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FORGING TONGS
by Jay Close
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ON THE COVER: Tong half by Jay Close—story on page 8.

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NOTICES

From The Editor - Heuristic Design

Some of you might recall that I read an occasional e-mail post for artists by Robert Genn. A few weeks ago, he wrote a column called "Heuristic Painting." Heuristic is a word that means "Helping to discover or learn, guiding or furthering investigation." As I read his column about painting, I realized his advice works well at the forge, too. About heuristics, he says:

"Generally used in the fields of invention... examples of its use would be 'seat of the pants' and 'trial and error.' Heuristic thinking generally results in reasonably close solutions. The benefits are speed and accuracy. Here are a few ideas for squeezing value from heuristics from any media:

Start anywhere. Accept 'nearly right' to get going.
Forego early accuracy and precision. Let early strokes determine later ones.
Assume a solution and try working backwards. Of two solutions, choose the simplest. Move forward on incomplete information. Think smart rather than laborious. Use intuition and go directly to the outcome. Trust your instincts."

Blacksmithing is an ancient craft, but too much "old thinking" can be a mistake. By remaining open to new ideas, rewards can come from unexpected places.

Brian Gilbert, Editor

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SPRING 2008
FROM THE PRESIDENT

Then John Henry he did hammer,
He did make his hammer sound,
Say now one more lick before quittin' time,
An' I'll beat this steam drill down.

Like many of you, I look at ironwork a lot. In books, in museums, in the shops and towns of folks I visit, wherever I find it. Even in catalogs. And let me tell you, there is some good work out there, even in the catalogs.

For a while now, I've been noticing precision, and how it seems to have changed for blacksmiths over the years. Looking at contemporary work, one of the things I've noticed is how tight a lot of our work is... how absolutely perfectly many of us can reproduce some shape in iron, and how absolutely clean we accomplish it. On the one hand, that kind of precision demonstrates a high level of skill from the smith. On the other, it also indicates that precision is a goal.

Precision doesn't happen by accident. Looking at examples of highly skilled work from the past, I see a different kind of precision. I look at those centuries-old rails or screens composed of tens, or even hundreds of the same part over and over, but none of them are actually the same. Lumpy tapers and scrolls keep them from being "perfect." Not that those worthy smiths lacked the skill we have today, or even that they lacked our precision; I think they had different goals. You might say that if they had a steel distributor to call, or if they had all of our power tools or measuring tools, those smiths would have had an easier time making things more uniform. But I don't think that gives them nearly enough credit. For starters, just look at the work they did. It seems impossible to believe they couldn't make two adjacent tapers the same length. No blacksmith has ever needed more than a story stick to save a layout. And, working for churches or kings, few smiths since have had such luxuries of time and labor. If they had wanted to make all those scrolls exactly alike, they'd have done it. Besides that, the precision in that work is unmistakable; it is just not the same as ours.

On the one hand, it is natural that in our modern industrialized world we are accustomed to precision and often equate it with quality. Uniformity is one of the first results of industrialization. Even before machines take over any given process, the human labor is divided into little bits and each bit is assigned to an individual. The result is that although no single person may have the knowledge to make the entire object, people get very good (and fast) at each part. Again, uniformity both demonstrates skill and can make assembly more efficient. Those are important goals, but at what cost, or how far should we hope to go?

The thing is, we've been here before. We all know the story of how the blacksmiths built the machines that made their work and skills obsolete, yet here we are. And here we go again with developing economies around the world providing smithy's that make both objects and parts, some of which are plenty good and for prices at which most of us can't hope to compete. So where does that leave us? If efficiency and precision are our goals, it looks like we're doomed to living history. The goals of uniformity and precision are ultimately a race against technology, and a race we are bound to lose.

Another thing is that when we look back at that old work filled with lumpy scrolls and tapers, disorder is not what we see. Instead, it holds our interest. After we awe over the sheer amount of labor and skill, that work holds our interest because it shows the hand that made it. Maybe because our eyes and brains realize subconsciously there is still more to see. And maybe that's an answer both as to why we shouldn't see our doom in those catalogs and how we'll survive again. More than survive, maybe one way that blacksmiths will continue to inject elements of beauty into the lives of our contemporaries might be by relaxing a little with the jigs and micrometers. In the end, what we share is a remarkably simple and somewhat brutal process, often better suited to making things work than making them uniform.

I certainly don't mean that we should contrive to make our work less skilled, or that we should abandon the tools that we've gained over the centuries. Some precision is necessary and the better we are at getting it, the better the project will go. We know that parts has to get to these two or three or five points. Some precision is desirable. It can give our work a sense of formality or austerity, but it can also sterilize our work. As a habit it can lead us straight to the parts catalog. As a goal, it can lead straight to obsolescence. How much is too much? Who can say, but it is something to think about. Try calibrating the eyecrometer instead of letting the ruler tell you when the part is right. It'll make you a better smith, and you'll be doing one thing that no technology will ever be able to imitate.

Chris Winterstein, ABANA President

Tom Clark Wins Bealer Award

Tom Clark was honored with the Alex Bealer Award in recognition of his many contributions to ABANA and to blacksmithing.

Tom reportedly says that this means more to him than all his first-place motorcycle racing trophies because this cannot be won--it has to be earned.

Tom is widely known as blacksmithing's "Energizer Bunny" and has been the unstoppable force behind numberless Iron-in-the-hat fundraisers at BAM and at ABANA conferences. Tom has been a leading demonstrator, is the founder of the Ozark School and the BAM Ozark Conference and has created a line of high-quality blacksmith tools.

The Bealer is given annually and is ABANA's highest award.
More About Hammer Corners

Frank Turley, Santa Fe, NM

Walt Hull mentioned my name (in the Hammer's Blow, Vol 16, #1) in connection with drawing metal with the hammer face corner (edge). I don't want to beat a dead horse, but I never used square-faced hammers. That probably dates from my horsehoeing days, but lots of American manufacturers put round faces on their forging hammers by chamfering the corners of the square stock. I understand the idea of canting a square hammer face for drawing, but I don't do it.

Walt may have seen me use the round hammer face edge as a top fuller while using the far anvil radius edge as a bottom fuller. I fuller top and bottom on the stock's edge this way. The workpiece is lifted 45 degrees over the radius, and the hammer blow is nearly like a regular one, except the hammer is pulled toward the operator at the last. I find it easier to do this with a round face than a square one, because you can catch it without worrying about which way the hammer haft is pointing. It takes practice.

Frank Turley
Director, Turley Forge Blacksmithing School

And a Response from Kevin Peffers

Burlington, Ontario

I am happy to see that my original letter (Hammer's Blow, Vol 15, #3) calling attention to forging with the edge of the hammer face has sparked discussion. Both Jymn Hoffman and Walt Hull make valid points, but some stray from the issue I had raised. As Jymn said, it is hard to convey all of one's points in an article or a short letter.

The issue I have when forging with the edge of the hammer face comes from the relationship between the hammer's center of mass, the direction of hammer travel, and the point of impact between the hammer and the work piece. I hope some diagrams will help explain this relationship, and thus the concern I have.

Fig. A: This is the 'ideal' case when using the edge of the hammer. Note the direction of the hammer lines up with the center of mass and the point of impact. In this case there will be no torque applied to the hammer and no rotation will occur.

Fig. B: With a slight change in the angle of the hammer face, you will see that the hammer's direction line does not line up with the point of impact. These un-aligned forces will create a torque that will cause the hammer to rotate. Finding the correct degree to angle the hammer face is dependent on each hammer's center of mass location and thus on its geometry.

Fig. C: If you change the direction of the hammer blow, you can even make the situation worse.

Fig. D: In my opinion, it is still best to use the edge of the anvil to start a geometry like the one sketched out by Walt Hull. By doing this you gain two advantages: one, you eliminate the possibility of hammer rotation, and two, you get much better accuracy in the placement of the geometry. Once your tapered face is started, then you can flip your work piece over and work it with your hammer on an angle, but with the face of the hammer (see Fig. F).

Fig. E & F: I would agree with Francis Whitaker's quote, "Tip the hammer face to form tapers..." I don't know the rest of the quote, but as you can see in these figures, you do not have to use the edge of the hammer when it is tipped while forging tapers.

Fig. G: Of course using a loose grip, which I agree is a good thing, will allow the handle to rotate slightly in one's hand. The problem is not only the rotation of the hammer, which is centered about the center of mass, but the translation of the hammer handle to one side due to that rotation. Of course this is exaggerated in this figure to show what I am describing. This slight translation happens very quickly, and is perpendicular to the original motion of the arm during the downward strike. It is this type of small, quick, jerky, change-of-direction motion that, if repeated over and over, can lead to muscle, tendon, and tendonsheathing injury.

Alfred Habermann, 1931-2008

Alfred Habermann, one of the most influential art masters of 20th-century blacksmithing died on April 28, 2008. The "Pope of the forge," as Habermann was affectionately called, died shortly before his 78th birthday. Habermann travelled the globe promoting blacksmithing and the forging arts. He influenced scores of blacksmiths in the art of modern metal design.

The international family of blacksmiths and the historical blacksmithing town of Ybbsitz loses with him an artist of visionary view and almost infinite creative force.

Learn more about Alfred Habermann in the next Anvil's Ring.
SHOP TIPS

Power Hammer Spring Guards

Judson Yaggy, Bristol, Vermont

When a power hammer spring breaks it can be very dangerous. Even if you have a mesh guard and are wearing safety glasses, a very small piece is still all it takes to injure an eye. To help contain flying bits, slip a length of large truck radiator hose of similar interior diameter and cut to length over your hammer spring. The hose, available at most auto parts stores, flexes and doesn’t impede the spring, but it’s tough enough to add another layer of protection to the system. Other parts can still break, so don’t rely just on a spring guard. See photo. (Outer guard removed for clarity.)

Addendum to “Care of Your Forging Hammer”

Wayne Coe, Sunbright, Tennessee

I was recently demonstrating the re-forging of a Swedish hammer for a local group. When I do this in my shop I use an eight-inch post vise and have no trouble getting it tight enough to hold the hammer in place. However, at this demonstration, using a five-inch vise, no matter how much we tried to tighten the jaws, the hammer kept slipping down as I attempted to re-forge it. When I got home I made this tool using two pieces of angle iron and a piece of quarter-inch plate. I used scrap that I had around but think that lighter-weight angle iron would be better because it would spring easier, allowing the hammer to be gripped. In use, the tool face or pien rests on the bottom plate, preventing the hammer from slipping down.

Before I was able to inform Brian of this addition to the article, my Blow arrived with the article therein… thus this addendum.
I received this book in anticipation of additional tool-making techniques beyond those by authors such as Larson (Tool Making for Woodworkers, by Ray Larson, 1997) and Weygers (The Complete Modern Blacksmith, Alex Weygers, 1997). What I found, although done well, was a repetition of techniques from a slightly different viewpoint. The author, Mike Burton, seemed interested in making tools using readily available scrap steel. Although he did comment on tool steel (mostly water-hardening and oil-hardening) and had many tips concerning what steels to use for various tools, his major enjoyment occurred when he could make a good tool and not have to resort to commercially available tool steel.

This book, while it has some blacksmithing content and some nice pictures of work in progress, is about the making of tools. The author provides alternatives to traditional blacksmith processes. For example, he uses a torch much more than a forge.

He describes several fuel options for those torches. One item that he doesn’t mention is a gas forge, but does mention charcoal, coal and coke as fuels. He has a chapter on “Tool Making Without Blacksmithing.” Another chapter is “Simple Blacksmithing Techniques.” The author deals with heat-treating and with sharpening of tools in other chapters.

I found this book exposed me to some new ideas, and caused me to re-examine old ideas from a different viewpoint. It revealed how a woodworker thinks about their tools. While I have made woodworking tools, I am not a woodworker and some of the impressions I have gleaned from this book may help me make better tools in the future.

The book consists of nine chapters followed by five projects. I was pleased that one of the chapters dealt with safety. In the chapter on heat treating, he covers the juicy apple quench. His projects start simply and uses concrete nails, drill rod, and saw blades. All in all, this book would be helpful for a person with a knowledge of tools but little blacksmithing knowledge. If you are into woodworking and making your own tools, this book is for you. If you are not, it’s still nice to read and see the processes the author goes through to get there.

You may have seen Alfred Habermann. At ABANA conferences, he was the big, bearded German blacksmith who usually directs the forging of very large, “modern-art-looking” pieces at the European tents. Other smiths treated Professor Habermann like a blacksmithing god. But gods don’t die, and unfortunately Alfred is no longer with us, so perhaps he is better described as a blacksmithing legend.

Habermann’s “sharpened view for the simple things” has influenced our entire generation of blacksmiths, even those of us who do not know his name. A traditionally trained European smith, Habermann refused to abide by the restrictions of traditional designs and instead went on to create an entire body of work that uses traditional smithing techniques to build completely new forms. He is the modern master of frehand design. When you see iron with heavy textures and spikes or flares projecting off into space— that is the influence of Habermann. When you see the plasticity of big iron worked to its maximum under the power hammer— once again, that is Habermann. You may not know who he is, but you will recognize “that look” when you see his work.

This book about Alfred Habermann is mainly a picture book. The first few pages detail, in both German and English, a bit of the history and philosophy of his works, but, for the most part, this book is about showing the work itself. Fortunately, his work is well documented and there are dozens of excellent black and white photographs of his major works. An additional treat is the occasional inclusion of Habermann’s original drawings of the work.

Read this book for the perspective it will give you on “modern art” in blacksmithing and next time you are forging on the big hammer, you might recognize where those crazy ideas come from.
Forging Tongs- Part Two

Lesson 22B- Drawing the Reins, Assembly and Adjustment
Text By Jay Close
Photos by Jane Gulden and Jay Close
Drawings by Tom Latané

Lesson 22B- Drawing the Reins, Assembly, and Adjustment

Step Six (drawing the reins):

There will be about 2 inches or 2 1/2 inches of unworked bar left before the layout mark you made in Step One. Photo 15 shows the bar, the forged jaw and pivot bolster with punched hole along with the unworked bar left to form the reins.

Ideally, the jaw and pivot bolster are in their final form and there should be little reason to reheat them. Efficient forging technique dictates that the reins be drawn out sequentially, working from the bolster to your cut-off mark, finishing each section before moving to the next.

We are forging tongs without using tongs, so heat transfer to the holding hand may be an issue. A longer starting bar can overcome this, but too long a bar can be awkward. A gloved hand is an option, but this too has drawbacks (see note below regarding the gloved hand). Regular cooling of the bar in the slack tub is also a useful strategy.

Another technique that can be used is to forge a "heat stop." When an abrupt change in the bar mass exists and the heat is transferring from the smaller mass to the larger, the heat transfer will be dramatically slowed at the juncture of the two masses. We can use this to good effect in forging these tongs.

Take a yellow heat on the area near the layout mark. Set the bar on the near rounded edge of the anvil with the layout mark about a half-inch from that edge. See Drawing 6. Keep the work as horizontal as possible. Forge a shoulder here on two adjacent flats of the bar.

Hit the bar with half-faced hammer blows driving it into the rounded corner of the anvil. Rotate the bar 90 degrees—left or right, it does not matter—and forge in a shoulder adjacent to the first. Work back and forth between the two shoulders using the "hit turn, hit turn" rhythm you learned when drawing a taper.

Work these two shoulders until the bar is reduced to about half of its original dimension or 5/16 inch square at the shoulder. Photo 16 shows the result.

**Target:** Take no more than two heats to reduce the bar to 5/16" square at the shoulder.

You have dramatically reduced the bar mass at the adjacent shoulders. This should help reduce heat transfer to your holding hand.

You have also established a target dimension on the small end of the reins. With the pivot bolster forged to final form and the small end target dimension established, the drawing down of the reins becomes a matter of working the mass in the middle into final form.

Move to the horn and draw the rein striving for an even taper in width from the bolster at about 5/8 inch wide to the adjacent shoulders at about 5/16 inch wide. Retain the bar thickness of about 5/16 inch from the bolster to the shoulders.

Use the horn to accomplish 90% of the mass reduction and then move to the anvil face to refine the shape and surfaces. Even using the horn to best effect, expect to take several heats to draw down the mass of the rein. (Photo 17)

Once the mass in the middle of the rein is reduced over the horn and the rein has begun to stretch, you should re-establish the linear and sequential approach to drawing down: work a short section complete in each heat; rough it on the horn and finish on the anvil face; work down the length of the rein, finishing the area near the "heat stop" last. Compare Photos 17 and 18.

**Photo 16.**

**Photos 17 and 18.**

Photo 19 shows the reins drawn and the shape refined.

At the end of your heat cut the bar free on the hot hardy (Photo 20).

The shape is shown in Photo 21 compared to a finished forging.

**Step Seven (finishing the reins):**

The tong blank should be at least 12 inches overall. With care this is enough length to hold the jaw in the hand while finishing. The faster you work the less heat transfer there will be, but if the jaw gets uncomfortable to hold, cool it in the slack tub.

As the bar heats in the forge, keeping a sopping wet rag on the end you want to hold is another strategy to help maintain a bar cool to the touch.

**Hint:** A point of preference, many smiths work with a gloved left hand which allows them to hold a workpiece that might otherwise be too hot to handle. The drawback to this practice is that...
it can instill the habit of grabbing a bar without first testing for radiant heat. Tongs are designed for holding hot bar. Otherwise, keep the bar cool to the touch.

With a yellow heat on the end of the bar, draw the remainder of the 5/8-inch square stock. Continue the taper from the bolster to the end.

To keep a cold shut from developing, your first hammer blows on each shoulder should hit at an angle. This pushes the upper edge of the shoulder forward toward the end of the rein. Photo 22 shows the shoulders being struck this way.

Note (forging dynamic): The forged material will move in the path of least resistance. When striking straight down on a corner, the path of least resistance is into the open air. The corner flows out. If that corner is the top of a shoulder being forged flat, the outward flow can result in a cold shut as illustrated in Drawing 7. Avoid this by first hitting the corner at an angle.

Forge the end of the rein to 5/16 inch square using the horn to accomplish most of the forging (Photo 23).

Round the square section end of the rein. It should look like Photo 24 with at least 3 inches of the rein rounded in section for a comfortable grip. See previous lessons on the proper rounding technique.

The tong blank should look like Photo 25 and measure at least 12 to 13 inches from the center of the pivot hole to end of the rein.

If needed, adjust the jaw on the anvil so that it is parallel to the rein. We will alter that in fitting to a specific bar thickness, but parallel is a good place to start. Drawing 8.

Step Eight (the other half):

If you began with a 5/8-inch square bar 24 inches long, 18 1/2 inches of it remains after cutting away the first tong half.

Keeping the held end cool, repeat the above eight steps forging the second half of the tongs.

Step Nine (assembly):

Match the tong halves for length of the reins measuring from the center of the pivot hole. Match for the width and thickness of the jaw. It may require reheating one or both of these tong halves to make needed adjustments. Once assembled, changes are awkward.

Assure yourself that the halves accurately mate with the punched holes aligned. Sometimes the bottom of the shoulder at the base of the jaw needs to be filed so the halves lie flat to each other. This is the “web” mentioned in Step Four. Photo 26 shows the problem area corrected.
CONTROLLED HAND FORGING

Use a convenient length of 5/16 inch diameter bar for the rivet. It should be an easy sliding fit in the two pivot holes. If not, slightly forge the rivet stock smaller in diameter or open the pivot holes by re-drifting (they may have distorted in completing the jaw blank) or by filing with a round file.

At light orange heat cut a ring around the bar on the hot hardy 1-1/4 inches from the end so that it is almost severed. See Photo 27. A set of dividers with this distance between the points makes a useful reference. This length of stock will allow a bit more than the equivalent of one diameter length of the stock to extend on either side of the join.

Reference Drawing 9. Keeping the rivet stock attached to the end of the bar provides a handle for the next heat.

Take a light orange to yellow heat on the rivet. Holding the tong halves in their proper orientation, insert the rivet and twist off the excess stock, setting it aside.

Work quickly with the peen of your forging hammer to spread the rivet on one end. Flip the assembly to address the other end in the same way. Keep the tongs properly aligned and the inside surfaces of the pivot bolsters in contact.

Make sure that the amount of rivet on either side of the joint is approximately equal. Make needed corrections by placing the short side into a thick bolster block or into the pritchel hole and tapping the long side down to match. See Drawing 10.

Switch to the face of the hammer and flip the tong again. Forge down the edges of the peened end. Angle your hammer to make a short pyramid shape like Photo 28 on one side, then flip to develop it on the other end.

Turning back to the initial end (which will have lost its peak), work around the circumference of the head, forging the edges down. Repeat on the other side.

You can continue to work opposite ends of the rivet this way as long as there is visible heat in the material. Once that visible heat has been lost, stop forging. The steel will be most prone to cracking at this temperature.

Photo 29 shows the assembled tongs.

Hint: If the rivet is not sufficiently headed on this one heat, you can work the head once it has cooled to room temperature. If you feel it necessary to take an additional heat to finish, do so with the following caution: heating in the forge it will be impossible to heat the rivet without also heating and softening the bolster around it. In re-heading, if you hit straight down on the rivet you will upset it through its entire length. It will quickly shorten as the hole surrounding it will widen to accommodate the rivet's increased girth. Worked to an extreme, you can forge the rivet flush with an ever-expanding bolster and no rivet head. Consequently, when taking a second heading heat, only work the edges of the rivet head, angling your hammer and drawing the edges down to the bolster surface.

Note: Some smiths use a round-faced hammer for heading rivets in this way or a ball peen. Both can be effective, but the job can be accomplished well with the regular cross-peen forging hammer too.

Step Ten (freeing the jaws):

Likely you have riveted the tongs tightly together so they will not move. Free the jaws by putting the pivot area of the tongs in the forge fire and heating to a bright red or orange heat. Pull them from the fire and work the reins open and closed through their full range of movement. Keep moving them as the tongs cool to well below red.

Make sure the tongs do not distort while doing this.

Hold the tongs horizontally as if gripping a bar. The tongs should fall open when the fingers release the bottom rein. There should be no sticking or tight spots. If this is not the case, they may need another round of heating and working.

Step Eleven (adjustment):

These tongs can be sized to hold anything from sheet to a bar about 1/2 inch thick. Above 1/2 inch thick usually requires a slightly different setup for the jaws.

HAMMER'S BLOW
CONTROLLED HAND FORGING

We will size these tongs to hold 1/4 inch thick flat bar.
Select a short piece of 1/4 inch thick scrap bar as the “sizer.” Three or four inches long is plenty.
Heat the jaws of the tongs to an orange heat and grab the sizer bar in the tongs. There ought to be enough grabbing effect even with the heated jaws to accomplish this.
Place the jaws on the anvil and forge them to fit with careful hammer blows. Work both jaws equally so they are pushed into full-length contact with the sizer bar.
If a post vise is available, it can be used to squeeze the jaws to the sizing bar. Photo 30.
Photo 31 shows fitted tong jaws, with each jaw making full contact with the bar.
In a similar fashion, the reins can be adjusted to a comfortable hand hold. Small adjustments can easily be done cold on the anvil. Greater change is best done at heat.
This is mostly a matter of changing the angle the reins make where they intersect the pivot bolster. Small changes there will cause significant changes in distance between the two reins where they are held.
A red heat on the area where the reins meet the bolster is usually sufficient, but creativity is often called for, holding the assembled tongs on the anvil to effect the needed alteration.
If you have adjusted the reins on the anvil, you will probably also need to recheck their fit to the sizer bar.
A post vise can ease the task of rein adjustment. Heat the reins where they meet the bolster and then put the sizer bar in place. Hold the jaws and sizer bar in the vise as illustrated in Photo 30 and manually adjust the reins for comfort and symmetry.

Targets:
It is most important that the two halves of the tongs match. The measurements shown in Drawing One are a good guide. Following the method outlined you should be able to match the dimensions of one tong half to the other to within plus or minus 1/8 inch in linear dimensions. Widths and thicknesses can be forged to within plus or minus 1/16 inch.
Plan on a heat each for the three shoulders needed for the jaws and pivot bolster.
Use one heat to punch and drift the pivot hole. That hole should be centered in the area of the pivot bolster.
Drawing down the reins may take several heats. From the point that the bolster is punched and drifted, use no more than ten heats to produce a ready-to-assemble tong half.
The tongs should tightly grip the bar they were sized to fit, in this case 1/4-inch-thick flat bar. Hold the “sizer” bar in the tongs and the free hand should not be able to easily dislodge the bar from the tong grip.
The joint should work freely without sticking. With the tongs horizontal, as if holding a bar, the bottom rein should fall completely open without sticking when it is released by the fingers. The reins should be a comfortable distance apart when holding the appropriate dimension bar stock.
The reins should be symmetrical, virtual duplicates of each other.

Further Steps:
Now that you can make tongs, having tongs opens up two more effective approaches to their forging.
1. The first alternative is to proceed as outlined above through Step Five (punching of the pivot hole). At that point cut the forging free at the layout mark. Then use tongs to hold the jaw while the rein is drawn down. Try to organize your forging in a sequential manner. Heat a small section to yellow and draw it on the horn of the anvil. Finish the shape on the anvil face to final dimension then move to the next section.
2. The second alternative forge welds round stock onto the jaw blank using a drop-tong scarf weld. This, of course, saves the effort of drawing down the reins. Review the prior lessons on forge-welding.
Less than 3 inches of the 5/8 inch square stock will be needed for each jaw. About 9 inches of round stock 3/8 inch in diameter is about right for each rein.
After forging the third shoulder and drawing a bit of the transition to the reins, leave the bar about 5/16-inch square on the end and forge a scarf. Note that the scarf must be oriented so that the jaw blank will lie on the anvil face for the weld.
Upset the round stock (the vise and a light hammer is useful for this) and forge it to about 5/16-inch square on the upset end and provide it with a scarf.
The drop-tong weld proceeds in the normal fashion. After the two parts are joined, forge the area at the weld into a smooth transition from rectangular section to round section. Finally punch and drift the pivot hole.
A refinement of the welding procedure is to weld one jaw section to a round about 18 inches long, enough for two reins. Then weld the second jaw to the other end of the round and cut the two halves free before assembly.

Acknowledgments:
Photos by the author and by Jane Gulden. Thanks to the American College of the Building Arts.

Photo 30 and 31.

Photo 32. Alternate jaw shapes.
Keep It Simple, Make It Elegant Part II

Variations on a Theme

by James A. (Jymm) Hoffman

Pittsburgh Area Artist Blacksmith Association

A friend was trying to make a more complicated chandelier when I suggested he try one similar to the one shown here. This four-candle chandelier was influenced by a chandelier in a museum that has more complicated candle holders forged out of the arms without any sort of cups to catch wax. Changes were made to protect the innocent and this has simpler elements to make. This will work well in a two-candle version.

Materials for one version:
2 pieces 1/4" X 3/4" X 10"
1 piece of 3/8" square X 18"
8 pieces of 1/4" round X 6"
4 pieces of 16-gauge sheet, @
2 1/2" X 2 3/8"
16 gauge sheet discs @
3 1/4" diameter
4 Rivets 3/16" to 1/4" diameter by 1/2" long

I started with the arms of the chandelier, first putting a center punch mark in the center of the flat side of a piece of 1/4" x 3/4" steel. Then I forged a taper on one arm from about an inch away from the center punch out to the end. Once I was satisfied with the taper, I set it off to the side of my anvil as a gauge for the other arm. I forged a similar taper on the other arm.

The next step was to turn the one arm around and repeat the taper to get both ends tapered the same from the center punch. Next is to take the first bar and repeat the taper.

Now it is time to punch a hole in the center of each arm, then shoulder, round finials with the rivet holes on the ends of the arms. Set these aside to air cool.

The next part I like to make is the vertical bar. First step is to scarf one end of the bar. About 1/2" from the scarf, round about 5 inches of the bar that will become the eye loop. Put two bends in the bar in the same direction. One bend is just past the scarf, the other where the rounding of the square bar stops. To make an eye loop on the end of a bar in which the center of the loop is to lie in line with the center of the shaft, put the bend in before making the loop. This makes a much nicer looking eye than trying to bend it after making the loop. Align the two bends and forge-weld together.

Forging progress- Setup for the forge weld- left, scarfed and pre-bent. Right shows the eye bent, centered, and ready to weld.

Once the forge weld is completed and dressed up, twist about 5 inches of the bar about 5 inches from the loop. I like to straighten twists by gently squeezing them in a vise. Then forge a tenon on the end of the shaft.

The center shaft completed

Next is the chain. In this case I made a chain of 7 loops made from 1/4 inch round stock 6 inches long. Make two links, joining with a third. Make another set of three and join with another link. This is what I refer to kids at demonstrations as chain math. 1+1=3, 3+3=7.

The chain is attached to the chandelier shaft with a ring made from the remaining 1/4 inch round by 6-inch long piece and is not welded. The ends are butted together.

Forging progression for the arms- left, tapered on one side, center, both sides tapered, and right, ends flattened and punched.

Left, preparing to weld two sections of chain. Right, the connecting ring is not welded.
Moving right along to the candle holders and wax catchers, I used the 2 1/2" X 2 3/8" 16-gauge sheet for these. The bottom of the holder is approximately 3/4" round on center. Once cut out, drill the hole for the rivet. I formed the candle cups by first bending over about 1/2" of the top edge. This gives a smoother, reinforced edge to the cup. Then form the rest of the cup in a pair of tongs I modified similar to Phil Travis' candle cup pliers shown on the PAABA web site. (http://paaba.net/Projects.htm

The wax catcher disks are first dished out as you would a ladle, then flattened— a trick I learned making flat-bottom frying pans. I used a 2 1/4" round bar to dress up the flat, but it can be done simply on the anvil if you don’t have a bar the right size.

Once all the parts are made, it is time to do the final assembly. I like to use a 3/4" bar in the vise, long enough to sit on the screw, to rivet the candle holder, wax catcher and arms together. Once the candle holders are attached to the arms, the tenon on the vertical shaft is heated up and peened over while hot. Below are some variations of vertical bars that would also look nice for this project. When increasing from 3/8" to 1/2" for the vertical, I recommend also increasing the size of the arms from 1/4" X 3/4" X 10" to 1/4" X 1" X 12" and the wax catcher cups to 4" disks.

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Spring 2008
3D Design for Artistic Blacksmithing

by Terry Ross

Austin, Texas

Blacksmiths enjoy adopting new tools and technologies. Contemporary smiths with a high-tech bent can use 3D drawing software to help in the design and fabrication of their projects. Having digital designs enables smiths to communicate and coordinate more easily with clients and co-contractors than they can using pencil and paper.

SketchUp®, available for free from Google®, is a 3D drawing package that I have been using to create full-scale working drawings. SketchUp® is widely used by architects. It is popular because it is easier to use than CAD. In general terms, SketchUp® is visualization oriented whereas CAD is engineering oriented.

To increase the usefulness of SketchUp® to blacksmiths, I have programmed three plug-ins (extensions) for SketchUp®. The plug-ins are Taper Maker, Curve Maker and Stock Maker. You can download these plug-ins free of charge from my website: www.drawmetal.com.

How can you use SketchUp® in metalwork design? Despite its name, you probably will not use SketchUp® to capture initial design ideas. Hand sketching with pencil and paper is still the quickest and easiest way to record your thoughts. Going from a hand sketch to working drawings is where SketchUp® comes in. The hand sketch in Figure 1 evolved into the SketchUp® design in Figure 2 which yielded working drawings for fabricating the stair railing shown in Figure 3.

![Figure 1. A hand sketch.](image)

©2006 Hammerfest Forge—Used with permission.

![Figure 2. Design in SketchUp®.](image)

![Figure 3. Stair rail fabricated by Hammerfest Forge.](image)

Here’s one way to create a metalwork design in SketchUp®. Let’s suppose you envision a curved tapered element in your design like the one shown in Figure 4 below.

![Figure 4. What you envision.](image)
To draw your element in SketchUp®, you must first imagine the center line that runs from end to end through your finished element and draw that line. SketchUp® provides a variety of line-drawing tools ranging from a freehand tool to a Bezier curve tool. (Another option, for drawing mathematically precise curves and spirals, is to use the Curve Maker plug-in or the plug-in “tools.”) In any event, suppose that you drew the approximately 18 1/2"-long line shown in profile Figure 5.

![Figure 5. Your Center Line.](image)

The second step is for SketchUp® to draw a curved tapered element to your specifications along your center line. To accomplish that, you tell Taper Maker what shape cross-section the taper should have and the dimensions of the cross-section at the beginning and at the end of your center line. For example, telling Taper Maker to draw a rectangular cross-section that is 3/8" x

![Figure 6. left. Profile view of taper. Figure 7. right. Isometric view of taper drawn by Taper Maker.](image)

3/4" at one end of your center line and 3/16" x 3/4" at the other end will result in taper shape shown in profile in Figure 6 and shown in an isometric view in Figure 7.

If you don’t like the way the tapered element looks, you can simply erase what Taper Maker drew and tell it to draw it again using a different cross-section and/or different dimensions. Figure 8 shows isometric views of several alternative tapers you might consider.

Taper Maker will draw tapers with round, square, diamond, rectangular, hexagonal or octagonal cross-sections. The lines you draw do not have to be the centers of tapers. You can tell Taper Maker to draw the taper to the left, right, above or below a line. Figure 9 below depicts several examples.

![Figure 8. Isometric view of alternative tapers.](image)

![Figure 9. Taper Examples.](image)

With Curve Maker you can draw spirals (Bernoulli, golden and Archimedean), sine and cosine waves, and helices. Curve Maker accepts as inputs the dimensions you want the curve to have. For example, Figure 10 illustrates a Bernoulli spiral drawn to two specified dimensions.

![Figure 10. Example of a Bernoulli spiral.](image)

Once you have a taper designed to your satisfaction, you can use Stock Maker to estimate how much stock will be required to make the taper. The first step is to describe the stock you want to use. For example, if you want to fabricate the element in Figure 7 from 1" square stainless steel, you need to tell Stock Maker what alloy you will use (e.g., 304), the cross-section shape (e.g., square), the cross-section dimension (e.g., 1"), and optionally, the weight and cost per unit (e.g., per lineal foot). Once you have given Stock Maker that information, it can compute how much of the stock will be required to fabricate any taper that you have designed. Figure 11 illustrates that approximately 4" of 1" square stock weighing approximately 1.12 pounds and costing

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**ART AND DESIGN**

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Figure 11. Stock requirements for your element.

approximately $6 will be required to fabricate the 18 1/2" taper shown in Figure 7.

Obviously, most designs comprise numerous elements, so Stock Maker can summarize all the materials required for a complete design, the total weight of the design, and the total cost of the materials. Having an accurate estimate of total materials requirements is essential when working with higher-priced materials like non-ferrous or precious metals. Figure 12 provides an example of total stock requirements for a project fabricated from two different alloys and three different stocks.

For more information on SketchUp®, visit the website www.sketchup.com. For more information on the plug-ins and more design examples, please visit my website at www DrawsMetal.com. You can e-mail me at terry@drawmetal.com.

Many thanks to Larry Crawford of Hammerfest Forge (www.hammerfestforge.com/) for permission to include images of his stair railing. SketchUp® is a registered trademark of Google, Inc.

Figure 12. Total stock requirements calculation.

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**August**

6-11 Annual Rocky Mountain Blacksmithing Conference 2008 at the Colorado Rocky Mountain School, Carbondale, CO. Demonstrators: Brent Bailey, Michael Bondi, Corkey Storer, Toby Hickman For more information, contact: Kamber Sokulsky at blackhawk-forge@hotmail.com or John Switzer at switz@mindspring.net.

7-10 7th International Bavarian Festival for Artist Blacksmiths and Metal Designers. Construction and opening of the third "Bridge of Friendship" worldwide, designed by artist blacksmith Michael Erdmeier, in memory of Manfred Bredohl (continuing the Memphis project - see Anvil Ring, Fall 2007) Forge-ins, workshops, lessons, festival program, music, Bavarian beer, etc. More information available on www.metall-aktiv.de. In conjunction with the blacksmiths festival- 5th World Congress of Damascene Steel. For more information see www.damaszener.de (application forms and information also available there in English).

**September**

4-7 Atlantic Coast Blacksmith Conference – A joint effort by the Northeast Blacksmith Association and other Regional Affiliates. Three days of hot metal featuring demonstrators Mark Aspery, David Norrie and Peter Ross. Numerous presenters, trade show, tailgating, bunkhouse and camping, food on site. To be held at the Ashokan Field Campus, near Kingston, NY. For more information: www.northeastblacksmiths.org or Jonathan Nedbor, 496 Towpath, High Falls, NY 12440.

19-21 The Guild of Metalsmiths Fall Conference (AKA The Madness) Our feature demonstrators this year are Howard Clark (Knives, many of you know who he is) and Mick Maxen from Southern England (dramatic uses of pattern-welded steel in all forms of artist blacksmithing.) We also offer an extensive family activities program, the usual auctions and fellowship. On-site camping is available. Venue is the Log House Antique Power Show south of Hastings, Minnesota. See www.Metalsmith.org for details and www.littleloghouseshow.com for directions.


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