The Neon Lamp "Flasher"

by
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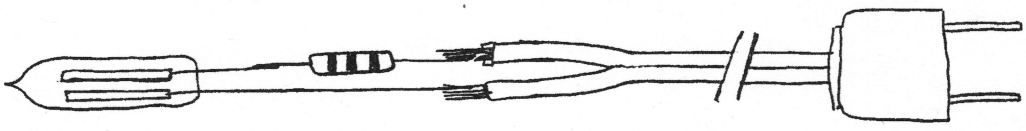
This simple little homemade device can provide a very effective demonstration of AC current, it's fun, and it's cheap! All you need is a little neon lamp, a resistor and an AC cord. Solder one leg of the neon lamp in series with a 10K, 1/2 watt resistor, and then attach to the AC cord. Heat shrink tubing is excellent insulation for this construction, otherwise use carefully applied electrical tape. Be sure to insulate throughly, you have AC power here.



The cord needs to be long enough so that you can swing it in a big circle in a darkened classroom. Before you swing it, just hold it up for all to see, and it makes a nice glow. It looks like a steady glow, but it isn't. Wiggle it back and forth and you see the first hints of the blinking effect. Wiggle it in a wider and faster arc, and the blinking is dramatic. Now whirl it in a big circle and everyone can clearly see that the light is on for enough time to make a "dash" several centimetres long, and off for enough time to make a gap that is also several centimetres long. The obvious explanation is the cycling of the AC current. But why is the "off" dash so long? Can't the current change direction almost instantly? It can, but the neon lamp requires about 70 volts to light. Draw a sine wave on the board, and highlight the section where the voltage is +70 to +170 to + 70 and the troughs where the voltage is -70 to -170 to -70. These highlighted sections are where the bulb is on. Looking at this graph shows why the off sections are as big as they are. (Remember that for household AC, the voltage fluctuates from +170 V to -170 V, and that the 120-V value is the rms (root-mean-square) voltage. 120 x 1.414 = 170.)

Make another neon lamp flasher and this time add a diode in series as well as a resistor. (If you add it to the lamp leg opposite the resistor, the construction is symmetrical and a little bit more convenient, but off course it doesn't matter electrically where you put it.) The polarity of the diode also does not matter. This device, when swung, has half of the "dashes" missing, since no current flows in one of the AC cycles.

If you have a DC supply that can deliver enough voltage to light the neon lamp, be sure to use it! Perhaps you have one for your Millikan apparatus. If it is current limited, you can safely use alligator clips to attach it to the prongs of your neon lamp wire plug. Turn up the voltage until the neon lamp glows. Now swing it, and of course, you get a solid streak of light, with no "dashes". Another benefit of the DC supply is that a close look at the lamp reveals that only one of the filaments inside the glass bulb is glowing. Actually, we should say that the neon gas is glowing around only one filament. Reverse the plug connections and the other filament is "on". Compare this to the neon bulb without the diode, and you see that both filaments are "on". If you don't have a DC supply that can deliver 70 volts, you might try using 9V batteries. It will take 8 of these, and they snap together

in series nicely. Use alligator clips to attach the two open terminals to your neon lamp cord.

If you examine some of the night lights the next time you visit WalMart, check out the smallest. They are nothing but a tiny plastic box with two prongs on the back. Guess what's inside. One neon lamp and a 33K 1/4 watt resistor!

One final variation on this demo is that you can use a bi-colour LED instead of a neon lamp. These glow red when current flow is in one direction, and green when it flows in the other direction. Whirling this creates red and green dashes. Great if you're doing your electricity unit around Christmas time! The only disadvantage is that it's not as bright as the neon lamp. (Don't forget the resistor!)

You might test different neon lamps. Some are brighter than others. The one I found at Radio Shack was not as good as in years past. Try different electronic shops. I found some good ones at Electrosonic.

A supplementary demo is in order if you can find a fairly old calculator. You need a calculator that has a red LED display. (Remember those?) It's battery powered, DC current, so the numbers shouldn't show dashes when you shake it. Right? Wrong! Shake it and the display does show the dash effect. Since these red LED displays use considerable current, part of their design is to make them blink. The electronic circuitry takes the steady DC and pulses it on and off. The display blinks fast enough so the human eye can't tell the difference, and with an on-off cycle that is actually off half the time, so the batteries last twice as long!

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Submissions describing demonstrations will be gladly received by the column editor.
