www.ijemr.net ISSN (ONLINE): 2250-0758, ISSN (PRINT): 2394-6962

Volume-5, Issue-5, October-2015

International Journal of Engineering and Management Research

Page Number: 84-87

An Review on Magnetic Levitation Principle and It's Applications

Praveen Rathore[1], Prakash Kumar Sen[2], Gopal Sahu[3]
[1]Student, Mechanical Engineering, Kirodimal Institute of Technology, Raigarh, C.G., INDIA
[2,3]Lecturer, Mechanical Engineering, Kirodimal Institute of Technology, Raigarh, C.G., INDIA

ABSTRACT

The name maglev is derived from magnetic levitation. Magnetic levitation is a highly advanced technology. It has various uses. The common point in all applications is the lack of contact and thus no wear and friction. This increases efficiency, reduces maintenance costs, and increases the useful life of the system. The magnetic levitation technology can be used as an efficient technology in the various industries. It's a technology that has been experimented with intensely over the past couple decades. This paper tries to study the most important principle uses and application of magnetic levitation technology and the development of magnetic levitation vehicles in Germany, Japan, and the United States.

Keyword*----* Magnetic levitation, magnetic field, magnetism, magnetic materials.

I. INTRODUCTION

Magnetic levitation, maglev or magnetic suspension is the method by which an object is suspended with no support other than magnetic fields. The magnetic fields are used to reverse or counteract the gravitational pull and any other counter accelerations. The principle of magnetic levitation has been known for over 100 years, when American scientists Robert Goddard and Emile Bachelet first conceived of frictionless trains. But though magnetically levitated trains have been the focus of much of the worldwide interest in maglev, the technology is not limited to train travel. Maglev can create frictionless, efficient for-out- sounding technologies. The two primary issue involve in magnetic levitation are

(1) Lifting force:- providing an upward force to lift sufficient to counteract gravity.

(2) 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 bearing and for product display purpose. Magnetic material and system are able to attract or pres each other apart together with a force depend on the magnetic field area of the magnet ,for example the magnet positioned in the magnetic dipole magnet , oriented with like poles facing each other ,so that the force between magnet repels the two magnet. Essential all types of magnet have been used to generate lift for magnetic levitation, permanent magnets, electro magnets, ferromagnetism, diamagnetism. Superconductor magnet and magnetism due to induced current in conductor.

The magnetic pressure of a magnetic field is calculated by:

$$P_{mag} = \frac{B^2}{2\mu}$$

Where P_{mag} is the force per unit are in pascals, μ is the magnetic field in teslas. And $\mu = 4\pi \times 10^{-7}$ N.A^{-2} IS is the permeability of the vacuum.

Stability: earns haw's theorem proves that using only paramagnetic material it is impossible for static system to stably levitate against gravity. however the servomechanism , the us emf diamagnetic material ,superconductor or system involving eddy current allow stability to be archived. in some cases the lifting force is provided by a mechanical support bearing little load. This is termed pseudo levitation.

II. BASIC OF MAGNETIC LAVITATION

2.1 Magnetic Fields

The creation of magnetic forces is the basis of all magnetic levitation. The creation of a magnetic field can be caused by a number of things. The first thing that it can

be caused by is a permanent magnet. These magnets are a solid material in which there is an induced North and South pole. The second way that an magnetic field can be created is through an electric field changing linearly with time. The third and final way to create a magnetic field is through the use of direct current. this Magnetic field creation are based on the Michael faraday's law.

This law states that if there is a change in the magnetic field on a coil of wire, there is seen a change in voltage. Taking that a bit further, it could be said that if there was a change in voltage, then there would be a change in magnetic field. This occurs in the coil when there is a current induced as a result of that change in voltage. a power full magnetic field can be created between the two coil. The direction of the forces created by Faraday's Law was discovered by a man named Heinrich Lenz. His theory states that "the electro moving force induced in an electric circuit always acts in such a direction that the current it drives around the circuit opposes the change in the magnetic flux which produces the electro moving force.

2.2 Types Of Magnetic Field

There are the following 3 types of the magnetic field

1. Permanent magnetic field
2. Electromagnetic field
3. Super conductor field

1. Permanent magnetic field

First type of levitation is the implementation through permanent magnets. These magnets are made of a material that creates a north and a south pole on them. This can be seen in Figure1. first type of levitation is the implementation through permanent magnets. These magnets are made of a material that creates a north and a south pole on them. This can be seen in Figure 1.In metals, the orbital magnetic moment causes nearby atoms to align in the same direction, creating a ferromagnetic metal. The strength of the magnetic field decreases inversely with the cube of the distance from the magnet's center

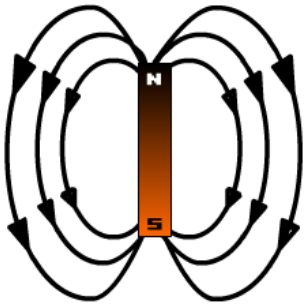

Figure 1: permanent magnetic field

The formal definition of a permanent magnet is "a material that retains its magnetic properties after and external magnetic field is removed.

2. Electromagnetic field

Electric current through a wire, you can create a magnetic field. When this wire is coiled around a magnetic material (i.e. metal), a current is passed through this wire. In doing this, the electric current will magnetize the metallic core. This can be seen in Figure 2

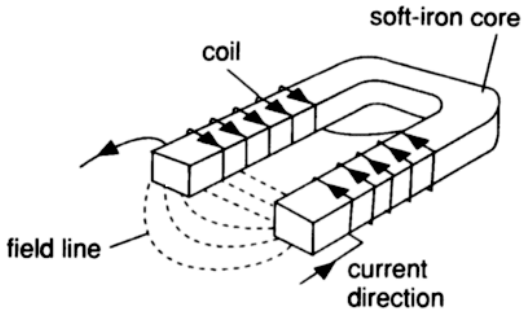

Figure 2: electromagnetic field

By simple principle you can create all sorts of things including motors, solenoids, heads for hard disks, speakers, and so on.

3. Super conductor field

The superconductive magnets are the same principles that are at work in an MRI. Superconductive magnets are the most common of all the magnets, and are sometimes called cryomagnetic. The idea behind the superconducting magnets is that there is a material which presents no electrical resistivity to electrical current. Once a current has been fed into the coils of this material, it will indefinitely flow without requiring the input of any additional current. The way that a material is able to have such a low resistivity to current is that it is brought to very low temperatures. The temperatures that are commonly found in superconducting magnets are around 258^{o}C. This is done by immersing the coils that are holding the current into liquid Helium; this also helps in maintaining a homogenous magnetic field over time.

III. WORKING PRINCIPAL OF MAGNETIC LAVITATION

The principle is that two magnetic poles (e.g., two north's) repel, and two different poles attract, with forces that are stronger when the poles are closer. There are four magnetic forces on the top: on its north pole, repulsion from the base's north and attraction from the base's south, and on its south pole, attraction from the base's north and repulsion from the base's south. Because of the way the forces depend on distance, the north-north repulsion dominates, and the top is magnetically repelled. It hangs where this upward repulsion balances the downward force of gravity, that is, at the point of equilibrium where the total force is zero. The lifting force is show in the Figure 3.

ISSN (ONLINE): 2250-0758, ISSN (PRINT): 2394-6962

Figure 3: lefting force due to levitation

IV. MAGNETIC FIELDS CAUSED BY MAGNETIZED MATERIALS

Electron spin is a quantum mechanical phenomenon. Its significance here is the fact that there is associated with the electron spin a magnetic moment of fixed magnitude. To determine the forces on magnetic materials, we use the fact that the magnetic moment of the electron spin acts as if it is a current loop. A volume of magnetized material contains a very large number of aligned electron spins The is illustrated schematically in the figure 4.

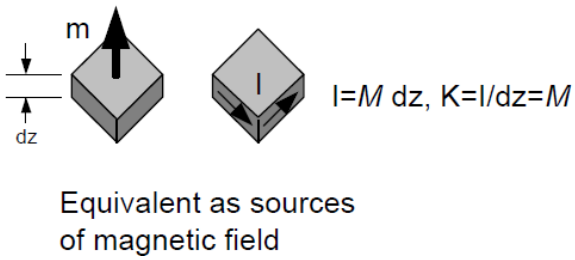

Figure 4: generation of magnetic field

The figure show isolates two small volumes. The one on the left generates a magnetic field due to its magnetic moment, one on the right generates a magnetic field by virtue of the current wrapping the volume (this is commonly referred to as a "current sheet."), and otherwise ignores the presence of the magnetic material. The two magnetic fields are entirely equivalent (external to the material). The material property *M* describes the strength of the magnetic material and the amount of current required per unit distance of height. The parameter K describes the current per unit height within the current sheet. For modern high performance neodymium-iron-boron permanent magnets, K~900,000 amps/meter.

V. APPLICATION OF MAGNETIC LEVITATION

There are the many application on the magnetic levitation some important application are as fallows.

1. Novelty Toys:- The most popular application for magnetic levitation by far has been through the novelty toys. This application has been made possible because of how relatively inexpensive it is to manufacture a small magnet for use with in a toy.

2. Globes:- One of the most popular gadgets is the magnetic globe. These electromagnetically suspended globes are actually high technology instruments. A magnetic field sensor permanently measures the height at which the globes are suspended. This sensor feeds that data into a micro computer in the base of the unit. This computer than calibrates the electronic magnets at the top of the frame based on the distance between the globes and the top magnet to keep the globes correctly positioned. Once it's levitating, it can even be spun slightly and watch as the globes rotate for extend periods of time. Figure 5 below shows an example of one of these magnetic globes.

Figure 5: magnetic leviated globe

3. Magnetic levitated trains:- the technology is applicable at transportation system. A super high-speed transport system with a non-adhesive drive system that is separate of wheel-and-rail frictional forces has long been a vision of railway engineers. Maglev, a combination of superconducting magnets and linear motor technology, realizes super high-speed running, safety, reliability, low environmental impact and minimum maintenance. Magnetic levitation is a system in which the vehicle runs levitated from the guide way (corresponding to the rail tracks of conventional railways) by using electromagnetic forces between the superconducting magnets on board the vehicle and coils on the ground. . As the vehicle is moving at a high rate of speed, there is an electric current that passes through the coils only at the instant that the vehicle is passing the coils. Once this happens, this turns the coils into the electromagnets temporarily. Once the

electromagnets are turned on, the interaction between the coils on the guide way and the magnets on the vehicle allow the vehicle to stay levitated above the track for a few centimeters.

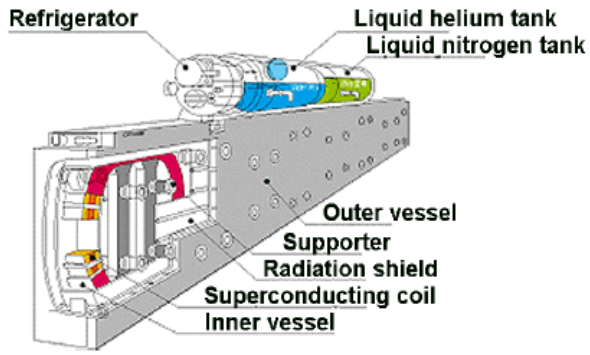

Figure 6: magnetic levitated train

4. Floaters (Steel Industry Application);- Magnetic Levitation doesn't have to be used for only transportation purposes. The principles behind magnetic levitation can be applied to manufacturing processes as well. these are used are through the used of magnets to continually count and separate sheets of steel that have already been processed. The reason that this method was devised was because of the error that was being seen on the products that were coming through the line. Using this technique you have no human contact with the steel and also no mechanical contact with the steel because of the sheets of steel are levitating above each other. These magnetic sheet floaters operate by the use of mutual magnetic repulsion to separate sheets in a stack. One of the advantages to this type of system is that it is able to handle clean, oily, or painted sheets of steel when normally there would have needed time to wait for the sheets to dry, clean the sheets off from the oil.

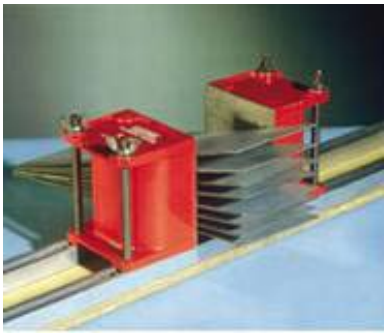

Figure 7: Floaters (Steel Industry Application)

VI. CONCLUSION

Magnetic levitation is a technology that is still being newly developed. There is no telling what the future holds for these types of applications. The current applications that range from the toys to military equipment are important in the development of new and more efficient ideas. Development into these new ideas will provide a push into commercializing superconductors for electric power generation, transmission and storage. energy storage is the latest in technology from magnetic technology. Whether these types of technologies will later be used as common as the house hold light switch, it is too early to tell. There is a lot of work that needs to be done in the research and a lot of money needs to be devoted to the cause. Although with careful education and research this clean, plentiful, and friendly way of producing force could prove to be a valuable asset to many developing technologies. The technology shows promise but will require a long and expensive development period before it can be evaluated as a candidate for commercial use. It the most reliable and full technology not only in the present also in a future. This paper tried to study the most important uses of magnetic levitation technology. The results clearly showed that the maglev can be conveniently considered as a solution for the future engineering needs of the world.

REFRENCES

[1] http://en.wikipedia.org/wiki/Magnetic levitation
[2] http://en.wikipedia.org/wiki/Electromagnet
[3] www.otherpower.com/glossary.html
[4] www.thinkgeek.com/cubegoodies/toys/61da
[5] www.eclipsemagnetics.co.uk/ToolsAndBases/1244.htm
[6] www.wikipedia.org/magneticmaterial
[7] http://www.superconductors.org/uses.htm
[8] www.rochestermagnet.com/devices/devices.htm
[9] www.rtri.or.jp/rd/maglev/html/english/maglev_frame_E.html
[10] http://www.physics.ucla.edu/marty/levitron/spinstab.pdf
[11] http://www.superconductors.org/uses.htm