

Example of essay on electromagnetism in speakers

[Environment](#), [Electricity](#)



Introduction

Electromagnetism refers to the creation of a magnetic force from the movement of electrical charges. In order to find application in most electrical appliances, electromagnetism concerns the use of electric current to make electromagnets. This field of electricity is called Electrodynamics. It can also mean using magnetic field to induce an electric current. This field of electromagnetism is called Electromagnetic Induction. Almost all electrical appliances use one of the two types of electromagnetism mentioned above especially those with moving parts. This paper discusses the application of electromagnetism in a speaker.

Application of electromagnetism in a speaker

The speaker is basically an electronic transducer which converts electric energy into sound energy. It operates on the principle of electrodynamics where it utilizes alternating Current (AC) to create a solenoid or electromagnet (Meade & Robert, 322). Though they may vary in size, type and shape among other things, speakers work on the principle of electromagnetism as they convert electric energy into sound energy.

Figure 1 Figure 2

Figure 1 and 2: Diagram showing the working of a speaker

Figure 2 shows a more realistic presentation of the electromagnetism assembly of a speaker. In this case the solenoid sits in a circular gap in the permanent magnet.

In the above diagrams, the “copper coil” and the “iron metal” are both attached to the diaphragm. The diaphragm vibrates along with the two parts.

When a small voltage is applied to the coil, the coil is magnetized or made to acquire magnetic properties. Current in a single wire obeys the Right Hand Rule which states that “ when holding a wire in the right hand with the thumb pointing in the direction of the current flow, the fingers wind round wire in a manner similar to the direction of the magnetic field created by current flowing in the wire” (Garg, 45). The other rule is that of a coil held in the right hand with the fingers coiling round the solenoid in the direction of the current flow in which case the thumb points to the North Pole of the solenoid. These rules give an indication of the relationships between current flow and the change in directions of polarity and the movement of field round a current-carrying wire all of which are essential in understanding the electromagnetism principles of an electrical appliance.

(school-for-champions. com)

Figure 3: Direction of current flow in relation to the movement of magnetic field round a current-carrying wire. (Right-Hand Rule)

When electric current passes through a wire it creates a magnetic field as shown above. The current induces electromotive force (EMF) which is equal to the time rate of change of the magnetic flux that is passed through a closed electric circuit. When such a wire is formed into a coil the magnetic field is concentrated in one area thereby acquiring the intensity to create an electromagnet (school-for-champions. com). The magnetic force of the electromagnet created in a speaker can be varied by changing the direction and amount of current that is supplied to the windings or the coils.

(school-for-champions. com)

Figure 4: Diagram showing the direction of current flow in a solenoid and the

resultant polarities.

The speaker has one permanent magnet adjacent to an electromagnet. The permanent magnet is fixed while the electromagnet or solenoid is movable or mobile. The electromagnet is created by inserting an iron rod inside the solenoid. The entire assembly of a solenoid and the iron rod is the electromagnet that acquires polarity when electric current passes through the coil.

When alternating current (AC) is passed through a coil it creates a magnet with a North Pole at the end attached to the positive terminal while the side attached to the negative terminal is magnetized to become a South Pole (Meade & Robert, 322). Since the current is alternating the resultant, electromagnet created keeps on changing polarity (Poles) and thereby developing the capability to attract or repel another permanent magnet bearing permanent polarity.

Figure 3 above shows a simple illustration of current flowing in a coil and the resultant poles of the electromagnet created. This illustration uses a Direct Current (DC) source of electricity. It is worth noting that the North Pole of the solenoid is created on the end solenoid attached to the positive terminal while the South Pole is automatically created on the end attached to the negative terminal (Garg, 78). It is this process that gets repeated over thousands of times per second that creates alternating poles of the electromagnet.

The like poles of a magnet repel while the unlike poles attract. The electromagnet can therefore be attracted and repelled by the permanent magnet adjacent to it. The cycle of repulsion between the permanent

magnet and the solenoid are repeated thousands of times each second. The diaphragm is attached to a cone which is made of flexible material such as paper or plastic. These materials amplify the vibrations resulting from the movement of the solenoid (Meade & Robert, 322). This creates a sound that corresponds to the electric signal received by the coil.

As the flexible material vibrates rapidly it pumps the sound waves into the surrounding air and eventually into the ears of listener. The frequency of the vibrations dictates the pitch (highness or lowness) of the sound produced while the amplitude of the vibrations affects the volume.

Figure 5: Interaction of the electric field and the electromagnetic wave.

Magnetic waves such as the one shown above are generated when a speaker is working. The vertical distance from the direction of propagation to the tip of the wave is the amplitude and they indicate the volume of the sound produced when a speaker is working. The distance between two crests (tips of the wave) is the wavelength and it indicates the frequency of the sound produced for a given electromagnetic interaction of electric field and electromagnetic wave (Garg, 67). Frequency can be described as the number of crests that pass a given point in one second. One cycle or wave per second is called a Hertz (HZ). A wave with 2 cycles passing in one second is described as 2Hz.

In order to produce all the varying frequencies of sound in a piece of music for instance, top quality speakers use different sized cones. In order to increase the amount of air that a speaker can move, the following can be done. The diameter of the cone can be increased or the distance that the diaphragm moves can be increased. Increasing the distance that the

diaphragm moves is equivalent to increasing the distance between the electromagnet and the permanent magnet (Garg, 67). In this case, once the electromagnet is magnetized, it moves a larger distance when it is attracted and retracts an equally larger distance when it is repelled by the permanent magnet. This results in lesser vibrations per a given unit time but the vibrations yield in more volume of air being pushed by the diaphragm.

The electromagnetic wave produced when a speaker is in operation can also be described in terms of the energy it generates. The unit of energy used is the electron volts (eV). One electron volt is that amount of kinetic energy that is needed to move one electron through one volt potential. As the wavelengths decrease the energy they possess increases.

Permanent magnet speakers such as the one discussed above perform well when in a transformer coupling. This is appropriate as it helps overcome low impedance of the electromagnet or the voice coil. These speakers produce sound with low audio frequencies very well while it produces mid-band frequencies fairly well but is very poor in producing high frequencies. The reason for this is related to the electromagnetic functioning of the speaker. In its construction, an iron core can only accommodate a limited number of turns (Meade & Robert, 322). This gives such speaker fixed impedance. The lower the frequency the inductive reactance of the solenoid is relatively low and large audio currents flow into the solenoid. This scenario results in a strong magnetic field around the solenoid and a strong interaction with the magnetic field of the permanent magnet. At high frequencies, the inductive reactance of the solenoid is high thereby limiting the amount of current flowing onto the solenoid. The result is reduced magnetic interaction

between the solenoid and the permanent magnet.

Electromagnetism in the traditional speaker such as the one shown in figure 2 has limited capability. The limited size of the magnet makes it possible for the solenoid to “ jump” out of the gap around the permanent magnet in case the input amplitude is too high. This can happen in case very high current passes through the solenoid. When the solenoid leaves the permanent magnet it may not be possible to realign the solenoid correctly and this results in poor and unbalanced interactions of magnetism forces which ultimately results in poor vibrations.

Conclusion

Electromagnetism on a level applicable to appliances refers to the use of electric current to create electromagnets. The speaker is one appliance that makes extensive use of electromagnetism. The basic principle of operation of electromagnetism is based on electrodynamics where electric current is used to create an electromagnet. Speakers have a permanent magnet adjacent to an electromagnet. When the electric current passes through a solenoid it magnetizes it and creates North and South poles on the electromagnetism through the electromagnetic waves generated. The passing of alternating current through the solenoid creates alternating polarity on the electromagnet. This causes the electromagnet to be repelled and attracted alternately by the permanent magnet. The mobile solenoid is attached to the diaphragm which holds a cone. As the solenoid moves in and out of the permanent magnet usually circular in shape, it moves together with the diaphragm and thereby causing vibrations. Electromagnetism in a

speaker is affected by the misalignment of the solenoid inside the permanent magnet in the traditional speakers. This can cause poor interactions of magnetic waves and therefore ineffective vibrations and sound.

Works Cited

" Basics of Electromagnetism by Ron Kurtus - Succeed in Understanding Physics: School for Champions." School for Champions by Ron Kurtus - online lessons for those seeking success. N. p., n. d. Web. 11 Aug. 2013. Garg, Anupam K. Classical Electromagnetism in a Nutshell. Princeton [N. J.]: Princeton University Press, 2012. Print.

Meade, Russell L, and Robert Diffenderfer. Foundations of Electronics: Circuits and Devices. Clifton Park, NY: Thomson/Delmar Learning, 2003. Print.