International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Maglev Power Generator

K. Sai Kumar[1], G. Sai Sushrutha[2]

[1]Department of Mechanical Engineering, Department of Electronics and Communication Engineering

[2]Vidya Jyothi institute of technology, Hyderabad, Telangana, India

Abstract: ***In today's world, with the increase in technology, power has become a basic requirement. Power can be generated through various sources. The most popular technique of generating power in developing countries like India is by using coal, fossil fuels, natural gas which are exhaustible and they also result in various kinds of threats to the environment. So, alternatives that can replace these kinds of energy sources are being implemented. Magnetic energy and strong magnetic fields can be one of them. This thesis gives an idea about how power can be generated through magnetic levitation. When a smaller magnet which is connected to a DC machine by certain means, is levitating above a base magnet of high magnetic field intensity, the mechanical energy to the machine is provided by the rotation of the levitating magnet and this mechanical energy can be converted into electrical energy and hence, power can be supplied. Thus, it can be used as a generator.***

Keywords: Magnetic levitation, working principle of DC generator, rotation of the levitating magnet

1. Introduction

Magnetic levitation is a method of suspension of any object by using magnetic fields which counteract the effects of gravitation. The concept of magnetic levitation was first introduced by Emile Bachelet in the year 1913.

As we already know, there are already trains running on the principle of magnetic levitation in the countries like Japan, Germany, and France etc. The power and energy consumed by these trains is less compared to the conventional trains. The basic working is that the guideway track, made up of magnets creates lift and propulsion simultaneously which results in the reduction of friction. This leads to the high speed movement of the train.

Apart from this, there are other applications of magnetic levitation in nuclear reactors, aerospace engineering, biomedical engineering etc

In order to achieve magnetic levitation and electromagnetic suspension there are various methods like servomechanism, rotational stabilization, using super conductors, induced currents and more. The following picture, (figure 1) shows the levitation of a magnetic material.

Figure 1: Magnetic levitation of a magnetic material

The main objective of this study is to generate and store the energy through magnetic levitation. Basically, a DC machine is an electromechanical energy convertor.

The idea is to make a machine work as a generator, so that it provides electrical energy or it can also store the energy by connecting a capacitor to it.

2. Working principle of a DC Generator

A DC generator is a device which converts mechanical energy into electrical energy. The constructional details and the parts of the 4 pole DC generator is shown in the following figure 2.

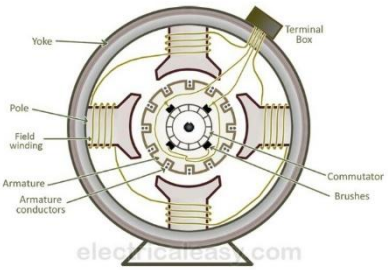

Figure 2

The armature core is the rotor which is a rotating part. The field coils produce an electromagnetic field and the armature conductors are rotated into the field. Thus, an electromagnetically induced EMF is generated in the armature conductors. The following diagram shows the armature core or rotor of a DC machine.

Figure 3: armature core (or) rotor

3. Magnetic levitation and different types:

As discussed earlier, magnetic levitation can be obtained through various methods.

Magnetic levitation can be achieved by superconductors as magnetic tube providing 16 tesla of magnetic field well, which involve in magnetic behaviour. Superconductors have the ability to create magnetometers which can measure up to 10-15 Tesla of magnetic fields.

Diamagnetic levitation can be used to magnetically suspend light materials. The perfect example for this is the levitation of frog which is non-magnetic in nature, but as it contains large water content in its body it is levitated in the presence of strong magnetic fields and hence, acts as diamagnetic material in the presence of strong magnetic fields. The following figure shows the levitation of a frog in a hollow magnetic tube. This experiment was conducted by Andre Geim in the year 1997.
It is found that water is levitated in a magnetic field of about 1400T along the vertical axis.

Figure 4: A picture of frog levitating inside a 32mm diameter vertical bore providing 16 Teslas of magnetic field

Some scientists believe that even humans can be levitated in a strong enough magnetic field.

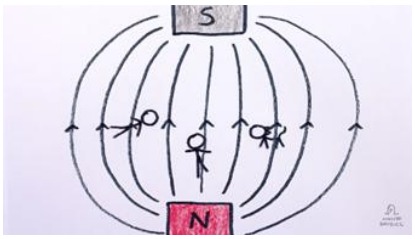

Figure 5

Pseudo levitation is a process in which two magnets are mechanically constrained along a single axis and are made to repel each other.

According to Earnshaw's theorem, no combination of electrostatic, magneto static or gravitational forces can create 3D potential for stable levitation in space but this does not consider highly magnetic materials and hence, can be applied here.

4. Main Discussion

Magnetic levitation is defined as a technique of providing suspension to any object without any support other than magnetic fields as stated before. In order to achieve magnetic levitation, lift and propulsion are simultaneously provided to the object and as desired, levitation is occurred. Now, we study how this is going to be helpful in generating or storing energy.

Consider a magnet is levitating upon a base magnet of higher magnetic field intensity. A DC machine is fixed such that the rotor rotates with the rotation of the levitating magnet. Generally, shunt generators are used in practice. Due to the mechanical energy provided to the machine, the shaft of the machine is rotated and hence, an EMF is generated in the armature due to the electromagnetic field present around it.

The levitating magnet is connected to the machine's shaft by the means of a connecting wire or any other convenient method so that, when the magnet rotates, the rotor also moves with the desired speed. The outer cover of the motor is fixed to a stand which is placed on the surface on which the base magnet is placed. A representative line diagram of the set-up is given in the following figure.

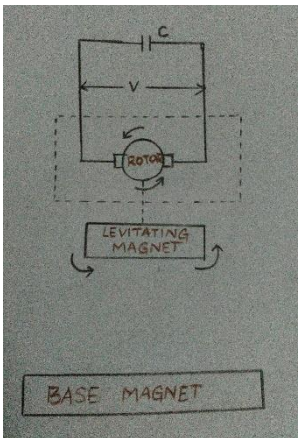

Figure 6

The EMF of the armature is given by the equation
E_a= (ϕZNP)/60A, where
Z=number of conductors of the armature core
N=speed of the rotor in rpm
P=number of poles
A=number of parallel paths in the armature
Φ=magnetic flux

For convenience, let us consider a 4 pole Dc generator with lap winding of the armature and 60 conductors in the armature. In a lap winding, the number of parallel paths is equal to the number of poles of the generator and therefore, A=4
Therefore, A=4; P=4; Z=60 which implies, E_a= (ϕ*60*N*4)/(60*4)

$$\Rightarrow \quad E_a=\phi N$$

Let the flux generated due to the magnetic field be constant and therefore, the EMF generated in the armature is directly proportional to the speed of the rotor N.

The output voltage obtained by the generator is given by $V=E_a+I_aR_1$. Assume that the shunt parameters of the generator are negligible. Then, the output voltage obtained is approximately equal to the EMF generated in the armature.

$$\mathbf{V=E_a.}$$

Assumptions:
Let us consider that the output power required from the generator is 500W. Power is given by the product of voltage and current i.e., P=VI

Usually, the output DC voltage is considered to be 220V.

⇨ 500=220*I

Therefore, the current generated at the armature must be equal to 2.27amperes approximately.
Now, let the constant flux be 1.5Wb.
Since, E_a=V= (1.5*60*N*4)/ (60*A)

⇨ 220=1.5*N

⇨ N=146.667rpm (approx.)

Therefore, the speed of the rotor must be about 146.67 rpm to generate an output voltage of 220V and power of 500W as assumed. This speed of the rotor can be obtained by the speed of rotation of the levitating magnet.
The speed of the rotor depends on the following factors.

A. Speed of the levitating magnet
B. Intensity of the base magnet and the levitating magnet
C. Distance between the two magnets which are used for the magnetic levitation.

Applications and future scope:
The concept of magnetic levitation is being explored widely. Though its implementation is more expensive than other means, it will have a huge range of applications in the future.

Magnetic levitated superconducting wires are used in MRI scans-(magnetic resonance imaging) system for medical purposes. The concept is used in launching space rockets, jet planes can be run using magnetic levitation, magnetic levitated cars would be developed which would run on the roads that would be made of magnetic guideways so that there would be no contact between the road and the vehicle. It can also be used in household decorative objects, trains, construction sites, ball bearings etc. It can also be used to let a device act as a power source as mentioned in the idea given in the above discussion and it would have a positive impact on the global economy and environment.

By using the above concept of providing mechanical energy to a DC machine, it can act as a generator and the energy generated by it can be stored by connecting capacitors in parallel to the output and this energy can be used when required. This energy generated can be used in various applications like fans, lights, chargers, invertors etc.

5. Conclusion

Hence, as stated above, magnetic levitation can be used as source to convert a motor as a generator which can supply power to various devices.

Many theories about magnetic levitation are being evolved and experiments are being conducted and research is being conducted to make a large use of magnetic levitation in daily needs and improve its ease of availability.

There may come a day when many countries switch to use magnetic levitated transport, power sources, space crafts, construction equipment and many more and this would be an environment friendly change.

References

[1] (hindawi.com/journals) –journal of engineering by Hamid Yaghobi
[2] (www.popularmechanics.com/technology/infrastructure) by Sarah Fecht
[3] Electrical machinery by P.S.Bimbhra
[4] ieeexplore.ieee.org by M.Yoshishige and M.kyousuke
[5] ^permanent magnet base of magnetic levitation