

# 1 About the Spark Apparatus

The spark apparatus leaves a spark trail on a long strip of cash register tape. The sparks are produced every  $1/60$  th of a second. By measuring the distance between the sparks and knowing that the sparks occur every  $1/60$  th of a second, the acceleration due to gravity can be measured. The pictures below show the laboratory setup and the box that I made which produces the spark.



Figure 1: The Spark Machine Tower and Sparking Apparatus



Figure 2: A spark jumps from the wire on the right, through the paper, to the metal ring on the falling bob. Then the spark jumps again from the metal ring to the metal rail on the left, completing the circuit.

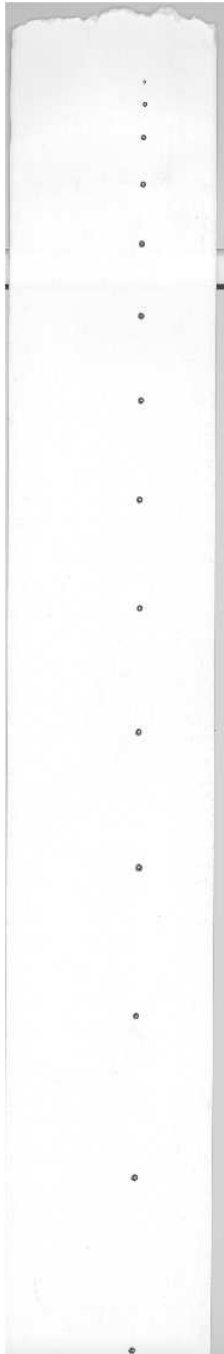


Figure 3: This is the resulting spark trail. Commercial spark machines only leave a faint trail. Also, they don't spark as reliably as this unit.



Figure 4: This is the box I designed and built. A 12V ignition coil inside the box produces the spark. Additional circuitry is included to make the apparatus spark every  $1/60$  th of a second.

## 2 How the Box Works

*WARNING: DON'T TRY TO MAKE THIS YOURSELF UNLESS YOU KNOW WHAT YOU'RE DOING. YOU COULD GET SERIOUSLY HURT.*

Recall that Ohm's law for an inductor is  $V_L = L \frac{dI}{dt}$ . So the goal is to make  $\frac{dI}{dt}$  very large so that the voltage across the ignition coil is very large. Then a good spark will result.

The voltage from the wall is 117 V<sub>rms</sub>. This corresponds to a peak to peak voltage of approximately 165 V<sub>pp</sub>, since  $(\sqrt{2})(117 \text{ V}_{\text{rms}}) \approx 165 \text{ V}_{\text{pp}}$ . Let's suppose that the peak to peak voltage from the wall is less than 130 Volts and that the SCR is off. As the peak to peak voltage from the wall rises above 130 Volts, the 130 V zenor diode begins to conduct to try to keep the voltage across the zenor diode at 130 Volts. This current goes to the gate of the SCR, and turns it on. Suddenly the ignition coil is slammed with high current. (i.e.  $\frac{dI}{dt}$  is very large.) The 100 Watt, 10 Ohm resistor prevents tripping the circuit breaker for the entire room. When the wall voltage falls, the SCR turns off. This process repeats every 1/60 th of a second since the AC frequency from the wall is 60 Hz. Note that the device is turned on through relays, thereby keeping the operator of the spark apparatus safe.

Numbers within parenthesis correspond to the number on the plexiglass cage  
 Color corresponds to the color of wire going to the numbered input to the cage

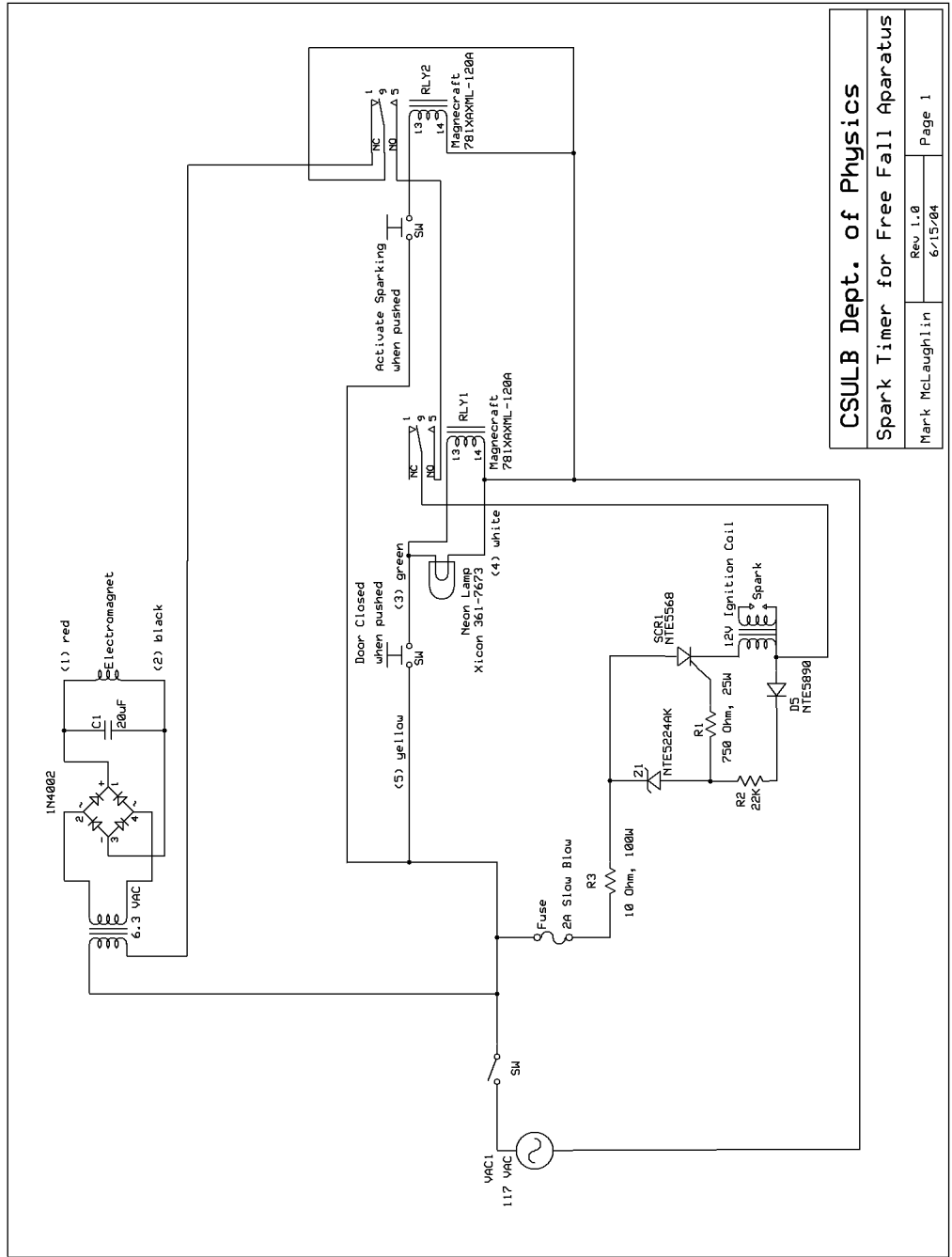


Figure 5: This is the schematic for the spark apparatus.

## References

"A Solid State Spark Timing Circuit", W. C. Elmore, AJP Volume 40 pgs. 487-488.  
March 1972

"Ignition Coil High Voltage Generators", <http://www.geocities.com/mistertippy/schematics/ignition.html>