Rivet Spinning

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I am slowly going over to the dark side and have started making folders. My current project is a small slip joint – bronze scales with silver menuki added as accents, held together with nickel silver rivets. Whacking on these with a ball pein hammer to set the rivets just didn't seem right, so I decided to explore "rivet spinning". Fair warning – what follows should be thought of being equivalent to experimental archeology – start with minimum information and then create the rest out of whole cloth. The premise is that a rivet can be set by combining a tool that spins while exerting pressure. Google isn't much help beyond these admittedly sketchy parameters. While there is a tool available from Jantz that is basically a steel cylinder with depressions on the ends (negatives of the dome-to-be-produced), there is little information on use. Further, I don't see how you can make two nicely domed heads with a single tool – while one end is being formed, isn't the other end getting mashed out of shape? And being a smith, I also don't see why I can't make the tools (hubris, I know).

So the basic premise is that spinning is: (1) trap the rivet between two rivet sets, one of which is in the chuck of a mill or drill press, then (2) turn on the machine while (3) leaning hard on the down feed. The pressure compresses the rivet and the spinning of the upper set nicely domes the rivet end. Initially, the rivet will spin and the bottom set also does a bit of work. Eventually, the rivet shank expands and no longer rotates, so it is necessary to flip the knife over (one side up sometimes, then the other). The bottom set now just keeps the bottom dome from being mashed, prevents (or minimizes) damage to the surrounding surface, and helps align the assembly. Given a shallow depression around the rivet hole, the result ought to be a nice pair of domed rivet heads, a tight fit, and no damage to the surrounding metal. Given this definition, something like the two pairs of spinners shown here need to be fabricated.

Since I'm going to use these on non-stainless steel rivets, hardened tool steel ought to suffice as the base material. It needs to be stout enough not to flex under pressure, so 0.5" O1 drill rod looked like the best choice (OK, I already had it). I arbitrarily cut some 4" long sections (more on this later) and annealed them. The first step is to produce a nice conical end. I could have used the lathe, but there is a faster method. Weld a bit of black pipe (Sch.40; 3/8" with a 0.493 ID) to some scrap angle iron. Bore the pipe out to a tad over 0.5". Cut / grind the angle to something like 45^{O} and clamp to the steady rest on the 2x72 knife grinder as shown. Put the blank into the chuck of a hand drill, fire up the grinder and the drill, and gently feed the blank into the belt. Stop when there is an approximate 3/16" flat left on the end.

This is a close-up of the grinding jig and one of the blanks after the grind. Repeat for as many as you need (at least two).

We now have to create the recess for the rivet head. Because I have the equipment, I tossed the blanks onto the lathe, used a combination drill and countersink to start the recess (a spotting drill would have worked just as well), and completed the recess with a 3/16" ball end mill. A two-flute end mill will give a hemispherical depression while a four-flute end mill will leave a little nipple at the center of the recess (the implication of that will be shown later).

With a bit of care, all of this could have been done on a drill press. Take a small section of 3/8" pipe with a 0.50+" ID, slip it partially over the pointy end of the blank, and slide a ½" transfer punch into the pipe. A tap with a hammer and the center is marked. If you don't have a set of transfer punches, spend the $10 at Harbor Freight! Clamp the blank into the cross slide vise on the drill press ($60 at Harbor Freight), align to the chuck and proceed as described above.

Eventually the lower spinner will have to be held securely on the drill press. You could use a set of V-blocks (mine came with the cross slide vise) or you could mill a couple of flats into the lower unit. Since I have to justify having my Bridgeport mill, you can guess what I did. You want two equal length flats on opposite sides of the blank. The setup is straightforward. A thin parallel plus a 3/8" lathe tool bit gets the blank securely held horizontally while allowing some of it to stick up out of the mill vise. The tool bit is positioned flush to the jaw sides. A shallow pass with the end mill creates the first flat. By turning the blank over such that the tool bit is snuggled into that flat and making sure the bit is still flush to the side of the jaws, the blank is ready for the second flat. As long as you start the cut in the same horizontal position, the flats will be of equal length and opposite one another.

If you have ever used the drill bits that have a more-or-less triangular end, you know how well they work in a drill chuck. The same idea can be applied to the spinners. Get some scrap hex material (a big hex nut would do in a pinch), drill a ½" hole in the center, add a couple of set screws and you get the jig shown here.

Insert a blank (pointy end down) and set the set screws. Place the assembly on the mill (vertically) in register (one "corner" flush to the edge of the vise jaws) and cut one of the flats. Leave the mill table in the same location left to right. Rotate the unit 120^{O} and repeat the cut. One more time gives you the snazzy blank shown here. Or you just could measure the interior depth of the drill press chuck and make sure that the upper spinner is longer than that. On my drill press, the depth is 3.5", so I lucked out on guessing 4" for the blanks. Either alternative works.

The next step is heat treating. I used oil hardening drill rod (O1), so all I did was use an oxy-propane torch to bring the blank up to critical temperature ($1500\,^{O}$ F by eye), then submerge it in quenching oil. The butt end was held in a set of tongs for this process. This is – to be generous – slapdash but sufficient for our purposes here. The blanks were tempered at $375\,^{O}$ F for an hour, so the final hardness ought to be in the lower 60's (Rockwell C).

It's finally time to actually use the spinners. Since one of the aspects of this technique is pressure, I needed to somehow support or brace the drill press table. My press is an old column type press with the traditional hand-crank, semi-floppy table. After spending more time than I should have playing with pipes, square steel tubing, screws from dead office chairs, etc., I remembered an old anvil stand made for a now long-gone portable smithing rig. The stand nicely straddled the base of the press and an old car jack completed the rig (as shown here). Do whatever you have to but make sure the table won't sag when the pressure goes on.

The upper and lower components need to be aligned. You can just eye-ball that or you can fish that piece of pipe used with the transfer punch mentioned above out of the scrap bin and use it as an alignment tool. Lock the lower unit in the cross slide vise and slip the pipe section over it. Adjust the X-Y directions of the vise until the upper spinner can slide into the pipe. Lock the vise and the system is aligned and ready for use.

Shown here (Ok – fuzzily shown here – try to hold a camera while operating the system!) is a test piece (hereafter referred to as the "knife") – a 3/8" thick piece of scrap brass with a 3/32" annealed bronze rivet-to-be. I eyeballed about a 3/16" excess (3/8" + 3/16" overall), so there ought to be about 3/32" on either side. When clamped (the press is NOT on), the alignment can be confirmed. If it is off left-to-right, the "knife" will not lie parallel to that plane. By tweaking the X-Y adjustment of the cross slide vise, the "knife" can be brought parallel to the gravitational plane. Cool, no? It will be *really* easy when doing to have the rivet section fall out of the hole and disappear under the vise (guess how I know). A couple of light taps with a small hammer ought to upset the ends sufficiently to prevent this from happening. So…turn on the press, make contact and start leaning on the down feed. Both the top and bottom ends will start to dome and you can see the shaft begining to thicken under the top dome. After a short while (I suspect) the shaft will swell to the point that the rivet stops spinning. When this happens, you'll want to flip the knife over and continue spinning and pressing on the what-was-the-bottom side. With a little bit of luck, you ought to get equal sized domes. If the rivet is too long, STOP. Go to the grinder and remove a bit, then spin again. You do not want to bend it over. By alternating the side up, you should be able to get nice domes without marring the surface around the rivet heads (based on my extensive experience of maybe a half dozen rivets).

Initially I was concerned about too tightly setting the rivets and thus locking the blade in place. Maybe I'm just a weenie, but on a mock-up knife, the fit was too loose after the spin was over. To firm up the fit, I welded up another jig (surprise!) to allow the use of the spinners as a hammer rivet set. It consists of a spine thinner than the lower spinner (here – about ¼") with two sections of the pipe aligned with each other and welded as shown. The lower pipe section is short enough to allow the lower spinner to be clamped in a machinist vise and still protrude. The upper section is shorter than the upper spinner and the gap is sufficient to get the knife between the spinners. Note that spine extends below the vise jaws. In use, the lower spinner is clamped and the jig is slipped over it.

Since the lower spinner is maybe 2" above the jaws, I added a piece of wood as a support for the knife. The vise has 6" jaws and the lower spinner is about 2/3 of the distance to the right. Since the anticipated knives to be used will have a menuki riveted and soldered to the scales, I wanted the wood support to be a bit shorter than the lower rivet set's top. I can always shim as needed to bring the knife perpendicular to the rivet set.

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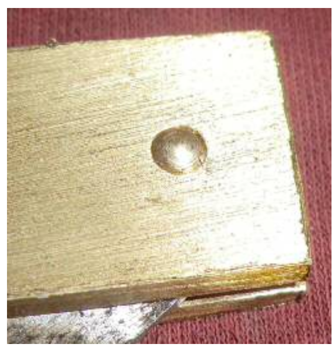
This picture shows the mock-up knife in the hammer rivet set jig. I supported the blade with my left hand while using the right hand to gently hammer the upper set. I gave it a couple of taps, checked the tightness of the blade in the scales and then repeated on the other side. The process repeated until the feel of the blade was right.

The results are pleasing (at least to me and I hope to my customers). Shown here are the rivets on the mock-up. There are fine lines visible on the rivet heads, so a bit of smoothing of the recess may be in order (before the heat treat!) . Remember the 4-flute ball mill mentioned above. The result is the rightmost image. I kind of like the dimple effect.



I'll leave you with the thought that all of this ought to be taken with a grain of salt. I've just begun to play with rivet spinning and, by no means, should this be taken as gospel. The time spent in making the jigs and the spinners was maybe a half-day and a certain amount of that was sitting with a cup of coffee and scratching my head (that's *head*!). I like the effect and the time to actually spin and tighten a rivet is comparable to just whacking it – but without the dings in the surrounding material. The $15 unit from Jantz *might* be able to replicate some of this but it can't (or shouldn't) be used for the hammer rivet set idea or simultaneously protecting the lower dome while forming the upper dome.

In fact, if there is sufficient interest in your neck-of-the-woods, making spinners might be a decent project for a hammer-in.