Thompson Coil Lesson

Plan

Amount of time Demo takes: 1-5 mins.
Don’t try this at home!

Materials

- Thompson coil inductor
- Foot switch power cord
- Aluminum ring(s)
- Mounted light bulb on copper coil
- Extension cord- **Needs electricity**
- Optional: liquid nitrogen

Set-up Instructions

1. Stand inductor upright and use thumb screw to move the conduit until it protrudes from the top by about 9-10”. Be sure that the inductor points true upward (use something under the feet to correct a tilt).
2. Plug the two banana plugs from the foot switch into their respective receptors on the inductor
3. Plug foot switch into outlet (120V).

SAFETY!

- If the inductor is not pointed straight up, the ring will not fly straight. Take care to be sure that it’s level. Similarly, the rings will fly off of the conduit at a good rate of speed. Having people looking at it from above is a bad idea.
- At times (when it’s close enough to it) a static charge can build up on the foot switch if it is close enough to the Van de Graaff generator. This is **not** the electricity in the foot switch, just in case people ask about it.
- Don’t plug foot switch into wall until banana plugs are plugged into coil - it will burn out cords!

Lesson’s Big Idea

- This demos electromagnetic induction, Lenz’s Law and electric flux.
- Lenz’s Law-an induced current is always in such a direction as to oppose the motion or change causing it.
- When the foot switch is depressed, it connects the inductor coil to an alternating current (AC). This creates a constantly changing **electric flux** in
the region of the inductor's interior. The conduit, being in this interior, is in this constantly changing field and the electrons within the conductor start to move around it. These create an *induced* magnetic field while also creating a changing electric field in the area of the conduit (because the electrons alternate in direction similarly to those in the inductor coil).

- The ring: the changing electric field of the conduit causes electrons to move around the ring and these electrons move in an alternate fashion than those in the conduit (by Lenz's Law) and create an opposing magnetic field. The magnetic field of the conduit and ring oppose each other, and the ring jumps off of the rod to get away.

- If the ring is held on the rod while the foot switch is depressed, the electrons moving around it need to deposit their energy somewhere, and they do so in the form of thermal energy. This can be felt because the ring will heat up (to the point of burning, if left for too long) and be warm to the touch.

- With the light: The electric field from the conduit causes electrons in the coil attached to the light to go in motion and they burn up their power in the light bulb without being repelled away.

![Diagram](image.png)

*Figure 1: The Currents and the Magnetic Fields within a Jumping Ring*

**Instructional Procedure**
1. To reel people in: just have the ring on the inductor and let it fly every now-and-again.

2. Optional: Dunk one of the aluminum rings in liquid nitrogen and launch it as normal. One will notice instantly that it will fly much higher than the other ring. This is because the super-cooled metal is a better conductor, causing a stronger effect.

Assessment/sample questions you can ask

1. What would happen if you put the ring on the conduit and placed the light bulb on top?
   a. The ring will want to rise up and off of the conduit but will be unable to do so because there will be too much weight on it. Therefore, it will hover about half way up the conduit and the light bulb will be lit with a dimmer intensity because it’s further away from the bottom of the conduit where the effect is stronger.

Conclusion

The big thing to remember is that it is Lenz’s Law of Electromagnetic Induction is being applied twice to make the ring jump.

References

- Physics Demonstrations: A Sourcebook for Teachers
- http://macao.communications.museum/eng/exhibition/secondfloor/moreinfo/2_2_5_jumpingring.html

Next Generation Science Standards

- K-5
  - K-PS2
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