# SONIC FIRE EXTINGUISHER

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**Abstract**—From the past few years the regular extinguishers that contain harmful chemicals are being used or even to extinguish fire water is being used. Hence to reduce the effect of harmful chemicals a new technique can be used that is extinguishing fire with the help of sound waves or we can say generating a particular type of frequency that extinguishes fire

**Keywords —Chemical-water free, sound waves**

## INTRODUCTION

We all know fire can be fought with water, Chemical , and even fire, but could we have ever imagined that sound could fight fire. Normal extinguishers use carbon dioxide that is harmful for the people hence this technique eventually depletes the uses of such chemicals. ? In our experiment, we are using technique of sound waves that could safely extinguish flames by drenching them in frequencies, rather than prevent them with water or chemicals as in Fig 1.4 we have stated that the uses of different chemicals in the extinguishers. Current method of firefighting using has significant drawbacks such as toxic to humans and even leaves residue (for dry chemical base fire extinguisher) while water base fire extinguishing techniques freezes in cold climates and ven they have the risk of conducting electricity. Using sound wave with certain frequency as a fire extinguisher will have significant advantages such as leaving no residues and non-toxic waste . Using a simple subwoofer attached to a amplifier that generates a particular frequency hence the major task was that which frequency would give us the result therefore after testing different frequencies we observed that, not only does sound have the ability to extinguish fires, but that the fire extinguishing capabilities vary inversely with the frequency- the higher the frequency, the lower the fire extinguishing effectiveness.hence we all concluded that the 60Hz was the appropriate frequency to extinguish fire. Fire absolutely can be counterd with sound, and the lower the frequency, the better.

 ISBN: 978-93-87793-72-9

## I. METHODOLOGY/EXPERIMENTAL

Combustion refers to a strong oxidation reaction in which a substance generates a rapid chemical reaction with oxygen to generate heat and light. Three factors are essential for this fire to be generated and maintained, which is called the 'third element of combustion'. The three elements of combustion are shown in , and if none of them is present, they are not burned.

Three elements of combustion

**Fuel (combustible material):**It is a substance that can be dehydrated in fire, divided into solid fuel, liquid fuel, and gaseous fuel. In addition, the characteristics of burning depend on the composition of the fuel.

**Heat (ignition source)** In order for the substance to ignite, it must have very high heat, and the amount of heat must be moderate. The size of heat required for combustion is divided into ignition point, flash point, and combustion point. Ignition point: The minimum temperature at which the fuel starts burning Flash point: The temperature at which the fuel burns when the fuel is turned on. Burning point: Temperature at which fire continues to drain when fuel is burning **Oxygen (air):** The material must be supplied with oxygen to take heat. Most liquids are difficult to ignite when the oxygen content in the air is reduced to 15% or less.

The principle behind the extinguisher is simple: as there are mechanical pressure waves that cause vibrations in the medium in which they travel, sound waves have the potential to manipulate both burning material and the oxygen that surrounds it.

Acoustics Fundamentals and Governing Equation

Acoustics is the **ambidextrous** field that deals with the study of all mechanical waves in gases, liquids, and solids as well as subjects such as vibration, sound, ultrasound and infrasound. The study of acoustics encompasses around the disseminate, triggering , and acceptance of vibrations and mechanical waves. There is one fundamental equation that describes sound wave propagation, the acoustic wave equation, but the phenomena that emerge form it are varied and often complex.The fluid momentum (Navier-Stokes) equation and continuity equations are , i.e. given in Fig 1.5

If the sound could be used to separate the two, the fire would be starved of oxygen and accordingly, would be snuffed out. After exploring the impact of different frequencies of sound on small fires. While ultra-high frequencies had little effect, the duo found that lower, bass frequencies – between 30 and 60 Hz – produced the desired extinguishing effect.

## LIMITATIONS

Needs a particular and low frequency with low bass which cannot be produced at all the times hence the fire will not extinguish.Generally works when there are damped conditions so needs a bit of working in the open areas like Petrol pumps etc. range

## FUTURE SCOPE

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The goal is to create something portable and affordable like a fire extinguisher that would generate the sound wave at the correct frequency, which can be done with the help of an oscilloscope that measured the waves. The device is used as tool to attack kitchen fires and to eliminate the toxic monoammoniumphosphate used in commercial fire extinguishers, we can see more uses: in confined areas in space, or wide areas outdoors, such as forest fires. Not having to use water or foam would be a bonus.

## WORKING MODEL


**Fig 1.1**

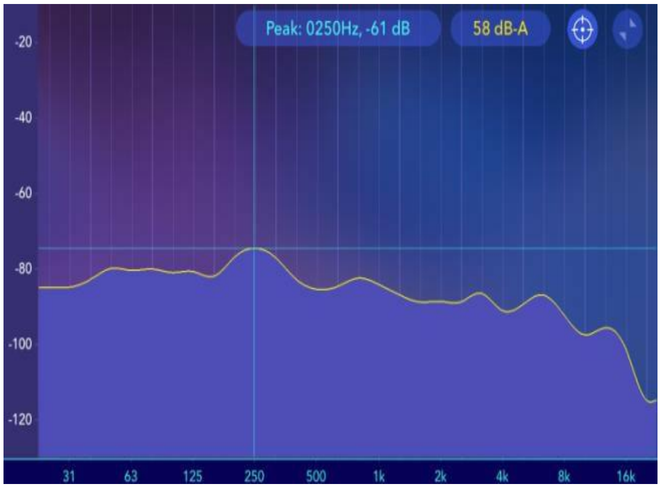


**Fig 1.2**

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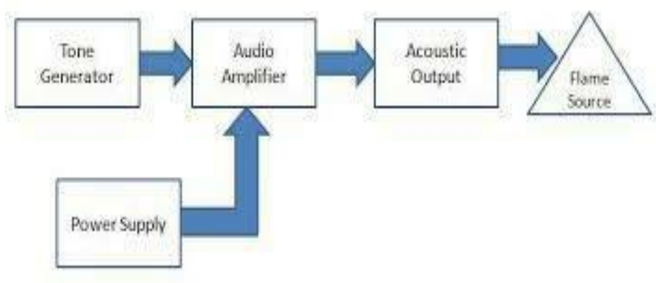


**Fig 1.3**

| Vapor Fuels | $CO_2$/air[a] (v/v) | $O_2$ Concentration (%) | Theoretical Minimum $CO_2$ Concentration[b] (%) | Minimum Design $CO_2$ Concentration (%) |
|---|---|---|---|---|
| Carbon Disulfide | 1.59 | 8.1 | 60 | 72 |
| Hydrogen | 1.54 | 8.2 | 62 | 75 |
| Ethylene | 0.68 | 12.5 | 41 | 49 |
| Ethyl Ether | 0.51 | 13.9 | 38 | 46 |
| Ethanol | 0.48 | 14.2 | 36 | 43 |
| Propane | 0.41 | 14.9 | 30 | 36 |
| Acetone | 0.41 | 14.9 | 27 | 34 |
| Hexane | 0.40 | 15.0 | 29 | 35 |
| Benzene | 0.40 | 15.0 | 31 | 37 |
| Methane | 0.33 | 15.7 | 25 | 34 |

**Fig 1.4**

The acoustic wave equation is given by:

$$\nabla \cdot \left(\frac{1}{\rho_0}\nabla p\right) - \frac{1}{\rho_0 c^2}\frac{\partial^2 p}{\partial t^2} + \nabla \cdot \left[\frac{4\mu}{3\rho_0}\nabla\left(\frac{1}{\rho_0 c^2}\frac{\partial p}{\partial t}\right)\right] = -\frac{\partial}{\partial t}\left(\frac{Q}{\rho_0}\right) + \nabla \cdot \left[\frac{4\mu}{3\rho_0}\nabla\left(\frac{Q}{\rho_0}\right)\right]$$

Where:

$c$ = speed of sound $\left(\sqrt{K/\rho_o}\right)$ in fluid medium

$\rho_o$ = mean fluid density

$K$ = bulk modulus of fluid

$\mu$ = dynamic viscosity

p = acoustic pressure (= p(x, y, z, t))

Q = mass source in the continuity equation

t = time

**Fig 1.5**

## 8.CONCLUSION

The requirement of such a type of a extinguisher is to eliminate the use of water or other renewable sources of energy. This type just requires sound at appropriate that extinguishes flames .Use of this type of extinguisher further eliminates the use of other extinguishers eventually leading to the less usage of toxic chemicals in the extinguishers .In the experimental part, different parameters could be used to further explore is study such as using different intensity of sound (by using different speaker power rating), positioning of sound towards the fire source and size of flame (or flame intensity) &varying design . Apart from that, measuring the output sound pressure , exit air velocity and temperature could also be taken into account.

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