involved in magnetic levitation are lifting forces: providing an upward force sufficient to counteract gravity, and stability: ensuring that the system does not spontaneously slide or flip into a configuration where the lift is neutralized. Magnetic levitation is used for maglev trains, contactless melting, magnetic bearings and for product display purposes.

4.Systems of Maglev Train

4.1 Electro Magnetic levitation

In this system, electromagnets are arranged along the side of the vehicle and below the iron rails in the guide way so that when energized, they are attracted up to the underside of the rails. Such a system is inherently unstable since, as the gap gets smaller, the force of attraction increases until the magnetic and rail come together. This instability is handled by incorporating an air gap sensor that controls the current through the electromagnets to maintain a constant air-gap distance. This system operates with an air gap of 1 cm or so. Also, this system levitates at zero speed, so no wheels are necessary.

4.2 Electro Dynamic levitation

When an electric field moves over a conducting plane (or conducting coils) it generates an electric current in the conductor. The induced current creates its own magnetic field which reacts with the original field that produced it in such a way as to repel the first field. From this effect comes the description “repulsive technique’*. This is much the same effect as two like magnetic poles repelling each other. The modem embodiment of this technique utilizes superconducting coils on board the vehicle to generate the magnetic field. In principle, the coils can be made from any material exhibiting superconducting properties. One popular material is niobium titanium. “Superconductivity” refers to the property of some materials which when cooled to the vicinity of absolute zero, exhibit zero electrical resistance. Thus a current, once started, will continue to flow provided the temperature is kept below the critical value which allows the superconducting characteristic to exist.

4.3 Guidance System

Guidance or steering refers to the sideward forces that are required to make the vehicle follow the guide way. The necessary forces are supplied in an exactly analogous fashion to the suspension forces, either attractive or repulsive. The same magnets on board the vehicle, which supply lift, can be used for guidance or separate guidance magnets. When a running Maglev vehicle, that is a super conducting magnet, displaces laterally, an electric current is induced in the loop, resulting in a repulsive force acting on the levitation coils of the side near the car and attractive force acting on the levitation coils of the side farther apart from the car. Thus, a running car is always located at the center of the guide way.

4.4 Propulsion System

Long-stator propulsion using an electrically powered linear synchronous motor (LSM) winding in the guide way appears to be the best known option for high speed maglev systems. It is also considered the more expensive option because of perceived higher guide way construction costs. Short-stator propulsion uses a linear induction motor (LIM) winding on board and a passive guide way. While short-stator propulsion typically reduces guide way costs, the LIM is heavy and reduces vehicle payload capacity, resulting in higher operating costs and lower revenue potential compared to the long-stator propulsion. A third alternative is a nonmagnetic energy source (gas turbine or turboprop) but this show results in a heavy vehicle and reduced operating efficiency. A maglev train system has three basic components: a large electrical power source, metal coils lining the walls and the track, and large guidance magnets which are attached to the bottom of the train. The power source is then able to create a magnetic field in the electrified coils along the track. Then, the magnetic field along the track repels the train so that it levitates above the ground while the magnetic field in the walls attracts and repels the train to move it along the designated path.

Figure shows how the maglev train moves along the track.

.

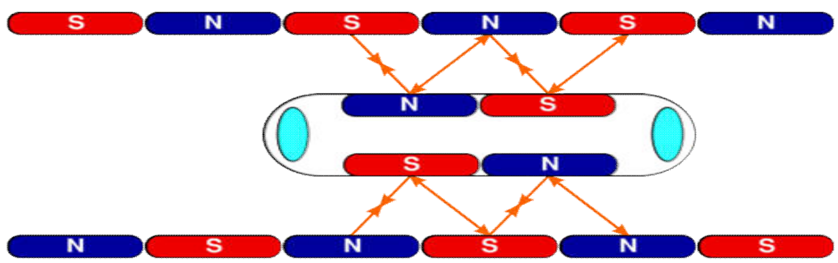

Figure 2- **Magnetic Fields that moves the train forward**

4.5 Braking system

A regenerative brake based on the linear synchronous motor is in use as service brake, which is supplemented by an electric brake as an emergency brake. In addition to the regenerative and electric brakes, sliding shoes made of metal skidding on the guide way and an aerodynamic brake using wind-pressure panels will be applied in combination with service and emergency brakes when anything unusual happens.

4.6 Implementation

Simple design is chosen for project model implementation. In this project track is developed by using iron metal sheets. These sheets are welded on one another to prepare the track. Now slot are made on this sheet at uniform distance from one another and also slot width is fixed to 1 cm. Now insulation sheets are used in these slots to reduce iron losses, efforts are done to reduce iron losses as low as possible. Copper wire is wound around the track passing through these slots at regular intervals. Hardware design was tested again and again until required results were obtained from the model.

Figure 3-snapshot of project

5.Result & Conclusion

Magnetic levitation trains have a lot of applications and advantages like they are fast exceeding the speed of 300 mph. it has no fuel consumption , cost is cheaper than flights , faster , effective , less maintenance . Used in transport both passenger and goods , no fossil fuel used , less noise , takes less space than conventional trains. These trains consume very less energy compared to conventional trains. They require no large engine kind of stuff as they run using linear motors. They Move a lot faster than normal trains because they are not affected by ground friction ; they would only have air resistance or drag resistance . They are incompatible with existing rail lines because they need a separate track to levitate, unlike the traditional high-speed trains. Initially the cost is very high but it may decrease in near future. Because of these numerous advantages of these trains over conventional trains, they have very vast scope in future in the field of rapid human transportation system

7.Refrenaces

[1] H. Tanaka, Seminar on Linear-motorized super speed Transportation System-Present and Future (in Japanese), Nov. 1987.

[2] Y. Kyotani, Extra No. Scientific American Dec. 1987.

[3] The saga of Maglev, Lloyd J. Money, 1984.

[4] Dr. Marc Thompson, PhD Thesis on Magnetic levitation, Literature Review of Maglev: Principle of superconductivity, Guide way considerations in Maglev, Car following models, propulsion force calculations, braking resistance, vehicle dynamics and other concepts of Maglev

References

List and number all bibliographical references that has important contribution on the paper, (if possible, limit to 30, which only are necessary citations are recommended). 9-point Times New Roman, fully justified, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example [1]. Do not abbreviate the months. Don't forget to put period (.) at the end of each reference. (See examples below)

11.1. Journal Article

[1] C. D. Scott and R. E. Smalley, "Diagnostic Ultrasound: Principles and Instruments", Journal of Nanosci. Nanotechnology., vol. 3, no. 2, **(2003)**, pp. 75-80.

11.2. Book

[2] H. S. Nalwa, Editor, "Magnetic Nanostructures", American Scientific Publishers, Los Angeles, **(2003)**.

11.3. Chapter in a Book

[3] H. V. Jansen, N. R. Tas and J. W. Berenschot, "Encyclopedia of Nanoscience and Nanotechnology", Edited H. S. Nalwa, American Scientific Publishers, Los Angeles, vol. 5, **(2004)**, pp. 163-275.

11.4. Conference Proceedings

[4] J. Kimura and H. Shibasaki, "Recent Advances in Clinical Neurophysiology", Proceedings of the 10th International Congress of EMG and Clinical Neurophysiology, Kyoto, Japan, **(1995)** October 15-19.

11.5. Patent

[5] C. E. Larsen, R. Trip and C. R. Johnson, "Methods for procedures related to the electrophysiology of the heart", U.S. Patent 5,529,067, **(1995)** June 25.