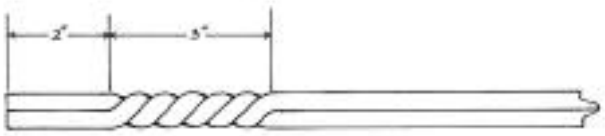
Twisting

By Bob Fredell
Illustrations by Tom Latané



1. The completed twist

Lesson Number Five--Twisting

Definition:

Twisting rotates the bar around its axis.

Intent:

The student will twist a 1/2"square bar one and one-half turns.

2. A Twisting Wrench.

The twist is 3" long and starts 2" from the end of the bar. The finished twist is to be straight and along the same axis as the untwisted portions of the bar. The entire length of the twist is even so that it does not easily show variations in the spaces between the turns. The twist is to be made to dimensions and in one heat.

Tools Needed:

You will need basic tools plus a twisting wrench, divider, container to direct water to parts of the twist and two lightweight bars 6" to 10" long.

3. An alternative type of twisting wrench.

Different types of twisting wrenches may be used. By welding a handle on to a smooth jaw plumbers' wrench an adjustable twisting wrench is made. The traditional "S" shaped twisting wrench may also be used. Experienced blacksmiths are able to use flat-lipped blacksmith tongs. However, beginners using this method run a higher risk of making a crooked twist because when applying the rotational force from only one side of the bar there is a tendency to bend the bar up, down or sideways.

Two light bars to test completeness of the twist.

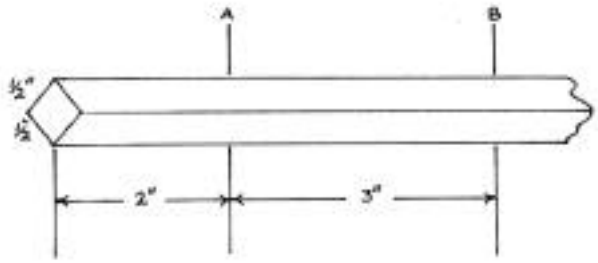
The exact size of these bars is not critical. Bars in the area of 1/4"x 1/2"x10", or slightly shorter, work well. The idea is to use straight, lightweight bars.

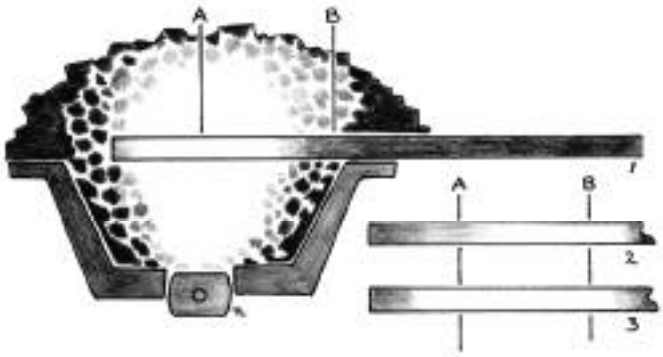
Water container

Use a container of your choice. You may use an old soap squeeze bottle, a tin can with a pinched top or anything else that produces a small, well-controlled stream of water.

Materials:

24" of 1/2" square mild steel





4. Measuring and heating the bar.

Step One:

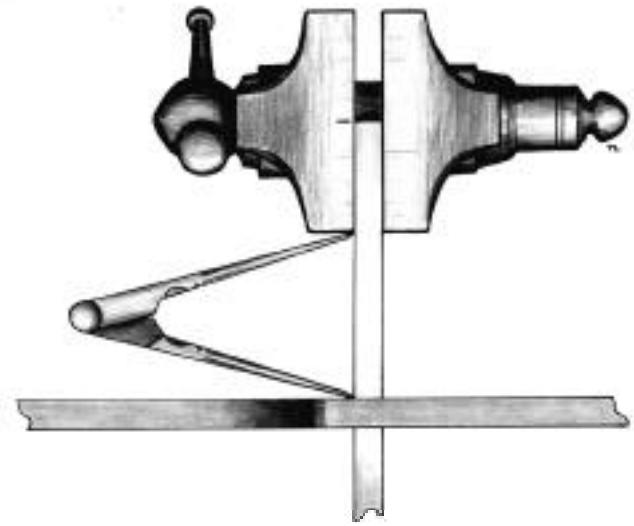
Place the bar in the fire so that 2" from the end of the bar is in the center of the fire and heat to a medium orange heat. Push the bar so that 5" from the end is over the center of the fire and heat to a medium orange heat. This is done to insure that the heat is well beyond the area to be twisted. Withdraw the bar and inspect the temperature. The color of the bar must be exactly the same for at least one inch beyond both directions of the area to

be twisted. Reheat as necessary to achieve a perfectly even heat that is three inches long. The length of this heat will ensure an even twist.

Hints:

An even heat makes for an even twist; an uneven heat makes for an uneven twist… *close* to even doesn't do it!

Do not heat the bar hotter than the recommended temperature because too high of a heat may cause the edges to crack when twisting.



4. Setup for twisting.

Step Two

Place 2" of the bar horizontally in the vise. This may be achieved in several ways. (a) Before heating the bar, center punch 2" from the end. However, this will leave a mark that you may or may not consider unsightly. (b) Place a chalk mark on the vise 2" from the end. This will work only if the twist is to be close to the end of the bar. (c) For twists in the center of a long bar, place a blacksmith's stand or other obstacle on the opposite side of the vise to act as a stop. *Note*—for some applications other than this lesson, the smith may find it useful to place the bar vertically in the vise.

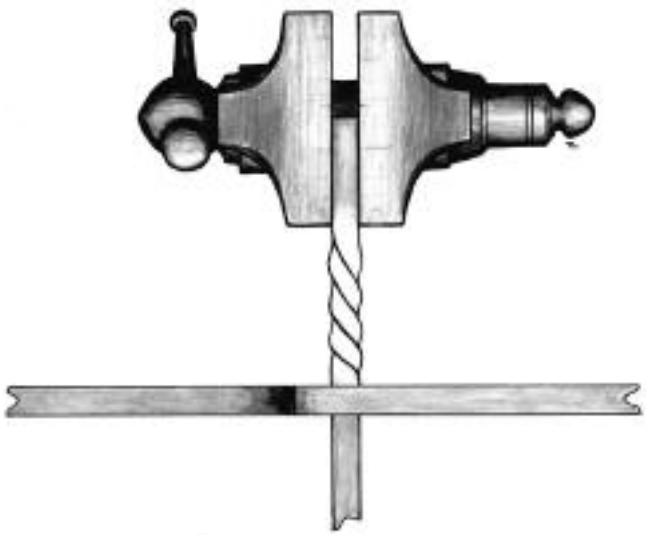
Use the dividers pre-set at 3" to determine the location of the twisting wrench and place the twisting wrench on the bar.

Hints:

When setting down the dividers do not allow the weight of the twisting wrench to rest on the bar as the bar may bend downward.

Step Three:

Twist one turn using even pressure with both hands. The twisting will take place only between the vise and the twisting wrench. Be sure to use gloves to protect your hands from falling scale.



5. Twisting in the vise.

Hints:

Be consciously aware of not bending the bar up, down or sideways, as this will put a bend in the bar.

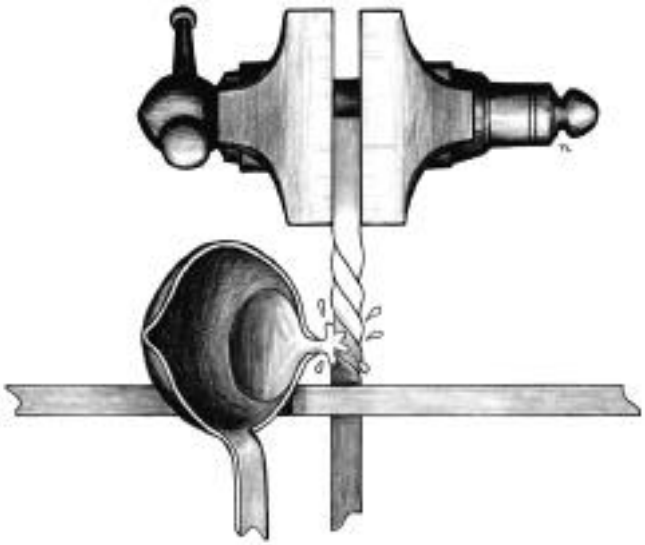
Some twists call for multiple twists in the opposite direction. Always make the first twist in the same direction to avoid forgetting which way to twist. (This may be either clockwise or counter clockwise.) It is well to develop the habit of always twisting in the same direction, except when the design calls for doing otherwise.

Step Four:

Quickly brush off the scale and inspect the twist. If part of the twist is tighter that the rest, cool it with water. Continue twisting to finish with exactly one and one-half turns.

Hints:

You will need some practice to learn how much water to use.



6. Cool tight sections with water.

7. Check the twist to make sure it's straight.

Step Five:

Sight lengthways down the bar; rotate 90 degrees and sight again. The bar, including the twisted and untwisted portions, is to be straight. The bar needs correction if you can detect a bend. Learn to train your eye to see deviations.

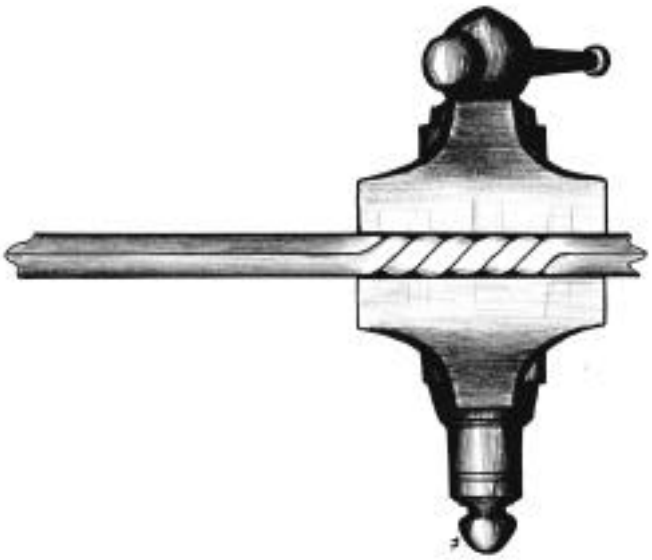
Beginners may need to use the following procedure to check for straightness: Place a straightedge lengthwise along the bar on a corner covering the twist and both untwisted parts. Do this on all four corners. The straightedge is to make contact with the untwisted corners and the corners of the twist.

If the bar is not straight and requires correction, proceed to step #6. If it is straight go to step #7.

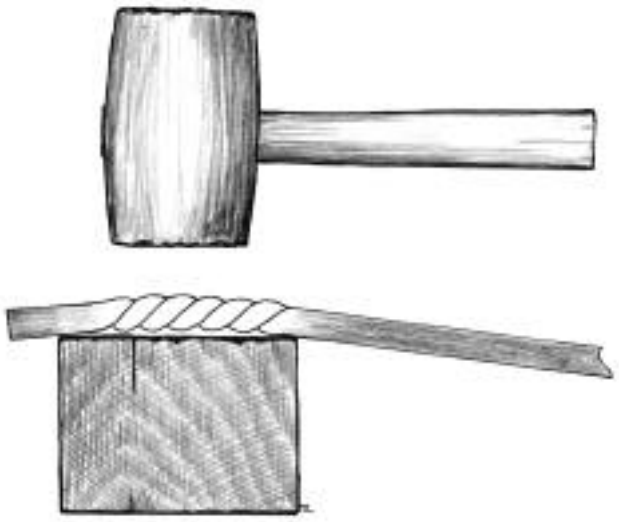
Step Six:

If the bar is simply bent, this may be quickly corrected by placing the twist in the vise on the diamond and gently tighten, rotate to the other diamond and tighten, then repeat this procedure on the flat of the bar. A second method is to place the bar on a block of wood and strike it with a wooden or rawhide mallet. Be sure to use wood to avoid deforming the edges of the twist. Wet the wood to reduce the amount of smoke in your eyes.

Correction may be more difficult if the bar is offset at the junction of the twist and untwisted portion. The block of wood method described above may correct the offset. Or, reheat to an orange heat, quench the twist to protect it and place the twist in the vise at the point of the offset. Strike the bar to move it back into alignment. At the same time apply pressure in the opposite direction at the end of the bar to avoid bending the bar.



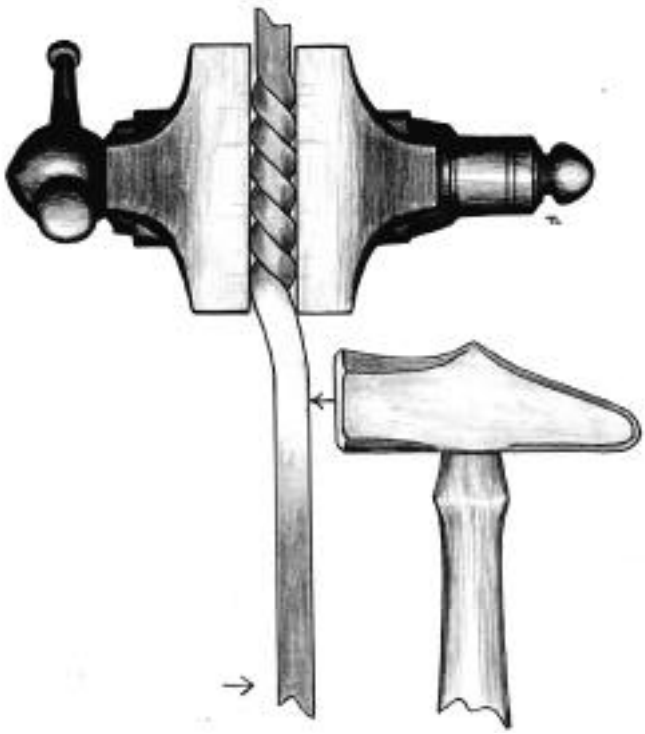
8. Correcting a simple bend.



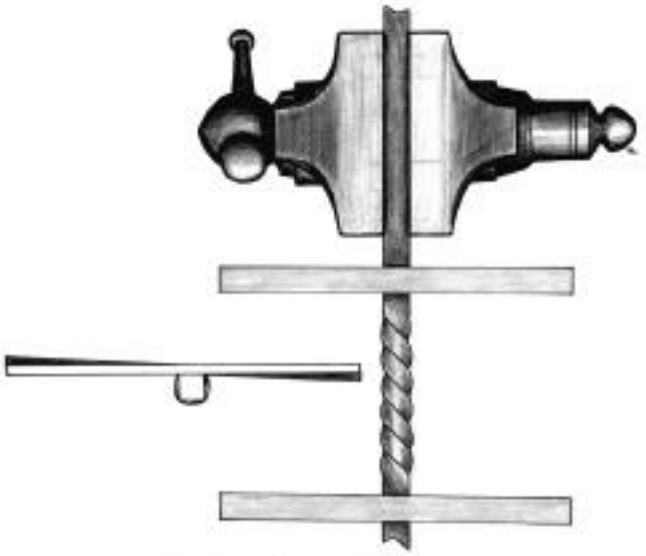
9. Another method for correcting a simple bend.

Hints:

Bends and offsets are most often caused by moving the twisting wrench up, down or sideways or allowing gravity to sag the bar downward when twisting. Be consciously aware of applying even pressure on both handles of the twisting wrench.



10. Correcting an offset bend.



10. Another way to straighten an overbent end.

Step Seven:

To check for exactly one and one half turns, place the twisted bar horizontally in the vise. Lay one of the light bars on the flat, untwisted portion at one end of the twist and at a right angle to the twisted bar. Likewise, lay the other light bar on the other side of the twist. Sight lengthwise down the twisted bar. If the light bars are exactly parallel you have completed this lesson. If they are not exactly parallel the bar is either twisted too much or not enough. Place the twisted bar back in the original position in the vise and adjust. This process may require the twist to be heated.

Targets:

The twist is to be:

1. 3" long and 2" from the end with a deviation no more than 1/16 of an inch.

2. 1 1/2 turns with the leveling bars as described in step #7.

3. No cracked edges.

4. Equal size increments of the turns. The spaces between each corner of the twist are to vary no more than 1/16" as measured lengthwise along the bar. *Note*—the vise and the twisting wrench are heat sinks causing slightly wider turns at the ends.

5. The entire bar is straight. A good test for straightness of the twist is to place a straightedge along the twist and check for contact with each of the corners of the twist. Also, sight lengthwise along the bar—there is to be no detectable crookedness for the entire length of the bar.

6. Complete the twist in one heat.

Forging Dynamics:

The length of the bar remains the same because the axis of the bar does not change. Twisting makes the edges stretch; the flat surfaces remain straight, although they have the appearance of being concave. A cross section of the twist will show the flat surfaces as straight.

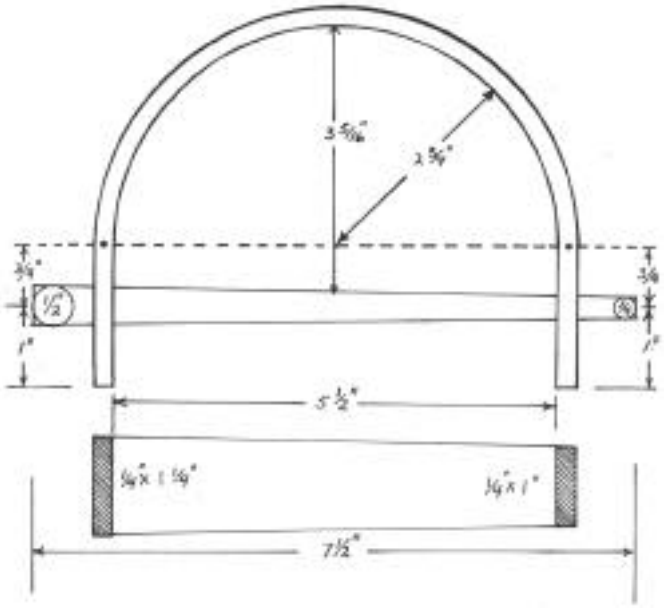
The corner-to-corner diameter of a square is greater than the face-to-face diameter. Before twisting the bar, the corners and the faces are parallel to the axis. When twisted, the corners and faces revolve around the axis at an angle to the axis. The corners, having a greater radius than the faces, will protrude farther out from the axis of the twist than will the faces. The radii of the face gradually becomes less moving from the corner to the center of the face; a concave shape is then created between the corners while the faces remain straight.

11. Forging dynamics of twisting.

Drawing, Punching, and Bending

By Peter Ross
Illustrations by Tom Latané

Lesson Number Six- Drawing Punching, and Bending



1. The final forged shape.

Definition: This lesson uses skills developed by previously published lessons.

Intent:

The student will learn to incorporate several basic skills into a single project while maintaining dimensional control.

Tools needed:

Basic tools plus tongs to hold 1/4" thick flat bar, tongs to hold 5/8" or 3/4" diameter on end, and punching tongs to hold punch (if using a short punch), center punch, rule, compasses.

Materials:

24" (or as convenient) of 1/4" x 1 1/4"

24" (or as convenient) of 1/2" square mild steel

5/8" or 3/4" tool steel to make two punches

Method:

It will take planning to achieve target dimensions. Let's start by thinking of the bent rectangular bar.

First, the bar must be the right length and the two holes correctly placed. If the bar is forged to proper length, the bending will be simple. We can accurately compute the overall length and the distance between holes from the plan (see lesson Four, Bending, *Hammer's Blow*, Volume 11, #2, Spring 2003). This will give us the "straightened" layout of the bar. With this layout established, the choice of steps can begin.

In planning a project, it is wise to do the less-predictable operations early and do the more predictable ones later. By "predictable" I mean in the dimensional sense- not the skills of the workman.

For example, forging a taper of precise length can be done with certainty (using the method learned in lesson one, *Hammer's Blow*, Volume 11, #1, Winter 2003), but it is difficult to predict how much stretching will occur while punching holes. If we punch early in the sequence, the uncertain effects on dimensions are resolved before drawing to final length. Maintaining correct dimensions will be simpler and more direct. Making the round tapered pin will not affect the dimensions or fit of the flat bar, and can be done independently.

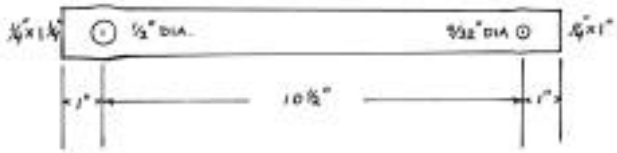
Step One:

Make two punches, each with a 4"-long round taper. One should end in 3/16" diameter and the other end in 3/8" diameter. Be certain that the entire taper is carefully forged and truly round. Any irregularities in the tool will transfer to the work.

Review Lesson #3 (drawing a round taper) if necessary.

Previous lessons have involved only mild steel, but for this exercise, we will need something tougher for the punch. If the punch is made of mild steel it will likely bend in use. Using a harder steel, even if it is not hardened and tempered, will make a more durable tool. At this beginning stage, I recommend avoiding more exotic and expensive tool steels. A very serviceable punch can be made from the simplest tools steels (such as W-1) and they will be much more forgiving for the beginner to use. The drawback of simple steels is that they are softer and will deform more easily during use, especially if they get hot. Good technique will enable you to use them with very little problem.

If you would rather not buy new steel, you may use a piece of scrap (such as a piece of coil spring) of appropriate thickness.



2. Flat bar in its unbent layout.

Step Two:

We will start with the flat bar.

Refer to the drawing of this project for dimensions and calculate the length of the flat bar before bending. Also determine the distance between holes. Review this procedure in Lesson Four (Bending) if necessary.

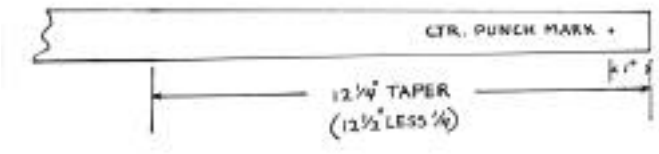
It is often a good idea to make a simple sketch of the piece as it should look before bending with these dimensions noted. At this stage, it is nothing more than a tapered flat bar with two holes.

Begin by forging a taper on the end of the flat bar. This taper does not end in a point, so draw the end of the bar only until

you reach the target dimension- in this case, 1/4" x 1". Square the end by upsetting if necessary. Once you have forged the end to dimension, work your way back up the bar until you have a straight, even taper 1/4" shorter than the desired length. This will allow for some stretching during punching and final corrections.

Hints:

Do not draw the bar too thin, as this is the hardest fault to correct. Any areas that are too thin must be upset to proper thickness. Refer to the lesson on upsetting if necessary.



3. The marked bar.

Targets:

Make sure the bar is an even 1/4 " thick the entire length of the taper. Variation should be 1/64" or less.

Hold length tolerance within 1/16"

Make the taper as smooth and straight as if it were the end of the project.

Step Three:

Measure from the small end to find the location of the small hole. Using the center punch, mark the location. Make a deep mark so that it will be clearly visible when the bar is hot.

Take a heat and punch the small hole.

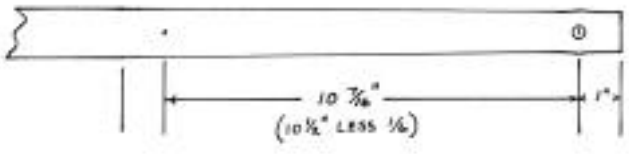
Drift the hole to 9/32" diameter using the punch.

Refer to lesson 2 (Hot Punching) if necessary.

Hints:

It is a good idea to mark the bar when cold (or mostly). This will avoid errors caused by measuring a hot, expanded bar: after the bar cools and shrinks, the marks can be off by as much as 1/8". Also, using the center punch on hot material may draw the temper from the small tip.

Targets:



4. The layout of the second hole.

Punch and drift the hole in the same heat. Since the punch is close to the final hole size, this should not be difficult. After drifting, the bar should be at a low heat and ready for smoothing. For this project, it will be acceptable to leave the bulge around the hole.

With practice you should be able to punch, drift, and smooth the bar in one heat.

Step Four:

Using the center of the first hole as the starting point, measure for the location of the second. Punch and drift the second hole to 1/2" diameter.

Hints:

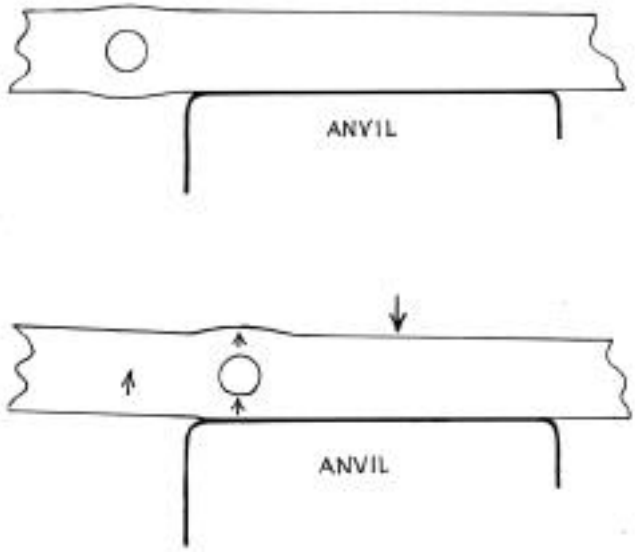
Rather than center punching the exact location, make the mark approximately 1/16" too close to the first hole. This will allow for inevitable stretching, and decrease the chance of the holes being too far apart. If there is any error to correct, it will be much easier to stretch the bar a little than to shorten it.

A more accurate measurement can be made when the bar is cool.

With the second hole finished, measure between the holes and correct the taper length to match the dimensions on your sketch. Final measurement is best done with the bar below a red heat, to minimize errors. This is also the time to make sure the taper is straight and even and the surfaces smooth.

For this project, the bulging of the bar edges around the punched holes may be left as is.

Once the holes have been punched and the bulges created, it is very important not to let the bulge rest on the anvil even when working in the middle of the taper. With a bulge on the anvil, the taper will not rest squarely on the anvil face. A hammer blow



5. Proper placement of the bar.

in this condition will bend the bar and squash the hole. This is an example of an idea presented in lesson one: the bar is squeezed by the hammer and the anvil simultaneously. You must think of what the anvil will do whenever positioning the bar.

Targets:

Hold length tolerances of each section to plus or minus 1/32", and overall length to within 1/16".

Step Five:

Now that final length is established, the piece can be cut from the bar. Make a mark on the face of the bar with the center punch, or on the edge with the hardie. Take a heat, and using the hardie, cut the piece from the bar.

Hints:

It is helpful to cut before bending for two reasons: first, if we are going to dress the end of the bar with the hammer, this is the last convenient time. Once the bar is bent, it will be impossible.

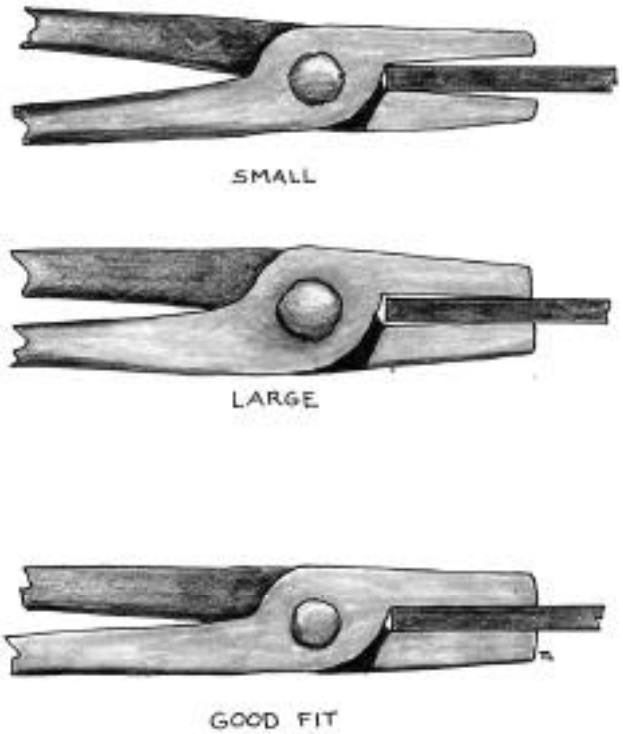
Second, cutting would deform the bend if it were already done. We would have to do the work all over again.

Careful cutting will keep the end of the bar as square as possible and make upsetting easier. Since this is a rectangular bar, it will help to cut part way through from all four sides. The intent is to keep the resulting burr as small as possible and centered on the end. If you cut equally from opposite sides rather than mostly from one side this will happen.

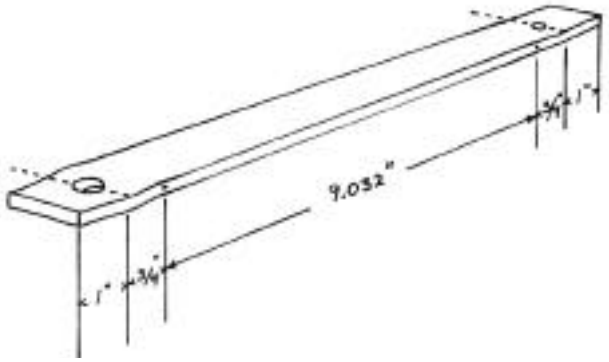
From this point onwards, it will be necessary to hold the piece with tongs. Simple flat jaw tongs will work well for this project. Most tongs are made to fit one size bar, though they sometimes will hold several additional sizes adequately. To check to see if tongs fit properly, the jaws should be parallel at the thickness of the bar. Thus, the jaws will contact the bar for the entire length of the jaw. Conveniently, one pair of tongs sized to hold 1/4" thick flat bar will hold the piece at either end, or anywhere in between.

Hints:

It may be necessary to square the end after cutting. If so, make sure to quench everything except the end itself to prevent undoing the accurate dimensions already achieved.



6. Proper and improper tong fit.



7. The bar with punch marks on edge.

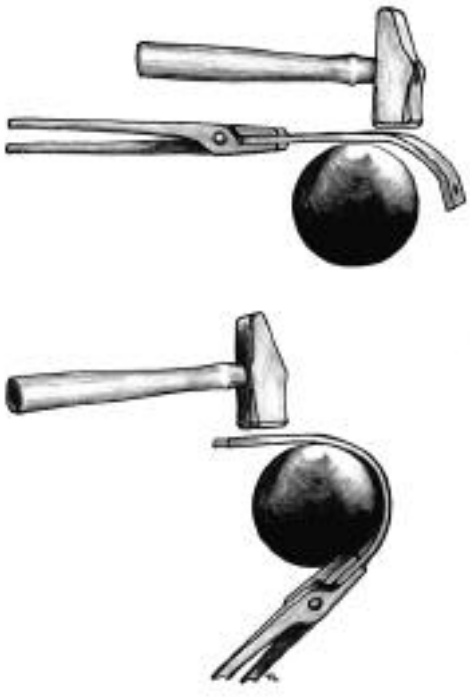
In preparation for the final step, it may be helpful to mark the limits of the bend (see Lesson 4, Bending) on the edge of the bar.

Step Six:

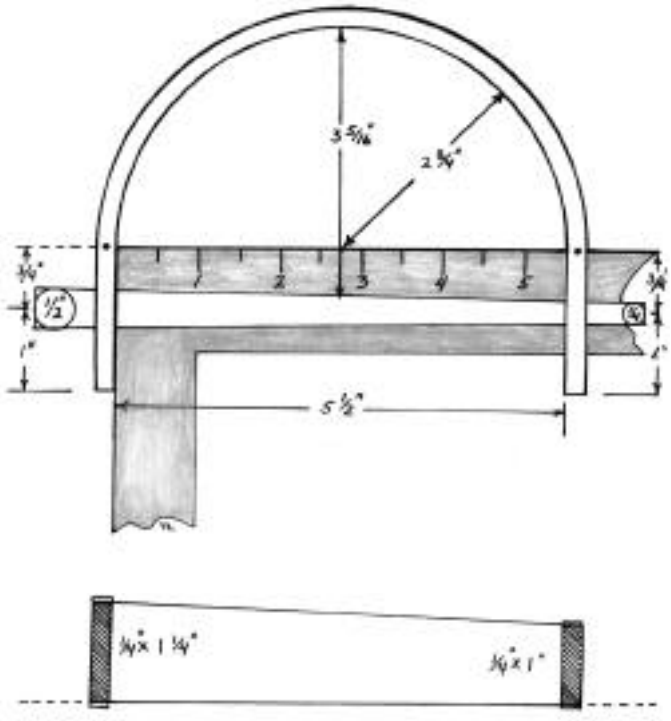
Bend the piece to match the given dimensions. Heat approximately one half the length of the bar and bend while holding the cold end in the tongs. Once done, switch grip to the bent end, heat the second half, and finish the bending. Switch grip as often as necessary to make corrections and adjustments.

Hints:

Since the bar is tapered, care must be used to get an even bend (it will bend more easily where it is smaller). If you have chosen to center punch the edges of the bar for reference it should be easy to determine if the bends start and stop at the correct places.



8. Manipulation of stock for bending on the horn.



9. A square can be used to assure that the curve begins and ends properly, to locate a center to check the curve, and to check that the straight ends are parallel. The sides of the curved bar should lie evenly on a flat surface except for the swelling around the punched holes.

Refer to Lesson Four (Bending) if necessary.

Remember, the two ends including the holes are not bent, but straight.

Targets:

The two straight sections at either end should be parallel in side and end views, and the correct distance apart. They should also be perpendicular to the imaginary "horizon" created by connecting the two dots.

With a straightedge connecting the two reference dots, check the radius of the bend and whether the ends are square.

Match the given dimensions within 1/16" or less.

Step Seven:

With the flat bar completed, it is time to make the tapered round pin.

Starting with 1/2" square bar, draw a round taper to match the given dimensions.

With the proper taper made, cut the piece from the bar and square the cut end if necessary.

Straighten and check for accuracy.

Hints:

Refer to Lesson Three (Drawing a Round Taper, *Hammer's Blow*, Volume 11, #2, Spring 2003) if necessary.

When cutting a round bar that is to have the end squared, cut evenly all the way around the bar. This will leave the resulting burr small and centered on the end.

Since you are using 1/2" square bar as a starting material, it is possible to make a pin which is larger than 1/2 " diameter. Therefore, use care in checking your progress.

Step Eight:

With both parts cool, slide the pin through the holes in the bent bar. The pin should stop close to the desired location, with close to correct amounts projecting from both holes. If the pin is round and straight, the distance between it and the top of the arc will remain constant even if the pin is rotated.

Check all given dimensions.

Hold tolerances to 1/16" or less

If you have made a full-size drawing, you can place the finished piece directly over it to check your results.

If the piece does not match the sketch, you can also figure out where the errors occurred; whether holes are in the right place, bending was accurate enough, or overall length was estimated correctly.