

SOUND FIRE EXTINGUISHERS IN SPACE



SHAIK SALAUDDIN¹, PAPARAO NALAJALA², BHAVANA GODAVARTHI

Abstract: The main motivation of this paper is to eliminate fire disasters in space using sound. The paper demonstrates an idea of a developing device which can extinguish fire using sound. Most of the things when compared to space are different from earth one of such is fire. Which is major threat in a International space station or in any other space ship. If a fire breaks out in space station astronauts would fight the flames in slightly different ways than they would on earth. First, they will turn off the ventilation system to slow the spread of fire, next they will shut off the power supply to the effected unit. Finally astronauts will seal the area and fill the area with a chemical extinguisher. Extinguisher used in this process may extinguish the fire and will ravage the total system in that particular area. So the proposed deals with fire without effecting any other system around it and avoid all messy chemical, therefore resulting in a electronic-extinguisher.

Keywords: Chemical Extinguisher, Fire, Sound, Space, Sound pressure level meter.

INTRODUCTION

Existing Extinguisher contains different chemicals, depending upon their application. Generally they are pressurized with Nitrogen or Carbon dioxide (CO₂), when this pressure released on fire will extinguishes the fire, as we know there are many such fire fighting agents such as water, potassium bicarbonate, evaporating fluoro carbons etc. All these agents have same property of leaving a unproductive system behind it. To deal with **Fire** we need to have complete information on fire and its working in space. The formation of fire requires three elements in a proper mixture they are fuel, oxygen and heating element. The fire formed in space will have different shape and properties, because of no gravity. Identification of fire comes with its flames but in space fire flames will be in the shape of a semi circle and with a blue colour flame which might not be visible when there are at lower precision. The smoke from caused fire will not be intended towards the smoke detectors and there is less chance of detection of fire in space. Despite of such kind

of behaviour of fire, there is a chance of extinguishing it by sound. If we discuss the procedure of spreading fire, with enough amount of fuel and oxygen and heating element fire is caused, the very first heating element from any source ignites the fuel in presence of oxygen, hence as air molecule get started burning, these molecule now behaves as heating element for other molecule around it and the process of convection (the movement of air) is done naturally on ground and ventilation fans in space station does the process the convection. As a summary we can say that fire is made to spread by heating elements. What if I remove this heating element or move it apart from fuel. This particular task is done by sound. In depth research on sound could help.

Image of Fire on Earth and in a Space station:



Sound is a vibration that propagates as a typically audible mechanical wave of Pressure and Displacement, through a medium such as gases, liquids and solids. As I underlined above sound is pressure wave and Displacement caused in the medium through with particles will move in a random direction, and transferring the pressure from one particle to the another, hence this how sound travel in any medium. Sound can be travel in two forms they are

- 1.) Longitudinal waves : Longitudinal waves, also known as "l waves", are waves in which the displacement of the medium is in the same direction as, or the opposite direction to, the direction of travel of the wave. Mechanical longitudinal waves are also called compression waves, because they produce compression and rarefaction when traveling through a medium.

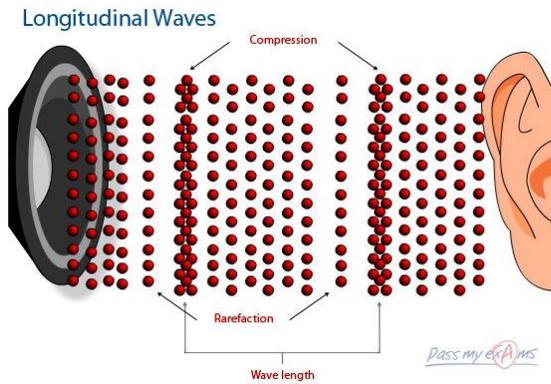


Fig.1. Particle movement in longitudinal waves

2.) Transverse Wave: A transverse wave is a moving wave that consists of oscillations occurring perpendicular (or right angled) to the direction of energy transfer. If a transverse wave is moving in the positive x -direction, its oscillations are in up and down directions that lie in the $y-z$ plane. Light is an example of a transverse wave. With regard to transverse waves in matter, the displacement of the medium is perpendicular to the direction of propagation of the wave. A ripple in a pond and a wave on a string are easily visualized as transverse waves.

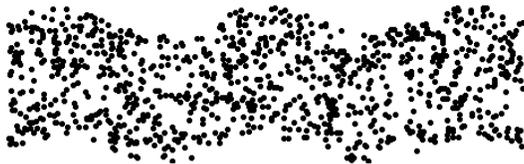


Fig.1.1 Image of transverse wave particles

OBSERVATION

Longitudinal waves are the most pressure waves and we can use these waves in our system. From Observations made above we can say that the particles of sound vibrates from one to next, can able to move the heating element from fire by creating a pressure in the area, but here there is a key point to remember that sound wave of any frequency may not vibrate the particles such that they can cause fire to put off. There are particular ranges of frequencies which can only extinguish fire.

IMPLEMENTATION

The block diagram explains the necessity of signal generation in different stages. The image of block diagram constructed below shows the working of the circuit.

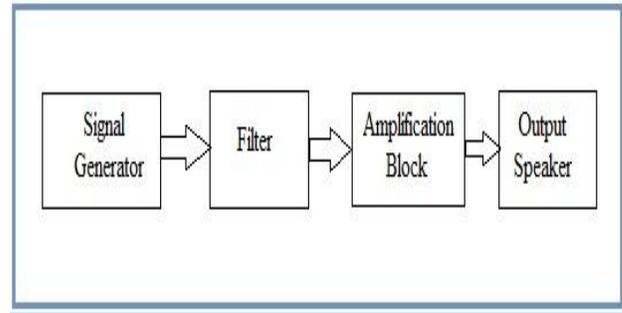


Fig.2. Block diagram of signal generator

The first block is Signal generator or frequency generator, which can generate repeating or non-repeating electronic signals. We need a single tone frequency generator because only single frequency signal are capable of generating the larger vibrations than other multiple tone frequency.

There are many different types of signal generators, with different purposes and applications. In general, no device is suitable for all possible applications. To have good signal with less noise i have making a circuit with a BC547b transistor to generate a simple sine wave.

The below image shows the circuit an sine signal generator.

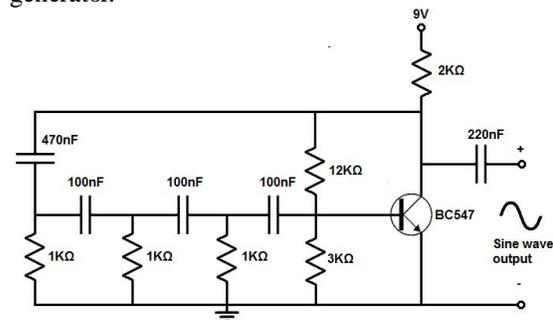


Fig.2. circuit a sine signal generator.

As image defines the circuit is an oscillator and output is gained without no input given. Also the sine wave frequency can be varied with the changing of few components in the circuit. Moving on to the next block which is an filter, hence I am using a toned oscillator and may require a filter to eliminate the noise in it or if I require to limit it I can use a filter block.

Amplification block

These blocks constrain the main operation of the device by controlling the gain and intensity of sound. These block constructs the wave which can be fed to the speaker as output. The image shows circuit

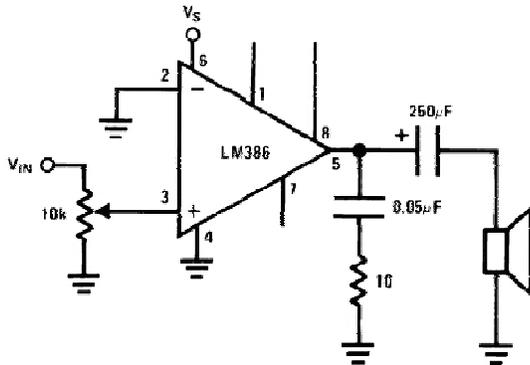


Fig.2.1 The block diagram fed to the speaker as output

The circuit comprises a IC lm386 Which is an audio amplifier and can generate a sine wave as per the requirement of the speaker. The LM386 is a power amplifier designed for the use in low voltage consumer applications. The gain is by default set to 20 and can be increased to maximum of 200 by the addition of external resistor and capacitor at pins 1 and 8.

The final block is an speaker which works on the Flemings left hand rule. The magnet in the speaker is surrounded by a voice coil which is wounded copper, both in a perpendicular direction. The electric signal is passed through the voice coil where it is induced by a magnetic field which creates a force to happen in the third direction. The image shown demonstrate the working principle of speaker.

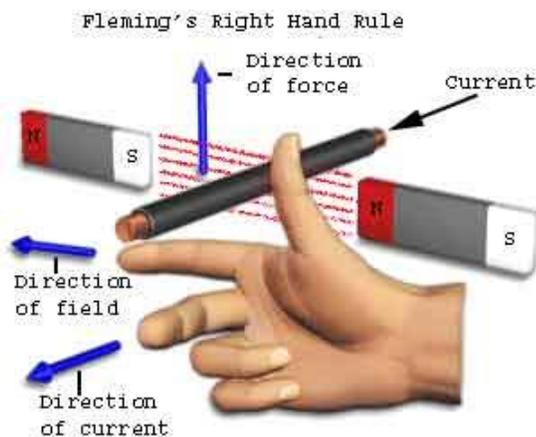


Fig.3.Working principle of speaker

We are related with the principle the force with which the drum vibrates is directly proportional to the number of molecules vibrated in the atmosphere.

SELECTING FREQUENCIES

The sound frequency for this purpose is related to the pressure which it is creating in the atmosphere. The sound frequency installed must have the capacity to vibrate the fire molecules in a vibrate pattern such that they should

not recombine with fuel to burn in presence of oxygen. To measure of a sound wave we can use normal formula relating gain and pressure or use of pressure sensing meter will be better solution. The pressure sensing element will be the microphone and feed the values to any micro controller.

The image below is the circuit of pressure meter.

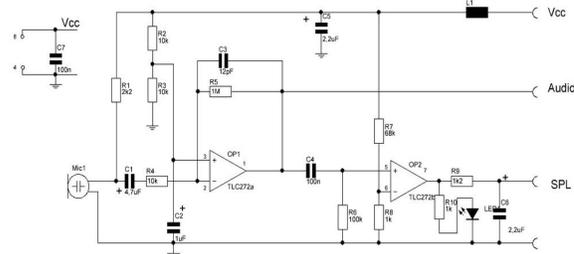


Fig.4.Circuit of pressure meter

The circuit her uses a simple concept of microphone which can receive sound as its input and drive the total circuit, a micro controller should be used to define the to define the values of pressure with certain mathematical calculation will be the best solution.so, the idea of using Arduino board will match our expectation. As my observation the frequency 40-65 Hz were the best to extinguish the fire.

CONCLUSION

The device made should must be installed in successive corners of the space station and must generate a sonic boom of sound at particular period of time without intervention of human.

REFERENCES

- [1]http://www.nasa.gov/missions/shuttle/f_fireprevention.html
- [2]<http://edition.cnn.com/2015/03/27/us/sound-fire-exting uisher/>
- [3] <http://www.wired.com/2012/07/wall-of-sound-fire/>
- [4] <https://www.youtube.com/watch?v=Rx1413aMafE>
- [5]<http://mentalfloss.com/article/62510/students-invent-fir e-extinguisher-uses-sound>
- [6]<http://inhabitat.com/engineering-students-create-a-fire-entinguisher-that-uses-sound-waves/>

AUTHORS BIOGRAPHIES

1. SHAIK SALAUDDIN Pursuing UG at institute of Aeronautical engineering, Hyderabad
2. PAPARAO NALAJALA Working as Asst. Professor, Dept.of ECE at IARE, Hyderabad
3. BHAVANA GODAVARTHI, Working as Asst.Professor, Dept.of ECE at IARE, Hyderabad