Eddy Current Coin Toss

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Abstract

A disposable camera's flash energy comes from the battery. Chemical energy stored in the battery changes into electrical energy and stores up to 350 volts in the capacitor. Then the electricity travels to a transformer where the 350 volts is changed into 4,000 volts. That energy makes a spark in the xenon gas, which creates a flash. The electrical energy that created the spark is then converted into heat and light when the flash goes off. In order to make the flash into a repeating strobe, I plan to make the flash go off automatically and more frequently. To do this I will have to add two computer parts. A capacitor, which stores electrical energy, and a sidac, which acts like a switch that automatically turns on when there is an adequate charge. To make the coin flip, I plan to have electricity flow through a coil thereby making a magnetic field. The changing magnetic field causes an electric current in the coin, called and Eddy current, which produces an opposite magnetic field. This makes the coin repel off the coil and into the air. The computer parts needed to do this are a diode, which makes electricity flow in one direction only thereby protecting the capacitor from being damaged, a silicon controlled rectifier (SCR), which is a switch that turns on and off automatically, and a resistor, which controls the amount of electricity that flows through it. For the coin flipper, instead of changing chemical energy into electrical energy and then into heat and light energy, I am changing chemical energy into electrical energy and then into mechanical energy, to flip the coin.

Hypothesis/Purpose

- Hypothesis

  I think that I will be able to flip a coin using the parts from a disposable camera flash. However, additional parts will need to be added.

- Purpose

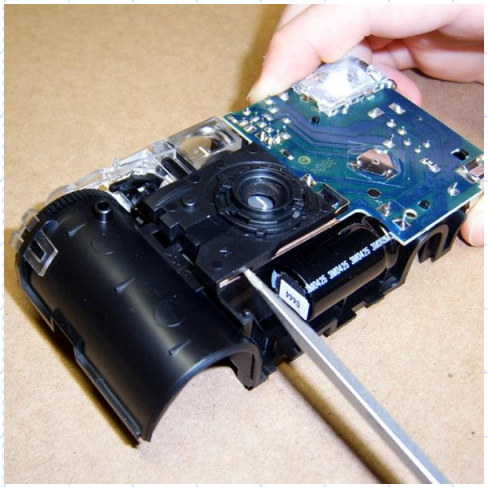
  Can you use the flash from a disposable camera to make a coin flip?

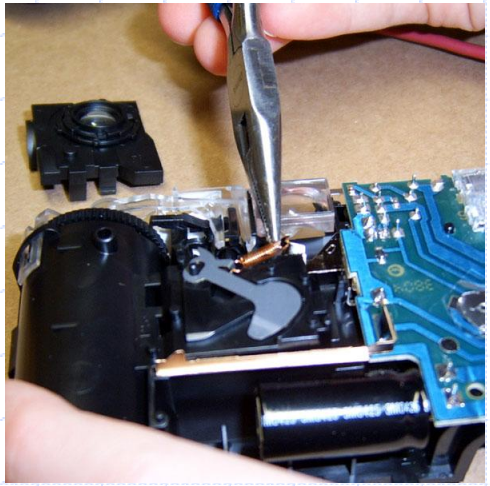
Procedures: Opening the Camera

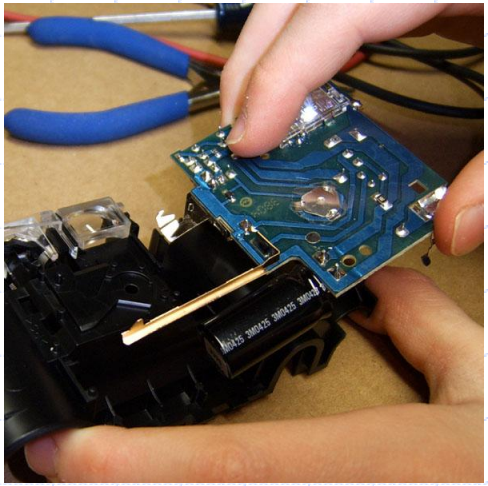
Part 1: Taking apart the camera

1. Pry the camera's cover using a screwdriver.
   (Don't touch circuit board)
2. Drain the power using a resistor.
3. Pry off the lens cover.
4. Use pliers to pull off the spring on the lens.
5. Remove other pieces of camera lens.
6. Pull off circuit board.
7. Discard other components.

Procedures: Opening the Camera



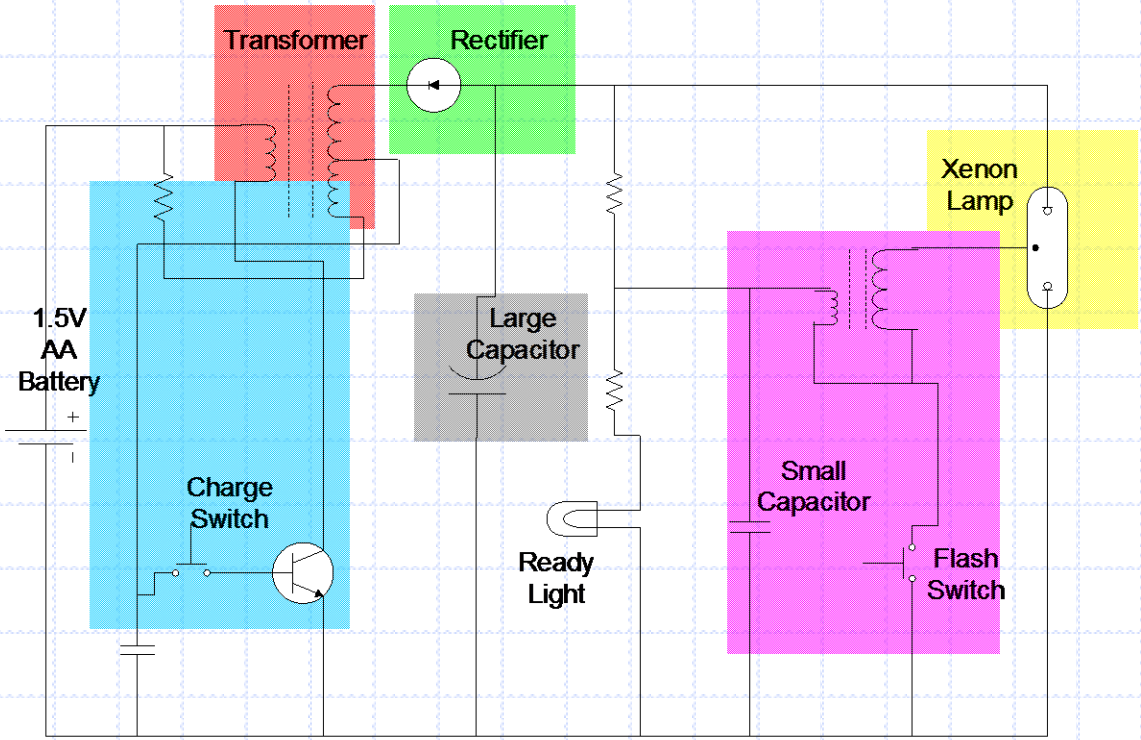




Explaining the Flash Circuit

The Flash Circuit has six major components

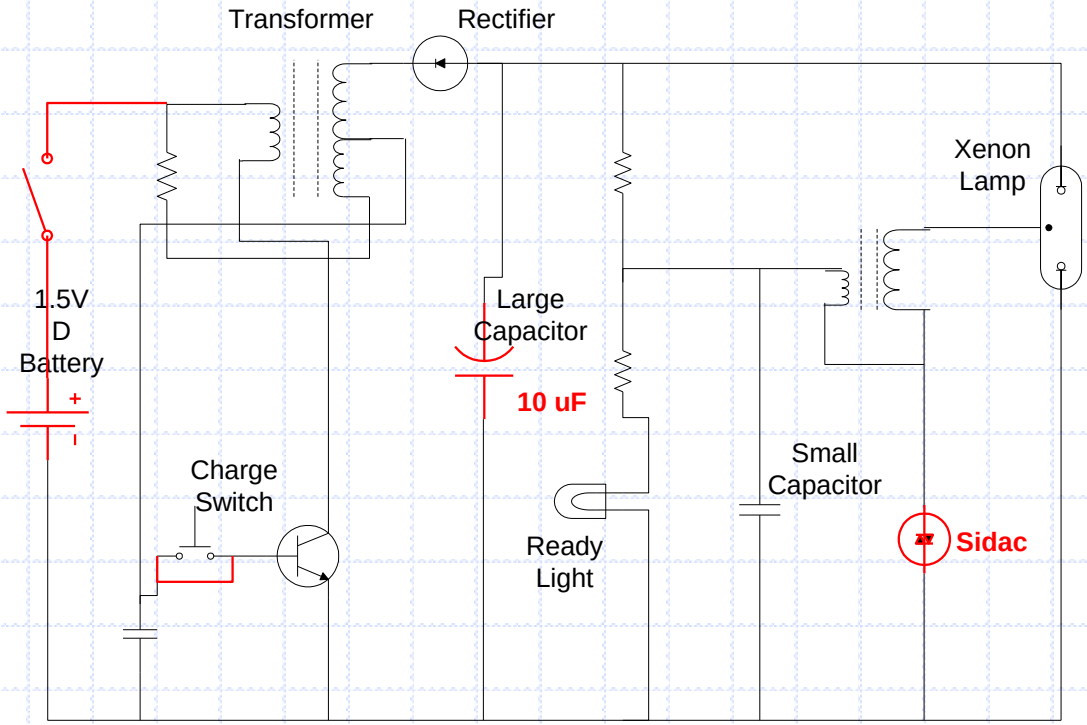
1. Oscillator - changes battery DC to AC voltage
2. Transformer - changes 1.5 VAC to 350 VAC
3. Rectifier (diode) - converts AC back to DC
4. Capacitor - charges to 350 volts DC and stores the energy
5. Trigger - makes a single pulse to start the flash
6. Flash bulb - makes a bright light



The Repeating Strobe Circuit

The Repeating Strobe

1. Added a switch to turn it on and off
2. Replace the 80 micro Farad capacitor with a 10 micro Farad
3. Add a jumper wire in place of the charge switch
4. Replace the trigger switch with a Sidac



Procedures: Building the Strobes

Part 3: The repeating strobe

1) Solder wires to D cell battery holder in place of camera battery. One wire should go to a toggle switch before going to the camera battery holder.
2) Solder jumper wire in place of push-button charging switch on circuit board.
3) Solder sidac across flash trigger contacts on circuit board.
4) Remove flash capacitor and replace it with a smaller capacitor.
5) Mount inside a plastic box.
6) Drill holes in the top of the box for the toggle switch.
7) Label the switch.

Part 4: The portable strobe

1) Replace the flash capacitor with a smaller capacitor.
2) Solder sidac across flash trigger contacts on circuit board.
3) Put an AA battery in the camera battery holder.
4) Put circuit board back in the camera.
5) Replace the camera cover.
6) Duct tape the camera cover on the camera to prevent the cover from falling off.

Data

- The repeating strobe, portable strobe and the flash worked as expected.
- The repeating strobe passed the ten-minute endurance test to see if it would stay at a steady pace.

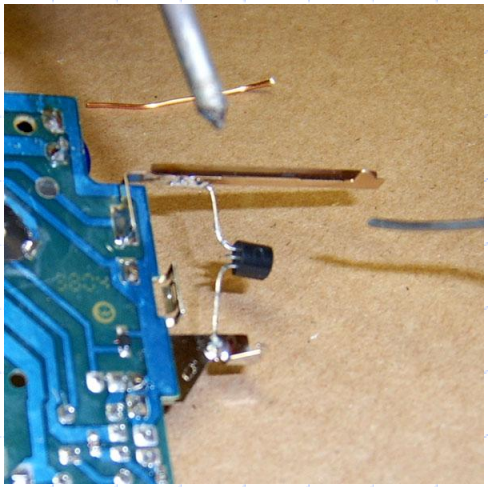
Coil Performance

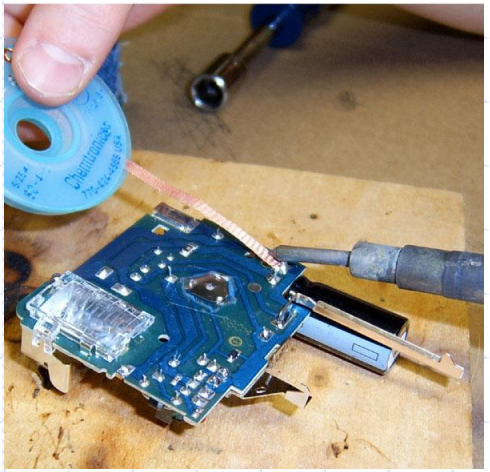
Number	Gauge	Stacked/ not stacked	Turns	Height (approximately)
First	20 Gauge	Not stacked	7 turns	< 1millimeter
Second	12 Gauge	Not stacked	5 turns	< 1millimeter
Third	14 Gauge	Not stacked	5 turns	1 millimeter
Fourth	22 Gauge	Stacked	11 turns	2 centimeters
Fifth	22 Gauge	Stacked	20 turns	5 centimeters
Sixth	26 Gauge	Stacked	30 turns	8 centimeters
Seventh	30 Gauge	Stacked	62 turns	5 centimeters

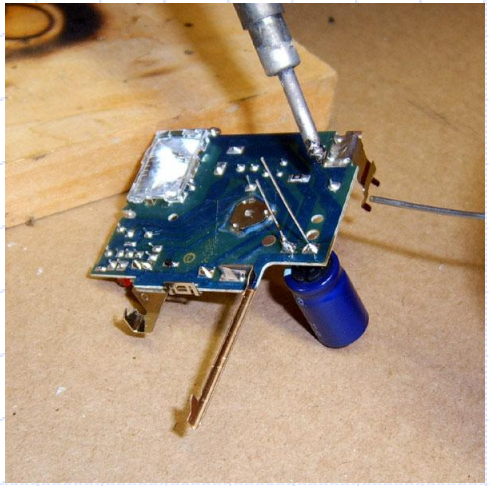
Analysis

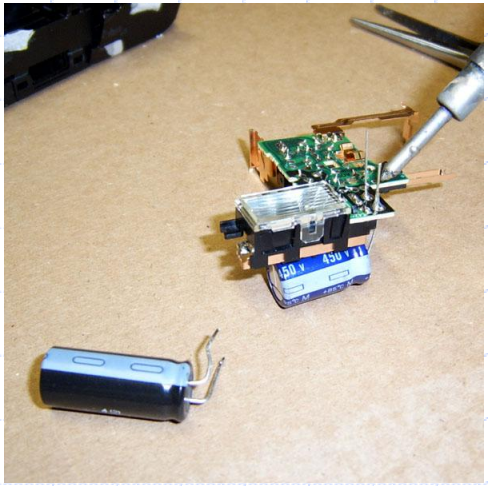
- The smaller capacitor in the repeating strobe lets the flash charge faster, but it isn't as bright.
- Construction of the coil is important to flip the coin as high as possible.
- Whenever electricity flows in and arc, it creates a magnetic field.
- The more turns a coil has doesn't necessarily mean the coin flips higher.
- The coin flips higher when it is glued down because all the energy is used in pushing the coin away from the coil and not pushing the coil away from the coin.
- The magnetic field makes the penny flip even though copper isn't magnetic because the magnetic field flowing through the coin produces an Eddy current in the coin, which generates an opposite magnetic field.

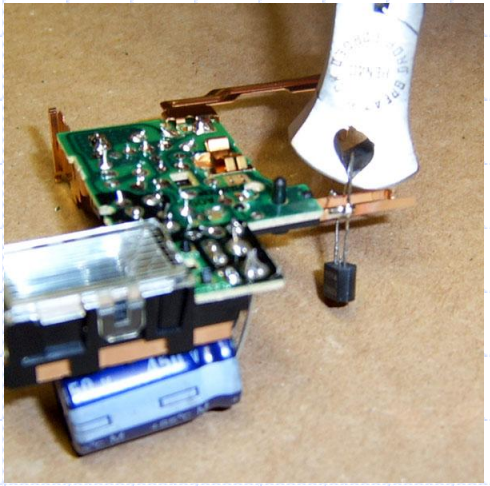
Procedures: Building the Strobes











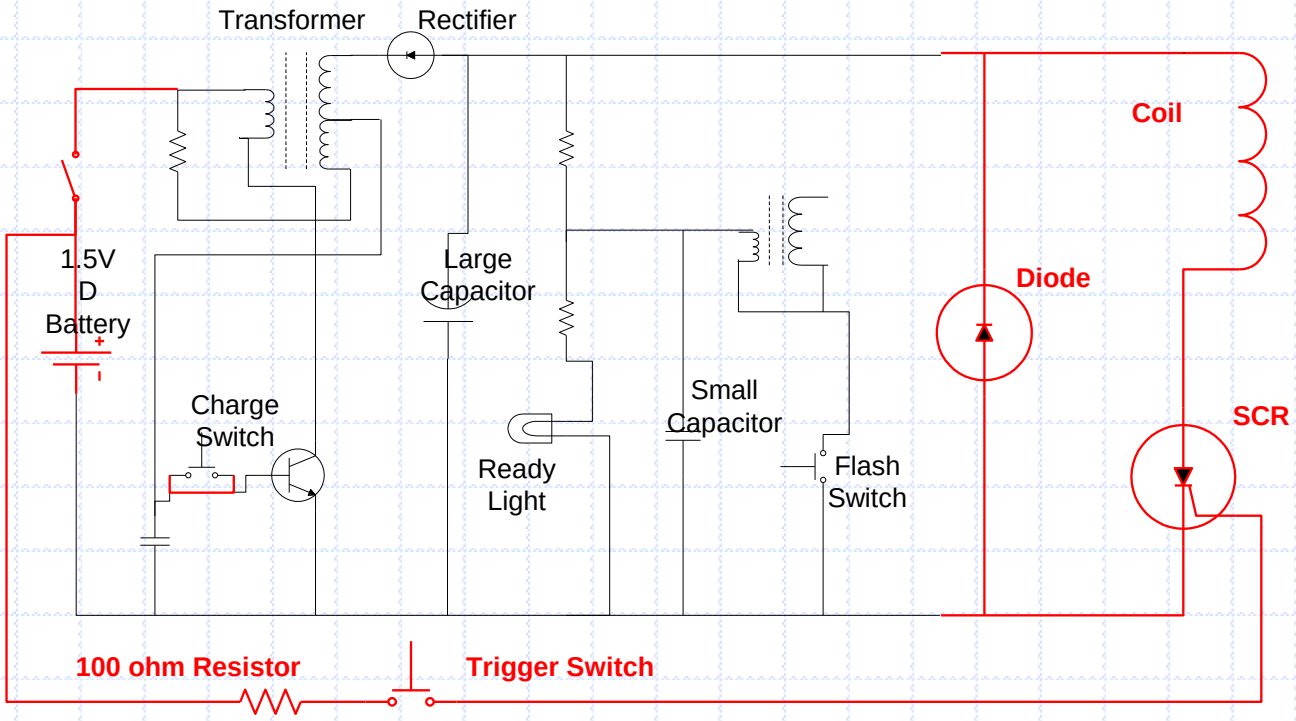
Conclusion

I found that it is possible to make a coin flip using the parts from a disposable camera. I also found that it is simple to change a regular flash into a repeating strobe by just adding two parts, a sidac and a smaller capacitor. To recreate the flash all that needed to be done was add some wires to switches, which in the camera, would have been right on the there. The recreation of the flash and the strobe lights worked the first time I tried them. The coin flipper, on the other hand, took some tests. The first through third coils weren't stacked, and they barely moved the penny at all. The coils that weren't stacked only had a few turns and were made of twenty, fourteen, and twelve gauge wires. The fourth through seventh coils were all stacked, and the height of the flip greatly increased. The fourth and fifth coils were made of twenty-two gauge wire. The fourth had eleven turns and the fifth had twenty turns. The coil with twenty turns flipped higher than the coil with eleven turns. The sixth coil was made of twenty-six gauge wire and had thirty turns. That flipped the penny higher than all of the other coils. The seventh coil was made of thirty gauge wire and had sixty-two turns. That coil flipped the penny slightly lower than the sixth coil did, so the number of turns didn't necessarily make the coin flip higher.

The Coin Flipper Circuit

The Coin Flipper

1. Added a switch to turn it on and off
2. Added a jumper wire in place of the charge switch
3. Removed the lamp and replaced it with a diode
4. Attached SCR, resistor, and a push button switch
5. Attached wire coil



Procedures: Building the Coin Flipper

Part 5: The coin flipper

1) Solder wires to D cell battery holder in place of camera battery. One wire should go to a toggle switch before going to the camera battery holder.
2) Solder wire across charge switch contacts on circuit board.
3) Remove camera flash bulb with soldering iron and replace with diode.
4) Solder wire from diode to SCR cathode.
5) Solder coil to SCR anode.
6) Solder wire from SCR gate to push button switch.
7) Solder resistor from push button switch to the other end of the camera battery holder.
8) Mount in a box.

The coil

1) Wrap wire around a pencil.
2) Push flat and glue.

Procedures: Building the Coin Flipper