Pilot Cutters

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One thing horologists share is a love of timepieces. Another thing we share is a love of the tools we use. In this article, I will introduce you to a group of useful tools you can make yourself -- which you'll surely enjoy making and using.

Similar tools are called "pin drills" or "piloted countersinks" or "counterbores" but I'll just call them "pilot cutters". You use them in your drillpress, and you make them using only your lathe, a jewelers saw, and needle files. They're easy to make, and you can make one in fifteen minutes.

Pilot cutter uses are many -- you can use them to shorten long bushings which are already inserted into plates. In another form, you can use them to make oilsinks or to increase the amount of end-shake in an arbor. You can also use them to cut recesses or pockets for screws.

The basic pilot cutter is as shown in Figure 1. It consists of a cutting surface with a vertical pilot pin. The pilot pin's function is to fit into a hole in the work material to guide and steady the cutter while it cuts. Similar cutters exist to cut steel, but the form I describe here cuts brass.

Pilot cutter uses.

An important use is to shorten bushings which are already inserted into plates. Too-long bushings must be shortened, and it's more time-efficient to shorten bushings after they're already installed in the plates. And then we sometimes receive work which someone else has bushed, leaving the bushings too long.

Skill and time are required to shorten bushings with a file, and the danger exists that plates will be marred. There's even more danger if a motorized tool is used to grind away bushing excess.

Insert a pilot cutter in your drillpress, and in a few seconds you can shorten a bushing, or even a lot of bushings, leaving behind only a nicely machined surface on the top of the bushing. You won't even touch the plate, with a little care. Pilot cutters can be made quite small, so that very small bushings can be shortened.

Pilot cutters can also cut or restore oilsinks. Oilsink cutters have rounded cutting flutes, as shown in Figure 4, or you can make a pilot cutter to cut conical oilsinks, also shown in Figure 4.

After you install a bushing into an existing oil sink, you can restore the oilsink with

a pilot cutter. The result is a nearly-invisible repair -- the new bushing doesn't show.

Pilot cutters can also make recesses into plates or bridges, such as recesses for screws. These cutters make such cuts quickly and cleanly, without chatter.

Another use for pilot cutters is to increase arbor endshake, when the only other alternative is to cut back an arbor to increase the length of a pivot -- which can be troublesome if the pivot is hardened. The pilot cutter can be used to make a shallow recess on the inside of a plate to provide some clearance.

Special pilot cutters can also cut decorative grooves around oilsinks. Such a cutter appears in Figure 5.

Making pilot cutters.

You make pilot cutters from ordinary water- or oil-hardening drill rod, which is a high-carbon, hardenable steel available at low cost from any tool supply house. I have cutters made from 3/32" to 1/4" drill rod, but for clock work 3/16" is probably the handiest. Usually I begin with about two inches of rod, but the length isn't critical.

There are two ways to make pilot cutters. The first is to make the pilot integral with the body of the cutter. You simply use your lathe to cut out the pilot, as shown in Figure 2.

The other way is to use your lathe to drill a hole in the end of the rod, into which you'll later insert a pilot pin -- much as you'd do when re-pivoting an arbor. This is shown in Figure 3. Make the pin of hardened material, such as blue pivot steel or music wire. Taper the pin slightly so it can be tap-fit into the hole after the cutter itself is hardened and tempered.

The diameter of the pilot pin isn't critical. Obviously, it must be small enough to fit into the target hole, but it can be quite a bit smaller than the target hole and still function well. You don't need a lot of different sizes for bushing work. If the pilot cutter wobbles when run, use a cutter with a larger pilot. The pilot pin length is also not critical. Its length should be about the same as the thickness of the material it cuts.

The next step is to make the flutes by sawing away material with a jewelers saw, as shown in Figures 2 and 3. Usually, I use size 00 saw blades, but of course tiny cutters require tiny saw blades. This is an easy job made easier with magnification.

The third step is to file clearance slopes on the backs of both flutes, as shown in

Figures 2 and 3. Be sure you take into account the direction of rotation of the cutter when filing the slopes -- it's possible to slope them in the wrong direction. And remember -- the slopes on the opposed flutes lie in opposite directions because the tool rotates around the center. Only a few degrees of clearance slope is necessary.

If you're making the integral-pilot kind of cutter, it's good to use a file with a "safe" edge -- one on which an outside edge of the file has been ground smooth. This helps to avoid marring the pilot.

It's a little harder to slope the flute backs of round-fluted cutters, as shown in Figure 4. The job can be made easier by first darkening the rounded edge with layout blue or a felt-tip pen, then filing up to the cutting edge -- use the darkening to indicate where you're filing. This job is easier when making cutters with separate pilot pins, since you'll file the slopes before you insert the pin.

The front of the cutting edge should remain vertical. This brings the cutting edge against the work material at a 90-degree angle, which is ideal for brass.

Decorative cutters, such as seen in Figure 5 are made by first making a cutter such as shown in Figure 3. Then file away material to form cutting triangles. Pilot diameter is more critical than in other cutters -- it should be close to the size of the target hole to keep the cutter from wandering.

Cutting edges can be improved by honing them smooth with an Arkansas slip or a fine diamond hone. The better the finish on the cutter, the better the finish on the work.

Once the pilot cutter is finished, harden and temper it. Heat the business end of the cutter until it's bright red, then plunge into oil or water. Temper it to a light straw color. I clean it with a rotary wire brush inserted into a rotary tool to make color changes visible. I temper with an alcohol lamp or a small butane torch.

Run these cutters at a fairly low rate of speed. The speed of most bench-top drill presses (about 700 rpm) is fine. Too much speed causes chatter.

While making and using pilot cutters is basically quite safe, you should use safety glasses and any other precautions deemed necessary.

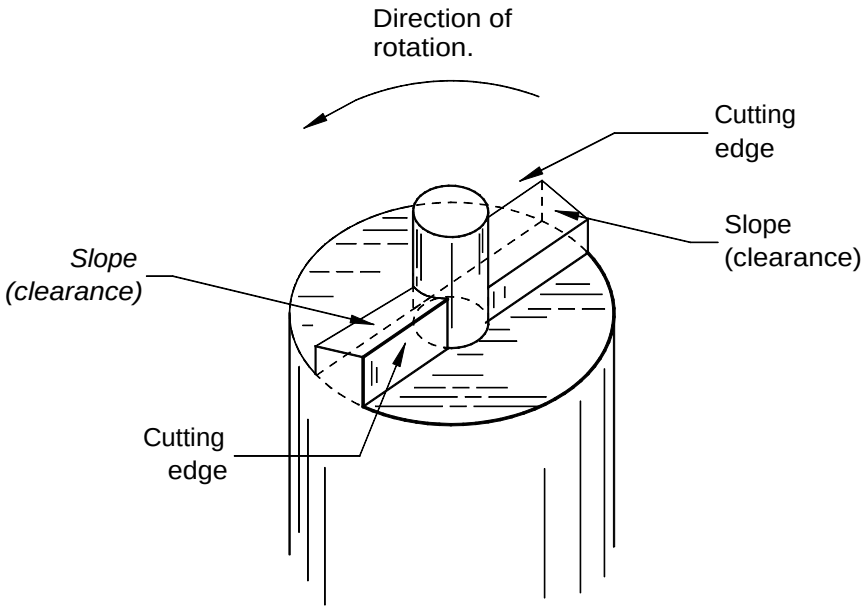

Direction of
rotation.
Cutting
edge
Slope
(clearance)
Slope
(clearance)
Cutting
edge

Figure 1

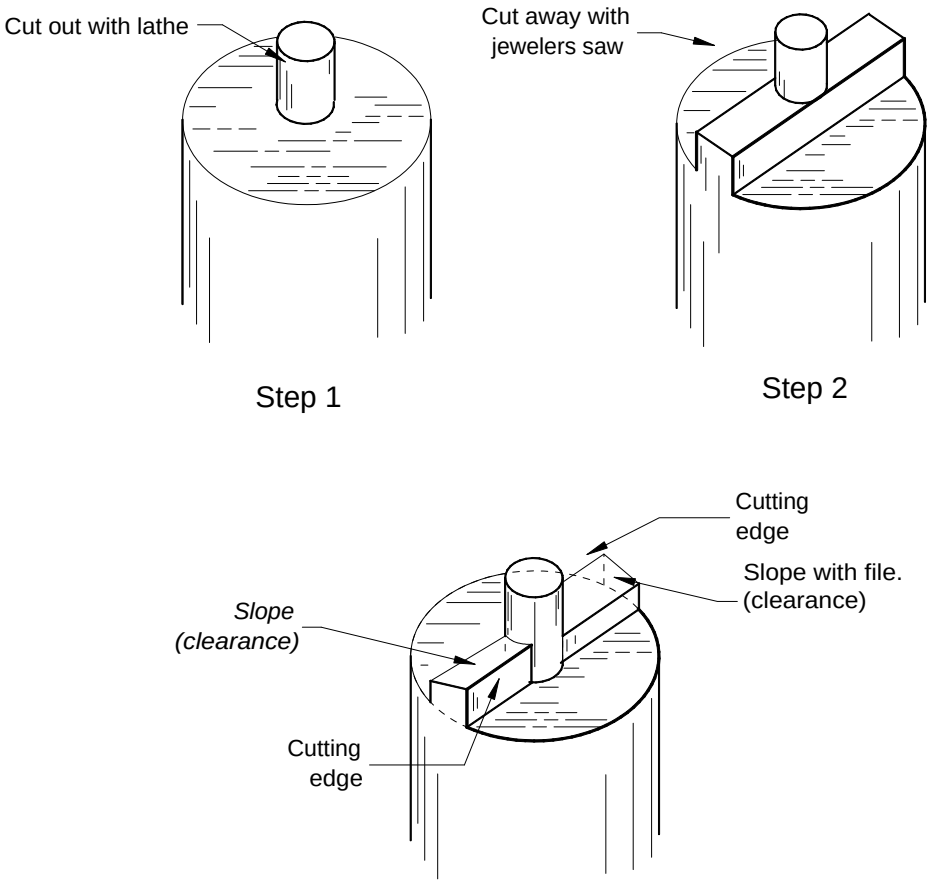
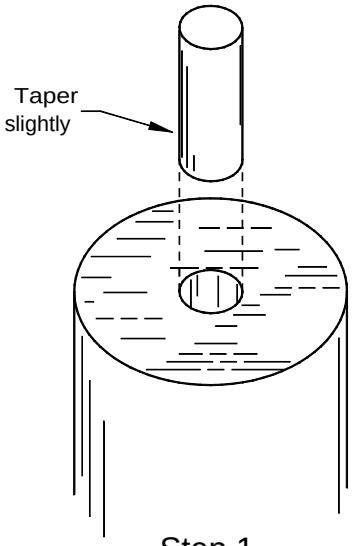
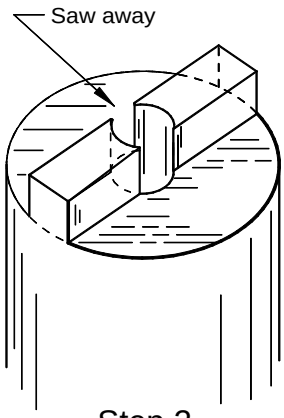

Cut out with lathe
Cut away with jewelers saw
Step 1
Step 2
Cutting edge
Slope with file. (clearance)
Slope (clearance)
Cutting edge
Step 3

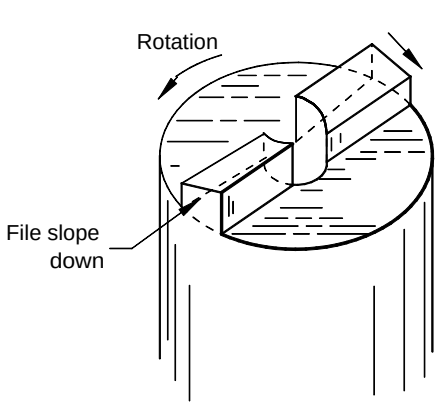
Figure 2



Step 1

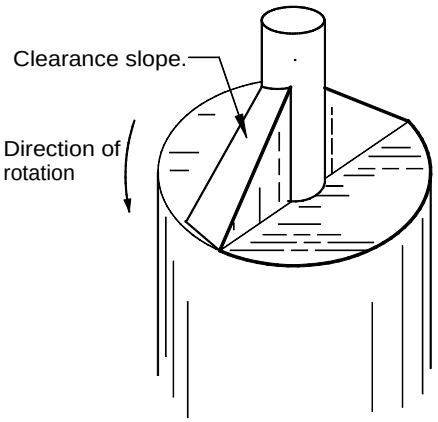


Step 2

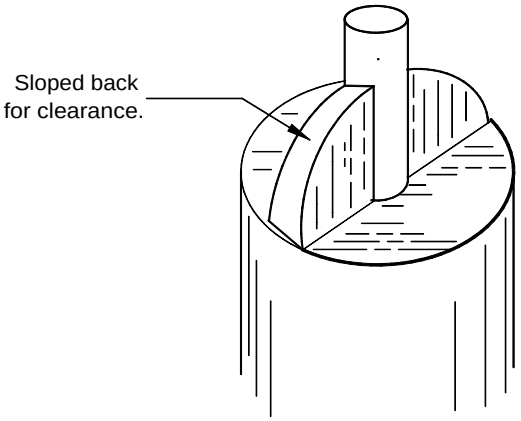


Step 3

Figure 3



Connical cutter



Oilsink cutter.

Figure 4

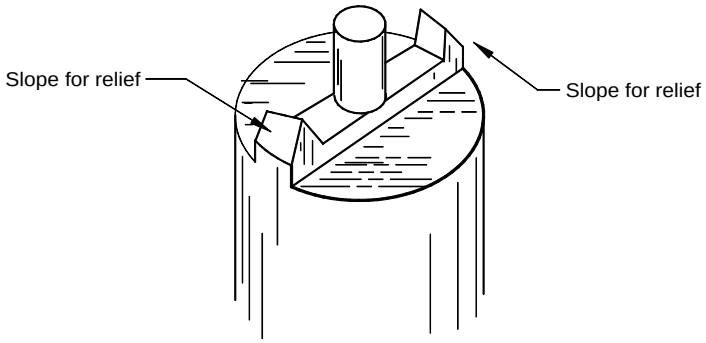


Figure 5