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The hand-held Tesla coil.* This apparatus has been in our classrooms for over fifty years and still stirs excitement. Originally used to test vacuum assemblies for leakage and for exciting spectrum, Geissler, and other electrical tubes, this unit has additional uses that are fundamental and entertaining.

If you hold the tip of the unit near a grounded metal object, the maximum spark gap is about 2.5 cm (1 in.). The "rule of thumb" is that a 1 cm air gap requires a potential of about 20,000 volts to cross it. Thus, this coil is operating at about 50,000 volts at its maximum. This voltage is enough to ionize air around the coil's tip and produce a "brush" discharge of electricity; it is like the St. Elmo's "fire" seen at the top of the tall masts on the great sailing ships of the 19th century. With this discharge, ozone (O_3) is produced; its odor is strong! Also, the coil can charge up an electroscope, poke holes through paper, start fires, etc. For fun, I reasoned, why not add a pistol grip (handle) to the coil so it looks like a "zap" gun?

I glued two pieces of 3/4" plywood together and attached it to the coil with two 57/82 mm hose clamps. (See the pattern.) I glued cardboard shims to the front of the "cradle" as the front of the bakelite case has a slightly smaller diameter than the rear. I layed out the work according to the diagram and cut out the "cradle" on a table saw first, using the straight edges on each side against the fence. Then do a "rough" cut on a scroll (jig) saw to separate the two pieces. Glue the two pieces together, matching the "cradle" sections. Cut out the final shape on the scroll saw, including the notches. Sand and finish as you like. Make two sharp bends in the hose clamp straps so they fit tightly in the plywood notches. When assembled, use your imagination, and let the fun begin!

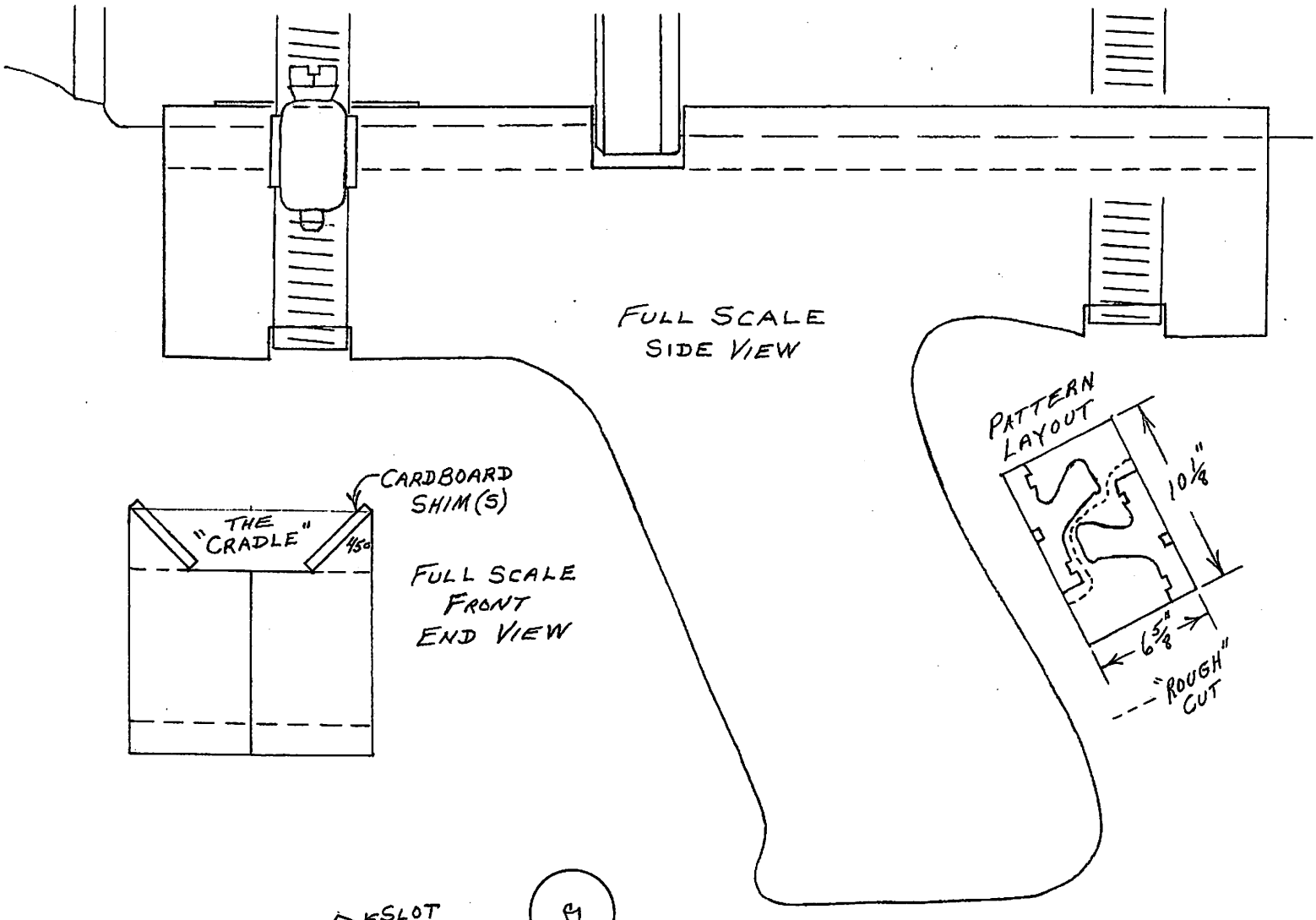
The "Tesla tower". With a little extra effort, you can construct a "zap" gun holder that can turn the coil into a two-way "plasma" globe. With some 3/4" pine or plywood, nine coarse-thread #6 x 1 5/8" drywall screws, and some velcro, follow the "tower" plan in the diagram. The clear 5" dia. incandescent light bulb is mounted on a wood block in a med. base #9063 Leviton pony cleat lampholder with two #8 x 1" RH wood screws. A ¼" x 20 thumbscrew, 1½" long, with a 3/16" and a ¼" washer make up the "clamp". Note that a ¼" shim must be glued to the lower side of the backpiece so the hose clamp screws clear; thus, the "tower" is slightly off-center. Because the tip of the coil must touch the center brass contact in the socket, a 3/8" dia. hole must be drilled up through the wood block and a 3/16" hole drilled up through the plastic (bakelite) lampholder. Assemble the "tower" with the drywall screws.

Presentation: With the coil turned up and in place, strapped to the tower, and bulb (globe) holder clamped down in the adjustable slot, plug in (turn on) the coil. Darken the room if possible, and watch the violet discharges in the bulb. Move your finger(s) near and touch the glass. Amazing! I wish I had a good explanation for what is going on here. No one I've met is very sure. Keep asking! Next, unplug (turn off), raise up the globe holder to clear the tip, remove the coil, attach a ground wire with alligator clips to the brass screw on the lampholder, have it lead to any nearby ground, and plug in the coil again. Bring the tip to the glass, and watch the discharge streak to the filament, just the opposite of the previous situation. Still amazing! Whether we understand everything that is going on here or not, there are still lessons to be learned. One is that under certain circumstances, glass can not shield (insulate) us perfectly from all electrical effects. Be careful.

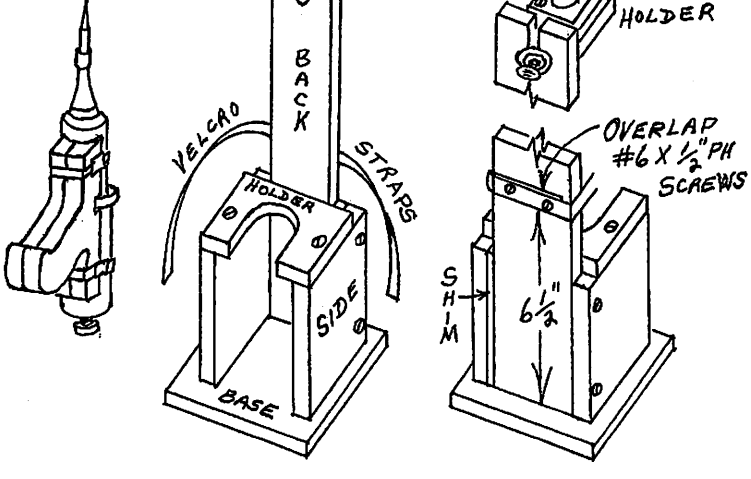
Lighting (exciting) fluorescent tubes can also be instructive and fun. The coil is really an induction coil (a DC transformer) that increases the voltage from 120 V up into the thousands. Fluorescent fixtures have "transformers" (ballasts) in them to supply the needed high voltage. This coil can do what they do; all that is needed for full effect is a "ground" connection. A person on one end of a 4 ft. fluorescent tube becomes that connection. Keep hand(s) on the glass, not the metal! For fun, a teacher I know "swears in" Star Wars Jedi Knights (students) this way! Also, have the person change the hand location on the tube; the tube does not light beyond the hand (ground). As you experiment with the coil, other learning (and fun) situations will arise.

Warning: The high voltage may be dangerous to high-tech equipment. As a precaution, I would stay a safe distance away from all electronic gadgets, computers, etc. to avoid an expensive accident.

* #61157-02 hand-held Tesla coil in a bakelite case from Science Kit of Tonawanda, NY, (800) 828 - 7777, about $200.

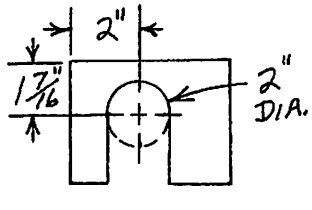


FULL SCALE
FRONT
END VIEW

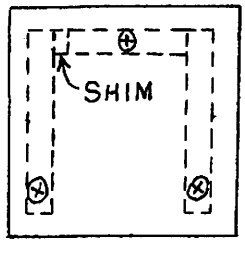


Base: 5½" sq.
Back piece: 2½" x 14"
Slot depth: 1 7/8"
Shim: ¼" x 4 3/4"
Side piece (2): 3½" x 4 3/4"
Holder: 2 3/4" x 4¼"
Bulb holder. 2½" sq.

top view of
holder



bottom view of
base (3 screws)



top view of
bulb holder