snapped off easily.

Targets:

–You should be able to cut the bar in one heat.
–The cut should be even. No "corkscrewing" or misalignment of cuts.
–The bar should remain straight. –The burr left on the end of the bar should be centered in the cross-section of the bar.

Notes: Some alternatives to nicking the bar on the hardy to mark where the bar is to be cut:

A.) For shorter cuts, you can draw a line on the face of the anvil. The line should indicate the length of bar you wish to cut. Measure from the near side edge of the anvil with chalk, soapstone, or for longer lasting lines, a felt-tip pen. Place the end of the bar even with the chalk line. Use the edge of your hammer face to indicate the line to be cut by lining it up with the edge of the anvil (with the hammer on top of the bar). Now carefully bring the bar and hammer to the hardy. Line the hammer edge up with the cutting edge of the hardy. Apply some downward pressure so the bar does not slide off the mark. Strike solidly and proceed as indicated in the lesson.

Alternate method of holding the short end with tongs to twist the bar.

B.) Some smiths prefer to use a center punch, and others a chisel to mark where bar is to be cut. If using a center punch, make sure the punch mark is deep enough so that you can see it when you bring the glowing bar out from the fire.

C.) For marking cold-rolled or high-carbon steels, use soapstone to mark the cut, then take an initial low heat (bright red). The soapstone mark should still be easily seen at this temperature. Nick the bar, (with a hardy, chisel, or center punch) then reheat to make the final cut as outlined in this lesson.

Controlled Hand Forging Lesson 14

Bending

Text and Photos by Dan Nauman

Lesson #14- Forging a 90-degree corner

Definition: Altering the centerline of a bar.

Intent: To learn how to forge a sharp 90-degree corner while maintaining the parent stock dimensions throughout the bend, and have the resulting two legs measure to a predetermined length.

Tools: Anvil, 16- to 20-ounce cross-peen hammer, center punch, steel square.

Material: 1/2" square x 20" mild steel.

Step One

Note: When producing a bend of this nature you will lose some length, equal to half of the parent stock thickness, on both legs.

Also, when figuring how much metal will be needed for this bend in a project, remember that your measurements should be taken from the center (or mean line) of the bar on your layout, and not from the inside or outside corners.

Our target length for the short leg that will be formed is 3 3/4", and a target length of 15 3/4" for the long leg. With that in mind, measure 4" from the end of the bar, and mark with the center punch.

Step Two

Heat the bar to bright yellow, with the center punch mark centered in the heat.

Note: A short heat for this step will reduce the work in succeeding heats. The length of the heat when initially pulled from the fire will be too long. If this heat is not minimized, the resulting bend will require more effort to achieve your goal.

The bright yellow heat will give you some time to quench the bar. Using a dipping can, quench the bar (with water) down to 1/2" on either side of the center punch mark so that the heated area is confined to about 1 1/2"… ideal for this initial bend.

After you have minimized the heat, make sure the center punch mark is visible on the side of the bar, and position the bar so that the center punch mark is over a 1/8" radius on the far edge of the anvil. Proceed to bend the bar over the edge of the anvil by striking the end of the bar down. Bend the bar so that it is at about a 100-degree angle. (See photo #1)

Notes- Do not use a sharp corner of the anvil or the vise to make the initial bend. This can lead to galling on the inside corner which may lead to forming a shut (overlap) during subsequent steps. A shut in steel can form into a crack, weakening the piece. A shut in wrought iron will cause the leg to fall off.

Our goal is to teach you to make this bend with a minimum of tools. However, some smiths prefer to use the vise to perform a controlled, gentle bend in Step Two (avoiding a gall), and then use it for a brace (or back-up) in succeeding steps. While this practice is not necessarily wrong, it must be noted that it takes precious time to place the piece in the vise. Also, the vise acts as a heat sink, robbing precious heat from the metal. These facts combined reduce your window of time to forge the corner.

Forging dynamics: From bending, the inside corner has now increased in cross-section from compression, and the outside corner has decreased in cross-section from stretching. This excess material on the inside corner can be moved to help replace the loss of material on the outside corner. The next step will help accomplish this task.

1. After the initial bend, the angle should be approximately 100 degrees, as shown here.

2. Position the hammer as shown when cross-peening the corner. Be mindful that you do not reduce the cross-section smaller than that of the parent stock.

3. Stand at the heel of the anvil to forge this form.

4. Vertical blow– note the position of the hammer and the short leg.

Step Three

In the same heat from step two, lay the bar on its side on the anvil so both legs are resting on the face. Using the cross peen of the hammer, carefully forge down the excess material on the inside corner back down to 1/2". The peen should strike the bend, perpendicular to the 50-degree mean angle, so that the metal pushes to the outside corner. The legs themselves will help prevent the metal from flowing into the inside corner. (See photo #2)

Step Four

Heat the bend to bright yellow. Quench the bar to concentrate the heat to 1/2" on each side of the bend.

Note: Your stance at the anvil is important for this step. It will be easier for you to swing the hammer if you position yourself with your shoulders square to the heel of the anvil. (See photo #3)

Place the short leg ten degrees to the right of vertical (ten degrees to the left if you are left handed), with the end down on the face of the anvil. Strike the bar five or six times with hard blows. The blows should be focused so that the hammer face is in the same plane with the long leg, and slightly to the inside of the axis of the short leg. (See photo #4)

In the same heat, position the bar ten degrees to the left (or ten degrees to the right if you are left handed), and redirect your blows with the hammer's face in the same plane as the short leg, and just below the axis of the long leg. (See photo #5)

Proceed to strike the bar with seven to nine blows.

Alternate back and forth from the short leg to the long leg until the metal reaches a dull orange color. Maintain an angle of about 100 degrees. Count your blows as explained above.

Forging dynamics: The reason you strike more blows horizontally is that your hand is not as solid a brace as the anvil is for the vertical blows, thereby requiring more blows to accomplish the same task of moving material

5.Horizontal blow-Note the position of the hammer and the short leg.

towards the corner. Also, using a lighter hammer such as a 16- to 20-ounce hammer minimizes the possibility of forcing too much material to the inside corner of the bend (which could happen when using heavier hammers).

The force delivered by a lighter hammer is expended on the surface of the bar. (See photo #6 of 1.8# hammer vs.1# hammer.)

Step Five

Your work thus far has also increased the cross-section of the bar at the inside corner. As you did in step three, use the peen to simultaneously reduce the cross-section, and push the excess material to the outside corner. Smooth with the face of the hammer. Be careful, as you do not want to reduce the corner to less than the parent stock size.

Step Six

Repeat steps four and five until the outside corner is visibly sharp (no greater than a 1/32" to 1/64" radius).

6. Use a smaller hammer to do this operation. The hammer on the left is a one-pound hammer– a good hammer weight for the task. The hammer on the right is a 1.8 pound hammer which is too heavy for this form.

7. When trueing the angle to 90 degrees, keep the short leg away from the anvil as shown here. Doing so will keep you from reducing the cross-section of the bar beneath the parent stock size.

Note: If the legs begin to bend during any part of these procedures, straighten them at once or the energy from your blows will do more to continue bending the legs, rather than forging the corner.

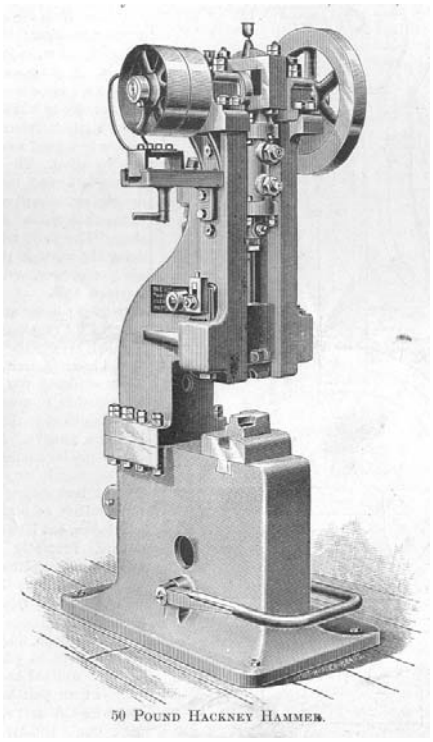
Step Seven

Heat the corner to bright yellow. Quench as in step four. Lay the long leg on top of the anvil. The short leg should point down off the anvil, with the inside corner away from the side of the anvil. With light blows striking horizontally towards the short leg, close the angle of the corner to 90 degrees (See photo #7). The legs can be straightened by lightly tapping on the anvil in any orientation that suits the task. Use the steel square to check your progress. (See photo #8.)

Note: Resist forging down on the bar on the corner of the anvil to achieve the 90-degree bend, or to straighten the legs. What you are trying to do at this point is to bend the bar to 90 degrees, not forge the bar to 90 degrees. Forging down on the legs to achieve the bend will reduce the cross-section of the legs near the corner.

Targets: -The short leg is 3 3/4" long, and the long leg is 15 3/4" long, plus or minus 1/16".
-Both legs lie in the same plane. No twists or bends.
-The stock size remains 1/2" throughout the forging.
-The corner is 90 degrees, with a radius of 1/64" to 1/32" for an outside corner.
- The legs are straight, and do not slope down to the corner.
-The surface of the faces are smooth.
-With practice, the corner should be forged in five to six heats.
-There is no shunt (overlap) on the inside corner.

8. Check your work with a square. Note that the legs are square, but there is a gap near the corner of the long leg, which should be corrected.



REDUCING THE SIZE OF A HOLE

by: Tommy Ward

Here are a couple of tricks for reducing the size of a drilled or punched hole that is found to be slightly larger than desired.

One method is to find a ball bearing with a diameter larger than the hole and drive it against the opening with a hammer to push the metal around the lip into the hole. This technique can be done cold, but may require heating the piece to a forging temperature if more material is to be moved or if the work is particularly hard. Repeat the process on the reverse side.

Another approach is to heat the area around the hole to a bright red and then carefully quench the "bottom" side of the work (the hole should be perpendicular to the water) while leaving the "top" part outside of the water. The submerged area will cool rapidly and shrink somewhat, but the portion of the metal remaining outside of the water will be drawn in more as it slowly air-cools - resulting in the "top" half of the hole being reduced in size. Reheat the piece and repeat the process on the opposite side. I have found it easier to hold the work pre-cisely half-submerged by bending up some coat hanger supports that span my slack tub. Make a couple of dry runs to get things adjusted, and then quenching will be a simple matter of lay-ing the heated material on the hangers that have been preadjusted for the correct depth. If you're really curious about how the shrinkage of the metal can be influenced, play around with the leaving the piece in the water until it cools to room temperature, or taking it out of the wa-ter and allowing it to air-cool after the initial quench.

Both of these techniques work better, of course, on thicker pieces of metal, and with a little practice can reduce the size of a hole by a surprising amount.

Reprinted from January 2017 edition of "The Upset", newsletter of the Mississippi Forge Council

A Better Way To Cool Tools

By Randy Stoltz

Both paraffin wax and beeswax have an excellent ability to absorb and store heat. Additionally both of these substances do not have a melting point, they have a melting range (i.e. they slowly liquefy over a range of temperatures not a single point like water). This makes wax a great medium for cooling punches, chisels, drifts, and other tools used to work hot steel as it will cool and lubricate the tool without the risk of hardening it.

I have used a mixture of paraffin wax, beeswax, and powdered graphite to cool my punches and other tools for some time now and have had very good results. You can use all paraffin or all beeswax but I used a 50 - 50 mix since the paraffin is harder than the beeswax (and I had I several pounds of it sitting around). I added the powdered graphite to improve the lubricating properties of the mixture. Graphite is a high pressure high temperature lubricant often used on dies or presses. It works very well on drifts to keep them from sticking. You can also use molybdenum disulfide powder for extreme lubricating applications but it usually costs a lot more.

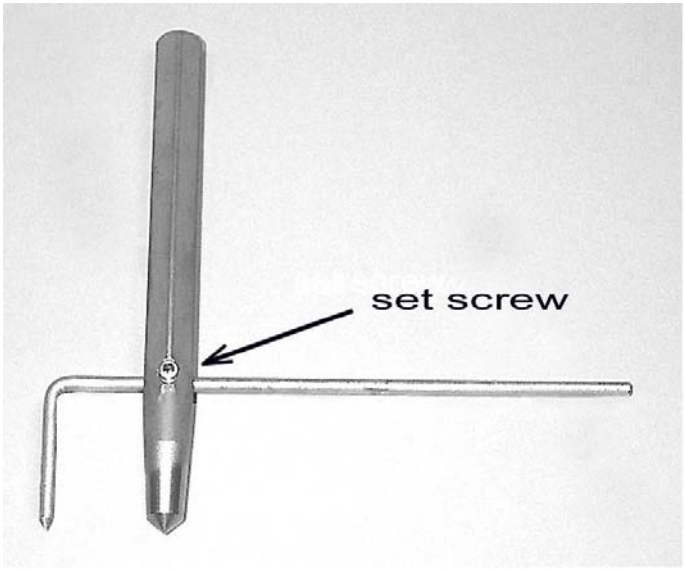
To make the mixture, I add one tube of the powdered graphite (.21 oz / 6 grams) to 2 cups of melted wax and pour it into a metal cup. Note that wax expands 5-10 percent when heated so leave some room in the cup. Here is some additional technical information. Paraffin wax is part of a family of hydrocarbon compounds known as alkanes with the general formula of nH2n+2 that are solid at room temperature. Paraffin that is liquid at room temperature is known as mineral oil. Beeswax is not a single compound but is a mixture of several compounds with the base compound very similar to paraffin. Both paraffin and beeswax are solid at room temperature and have a flashpoint of 400° F. The melting range of paraffin wax varies with the exact compound but can be classified as: low (125° F - 135° F), medium (135° F - 145° F), And high (150° F - 165° F). Beeswax has a melting range of 144° F - 147° F.

Reprinted from The Anvil's Horn, January 2011.

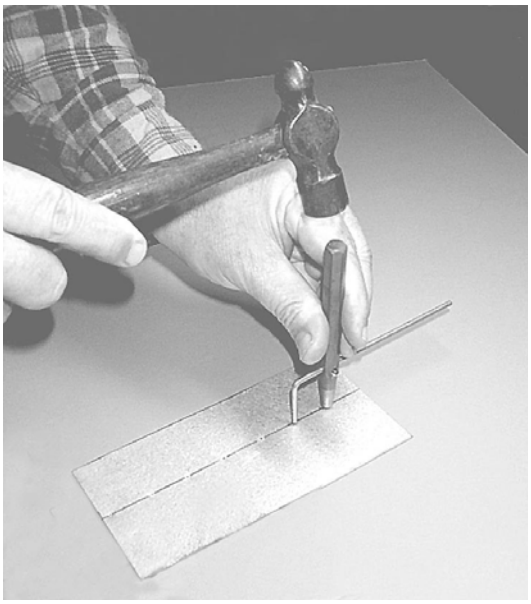
A SELF-MEASURING CENTER PUNCH

by Tommy Ward

From time to time I've had to drill a succession of equally and accurately spaced holes. Although laying out the hole spacing can be done fairly quickly using a transfer compass, the positioning of the compass points, scribe marks, and ultimately the point of the center punch itself, each present the opportunity for a slight error (particularly with my aging eyesight). Over a series of holes these small individual errors can "stack up" and result in a significant overall change in dimension. The solution to the problem is a "self-measuring" center punch. This little trick is neither new nor original, and is one I first recall having seen many years ago in an old metal trades manual.



A standard center punch can easily be fashioned into a self-measuring type by drilling a perpendicular hole thru its shank to receive a lateral locating rod. A point is sharpened on one end of a small diameter rod (I used 9/32" piano wire) and the sharpened end is bent ninety degrees to form the locating "leg". Cross-drill and tap the punch shank to accept a setscrew which will be used to lock the adjustment of the locating leg. Although punches are generally regarded as being a fairly tough steel, I had no trouble drilling a pilot hole through mine with an 1/8" dia. TiN coated bit running at 1500 RPM and using a coolant. The dimensions of things are not critical, but care should be taken to insure that the lengths from the cross arm to the tips of the punch and locating leg are identical.



To use the device, set the desired distance between the tip of the punch and the locating leg, lay out a longitudinal reference line on the work, and punch the location of the first hole. Then place the point of the locating leg in the first mark and punch a second mark on the reference line. This sequence continues for the remainder of the layout as the locating point is placed in each successive punch mark, a new mark is punched on the reference line, and the process is repeated as needed.

Reprinted from January 2017 edition of "The Upset", newsletter of the Mississippi Forge Council and the Indiana Blacksmithing Association, the Forge Fire

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Contact : Tim Neu to register for hammer-ins or subscribe to the newsletter;
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