A Project of Cleaning Smog and Particulates by Using Smog Cleaner with Negative-Ion Generator

R. Jagan[1], R. GokulaKrishnan[2], S. Ramar[3], S. Manikandan[4], D.R.P. Rajarathnam[5]

[1,2,3]*Student, Department of Mechatronics, Paavai Engineering College (Autonomous),Tamil Nadu, India.*

[4] *Assistant professor, Department of Mechatronics, Paavai Engineering College (Autonomous), Tamil Nadu, India.*

[5] *Professor, Department of Mechatronics, Paavai Engineering College (Autonomous), Tamil Nadu, India.*

ABSTRACT

The main objective of this project is to clean smog from the environment by cleaning micro-level dust particles. Smog is a mixture of smoke and fog, it contains a mixture of air pollutants and fog with suspended dust particles, it causes major health problems and reduces visibility. The smog was cleaned in special process by using negative ion generator, the negative ions which are generated by Air-ionizer are negative charged particles that are highly attracted to dust particles, it makes particulates into clusters hence it can be easily captures by filter which is fitted at the outlet. Basically fog is a high dense air with suspended water droplets, the density of fog is reduced by heating the intake fog by heating element and this heating element temperature is controlled by digital temperature controller thermostat which is programmed as per our convenience. We use timer for controlling intake and exhaust fans motor controls for optimization.

Keywords –*Heating coil, Negative-ion generator, Thermostat, Timer.*

1. INTRODUCTION

The mixture of smoke and fog causes smog, it causes major health problems. The air pollutant is major reason for smog formation, it includes particulates, sulphur dioxide, nitrogen oxides and other gases. This gas combines with ozone and particulates with the presence of sunlight to form smog, this is due to photochemical reactions of sunlight with these gases. According to National air quality Index in India permissible level of Particulate Matter ($PM_{2.5}$) is 31µg/m^3, but current level of $PM_{2.5}$ (particles lesser then 2.5 micrometre in diameter) exceeds more than 60µg/m^3 based on November 2009 air standard reports. The particulate matter can dame stones and infrastructures, it can damage forest and crops it widely affects agricultural crops and reduce yield. Major respiratory health problems are caused by these air suspended particles. This project was made for cleaning particulates presence in the atmosphere and smog, exposure on smog may affects human health. Most of the countries like India, China, United Kingdom, United States, United Arab Emirates and many other countries facing struggles of smog if particulate matter was removed smog it will adversely reduce smog occurrence on metro cities and atmosphere. China alone can spend nearly 44 billion dollars for clean energy projects.

Fig1.1 Block diagram of various processes in smog cleaner.

This smog cleaner has simple step by step process to clean smog from the atmosphere first step process is suction of atmospheric smog through intake, we use high speed motor with inverted angular propeller blades to achieve high suction rate, the second step process is heating the smog to convert tiny water droplets into water vapour it was done by heating coil we use nichrome coils as heating element because it has high resistance and requires low power consumption, these heating coil temperature was controlled by Digital temperature controller thermostat. Third step process is make particulates into clusters it was done by negative ion generator (or) Air-ioniser, it generates negative ions which are negatively charged particles, the dust particles in atmosphere are positively charged particles so it creates force of attraction between ions and dust particles and made particles into clusters. Fourth step process is filtering the treated smog in this process the clusters are captured by the filter and releases air through exhaust fan at the exhaust port. The digital timer is used for controlling the motor actions at the inlet and exhaust ports for constant operation. The block diagram of various process involves in smog cleaner were described in fig 1.1 for better understanding the process in inside the smog cleaner.

2. LITERATURE REVIEW

David Hu and Juyuan Jiang work is related to find out smog issues and Particulate Matter (PM) pollutant control strategies. They made research about an integrated multi-pollutant control strategy in china. [1]

John D.Proynoff invention is related to an improved ion generator comprising a set of specifically shaped electrodes for electrostatic environmental conditioner. [2]

Paul C. Adams work is related to improve electrostatic air purifier and ioniser combining the filtration, precipitation and generation of negative ions. [3]

Roger goulet, Joseph cutri and Joseph de yulio invention is related to air filter unit of the HEPA type having core of zigzag folded media enclosed by four side frame having two side casting and two side end casting for achieving good filtration rate even at high temperature environments. [4]

3. COMPONENTS SPECIFICATIONS

The smog cleaner has variety of existing components which are configured to perform specific task to clean smog each components depends on each other to achieve open loop control operations. The Air-ioniser, heating element and air filter are the major components of smog cleaner.

3.1 Brushless DC motor

Fig 3.1 Brushless DC motor

The brushless DC motor is compact and powerful, it can be easily controlled by electronic circuit so its performance can be optimized quickly according to our needs. The brushless dc motor configured with customized turbine blades can improve the intake suction of atmospheric smog into the smog cleaner. This brushless DC motor has 12V 10A power rating with speed of 1000Kv (constant velocity) and also we use 30A Electronic speed controller (ESC) to control and regulate speed of the motor. The ESC control motor actions by adjusting the timing pulses of current delivered to several windings of the motor.

3.2 Heating coil

Fig 3.2 Nichrome heating coil

In general heating coils are devices it converts electrical energy into heat energy. Heating coil is used to reduce density of smog. In this project we use 220V 800Watts, 0.4 mm thickness Nichrome heating coil to provide better performance under controlled manner of power supply. Nichrome consist of 80% chromium and 20% of nickel so it has high resistance to electric current and produces high temperature.

3.3 Negative ion generator (or) Air ioniser

Fig 3.3 Negative ion generator

Negative ion generators are proven to clear the pollen, pet dander, mould spores and particulates. A good negative ion generator can significantly decreases airborne viruses and bacteria in air. It is made by combination of 10ohm resistors with 1N4007diode and 100µF 275v capacitors.

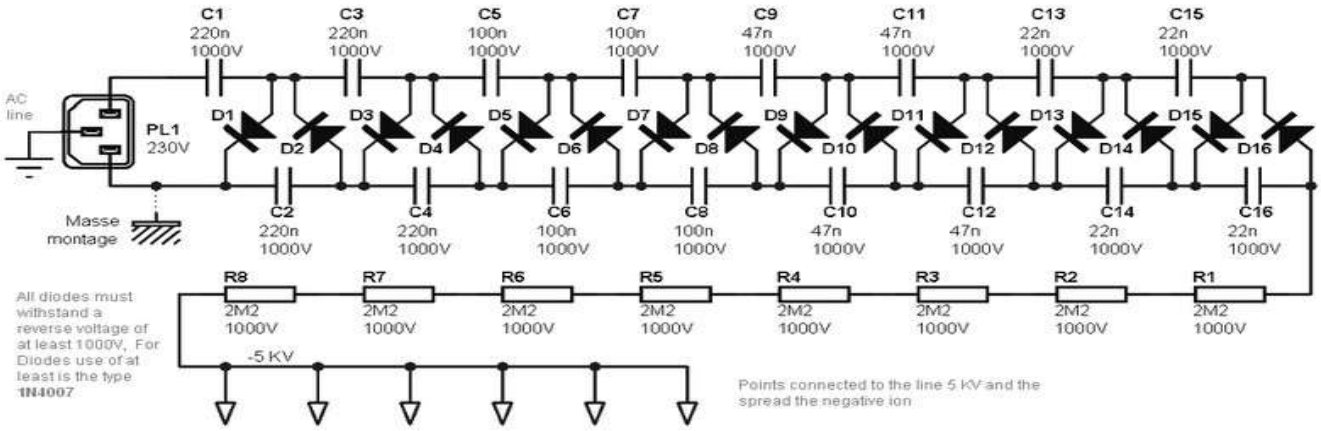

Fig 3.3.1 Circuit diagram of negative ion generator

The fig 3.3.1 shows that the circuit diagram of negative ion generator and sequence of the electrical elements in Air ioniser. Negative ion generator was used to reduce particulate matter in the smog. The negative ion generator produces negative ions, this negative ion attracts particulates and dust particles and made them into clusters, and this was due to electrostatic force of attraction between particle atoms and negative ions.

3.4 HEPA filter

Fig 3.4 HEPA filter

HEPA stands for High Efficiency Particulate Air. HEPA filters are different from other filters it has composed mat of randomly arranged fibres. The air space between HEPA filter fibres is more than 0.3µm. It can easily trap the particulate matters and dust particles. It has capable of filtering particulates and fine dust particles which are reason for smog formation, before they enters into HEPA filter, the intake air is subjected to passes through the normal primary air filter to increase HEPA filter life.

3.5 Digital timer

Fig 3.5 Digital timer

Digital timer used for periodically switched on and off operations, It can be pre-programmed on daily or weekly basis, these timers monitors times for their operation of automated control process. This timer was used to automatic ON/OFF for the circuits in smog cleaner at regular intervals of time.

4. DESIGN OF SMOG CLEANER

The smog cleaner has well packed with working elements so its design should be unique and functional, especially the inlet and exhaust ports design must be well for its operation and its electrical components should be placed at their respective places to get required performance from smog cleaner.

4.1 Design layout

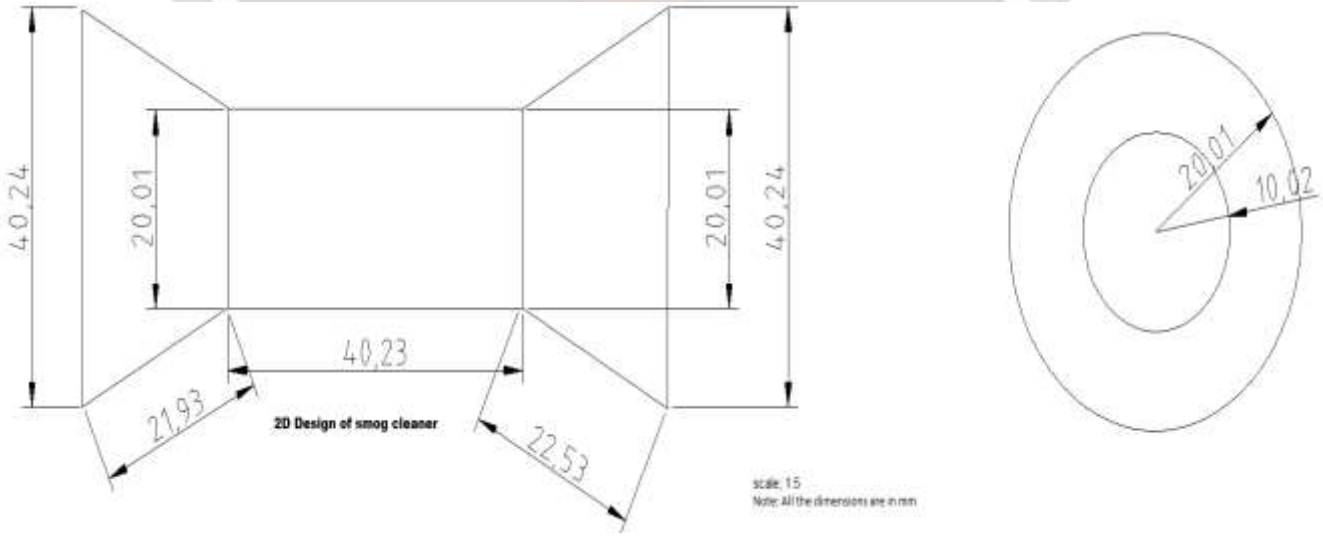

Fig 4.1 Design layout of smog cleaner

In this design layout the smog cleaner was made up of two truncated hollow cone at both ends and circular hallow cylinder at the centre between these truncated hollow cones. The outer diameter of hollow cylinder is 115mm and inner diameter is 110mm, its length is 450mm. The truncated hollow cones are identical to each other each of

these truncated hollow cone have same size and orientations let see dimension of truncated hollow cone outer diameter is 165mm, inner diameter is 115mm and length is 110mm. These shapes are made by using stainless steel sheet metal with 0.50mm of thickness. These above mentioned identical structures are made by using sheet metal folding operations.

4.2 Schematic diagram of electrical connections in smog cleaner

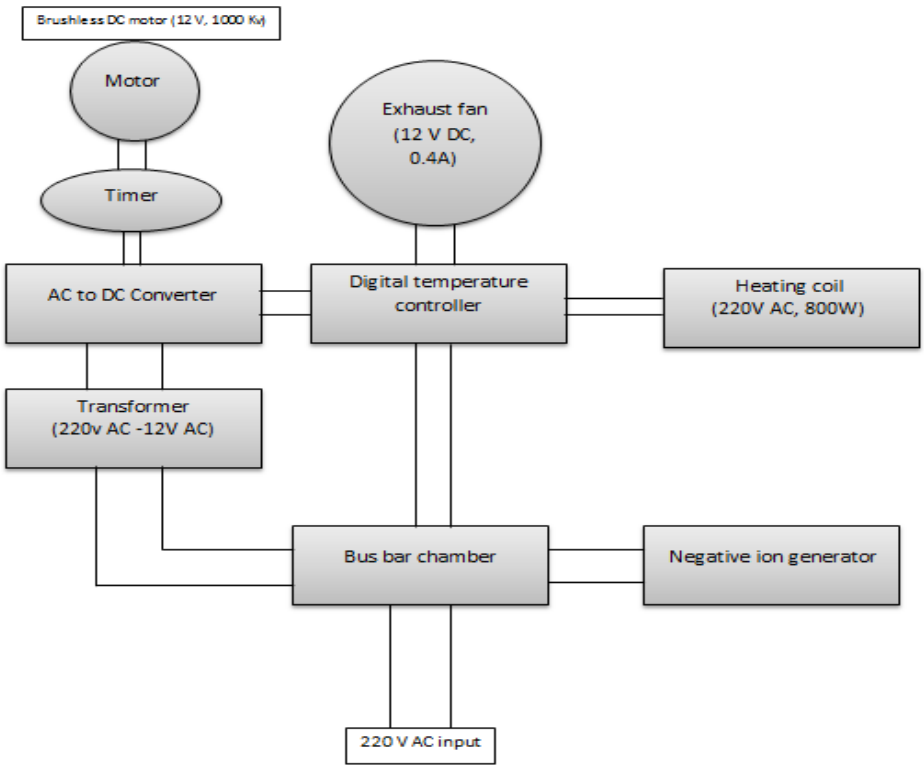

Fig 4.2 Schematic diagram of electrical connections in smog cleaner

In fig 4.2 shows that the electrical connections in smog cleaner, it uses 220V, 60Hz AC power supply. The bus bar chamber is used to provide the proper connection to all the functional elements in smog cleaner. The brushless motor, digital temperature controller and exhaust fan requires DC power source so input of 220AC power is step-down into 12V AC by step-down transformer and it is converted into 12 V DC power by using bridge-rectifier. Timer has in-built battery so it does requires power for control operation but needs external power to operate another component in this system it only act as electronic automatic switch so it requires power to operate external components. Digital temperature controller is an electronic device it regulates voltage to external circuit according to pre-taught program based on external temperature, for example if we set to ON the circuit when it reaches 20ºC and OFF at 50ºC then it ON/OFF when temperature reaches at pre-set value**.** The Air-ionizer continuously get power to generate negative ions.

5. WORKING

The smog cleaner was specially designed to clean the particulates and smog from the atmosphere. When 220V AC input was given to the bus bar chamber it distributes energy into different components of the smog cleaner. The intake port consist of brushless DC motor with turbine blades rotates at the speed of 8000RPM, it sucks atmospheric smog into the inlet then nichrome heating coil get energised to produce heat to reduces density of smog, its temperature was controlled by digital temperature controller thermostat. The negative ion generator continuously generates negative ions to make particulates into clusters by electrostatic force between particles. The primary air

filter is used to reduce large dust particles and HEPA filter were employed to reduce particulate matters. Exhaust fan at the outlet port liberates purified air into atmosphere. This Smog cleaner reduces smog up to 8 metre radius from its surrounding.

6. CONCLUSION

The air pollution is major environmental problem in our planet it causes major problems for humans, animals and plants, everyone in our earth have rights to breath quality air. Many countries have taken so many steps to control air pollution. They implements new laws and norms to reduce pollution, but it cannot reduce existing pollutants from the atmosphere that's why we use smog cleaner like devices to reduce existing air pollutants, we must recycle air like how we recycle contaminated water into fresh water for better utilization. This smog cleaner is small compact and easy to use and portable. In future we can add extra components like UV lamp to sterile air, since most of chronic lung diseases caused due to air-borne micro-organisms, Oxidiser and reduction agents to control air pollutants gases and so on. We invent this smog cleaner to improve quality of air because the quality air is our best asset for our future generations.

7. REFERENCES

[1]. A study of smog issues and PM2.5 pollutant control strategies in china by David Hu, Juyuan Jiang at journal of environmental protection, 2013, 4,746-752 in Scientific Research Publishing (SCIRP).

[2]. Ion generator or electrostatic environmental conditioner was invented by John D. Proynoff and registered in United States patent US4227894A.

[3]. Air purifier and ionizer was invented by Paul C. Adams and registered in United States patent US4253852A.

[4]. HEPA air filter for high temperature environments and method of fabrication was done by Roger goult, Joseph cutri de yulio and registered in United States patent US4885015A.