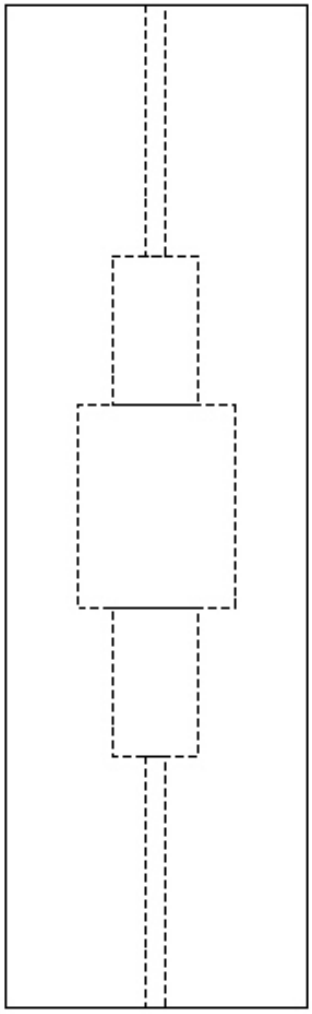
Drilling a Hole that is Larger in the Middle than At the Ends, version 2

By R. G. Sparber

The challenge



I actually needed to drill a hole that looks like this in profile. The narrowest part is 1/8” in diameter. How to do it?

I did use a lathe and standard drill bits. No boring bar was employed.

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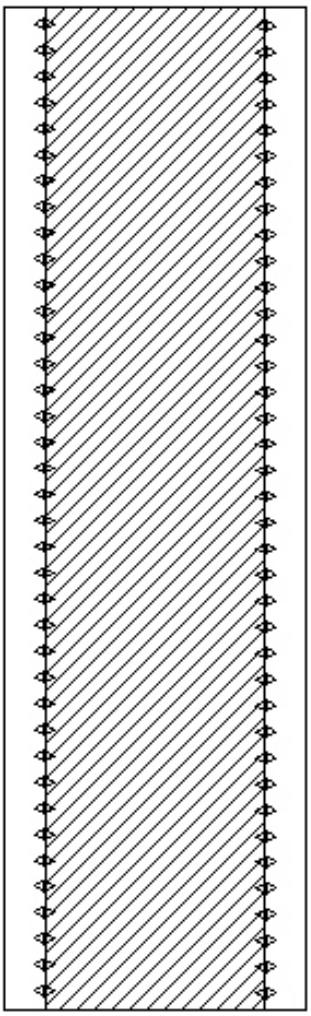
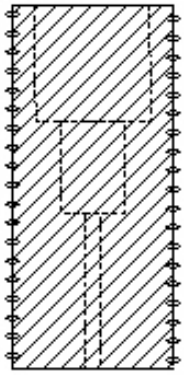
If you can't solve the problem, change the problem

I had a wonderful college professor who would periodically give us this wisdom. It is, in fact, impossible to simply take a standard drill and make the hole shown on the last page by drilling straight down. OK. So what can I do? I can drill holes of ever decreasing diameter. But how do I drill from the inside out? Here is how I did it.

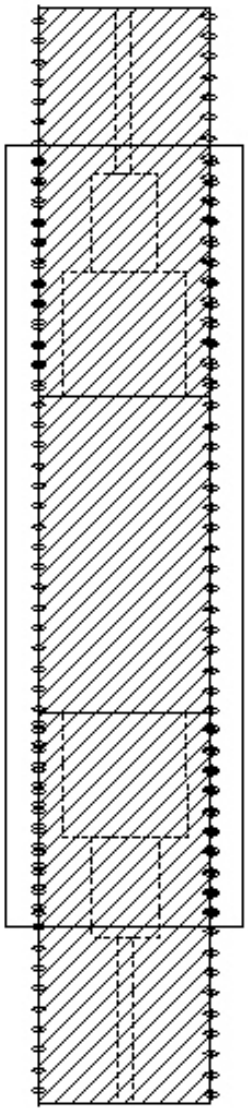


Step 1 – drill a hole centered on the final hole but larger than the largest inside diameter (ID) and equal to the next larger tap size. Then run the tap all the way through. If you can't reach, you may be able to tap from both sides but don't expect the threads to match in the center.

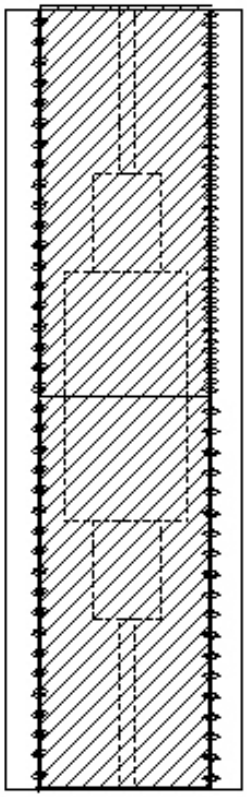


Step 2 – take some threaded rod that matches this tapped hole and drill the ID of each section on a lathe. Where possible, you can drill more than one ID. In my case it is very easy since I can step drill all the IDs in the same slug. But if I wanted to neck back down in the center, I would just cut a separate slug with just that ID.

I have symmetry so made two of these slugs. The ends are squared off while the part is in the lathe.



Step 3 – thread in the slugs. If you intend to leave it this way, use a bit of Loctite® on the threads before assembling. For better alignment, feed a close fitting rod through both slugs while the Loctite sets.



Variations to this approach

Larry Gill suggested that I can do away with the threaded bore and just use slugs that are a sliding fit. Set screws or Loctite can be used to secure the slugs. A side benefit of this approach is that the holes would be more concentric since there would not be the play due to the threads.

We can also combine these ideas. Say we drill the tap hole but only cut 3 to 6 threads into each end. This leaves the rest of the hole smooth. Drill the needed holes in the two short threaded plugs. Between the plugs, fill the hole with smooth sided slugs drilled to the needed ID. The threaded slugs keep the smooth sided slugs in place.

It is also possible to use a shaper or broach to cut a keyway in the bore. Cut a matching keyway in all smooth sided slugs. Drop a key down the bore into this keyway. In this way we can prevent the slugs from turning in the bore. This enables us to have features through each slug that are not symmetric and need to be oriented a specific way. One example is an offset hole that works with adjacent offset holes to form some complex function.

No need to just have solid slugs in the hole. Springs could be in the lineup. We can also have a mix of materials.

Rather than have two threaded slugs to seal the ends, we could drill a blind hole and then drill the small hole through that end. The ledge that is created will hold in the smooth sided slugs. A threaded slug at the other end would hold it all together.

Real World Applications for this Technique

There are many cases where the designer needs a hole with a complex change in ID. For example: carburetor jets, liquid valves, and aspirators. Thanks Curt.

Acknowledgement

Thanks to Larry Gill for finding all of my clarity, spelling, and grammar errors. Thanks to Curt Wuollet for providing critical review plus real world applications for this technique.

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