

Design of Portable Plasma Device using Inductor, Capacitor and Coil resistor circuit

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Abstract – Here Portable plasma device is designed by using the inductor, capacitor and coil resistor circuit. The ignition coil is used as a inductor and high voltage generator with the help of the capacitor of 0.68uf 400v in series with the dimmer circuit ,nominal of 300 watt,220 volts AC with the frequency of about 50 Hz and temperature range from -20°C to +40°C .

Index Terms— Capacitor, Frequency, High voltage generator, Ignition coil, Plasma

1 INTRODUCTION

THE plasma, moldable matter is also called the fourth state of matter. There are so many techniques for the generation of plasma in a lab. It can be generated artificially by heating and interaction of neutral gas with the electromagnetic field. Its formation depending upon the surrounding temperature and density of gas. It is the lavish form of matter in this universe. The Plasma is also generated by resonant charging circuit which consists of thyristors; transformer and spark gap switch [1].It is also as an opening switch for the vacuum inductive storage system for the electrical diagnostics and nuclear activations [2]. The triple plasma device is also made by using the Langmuir condition for the existence of electron beam in the layer of high potential side [3].For the automobile engines; the pulsed plasma capacitive discharge is used as an ignition system. The capacitance of 1 to 20 microfarads with the ignition coil is used to produce the pulsed plasma [4].From the kinetic modeling by increasing the energy of the electron its ionization rate can also be increased as a new effects such as field reversal, inter pulse ionization and two cathode effect [5].A new technique for plasma actuator has been induced by using schlieren technique, fluid modeling and burst mode operation which allowed the study of flow pattern and force of induced plasma [6].Pulsed plasma jet is used to control the supersonic motion. The velocity of plasma jet depends in the heating of gas with the efficiency of 10% [7].

The plasma arc is used as treatment for the biological tissue also used for the medicine [8]. Here by using the inductor, capacitor and resistor the high voltage plasma is designed which is more cost effective, reliable and very good for the beginner and the researcher.

2 METHODOLOGY

For the design of the plasma generator devices following things are in used

- a. Ignition coil
- b. High watt resistor of 1.6ohm
- c. Dimmer circuit

a. Ignition Coil:

It is also called the induction coil use in automobile for producing the high voltage. It needs the external resistor with 12 volts of power supply. Its internal resistance is eight to ten ohm that is the resistance of the coil. The electronic ignition systems use a transistor to provide pulses to the ignition coil which is not required for the diesel engine. Here ignition coil used model is Lucas Ignition coil-7C 12 .

b. Coil resistance:

The coil resistance which is used in this device is the new coil resistance Lucas type which is used in Suzuki Maruti 800 Van with the fixing point distance of 35mm from the center point of the hole and resistance of 1.6 ohm.

c. Dimmer circuit:

The dimmer used in this experiment is nominal of 300 watt,200to 250 volts AC with the frequency of about 50 to 60 Hz and temperature range from -20 to +40 using a PVC/ABS and the IP rating of IP25 with the product code BL-YMD220v.

In this plasma generator device, the dimmer circuit controls the current passing through the ignition coil to control the heating in the ignition coil the external coil resistance is used for the protection of the ignition coil. The copper

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plate of size 5cm x 2cm is connected to the high voltage terminal of the ignition coil for the discharge panel. The external capacitor of about 0.684 μ f 400v is also connected in series with the dimmer and the ignition coil. The distance between two copper plats should to up to 1 cm for the proper discharge.

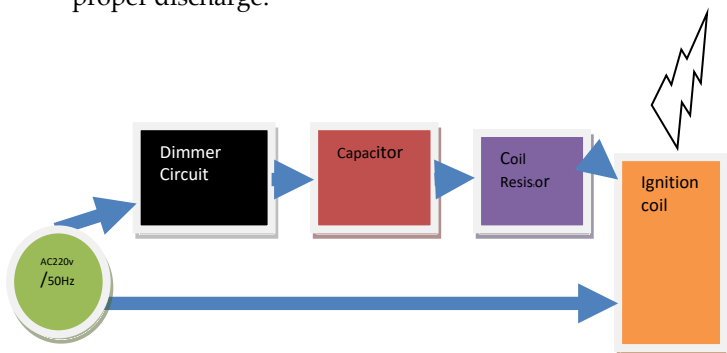


Fig.1. Diagram of Plasma device



Fig 2: Plasma Device at Lumbini International Academy of Science and Technology (LIAST) Research lab ,Manbhavan ,Lalitpur,Nepal

3 RESULTS AND DISCUSSION

The device consumes the 100mA current with the voltage of 220 volts and the output of this device is about 0.9 mA and voltage of 30kilo volts. The discharge occurs between the two parallel copper plates has been observed from 1 mm to 1cm. The color of plasma produced is violet in color with the diameter of about 1millimeter with the crackling sound. It generates the ozone and nitrogen oxides so open and well ventilated area should be needed for the experiment. As this device contains high voltage so always switch off the power before touching it.

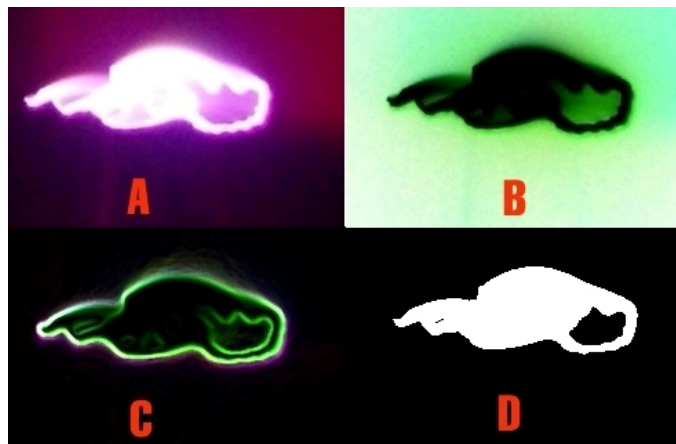


Fig3: Plasma Image using Adobe Photoshop CS version 8.0
In fig A is the normal view of plasma taken by Sony DSLR-A230 Dimension 355x339, ISO-400, Focal length 18mm with no flash, Exposure time 4 sec, F-stop f/3.5, Bit Depth 24,, Fig B is the color invert mode .Fig C is at the glowing edges with edge width 2, Edge Brightness level 5 and smoothness level 6 .Fig D is at the threshold level of 200.

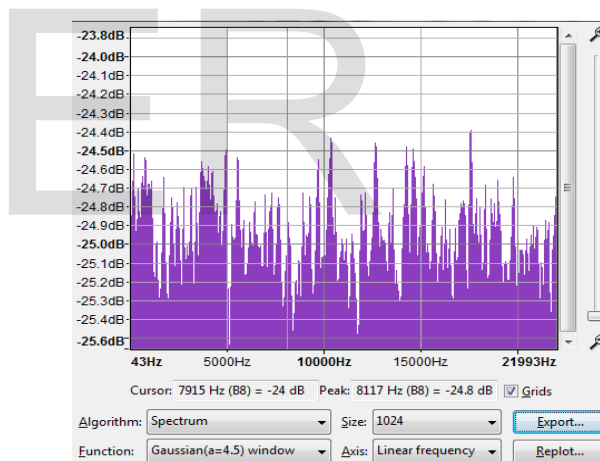


Fig4: spectrum analysis with Gaussian a=4.5 with size 1024, linear frequency

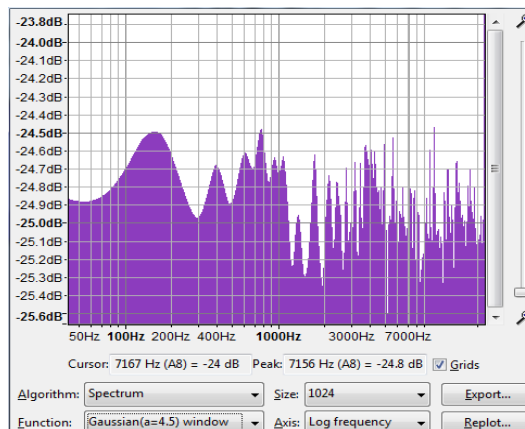


Fig 5: spectrum analysis with Gaussian a=4.5 with size 1024, log frequency

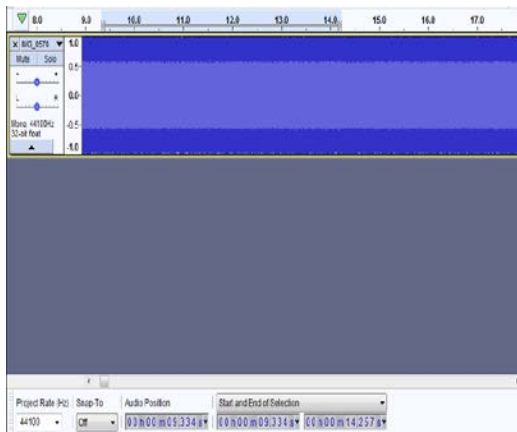


Fig6: Spectral Analysis using audacity software

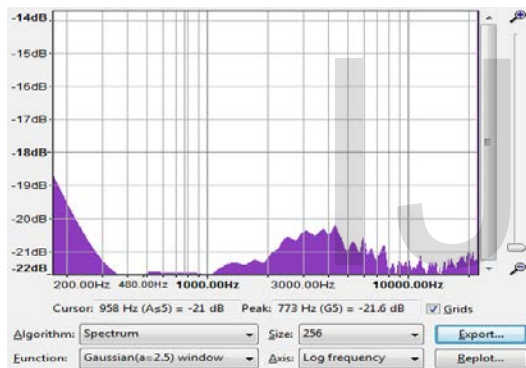


Fig7: spectrum analysis with Gaussian a=2.5 with size 256,log frequency

Above Fig4 to Fig 7 are the spectral analysis of the of plasma using the Audacity Software with the Gaussian at a=2.5 and a=4.5 at log and linear frequency respectively.

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