2021

Speaker Report

ENGINEERING SCIENCE
(STUDENT) - ABDULBASIT JIMOH

C00278683

Introduction

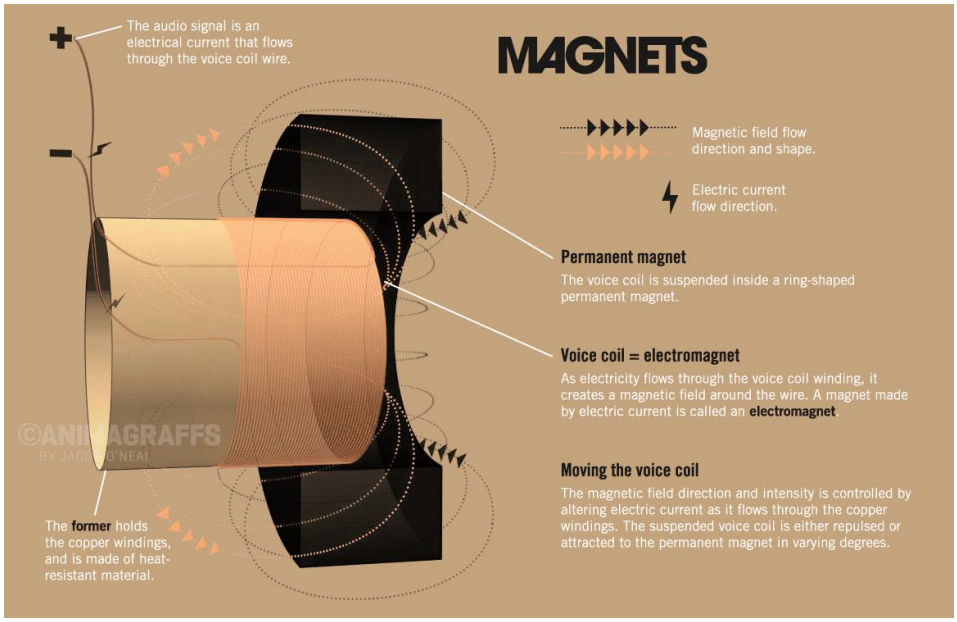
The aim of the project is to make a DIY speaker from common materials found at home and the speaker should be connect to an Aux cable which can be connected to a mobile device to play songs, with the speaker having a decibel of at least 80db(decibels).

What is a speaker?

Speakers are devices that convert electromagnetic waves into sound waves. "Speakers Definition - Tech Terms." 27 Feb. 2010, https://techterms.com/definition/speakers.

How does a speaker work?

An electric current is sent from a mobile device (phones, laptops etc) through an aux cable to the voice coil. When electric current flows through the voice coil, it becomes an electromagnet thanks to Faraday's Law, which states that any change in the magnetic environment of a coil of wire will cause a voltage to be "induced" in the coil, and vice versa. Hence, the direction of the current passing through the voice coil determines the magnetic polarity of the voice coil. The polarity of the permanent magnet is always the same, so depending entirely upon the direction of current flowing through the voice coil, the voice coil will either be attracted to or repelled from the permanent magnet. And so, every time the current changes direction, the voice coil changes direction too. Now, because the voice coil is attached to the cone, any movement in the voice coil is translated directly to movement in the cone. Thus, the movement of the cone is ultimately determined by the direction of current flowing through the voice coil. When the coil moves, it pushes and pulls on the speaker cone. This vibrates the air in front of the speaker, creating sound waves. "Weebly - The Physics of Speakers - Background" https://physicsofloudspeakers.weebly.com/.

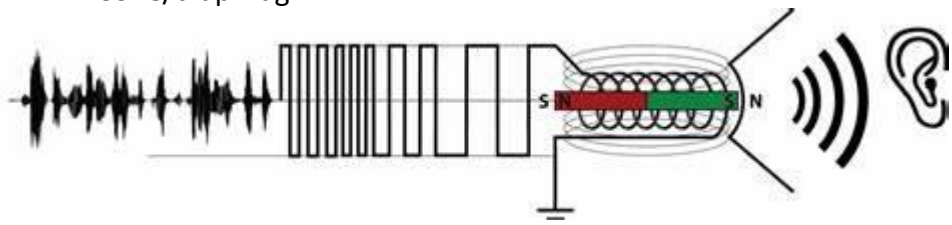


"Weebly - The Physics of Speakers - Background" https://physicsofloudspeakers.weebly.com/.

Parts of a speaker

Looking back at how a speaker works you only need 3 things to make a speaker that produces sound.

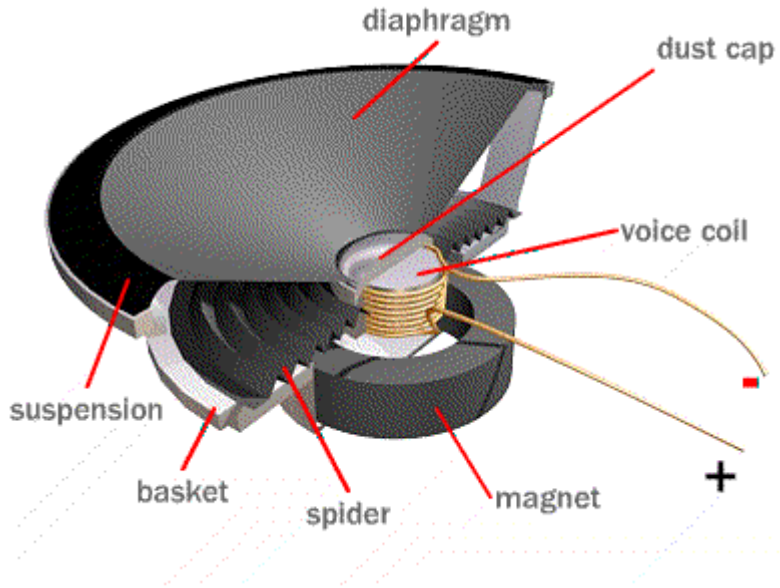
- Permanent magnet
- Voice coil(electromagnet)
- Cone/diaphragm



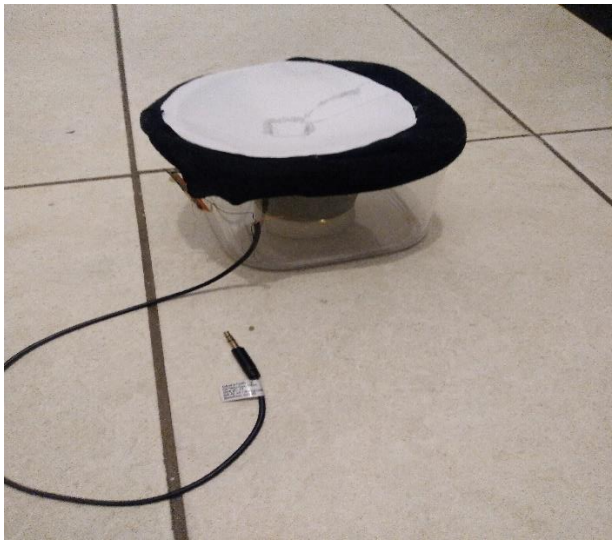
Note: the voice coil must be connected to an audio signal source

The parts of a standard speaker are:

- **Permanent magnet:** Often a rare earth neodymium
- **Voice coil:** moves the diaphragm
- **Cone/diaphragm**: Moves back and forth allowing the air in the surroundings to move, creating sound.
- **Spyder**: A type of suspension that keeps tension on the voice coil but allowing it to move.
- **Suspension:** an elastic material that keeps tension on the diaphragm but allowing it to move.
- **Dust cap**: Protects the Voice Coil from dust.
- **Basket:** A frame which holds the speaker together.
- **Container:** where the speaker is placed
- **Bottom plate:** holds the magnet in place



My speaker



Parts of my speaker:

My speaker is made up of 5 parts namely

- ***Permanent Magnet:***

  I used two ½ inch cube neodymium magnets. This is because the depth of my container is quite high, and I don't want to increase the height of my cone or my voice coil so as not to affect or unbalance the speaker performance

- ***Cone/diaphragm*:**

  my cone was made from a sheet of A4 paper.

- ***Suspension:***

  My suspension was made from a piece of cloth cut to cover the edges of the cone to connect it to the container keeping it in position while letting it move freely.

- ***Voice coil:***

  My voice coil bobbin (material in which the wire is wounded around) was made from a cereal box cut into a rectangle, then folded and glued to form a cuboid.
  The coil wire is an enamelled copper wire of diameter 0.2mm and length 6.2m and the diameter of the winding is approximately 5cm with 3 layers tightly wounded around the bobbin together with a measured resistance of 6.3Ω. The length was discovered using the formular p= RA/L (Resistivity formula) with the resistivity of copper being 1.68×10^{8}

- ***Container:***

  The container I used was a plastic provision container.

Assembly

- Put two plastics in my container to reduce the depth
- Placed two ½ inch cube neodymium magnets on the plastics
- Cut a circular shape from an A4 paper and formed a cone from it
- Glued my bobbin to my voice coil
- Glued my suspension to my cone
- Then I put everything together

Tests

I performed 3 tests after the assembly:

First test: the first test was quite disappointing I recorded 72 decibels. After going back to figure out where there was problem, I discovered that the coil wire was not tightly wounded together so I took it apart and did the winding again but this time I made it tightly packed together. I then put it back together and did another test.

Second test: the second test was better than the first I recorded 82 decibels. I passed the project, but I wasn't satisfied with my output, so I went back did some researches and found out that if the coil is tightly packed with layers it increases the efficiency of the electromagnet, so I took it apart again tried layering the coil wire then I put the speaker back together again. I then went ahead to do my final test.

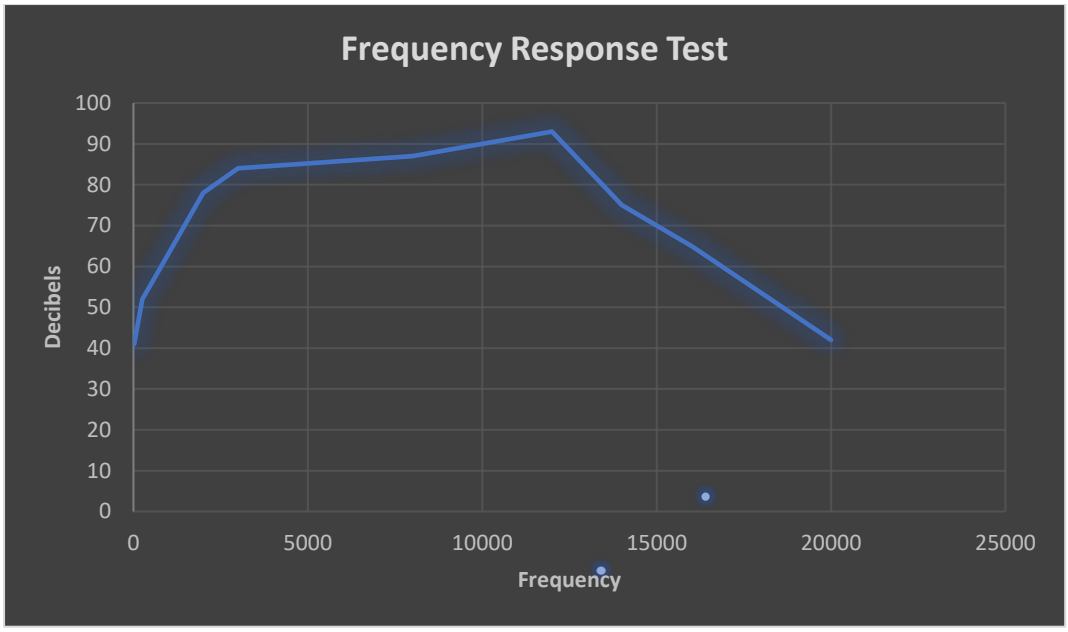
Third test: I recorded 90 decibels on my last test and was among the best in the class, I was satisfied with this and then went on to perform how accurate the listening experience will be using the frequency response test

Frequency Response Test

I conducted my frequency response test using the frequency response test video on YouTube https://www.youtube.com/watch?v=qNf9nzvnd1k

The outcome of the test is as follows:

Decibel Range	Result	Remark
20Hz – 2kHz	poor	I couldn't hear anything at the beginning but started to hear sound towards 2kHz
2kHz – 14kHz	good	As the frequency went on in this range it became audible a sharp sound could be heard and became louder before it stopped towards the end
14kHz – 20kHz	poor	Couldn't her anything in this range



Conclusion:

In conclusion, the speaker was a success as it was able to give out good quality sound but it could be a lot better if some other component was added to the speaker and if it was mounted properly in a case. With regards to the result of the frequency response test it is ± 9db that's pretty good for a homemade speaker but not good enough for a standard speaker.

References:

- https://blog.landr.com/how-do-speakers-work/
- https://www.headstockdistribution.com/technology/loudspeaker-parts-2
- https://forum.audiogon.com/discussions/what-is-the-working-principle-of-the-loudspeaker-2
- https://techterms.com/definition/speakers
- https://youtu.be/pJ0gKzoRrx8
- https://youtu.be/bJGd3YKU9wA