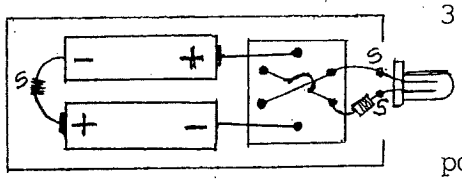
John B. Johnston, The Faraday Center, 103 Creamery Rd., Livingston Manor, NY 12758
(845) 439 - 4706

Demonstration aids - One of my grandfathers ran a very successful general store for seven decades in the 20th century. His guiding axiom was, "Anything well displayed is half sold." We physics teachers are "selling" the laws of physics to our audience via well organized demonstrations (displays?). Sometimes that requires the construction of special apparatus to make the demo clearer, more durable, and/or easier to perform. Some examples follow.

(a) In "Keepers! I", (e)9. uses a Bicolor LED, R & G to illustrate the presence of alternating current in a standard 120 V circuit. To "prove" that the Bicolor LED is truly Red in one direction and Green in the other, construct a simple DC circuit with a reversing switch (1.). All that is required to construct this gadget is 2 AA batteries in series, a DPDT knife switch, a 220Ω resistor in series, a Bicolor LED lamp, some connecting wire, and a mounting board (3/4" pine?).

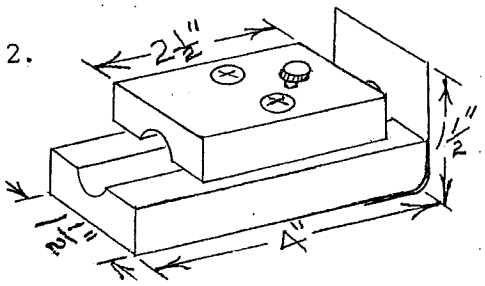
1.



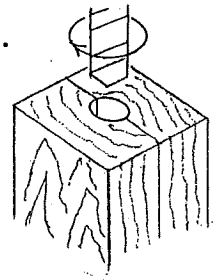
3 solder points(S)

(b) When the laser pointer (pen laser?) became available, we had a new tool for many of our laser demos. However, it had two drawbacks for physics teachers; it was handheld and only had a "press" switch to keep it on, neither of which was desirable for continuous optics demonstrations. Masking tape and rubberbands were used temporarily to correct these problems but were not a permanent solution. Although it requires an initial investment of time to construct, both problems are solved with a special laser pointer holder that has multiple uses. Because so many different pointers are available, a simple, "generic" holder is described that includes the essential characteristics that can easily be altered for a specific pointer. The holder is designed to sit flat for use or storage, to stay on or off for periods of time, to be mounted on rods for ringstands, and to hold attachments on its front via magnets or masking tape. It's also designed to make dry cell removal easy when not in constant use. Warning! Never leave dry cells of any kind in a pointer for extended periods. All cells can leak, corrode, and ruin the pointer! The necessary materials are some 3/4" pine, two #6 x 1¼" coarse thread drywall screws, a #8 x 32 x ½" alum. set screw (screen door part), a T-nut (¼" x 20, 7/16" long), two #6 x ½" panhead screws, and a 2¼" x 1½" piece of sheet steel. See diagram (2.).

2.



3.



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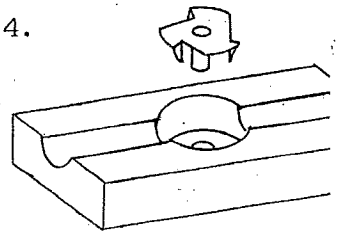

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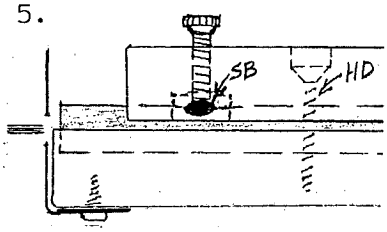
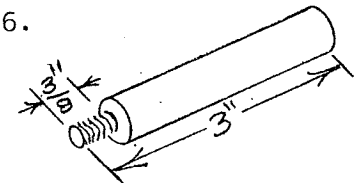


Construction: Measure the diameter of the pointer's barrel, usually about a ½". Select two pieces of 3/4" clear pine 4" x 1½", clamp them together (3.), and set them on end, straight up, in a drill press. Using a 7/16" bit, drill straight down the center. (If you aren't perfect, you're still okay.) Locate the T-nut in the center of the bottom piece. Countersink a depression for the T-nut with a 3/4" dia. Forstner bit (4.); the center shank of the T-nut must not extend beyond the bottom's surface. Select a 5/16" drill bit for the shank's hole in the wood; slam in the T-nut. Place the pointer in the "cradle" of the bottom piece with its front just short of being even (5.); the back end of the pointer should extend beyond the board for easy dry cell exchange. Cut the top piece down to 2½" long and place it on top of the pointer. Locate the pointer's switch button (SB); a slight "depression" with a smaller Forstner bit may be necessary. In the center of the depression, drill a slightly undersized hole for the alum. set screw so it can self-thread into the soft pine. When the set screw and the switch button align (make contact), locate the final two "hold down" screws (HD). Take the piece of sheet steel and make a sharp 90° bend at the 1½" point. Attach the bent steel to the bottom of the wood block *WITH* the two short panhead screws. With everything in place, turn on the laser. Mark the beam's spot on the sheet steel, and drill a 5/16" hole in the steel for the beam to pass through.

You're done! (I always have two red and two green pointers with holders ready to go!)

6.



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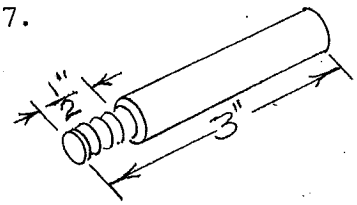

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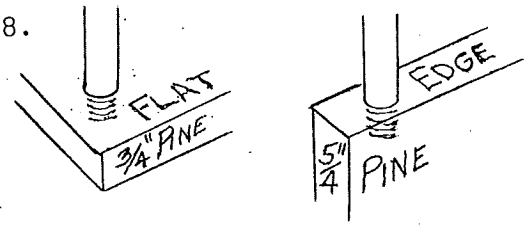
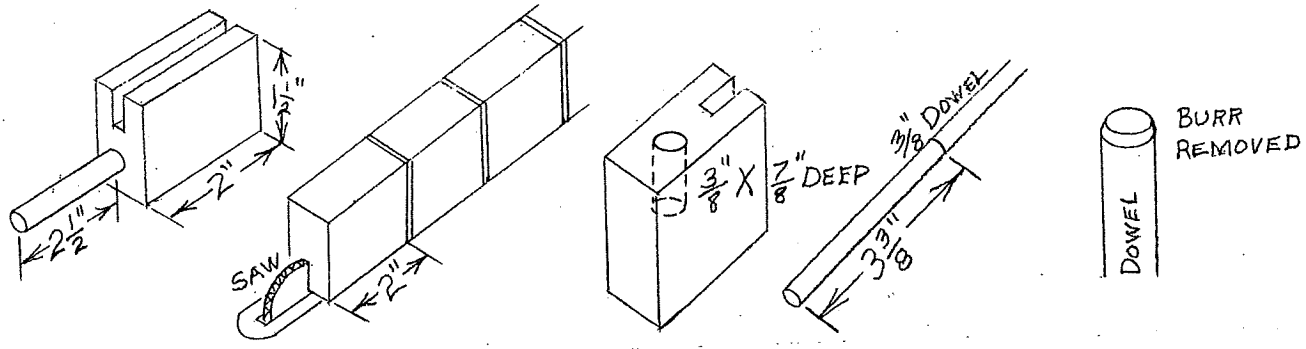


(c) The ¼" x 20 thread size is a "universal" standard in most of the USA, thus the choice of the above T-nut; hardware store bolts can easily be used with this holder. However, I went further; I had a machinist take several ½" dia. alum. rods, 3" long, and cut ¼" x 20 threads, 3/8" long (6.). They make ringstand set-ups easy!

(d) In many of the demos described on this website, ringstands are used for best display; often they are made of wood, mostly pine. This is by design; pine accepts a coarse thread well if it is threaded carefully. The 3/8" x 16 thread size works best. I had a machinist take several ½" dia. alum. rods, 3" long, and cut 3/8" x 16 threads, ½" long (7.). If an 11/32" hole is drilled in soft pine, it can be "threaded" by the alum.rod being twisted (screwed) into it. A little soap or paste wax on the rod's threads helps. However, if the task gets a little too difficult, use a 3/8" x 16 tap, but only part way in. (Taps usually tear out too much material, leaving a loose fit. For a tight fit, practice on some scrap pine first.) The 3/8" x 16 thread works well on the <u>flat</u> side of a 3/4" board but <u>not</u> on its edge (8.).The <u>edge</u> of the thicker 5/4" board is recommended for the 3/8" x 16 thread.

(e) Threaded alum. rods are preferred over glued-in wooden dowel rods in many cases because they are removable and can be used for other demos. Also, they are stronger for heavier apparatus, and with the alum. rods removed, the apparatus can be set on shelves, etc. for easy storage. There are situations, however, when the use of dowel rods is preferred. For example, in optics many demos and lab set-ups require only small, light-weight holders for gratings, lenses, etc. They can be simply made from 3/4" pine and 3/8" dowel, and made in large numbers, if necessary (9.). One example for diffraction gratings is a pine stick, 8 3/8" x 1½" x 3/4", passed over a table saw set at a depth of a ½", and cut up into 2" lengths. Drill a 3/8" hole 7/8" deep in one end of each block, cut up the dowel in 3 3/8" lengths, sand off the burrs on the ends, add glue (Elmer's?), and gently hammer a dowel in each hole. If the groove is too wide, add small cardboard shims or masking tape to "narrow" it down. With a right angle clamp, a ringstand, and only <u>light pressure</u> on the dowel via the set screw, a good set-up is accomplished. For storage, the holders sit neatly on a shelf. You can also make special holders for odd-shaped objects using the same basic design; a "collection" of special holders will result.

9.



Clarification: In (b), the alum. set screw becomes the on-off switch for the pointer. Screwing it in turns the laser on; backing it out turns the laser off. The threaded alum. rods in (c) were designed for the holders but are used with other apparatus and displays, as well.