Capital X: Designing and Testing a Procedure for Building an Inexpensive X-ray Generator

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In this project, a procedure for building an x-ray generator was developed and tested. This procedure uses inexpensive or common materials (around $200 total) for the x-ray tube and power source. This generator consists of three main components: the vacuum chamber, the electrodes, and the power source. The vacuum chamber and the electrodes make up the x-ray tube, and an AC circuit generator generating up to 19kV supplies power to the x-ray tube. The vacuum chamber is attached to a vacuum pump to allow for changes to be made to the electrodes without destroying the x-ray generator. The electrodes use a cold (or hot) cathode filament and a metal target. The power source uses an automotive ignition coil along with a capacitor and two dimmer switches to increase input voltage. The vacuum chamber allows the input, or accelerating, voltage to generate arc flashes between the electrodes which generate x-ray radiation when striking the metal target. Radiation is detected using a Geiger counter. X-rays were counted at an average of 596.97 counts per minute, and reached a high of 1948.5 counts per minute. Safety precautions include minimizing the duration of exposure as well as maximizing distance and shielding. A radiation safety official has approved the safety of this project. Testable variables include target material, cathode type, thickness of shielding in front of detector, and arcing distance. This project has applications in research, medical diagnoses, and affordable science. This procedure can be improved and applied to create a more portable and effective x-ray generator that costs far less than current x-ray machines.