LOW FREQUENCY BASED FIRE EXTINGUISHER

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Abstract

Fire is basically heat and light from rapid combustion of oxygen and other materials. The basic fire extinguishers, such as foam based, or water based are very effective but they may cause damage to the indoor equipment. Hence the aim of this project is to use infrasonic acoustic waves to extinguish a flame instead of foam based or water-based fire extinguishers. The infrasonic sound wave fire extinguisher is based on the principle of suppressing the flame by lowering its temperature with contacting the vibration energy from low frequency sound and then blocking the oxygen supply. We will be using infrasonic sound waves i,e the frequency used will be below 100hz. The extinguisher developed using this technique can be used for typical residential and commercial use. It can be very useful for extinguishing fire in spacecraft applications.

Keywords: *fire extinguisher, blaze, douse, fire*

1. Introduction

Fire is basically a process in which substances combine chemically with oxygen from the air and typically give out bright light, heat, and smoke. For a flame to exist a combustible material or gas should be present along with enough oxygen to sustain rapid combustion. The combined reaction of all this releases the energy as heat and light.

There is a vast variety of fire extinguishers available in the market. Some of these include powder based, fluid based, water based etc. Although conventional fire extinguishers are ideal for use in warehouse and factory environments and other areas where there are considerable advantages offered by their effectiveness and multi-purpose application but the disadvantages of their residual properties that pose threat to the equipment can be ignored. Issues may arise when using these extinguishers in case of an emergency. For example, the powder, fluid, or gas inside the extinguisher may get solidified and get stuck inside the container. The powder residue can cause damage to electronic equipment such as circuit boards, computers etc. The ammonium phosphate within the powder-based fire extinguisher can undergo hydrolysis to form phosphoric acid which is very corrosive to metals and alloys.

This is where an acoustic sound wave-based fire extinguisher comes into use. This type of extinguisher provides the least destructive and the cleanest way to put out a flame. It doesn't use water or any chemical fluid like traditional fire extinguisher but only the infrasonic sound waves. It uses low frequency sounds which have high vibrational energy which when touches flame scatters the flame and blocks the inflow of oxygen which in turn douses the flame.

2. Hardware

2.1 Subwoofer

Figure 1. Subwoofer

A subwoofer is a special type of speaker which is dedicated to the production of low- pitched audio frequencies known as bass. In this project we are using a subwoofer of Diameter of 12 inch which gives a peak power of 800W. This is a Dual coil subwoofer that means it has two coils with separate input ports. Each coil has a input impedance of
2Ω which makes total input impedance of 4Ω.

2.2 Audio amplifier

Figure 2. Audio amplifier

It is used to drive the subwoofer. An audio amplifier circuit is used to amplify the input audio signal. It increases amplitude level of an input audio signal. There are different class of Audio Amplifiers. We are using a 2.1 Channel Class D Audio Amplifier because we have 2 coil Subwoofer.

2.3 SMPS (switching mode power supply)

Figure 2. SMPS (switching mode power supply)

It basically converts high voltage to low voltage, basically SMPS is a stepdown transformer. It is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. The Input power is 230V AC; the Output is 12V 5A DC.

2.4 Tone generator

Infrasonic sine wave tone is supplied to the amplifier .Frequency band: 25-35hz

2.5 Vortex cannon

It is a Cylinder-Shaped equipment used to increase the directivity & the pressure of Sound.

3. Methodology

Infrasonic sound refers to the sound waves below the frequencies of audible sound. These infrasonic waves have high vibrational energy. The principle behind the extinguisher is simple. The sound waves are mechanical pressure waves that cause vibrations in the medium in which they travel. The sound waves have the potential to manipulate both burning material and the oxygen that surrounds it. To successfully extinguish the flame, we have to separate the oxygen from the burning material. If the sound could be used to separate the two, the fire would be starved of oxygen and, accordingly, would be doused.Tran and Robertson explored 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. Consisting of an amplifier and cardboard collimator to focus the sound, the duo's final extinguisher prototype.

Figure 3. Working Principle

One of the most important aspect is the utilization of wind. Wind generally creates white noise, but in this case, we have covered the wind with sound of a certain infrasonic frequency. When wind acquires certain sound frequency the resonance magnifies it and creates an amplified sound-wind amplifier. A speaker produces the sound of low frequency 100Hz and creates sound-wind which resonates it by utilizing the horn effect to magnify 15 times larger in power. The magnified sound-wind touches the flame and instantly extinguishes the flame.

4. Implementation

Figure 3. Implementation

The first block is Signal generator or frequency generator, which generate sinusoidal signals. Here we make use of low frequency electrical sine waves of the frequency range 30-90 Hz, which are needed to be a single tone frequency because only single frequency signals are capable of generating the larger vibrations than other multiple tone frequency. The sound frequency installed must have the capacity to vibrate the fire molecules in a vibrating pattern such that they should not recombine with fuel to burn in presence of oxygen.

An audio power amplifier (or power amp) is an electronic amplifier that reproduces low-power electronic audio signals. It amplifies the single tone signals from the generator and sends them to the focusing guide to direct these waves on the flame

5. Conclusion

The sound wave-based fire extinguisher is than the conventional fire extinguishers. It provides a clean and safe method to extinguish fire. It can be used for residential as well as commercial applications. We successfully developed a prototype of infrasonic sound wave-based fire extinguisher. Using the frequencies of about 30-35 Mhz and a distance of around 1 mts we were successfully able to extinguish a flame. One can generate a specific air velocity using various combinations of pressure and frequency. This technique of suppression would require knowledge of the geometry of the acoustic cavity, so that the optimum placement of the speaker(s) can be achieved, as well as excitation with optimal the resonant frequencies for the room.

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