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The Effects of Ionization on Spark Energy Content II

The purpose of this experiment was to investigate the nature of sparks and the effects that the ionization process by which sparks travel through the air has on spark energy content. We posed the question: Is there an increase in the electrical energy of a spark as part of the process by which sparks travel through the air? How do the distance that the spark travels and the dielectric properties of the gas that the spark ionizes affect the change in electrical energy? To conduct our experiment, we constructed a Marx generator, an electrical circuit capable of generating high voltage pulses which exceed the dielectric breakdown strength of air. As opposed to the Tesla coil we used in our previous experiments, our Marx generator does not emit radio waves, which allowed us to quantify the energies (i.e. the voltage and current) of the sparks it generated more accurately using an oscilloscope. Testing our first variable, spark gap length, involved a similar process to last year's experimental procedure; we adjusted the distance between the anode and cathode of the spark gap and took measurements at either side of the gap. The ratio of output to input power was measured to be greater than one for certain spark gap lengths. To test our second variable (the gas ionized), we obtained a vacuum pump and chamber and inserted the anode and cathode. We then obtained samples of nitrogen, helium, and argon and measured the electrical energies of sparks fired through relatively pure concentrations of the above inert gases and a near vacuum. Both the input and output energies of all these sparks were less than that of sparks fired through air, suggesting that the increase in output energy observed in our first experiment is attributed to the ionization of atmospheric gases with lower breakdown voltages.