Jack R. Smith K8ZOA
Telecommunications Consulting
7236 Clifton Rd.
Clifton VA 20124
[Jack.Smith@cox.net]

All Keyed Up

Over this neat project.

Hand-sent Morse is enjoying a renaissance. A variety of straight keys are available for purchase by Morse aficionados, including some that tip the price scale near $200. Although my surplus J38 is still functional 40 plus years after I bought it, I decided to design and build my own straight key.

I used a milling machine, lathe, and metal-cutting bandsaw to make my key. With a bit of redesign and a lot more work, you could build a similar design using only a drill press and normal hand tools.

A note on materials

I've made aluminum, brass, and stainless steel versions of my design. Aluminum and brass are much easier to work than stainless steel and should be used if you only have simple tools. Brass has a nice color, polishes up easily, and is the traditional construction material for "brass pounding." It can be lacquered to retain its sheen. If you use stainless steel, I suggest drilling all tapped holes one or two drill sizes larger than normally recommended. There isn't much mechanical stress in the key, and oversized holes will reduce the risk of tap breakage in stainless steel without impairing performance.

Bearing block

I made the bearing block (**Fig. 1**) from a 1" length of 1" square bar stock. In my design, the armature is restrained from side-to-side movement only by the clearance in the bearing block slot. Mill the slot for the armature, making it slightly oversize so as to permit the armature free rotation, but without excessive side-to-side play. I found about 0.005" of excess width worked well. If the slot is too wide you may use shim washers to control excess side play. If you don't have a milling machine, it should be possible to make the bearing block by drilling and filing. In this case, aluminum or brass is a much more practical material than stainless steel.

The armature rotates in Oilite® bearings. (Oilite is a porous bronze material, with oil trapped in its interstices.) The bearings are a press fit into the bearing block. Oilite bearings are not strictly necessary, and a plain bronze bearing would likely work. An even simpler design would omit press-in bearings and instead use the bearing block itself.

For the bearings to fit, the 0.375" mounting holes should be drilled slightly undersize using a "U" drill and reamed to final size with a 0.375" reamer. Press or drive the bearings in place.

The bearings and their mounting holes must be accurately aligned, or else the armature may bind. Drill and ream in one pass from one side, rather than separately from each side.

I made the inner diameter of the Oilite bearing slightly oversize with a 0.252" reamer to ease the fit with the 0.250" axle shaft. (Passing a drill or reamer through an Oilite bearing closes up the pores and may tear the bearing surface. This would be inadvisable if the bearing were to be used at high speed, but is acceptable for a hand key.) I reamed to 0.252" after pressing the bearings into the bearing holder, taking care to align the reamer to the bearing hole. Alternatively, the axle shaft could be reduced a couple thousandths of an inch in diameter with sandpaper and the Oilite bearings kept as-is.

Armature

The armature (**Fig. 2**) is made from a 4-1/2" length of 1/2" x 1/2" bar stock. I milled the knob end of the armature to 1/4" to give me a better grip on the knob, but this is a personal preference item. If a milling machine isn't available, the thickness reduction could be accomplished with a hacksaw, or a file.

It's important that the axle shaft hole is made at right angles to the armature as accurately as possible, as any angular error may cause the armature to bind in the bearing block slot.

I drilled the axle shaft hole with a 1/4" drill and reamed with a 0.252" reamer. If you instead decide to reduce the axle shaft to a couple thousandths below 0.250", the 0.252" ream isn't necessary.

My design uses an upper spring adjustment washer with a hub that when fully retracted fits into a pocket milled into the armature. I used a 3/8" end mill to produce a flat-bottomed pocket.

The spacing adjustment screw can work loose as the key is used, so I added a 6-32 locking screw at the end of the armature.

Base plate

The base plate (**Fig. 3**) is made from a 5-1/4" length of 3" x 1/2" cold rolled steel bar stock. I like a heavy base, and this substantial block of steel meets my desires.

The bearing block and the ground connection post are mounted to the base plate with 6-32 screws. I used socket head cap screws, and used a counterbore to recess the heads of the SHCS screws to be flush with the bottom of the base plate. Alternatively, 6-32 flat head screws could be used and flush countersunk.

It's important that the screw holes that attach the bearing block be accurately located so that the armature is centered and parallel with the long axis of the base plate.

I didn't want the spacing adjustment screw to contact the base plate, as it would, over time, chip away the paint. To give the adjustment screw a safe contact point, I drilled and tapped the base plate for a 1/4-20 thread and screwed in a 1/4-20 x 1/2" stainless steel

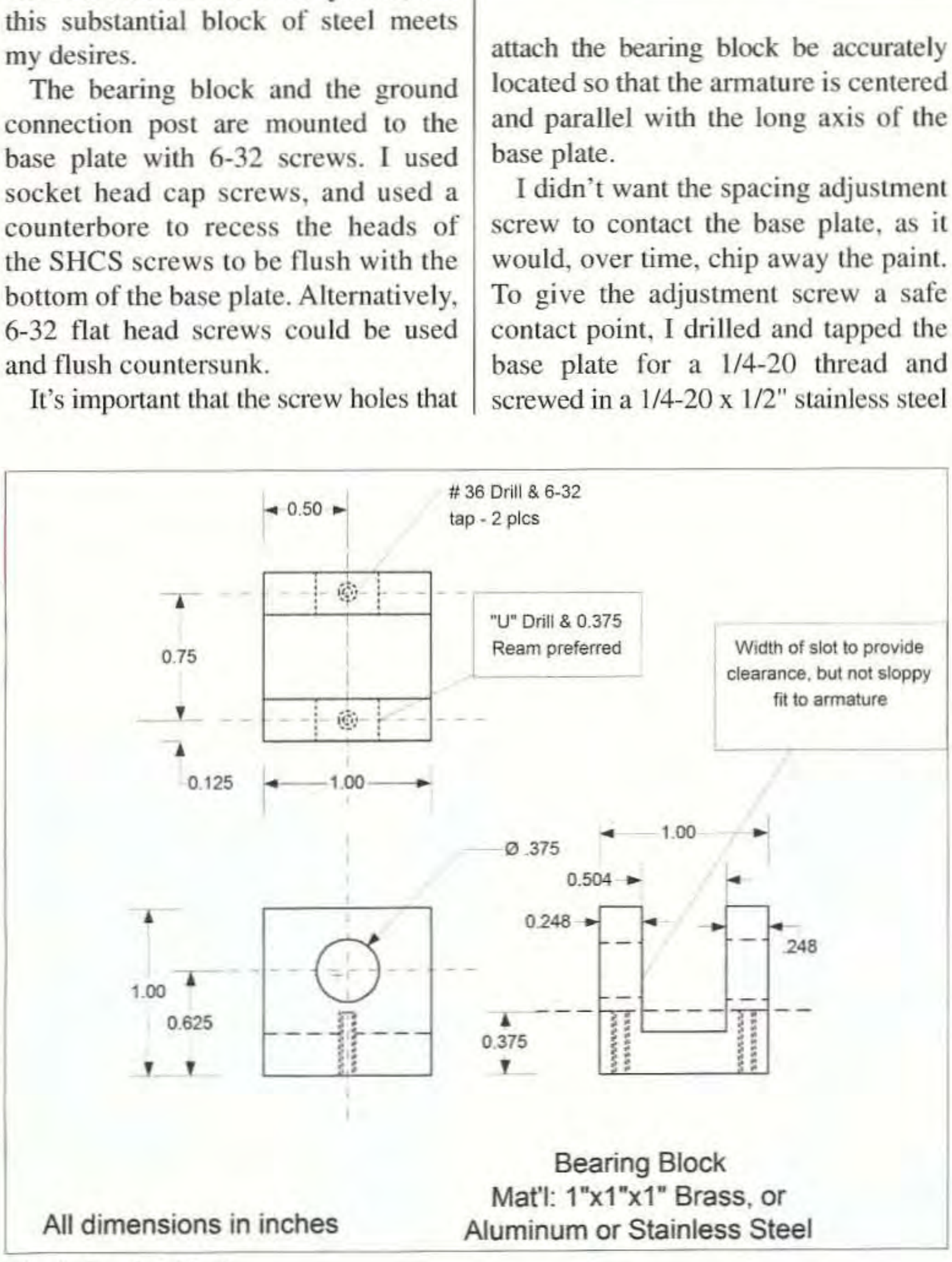


Fig. 1. Bearing block.

Qty.	Description
1	1x1x1 in. material for bearing block, brass/aluminum/stainless steel
1	1/2x1/2x4/5 in. armature, brass/aluminum/stainless steel
2	Oilite bronze bearings, 3/8 in. OD 0.25 in. ID x 0.25 in.
1	baseplate, 1/2x3x5-1/4 in. cold rolled steel
2	3/8 in. diam. x 1 in. long drill rod for connection posts
3	1/2 in. OD x 1/8 in. thick Delrin washer, clearance hole for 6-32 screw
1	1/2 in. OD x 1/8 in thick Delrin washer, 0.25 in. clearance hole
1	0.250 in. diam. x 1 in. long drill rod for axle
1	6-32 hex key head set screw x 3/8 in. long, cone point, stainless steel
1	1/4-20 x 1-1/2 in. stainless steel bolt, cut down for fixed contact
1	1/4-20 x 1/2 in. stainless steel bolt, for fixed space contact surface
2	8-32x3/8 in. hex key set screws
2	6-32x1/2 in. socket head cap screws
4	6-32x1/2 in. socket head cap screws
1	6-32 hex key set screw x 3/8 in. long black oxide cup point
1	6-32 hex key set screw x 1/4 in. long black oxide cup point
1	lower spring support from 1/2 in. steel rod
1	upper spring support from 3/4 in. steel rod
1	spring, 12T 0.021 in. wire 1 in. long 0.26 in. ID
1	knob, plastic or ceramic drawer pull
4	felt or plastic feet, self-adhesive
1	6-32x3/8 in. socket head cap screws

Table 1. Parts list.

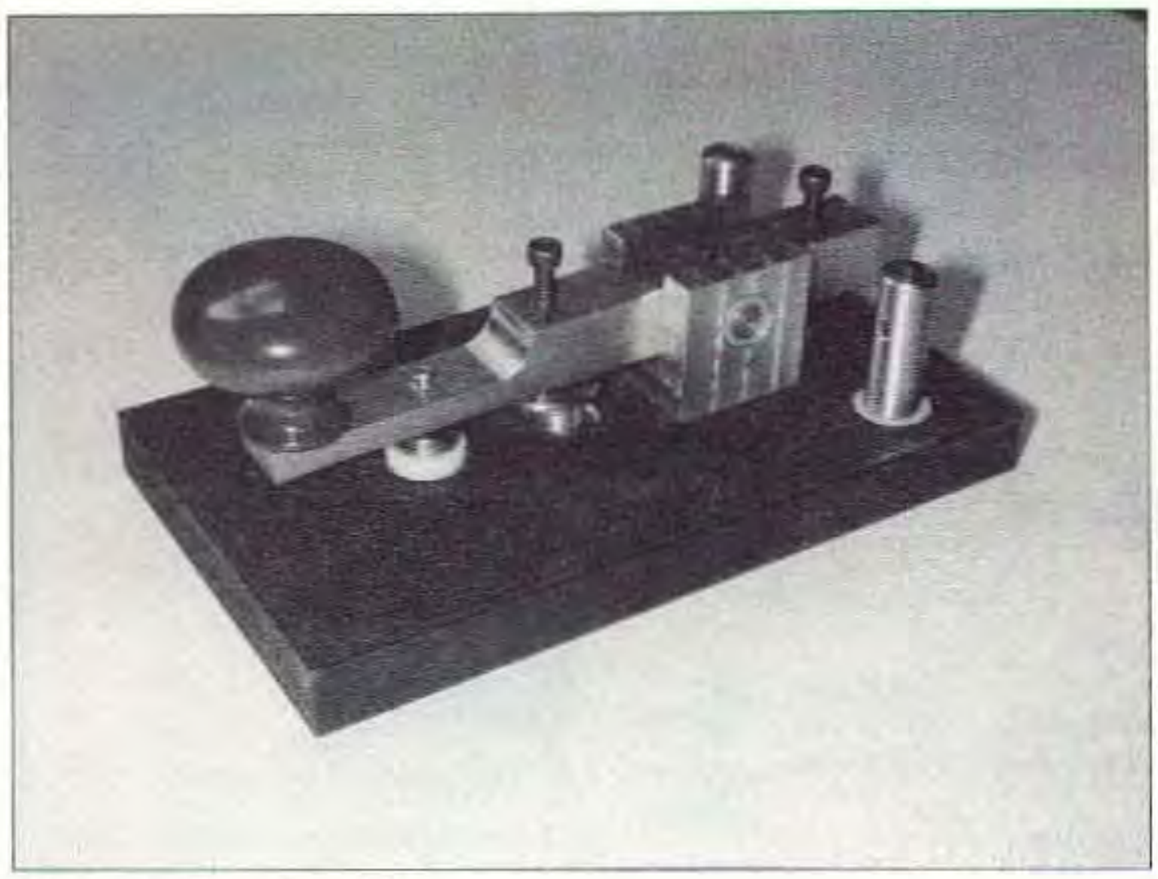


Photo A. *Completed key.*

Photo B. *Milling the bearing block.*

bolt, positioned so that the adjustment screw strikes the bolt head. To dress up the striking point, I surfaced the hex bolt head and turned the head round. The appearance is of a smooth cylindrical pin. The round-headed bolt can be turned in finger tight and then final tightened with padded jaws pliers.

I also wanted the bottom of the spring to not contact the painted base plate. I milled a 1/2" diameter pocket 1/16" deep to hold the lower spring retainer.

The hot side connection post and the fixed contact must be insulated from the base plate. I made insulating washers from a 1/2" diameter Delrin rod. Nylon or other similar plastics would work as well. The base plate has flat-bottomed pockets to accommodate the washers. The pockets are milled 1/4" deep to permit the screw heads to be flush with the bottom of the base plate. In addition, I milled a 1/4" wide slot between the hot side connection post and the fixed contact to contain a connecting wire. I insulated the lugs with heat shrink tubing to prevent shorting against the base plate.

Miscellaneous parts and assembly

Fig. 4 details the remaining custom parts required for the key. The drawings are self-explanatory. Since many of these parts are visible, try for good-quality workmanship — chamfer edges and polish out any nicks or scratches. When drilling and taping the connection posts, soft jaws on the lathe may reduce marring.

I use a standard drawer pull, available at any hardware store, for a knob. I've used both plastic and ceramic pulls. If you use a ceramic pull you may find it necessary to go to a heavier spring to offset its increased weight.

I found a suitable spring at the hardware store. It is wound from 0.021" diameter wire, 12 turns/inch, with an inner diameter of 0.26 inches. The spring was two inches long, and I cut it in half for my key. Spring tension is a personal preference, and I like a small spacing, soft tension key. A good hardware store will have a selection of springs, so experiment until you find one to your liking.

The armature contact is a 6-32 x 3/8" stainless steel cone tip set screw, adjusted to have the cone part of the tip protrude below the bottom of the armature. This results in a stainless-steel-to-stainless-steel contact, which has proven satisfactory. If you can't find the cone tip set screw, you can grind the tip of a standard stainless steel set screw into a cone shape. To

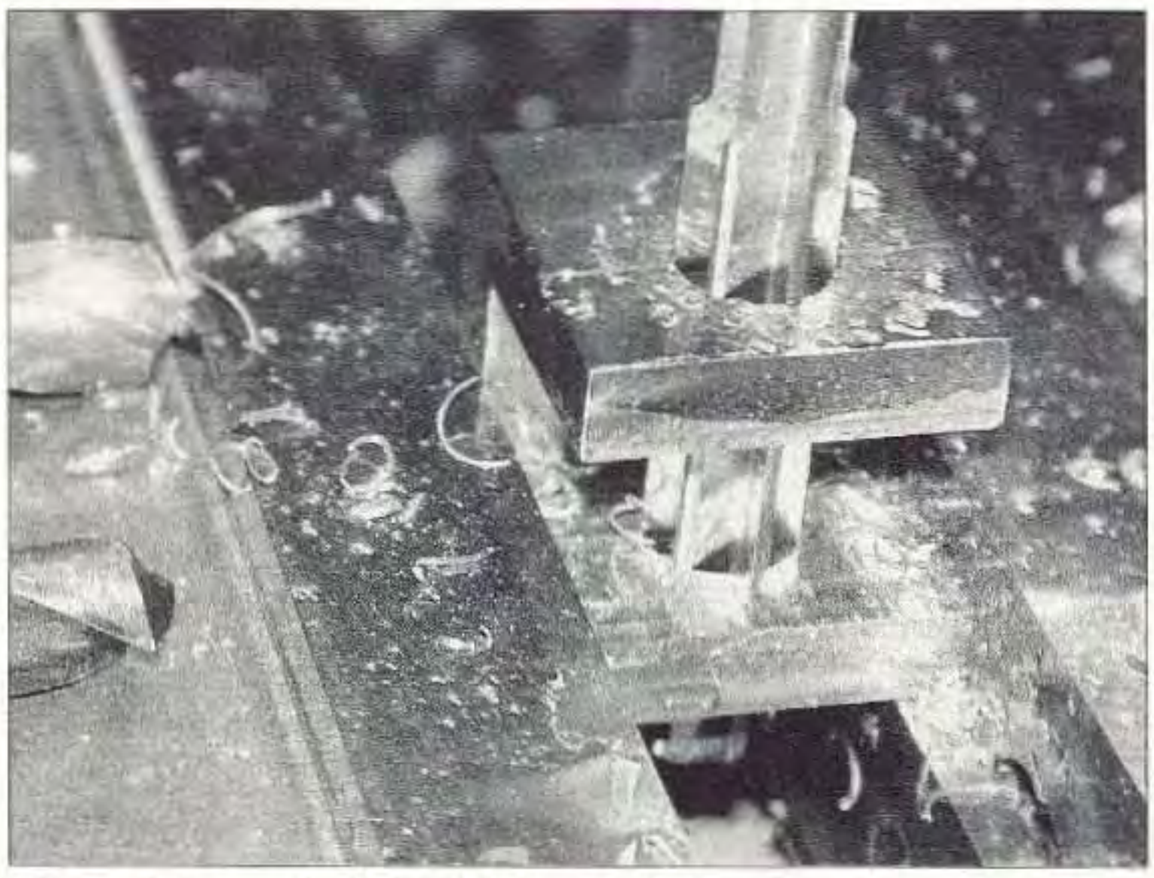


Photo C. *Ream the 0.375" hole for the bearings.*

Photo D. *Milling the reduced part of the armature.*

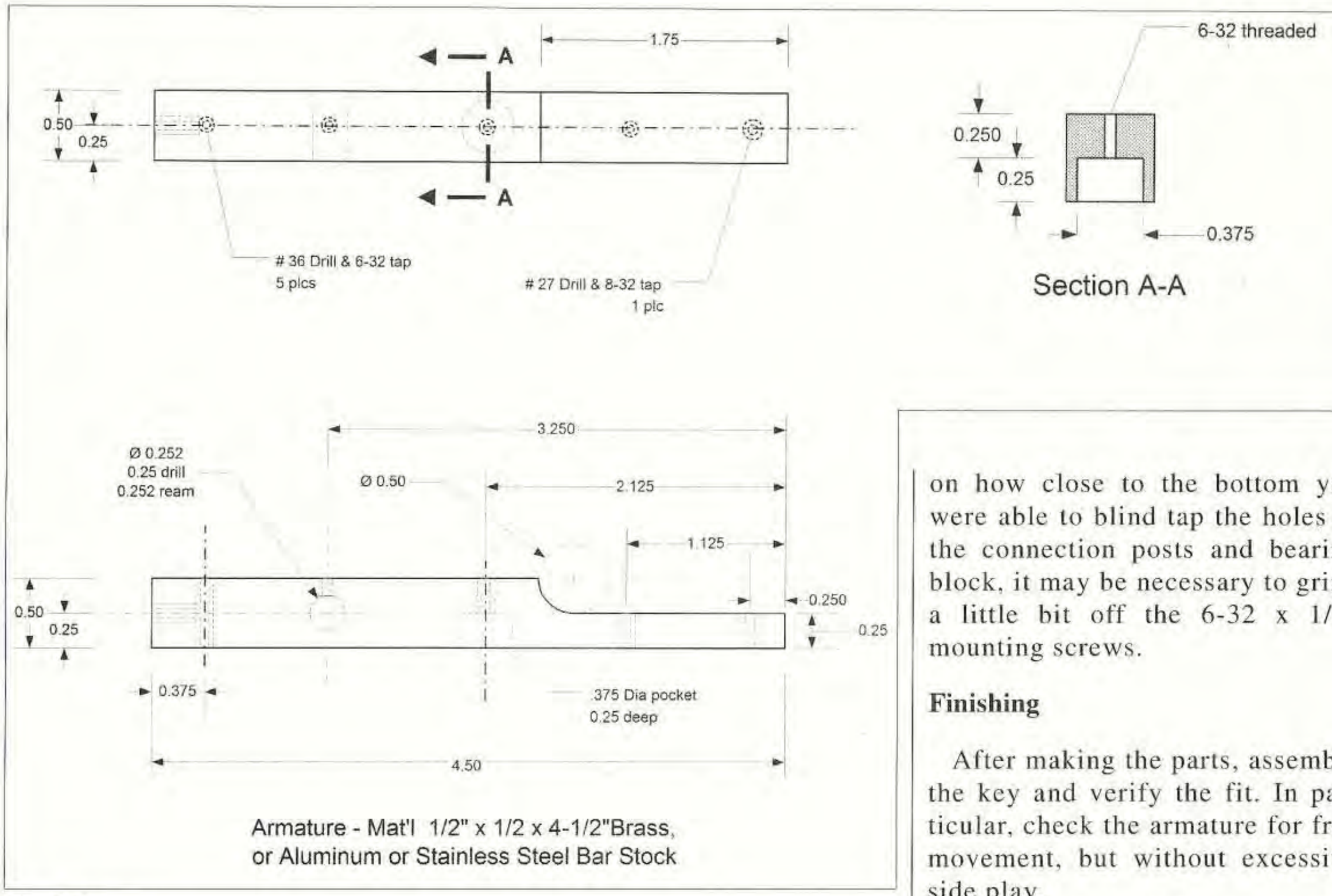


Fig. 2. *Armature.*

retain the set screw contact in the armature, I used Locktite 222 small thread locking compound. Fingernail polish would likely work just as well.

The spring tension retaining screw and the spacing adjustment screw are 6-32 x 1" SHCS screws. I used black oxide screws to provide color contrast, but you may prefer stainless steel.

Use a 6-32 x 1/4" set screw to hold the axle shaft to the armature. A 6-32 x 3/8" set screw locks the spacing adjustment screw in place. Again, I used black oxide set screws, but stainless steel would provide a different appearance.

The connection posts and the bearing block are held in place by 6-32 x 1/2" SHCS. I used 8-32 set screws in the top of the connection posts, but you may prefer 8-32 thumb screws. Depending on how close to the bottom you were able to blind tap the holes in the connection posts and bearing block, it may be necessary to grind a little bit off the 6-32 x 1/2" mounting screws.

Finishing

After making the parts, assemble the key and verify the fit. In particular, check the armature for free movement, but without excessive side play.

When you are satisfied, disassemble and prepare the key for painting and polishing.

After degreasing the parts, I sanded the base plate with a medium-grit emery paper and then painted it with a bare metal primer coat, followed with a finish coat of Krylon "Black Wrinkle." I like a wrinkle finish because it covers up minor blemishes in the base plate that might not have been removed with the sanding. Install

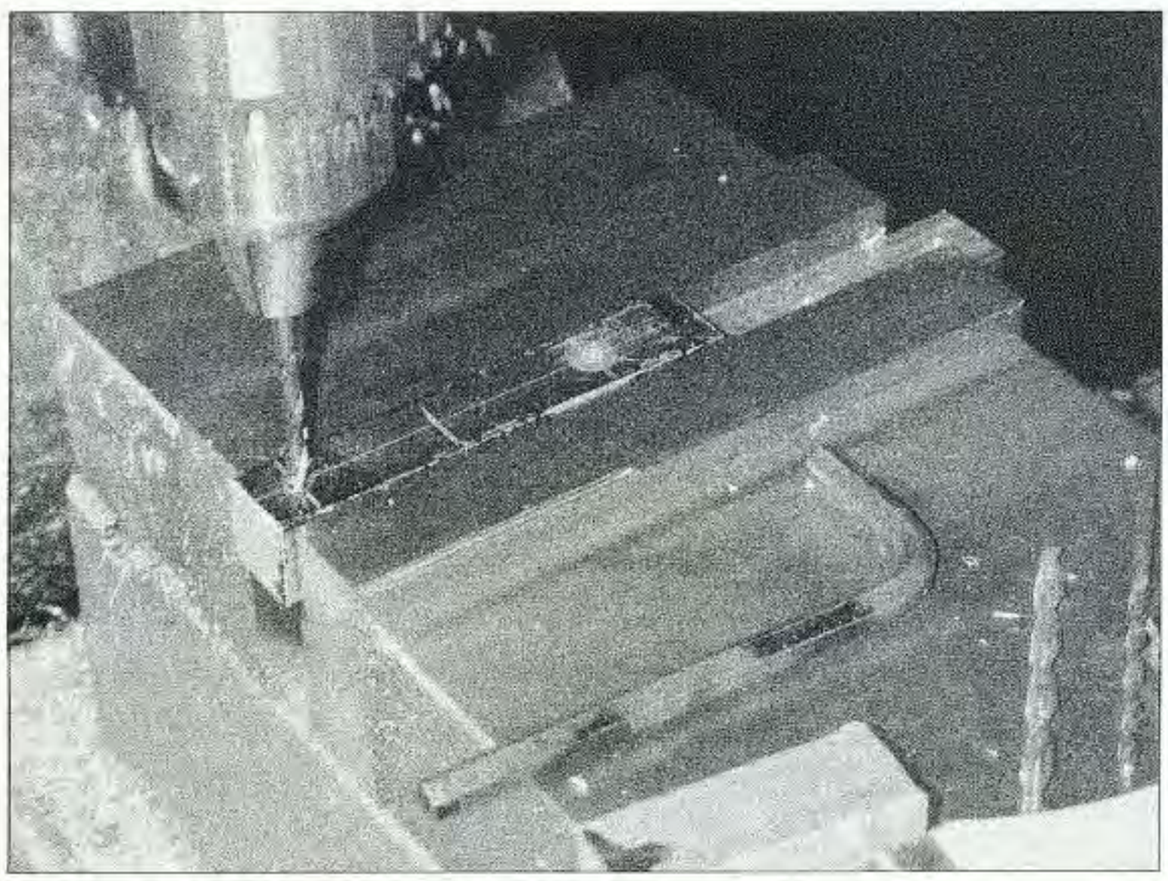


Photo E. *Drilling the armature.*

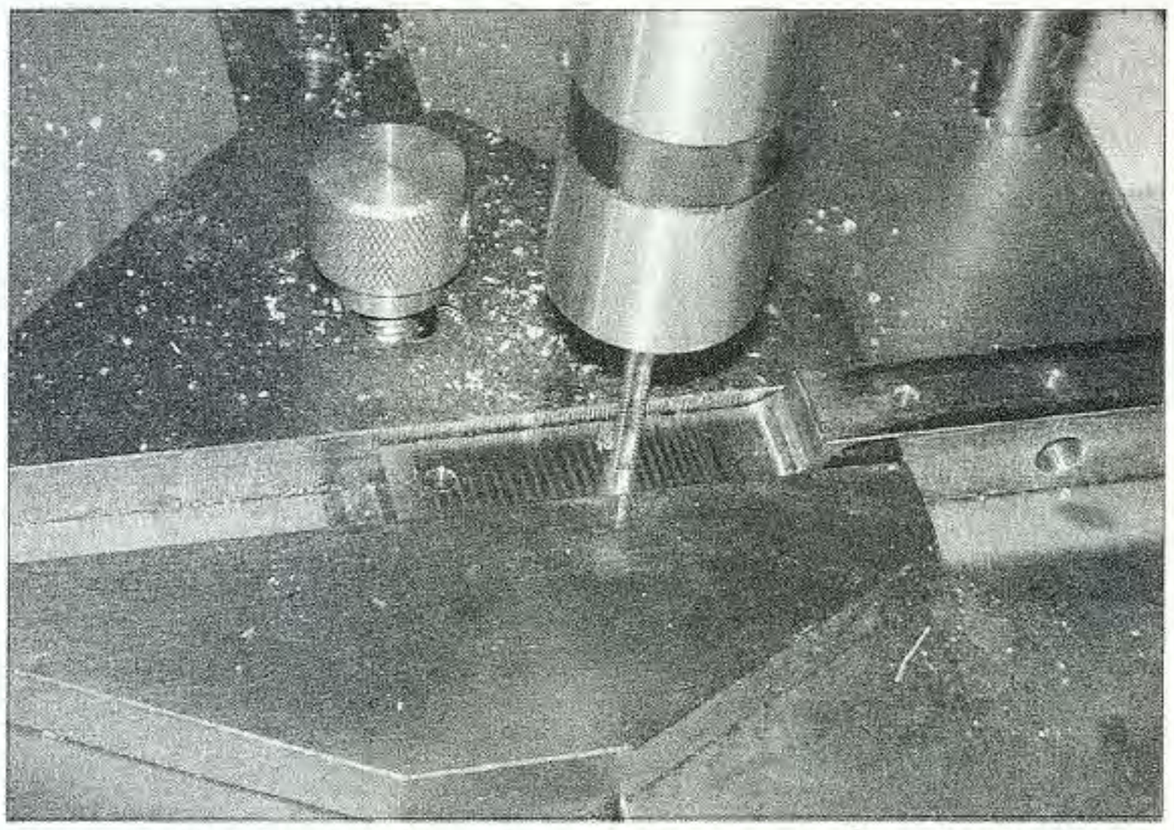
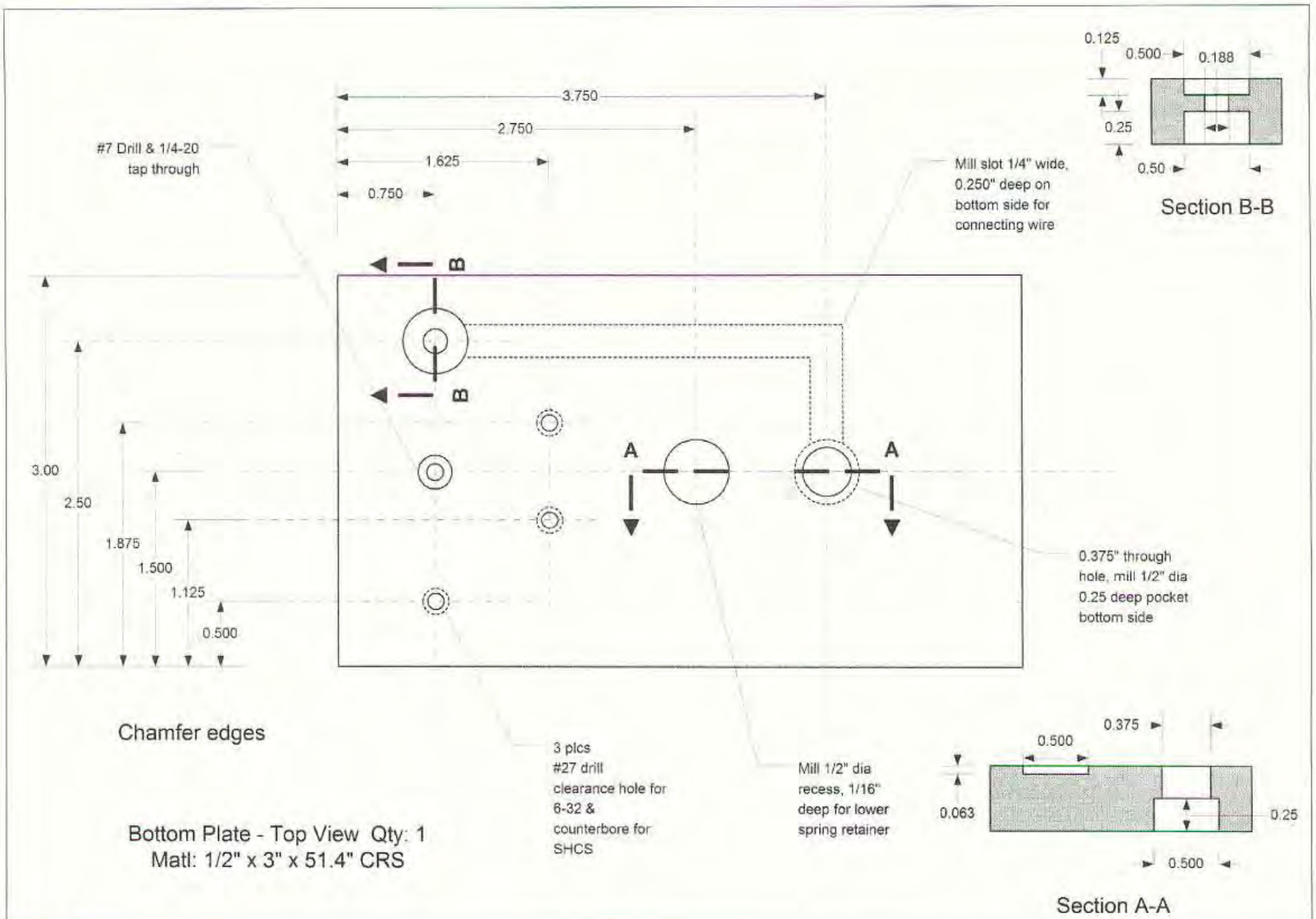


Photo F. *Using a hand tapping machine to tap the threaded holes in the armature.*



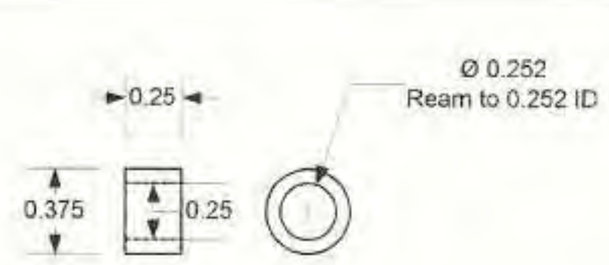
Bottom Plate - Top View Qty: 1
Matl: 1/2" x 3" x 51.4" CRS

Fig. 3. Base plate.

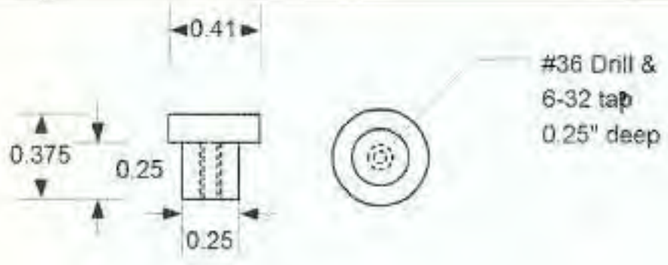
self-adhesive felt or rubber pads at the four corners of the base plate to stop the key from sliding or marring your desk.

I finished the armature and bearing block with fine-grit emery paper, followed by an automobile "scratch and swirl remover." This produced a

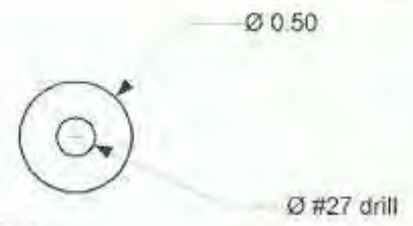
***Photo G.** Marking the base plate using a height gauge.*



Bearing - Qt'y 2
Mat'l: Oilite Bronze

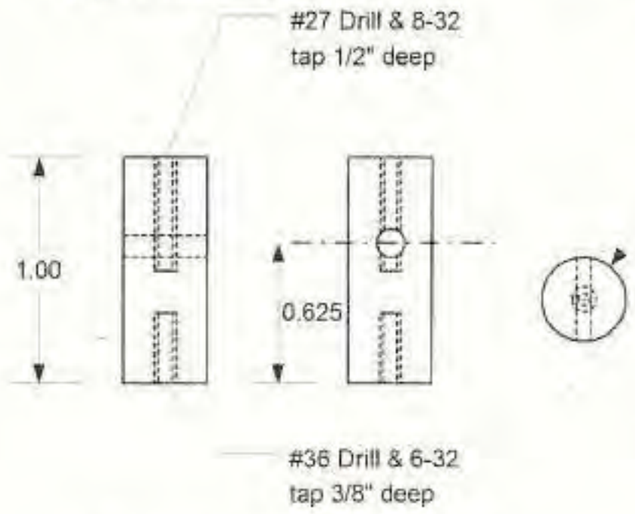


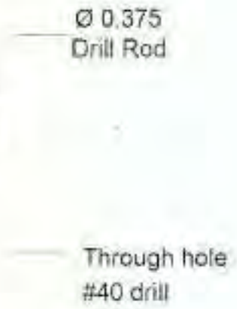
Fixed Contact
Make from 1/4x20x1-1/2"
SS Bolt, turn hex head to round &
surface head



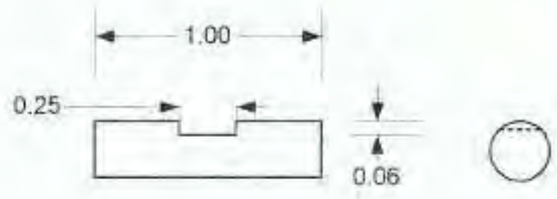
Matl: Delrin or similar
0.125" thick. Turn from 1/2" dia
rod

Insulating Washer
Qty: 3 w/ ID = 6-32 clearance

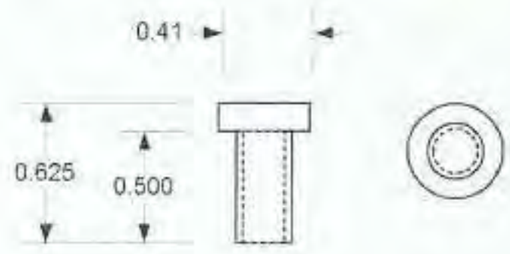




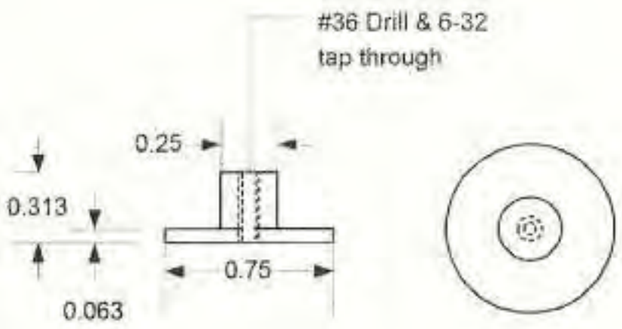
Connection Posts Qty: 2
Mat'l: 3/8" dia drill rod



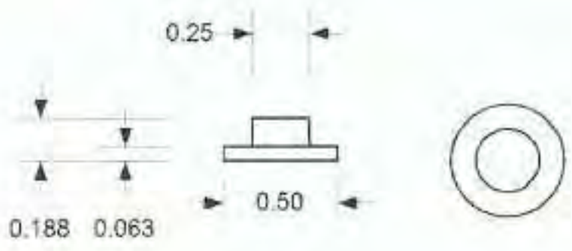
Axle Shaft Qty: 1
Mat'l: 0.250 Drill Rod
Mill flat for setscrew centered
horizontally Chamfer ends



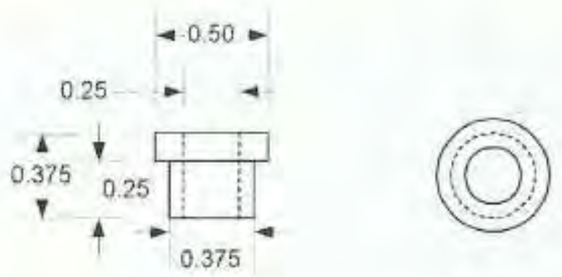
Spacing Striking Surface Qty: 1
1/4-20 x 1/2" Stainless Steel bolt,
turn head round and surface head



Upper Spring Adjustment Qty: 1
Turn from 3/4" dia brass or
steel rod



Lower Spring Retainer Qty: 1
turn from 1/2" brass or steel
rod



Insulating Bushing for Lower
Contact Qty: 1
turn from 1/2" dia Delrin rod or
similar

Fig. 4. *Miscellaneous parts.*

nice luster when applied to brass and aluminum. After polishing, you can treat the armature and bearing block with clear lacquer if you

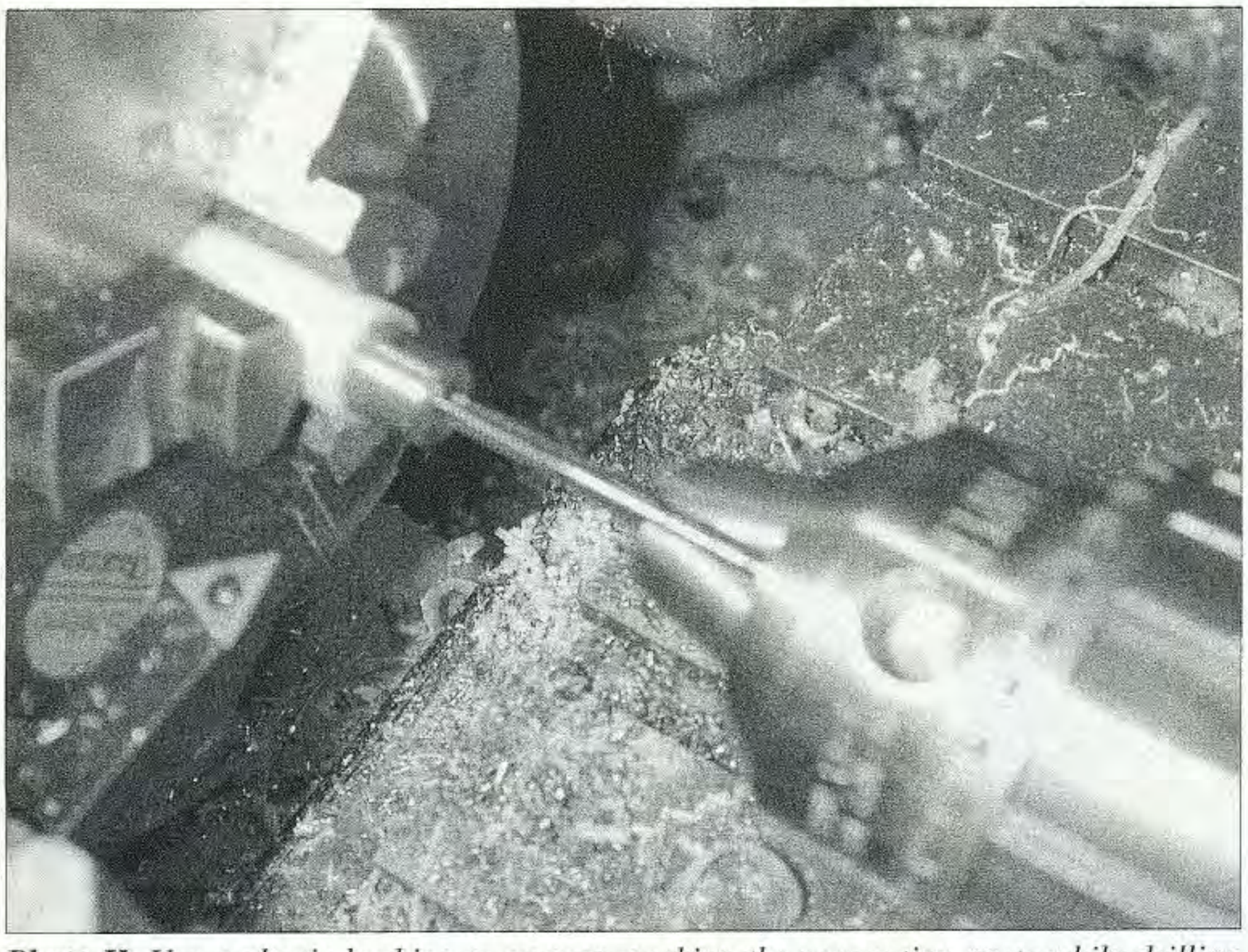


Photo H. *Use a plastic bushing to prevent marking the connection posts while drilling and tapping.*

Photo I. *The knob is a drawer pull. The upper contact is a cone-pointed set screw.*

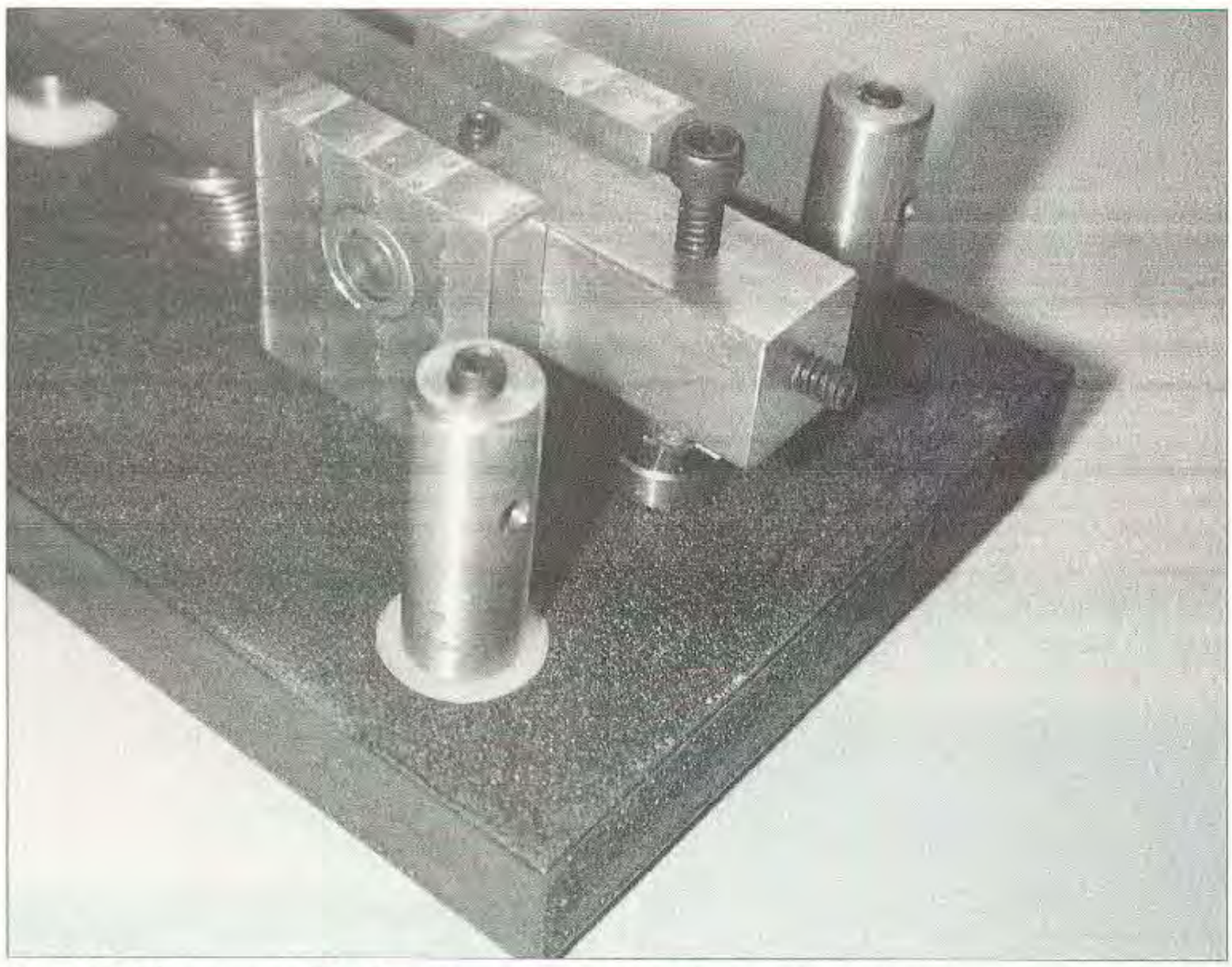


Photo J. *The space adjusting screw is locked in place with a set screw.*

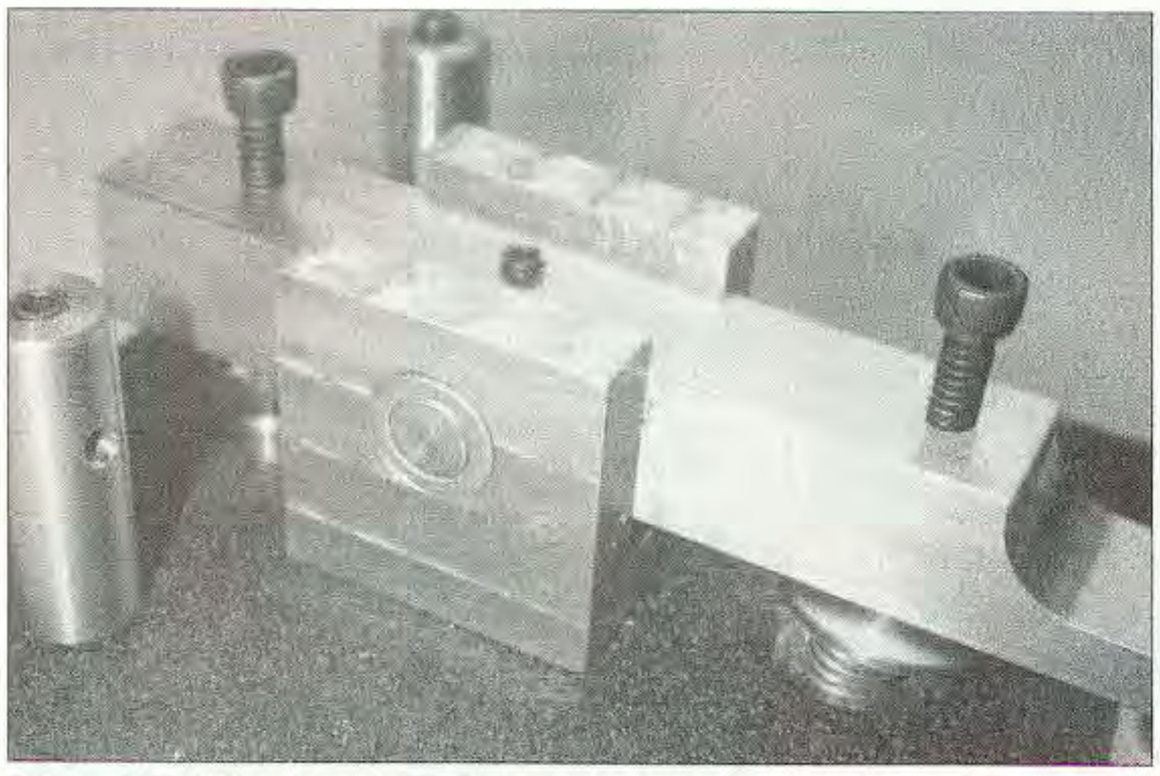


Photo K. *Oilite bearings fit into the bearing block.*

wish to preserve the color in brass or aluminum.

After painting the base plate, go back in with the counterbore tool and remove any paint that may have found its way into the three 6-32 SHCS holes, as these screws must make good electrical contact with the base plate.

Make a short connecting jumper between the fixed contact and the hot side connection post, using ring lugs on both ends of the wire. Route the wire through the milled slot.

Parts availability

Buying small quantities of metal is often difficult. I ordered the bar stock and base plate stock from Online Metals, at Web site [http://www.onlinemetals.com/].

I ordered small hardware and plastic stock from MSC Industrial Supply, at Web site [http://www.mscdirect.com/].

Neither company has a minimum order quantity.

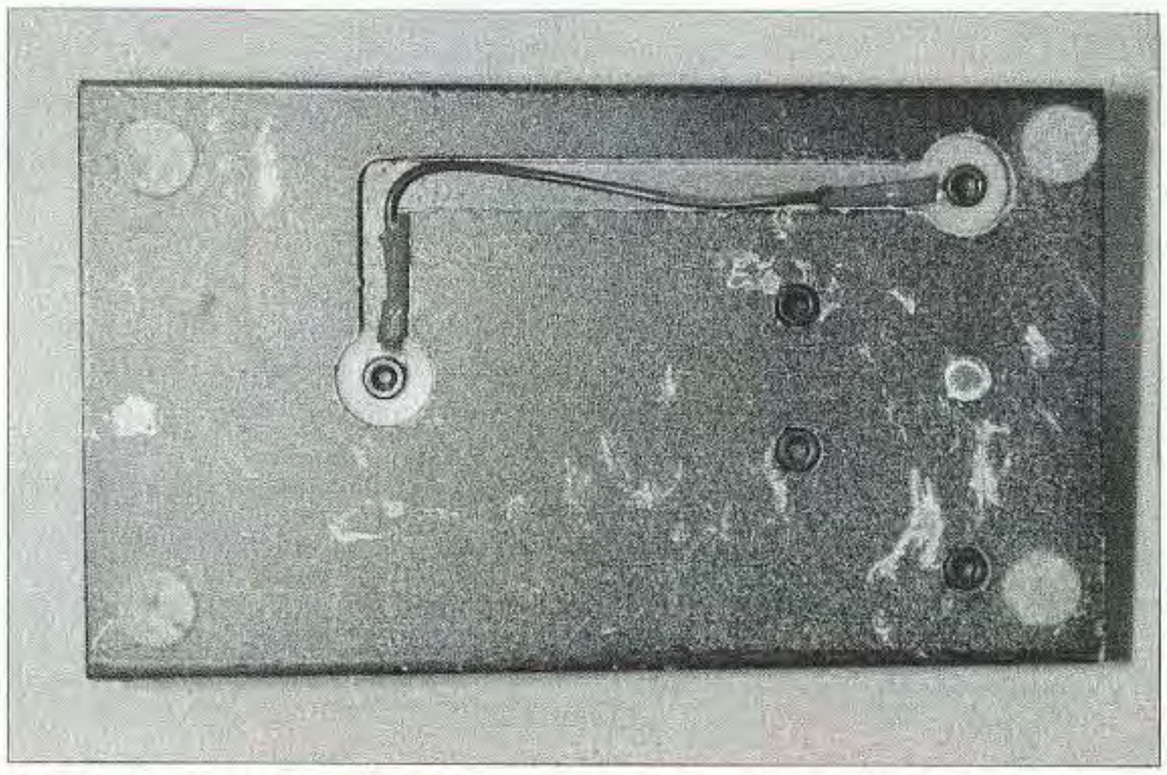


Photo L. *Route the connecting wire through a milled channel.*