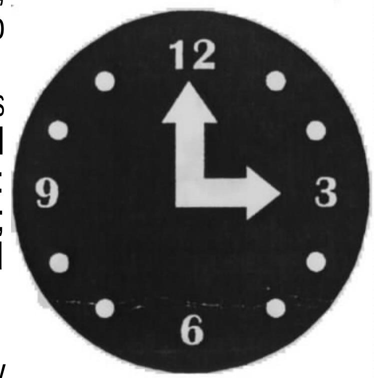
MAKING THE MOST OF TIME IN YOUR SHOP

Time is our most important resource. There seldom seems to be enough of it to accomplish all that we set for ourselves to do. I've put together the following article both from my own thoughts and experience and from many other sources. Some of these sources are conversations with other smiths, exchange newsletters from ABANA chapters, conferences, demonstrations, classes and lectures, books, and THEFORGE e-mail forum. I have tried to give appropriate credit, but admit that in many cases I do not remember the source. Sincere thanks to all who have developed and communicated ideas on this matter, and my profound regrets to those who are not given proper credit. **KDZ**



Optimizing time in the shop is a perpetual struggle, and this article will come at the issue from four directions: health and safety; layout and storage; processes and procedures; and tools and equipment.

Foremost is **Health and Safety.** Nothing will delay a project as quickly as a trip to the emergency room and the subsequent recovery and healing time. Loss of hearing may not show up immediately, but will have a significant impact on your ability to communicate with customers suppliers and demonstrators. A case of 'tennis elbow' can restrict your hammering for a couple of months. (More on pg. 14.) There are ways to reduce the chances of these things happening:

- Get appropriate training in the possible hazards associated with what you want to do, whether that is arc welding, oxyacetylene cutting and welding, using a gas or a coal forge, or using potentially hazardous chemicals and solvents.

- Read the directions before you start to use equipment. Look for hazard statements on the labels of paints, solvents and other chemicals. If you have any doubts, get a copy of the Material Safety Data Sheet (MSDS) or consult with someone who is an expert in the use of the material.

- Don't over stress yourself. Stay in good physical condition. Learn and use exercises to minimize repetitive stress injury to wrists and arms. The same goes for abdominal and back strengthening exercises to lessen the risk of injury from heavy lifting. Most of all, know your limits. Know what you can safely lift; get help or use mechanical assistance for heavy moving.

- Take a break or quit for the day when you are getting tired or inattentive to details. Be aware when you at risk of accident because of alcohol or drugs, or because you are preoccupied with anger at someone or something. Even anger with your own mistakes can ruin a day.

- Wear ear protection, especially when doing heavy hammering or working with a ringing anvil.

- **ALWAYS** wear appropriate safety glasses to protect against flying scale, chips off hammers or other hardened tools, and fragments thrown off by grinders and wire. Use appropriate lenses to protect against ultraviolet and infra-red radiation from arc welding, gas welding, and even forge welding.

- Start your forging sessions with a light hammer and light work until your arm is warmed up. Alternate between heavy and lighter hammers to rest your arm. If you can switch between left and right, all the better. Set your anvil at an appropriate height, to avoid over-extending your elbows and to allow standing straight while you work.

Many people find wrist high to be a good choice, but make sure your anvil and other work surfaces are at the optimum height for *you.*

- Keep your shop in good order, plan a layout for your workplace that allows for convenient storage of tools and materials. Avoid having clutter underfoot, and keep your shop clean. This is a safety measure, and also helps reduce wasted motions and time spent looking for the next tool or piece of stock.

Layout and Storage

- Put your anvil next to your forge, where you can turn to it with one or two steps. This minimizes loss of heat, making forging easier. If you do much work with very small stock, put a small anvil block on the forge table so you won't have to step away from the fire at all. Have a set of loops on the anvil stand to hold the frequently used anvil tools, and a nearby stand to hold hammers and tongs.

I have a portable tool stand made from an old spoked wheelbarrow wheel with an extra ring to divide up the spaces, an idea copied from Bill Wojcik. It is also good to have a small tool tray attached to the anvil stand or the post vise to hold chisels, punches, etc. for use. Your collection of chisels and punches may be set into holes drilled in a wooden block, or compactly held in one-pound vegetable or pet food cans.

Lengths of bar stock can be stored vertically, but segregated by size and length. Shorter cutoffs can be stored on shelves or in cans. The key element in storage is to have one place for each tool and size of stock or other supplies, so you have only one place to look when you need something.

It can't be emphasized too strongly that your work place should be kept clean and neat. You will waste too much valuable time when starting to work if you have to put things away from the last time, or clear the work area of clutter.

Processes and Procedures

First comes the Francis Whitaker dictum: "Get it hot and hit it hard!" Steel moves much more easily at an orange-yellow heat than low orange. Forging below red is only useful for final surface finishing and minor straightening. Add to the set "Hit it accurately." Good hammer control is an important skill to practice.

For drawing out tapers or other thinning, use the edge of the anvil or a bottom fuller, like Bill Wojcik's 'wonder bar' to speed up the process. You can also use a narrow peen or the corner of a square faced hammer to get a similar effect.

When forging an upset square corner, start by using bending forks and a narrow heat to get near the desired shape before you start hammering. You should be able to bend to an inside radius equal to the stock thickness.

For larger projects, Whitaker's guidance is sound: Make a full-scale drawing of the project on your layout table or on a piece of sheet metal (gypsum dry wall works o.k. too) so you can compare each work-piece to the design as you go. Saves a lot of mistakes and rework when you can get an early look at deviations from the intended shape or size.

If you are making more than two or three of a given piece to the same shape and size it is usually worthwhile to set up a fixture to set each piece to the right location and curvature.

The quickest finish that is also reasonably durable is wax melted onto hot iron oxide (fire scale). Bees' wax is o.k., although it does feel a bit sticky. Peanut oil baked on at high temperature is another good choice, but not as simple as wax. You have to take care not to get the work so hot that the oil burns off. Both beeswax and peanut oil are acceptable finishes for kitchen utensils.

Work two pieces at once. Let one heat while you are forging the other. From Ed Grove: Make extra pieces of commonly used components whenever you have odd moments.

Make all the component parts of your item before you start to assemble the piece. It will go faster if you assemble all like parts before you go on the to next.

Tools and Equipment

Even if you are skilled at managing the fire, use of a gas forge is a timesaver. Temperature control is easier, and you can more easily heat two or more pieces at once without fear of burning. The typical gas forge has its limitations if you are working with large shapes. I solve this problem by having a forge which is a burner plus stacked insulating firebricks. This way I can fit the fire to the work.

The 4" or **41/2"** angle grinder is a very hand shop tool. Many smiths have three or more to eliminate changing wheels from one operation to the next.

A chop saw (abrasive cutoff wheel) or a horizontal bandsaw are handy for cutting stock to length. I prefer the horizontal bandsaw, because it allows you to set up the cut and then do something else until the cut is done. On the other hand, the abrasive cutoff wheel allows you to cut hardened tool steel almost as easily as mild steel.

If you do a lot of heavy work, a power hammer, either mechanical or air operated, is a major labor and time saver. The treadle hammer can be used for occasional heavy forging, but it is most useful for decorative
chasing and chiseling with appropriately sized tools.

For polished work, a belt sander with a variety of grits, together with a polishing wheel is the way to go.

Another from Ed Grove: Make tongs to fit each size of stock you work. This is especially valuable for larger sizes, to avoid dropping your work in the middle of a forging heat.

These are some rather elementary, but important steps to take in insuring your time at the forge is optimized by simple steps that any blacksmith can and must do. As Dan Boone pointed out during one of his demos, you are only one person and when you can't work any faster you have to work smarter in order to make the most of your possibilities and your time at the forge. And that may be the difference between making a living or not.

Your comments and any additional ideas are welcome and will be published in the next newsletter.

- Ken Zastrow

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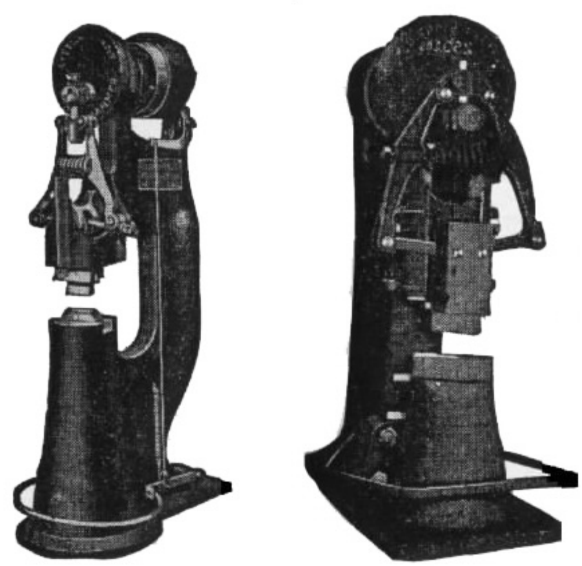
January/February 1999



The Heat Treatment of Chisels;
from the forge list,
With the author Glen Davis' permission

Jeff,
I have been waiting for someone to ask these questions so I may add my practical interpretation of heat treating. I worked in a forge shop in the late 60's and retired as a teacher of manufacturing technology after 30 years last May. I am not an engineer, but consider myself to be a practical craftsman. Carbon steel with a carbon content of above 0.3% will respond to heat treating if it is heated above the upper critical temperature and quenched faster than the critical cooling rate. The upper critical temperature, is the temperature minimum required to produce a phase change to austenite or a face-centered-cubic (fcc) microstructure.

With plain carbon steel, steel which does not have any appreciable alloying elements added, the steel will loose magnetic properties as it reaches the Currie temperature or the upper critical temperature. At this point the carbon will go into solution with iron. This is often referred to as putting the carbon in solution. The austenite phase or the fcc microstructure can hold approximately 2.0% carbon in solution. As steel is heated to the upper critical temperature or the point at which carbon goes into solution with iron a fine grain structure is formed. As steel is heated to a higher temperature or is held at the upper critical temperature for a long period of time, grain size will continue to increase. Overheating steel during forging will increase grain size and produce a weaker forging than desired. Under heating or forging when the steel changes from red to black, as in the forging of a chisel, will create stresses which often produce the thumb nail crack as can be seen down from the cutting edge of the chisel. This thumb nail crack is easily visable when heating the chisel to the quenching temperature after grinding.

A steel with 0.4% carbon, like AISI1040 steel, will make a decent chisel and cut mild steel. Maximum hardness is possible with a steel containing around 0.86% carbon and is referred to as the eutectoid composition. The eutectoid composition of carbon steel is that percentage of carbon which requires the lowest upper critical temperature to produce the phase change to austenite (fcc) when heated. Hardness increases as carbon content increases up to around .86% carbon where a maximum hardness on the Rockwell C-Scale of around 68 is reached if the steel is quenched faster than the critical cooling rate after being heated to the austenite temperature. Additional carbon will not increase hardness but will increase wear resistance by forming additional carbides. On plain carbon steel, the higher the carbon content the more star bursts will be present with a spark test on a grinding wheel.

A water hardening steel can be quenched and tempered in a single operation. Heat to the austenitizing temperature, the point where it loses its magnetism, and quench in water for a few seconds and remove from the water and polish with emory cloth to obtain a bright surface while the steel is black but hot. Observe the color as the surface changes color from the remaining heat in the chisel. The temper colors will run to the cutting edge and when the correct color is obtained, plunge the chisel into the water quench and cool to room temperature.

The temper colors are transient oxide films indicating the temper of the steel. A good temper for a chisel is a bronze color. When the bronze color reaches the cutting edge of the chisel, the chisel should be cooled rapidly by plunging back into the water to avoid a higher tempering temperature and the temper colors continuing to run. Oil hardening tool steel requires a two step process. First heat the steel to the austenite temperature and quench in oil faster than the critical cooling rate to produce as much untempered martensite as possible. Swirl the chisel in a circular motion to break down the insulating layer of gas formed and prevent flame-up from occuring. The critical cooling rate is the rate of rapid cooling that will produce the maximum amount of martensite without picking up soft pearlite from too slow a cooling rate. After cooling to room temperature, (leave a little heat in the steel to avoid excessive stress), polish the chisel with emory cloth to obtain a bright finish.

Reheat the chisel with a torch gradually beginning about 1 inch back from thecutting edge. When the temper color progresses from light straw to dark straw to bronze, plunge the chisel in a container of cold water to stop the tempering process. (Continued page)

The heat treatment of chisels; continued

For a steel to respond to heat treatment two factors must be present. One is the steel must be capable of undergoing a phase change and the other is there must be sufficient carbon to produce martensite. Martensite is a supersaturated solid solution of carbon trapped in a body-centered-tetragonal form of iron. If steel is allowed to cool slowly, the microconstituents formed are depending on the carbon content of the steel a combination of ferrite, pearlite, and cementite and will not produce hardness.

Hardness in steel is produced when steel with carbon in excess of 0.3% carbon is cooled fast enough to cause carbon in the fcc crystal lattice structure of iron to try to transform to the lower temperature microconstituent of bcc iron. Since the bcc form of iron can hold only 0.035% carbon, the additional amount of carbon beyond 0.3% causes the body-centered-cubic iron to be distorted to a highly stressed body-centered-tetragonal form of iron (untempered martensite) as the steel is cooled faster than the crital cooling rate. When the carbon content is increased from 0.3 % to 0.86% the amount of stress is increased and the corresponding hardness increases. The higher the tempering temperature the more hardness is given up to provide toughness.

Hardness must be sold to buy toughness.
The phase change temperature of alloy steels does not always respond to a loss of magnetism and are difficult to predict. Phil Baldwin, bladesmith, stated the forged O1 tool steel or AISI1095 maintains a superior cutting edge when compared to high alloy tool steels because the high alloy steels are suceptable to micro-flaking on the cutting cause the high alloy steels are suceptable to micro-flaking on the cutting edge.
Hope this information is helpful.
Glen Davis

Grain Size Demonstration

The grain size change in carbon steel can be demonstrated by forging two cold chisels, one forged at recommended forging range temperatures and the other at elevated temperatures. Using carbon steel with at least 0.4% carbon, forge a wedge or chisel point on chisel number 1 maintaining the temperature in the red heat range while forging. After the chisel point is obtained, reheat the chisel to "cherry red" around 1650 degrees F and allow it to cool in still air.

This reheating and cooling process is referred to as normalizing. It allows the steel to return to a normal condition eliminating forging stresses Using the same steel or the other end of the bar from which chisel number 1 was forged, forge a chisel point on chisel number 2 allowing the temperature to reach the yellow heat range while forging. After the chisel point is obtained, reheat the chisel to "yellow hot" around 2000 degrees F and allow it to cool in still air. This reheating and cooling process would normally relieve stresses and refine the grain structure; however, by overheating prior to cooling in still air, larger grain size is produced.

The grain size of the two chisels can not be observed without metallurgical analysis in the normalized condition. When an attempt is made to break the end of the chisels to observe the grain size, they will bend and not break. Both chisels should be reheated and quenched. Chisel number 1 forged at the lower temperature should be reheated to "cherry red" about one inch from the edge and quenched in water and chisel number 2 reheated to "yellow heat" and quenched in water.

By heating at different temperatures and quenching both chisels in water, the thin forged ends of the chisels can be tapped with a hammer or placed in a vice and broken off allowing the grain size to be observed with the naked eye. Be sure everyone in the shop is wearing safety glasses before breaking the ends off.

The untempered martensitic structure of steel breaks like glass. The grain size of the lower temperature forged and quenched chisel number 1 will be fine with grain boundaries nearly impossible to observe. The higher temperature forged and quenched chisel number 2 will exhibit pronounced grain boundaries with grains easily seen. The grain of overheated steel can be

refined and made smaller by allowing the steel to cool slowly from the high temperature and reheating to the lower correct temperature and allowing it to cool in still air. Normalizing prior to heating and quenching at the recommended temperature will help refine the grain (make grains more homogeneous or disperse carbon evenly in the grain
rather than allow it remain concentrated at the grain boundary where it migrated during overheating) and reduce the grain size. Overheating carbon steel will decarburize the surface and increase scale formation. Hope this will demonstrate how fine and coarse grain size is produced.
Glen Davis

Tong making by Mike Boone

From: "mike boone" <boonewi@frontier.net>
To: <theforge@qth.net>
Subject: RE: [TheForge] how do you make tongs?

One way that I make my tongs, that is different than any formula I have seen, is to start with rectangular stock. I use 3/8" x 1" for most of my general tongs. If you start with a rectangular cross-section and make your off-sets on the thin edge of the bar then the eye (boss) has a very consistent and good chance of coming out correctly and not sloppy.
I usually mark the bar 2" from the front edge, for the jaws, on one side and then make another mark on the underside at 3" from the front. The 1" in the middle of the two marks becomes the eye (boss). Now forge the first offset without changing the shape of the boss area (use half-faced blows to create the offset). Now that you have the first offset turn the bar on its' side and hang the front off of the far side of the anvil and put your 45 degree offset blow to end up with centered jaws. Now take a heat, turn your bar opposite of the first offset and offset the beginning of the reigns with respect to not fouling the boss again. Now is when I would round up the boss. Now draw out the reigns and viola!
Hopefully this helps.
Mike Boone
Boone Wrought Iron
Dolores, Colorado
http://www.BooneWroughtIron.com

Thoughts on teaching and sharing knowledge with beginners;

From: JoeToolie@aol.com
Subject: Re: [TheForge] First coal fire
To: theforge@qth.net

I'm one of those "sponges" that has been on The Forge list for some time but rarely contributes any input. I felt compelled to add a some comments in regard to the "First Coal Fire" question recently asked by a novice smith. The responses made by list members reminded me of why I so enjoy blacksmithing so much. I, like most of you other guys, enjoy making things with my hands. But it goes a step further, I also enjoy the process of doing it as much as I enjoy the end product. There aren't many of other crafts that let you reap this double enjoyment as well as smithing does. You see a picture or acquire an old forged tool and immediately, the wheels start churning, thinking about how the smith went about making it. You ponder the order of forging steps that have to be followed to duplicate it. You may spend the better part of a session beating to death a hot piece of iron only to find that that's not the way he accomplished a tough section, but you don't take your failure to heart. Those failures are what make you a better smith.

The down side of taking up blacksmithing is it's learning curve. There aren't many of us so gifted that we are able to master all the necessary skills involved in short order. Something as basic to the craft as making and tending a fire, is an essential skill that must be mastered in order to forge the simplest of things. I guess it's the knowledge of this, that makes accomplished smiths so willing to help those who are just starting out. You just don't find this sharing of information and skills/ methods, in many other crafts. My hat's off to you that know, are willing to show. My advise to those new comers to smithing is to give it some time. The way to master the skills is by practicing, reading about and asking other's who know about them.
If it were easy....it wouldn't be as much fun.
Joe Grasso

Contemporary Picket Decoration

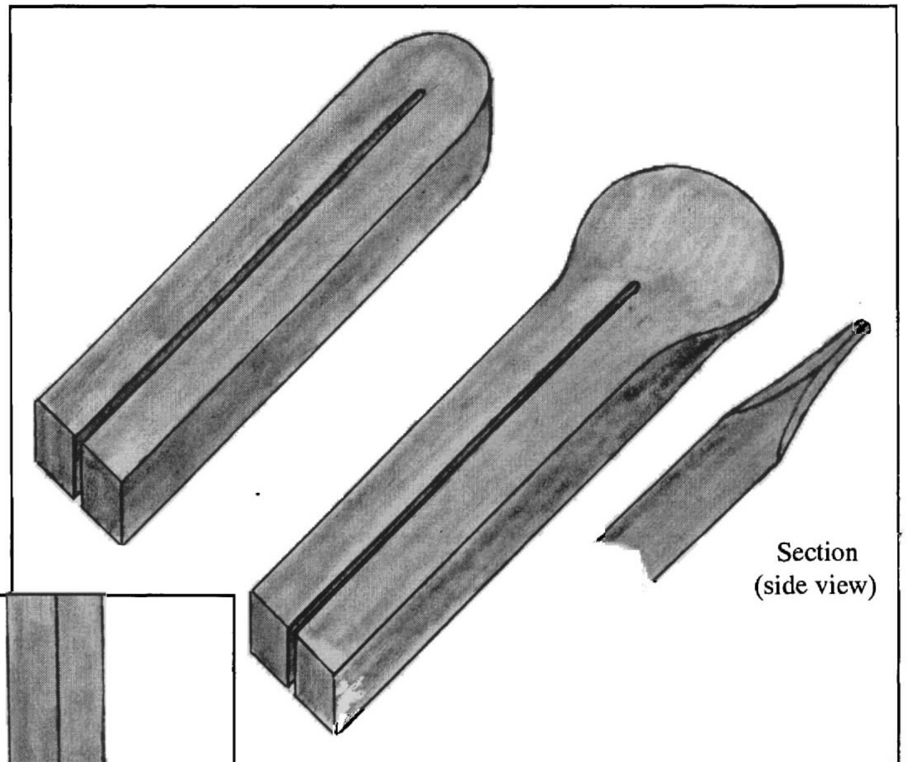
George Dixon, Metalsmith

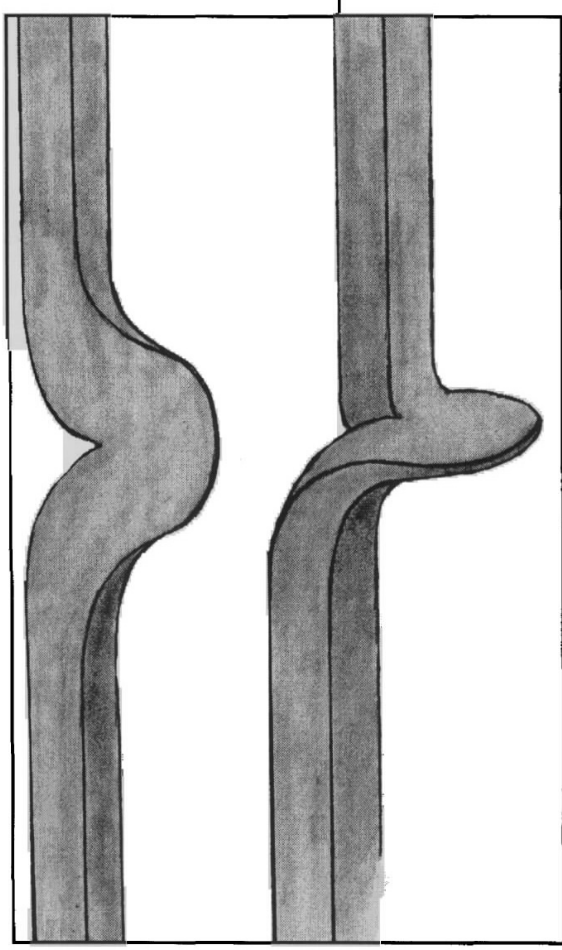
Heat,

fold,

forge,

then open!





The two variants of this motif are shown at left. They both come from the same preparatory form, which is illustrated above. The bar stock is heated and folded over tightly. Another heat is taken and the folded end is drawn out. As the section above shows, the piece is drawn out evenly. Use the anvil horn for the last adjustments.

Once the center is drawn out, and the forged area is blended back into the picket bar, take a localized heat (yellow) and open the effect. If it is opened along the axis of the bar, you get the far left effect. Open the forged area across the axis of the bar and you get the near left effect.

Try putting several of these effects on a single bar, switching sides as you go.

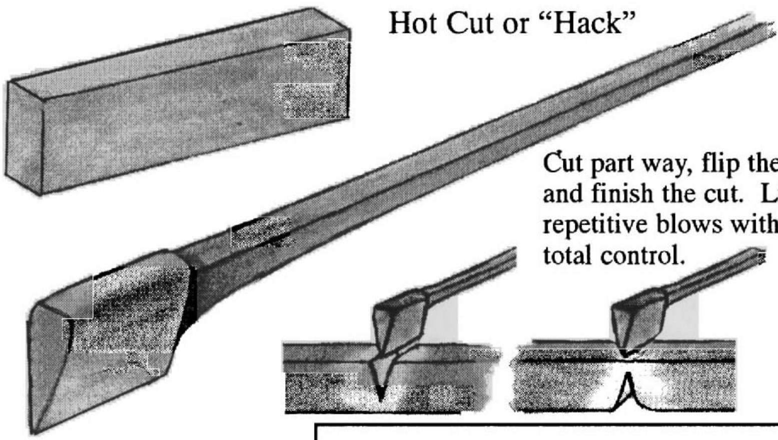
And......

Wear Safety Glasses!

Three Easy To Make Power Hammer Tools.

George Dixon, Metalsmith

Hot Cut or "Hack"



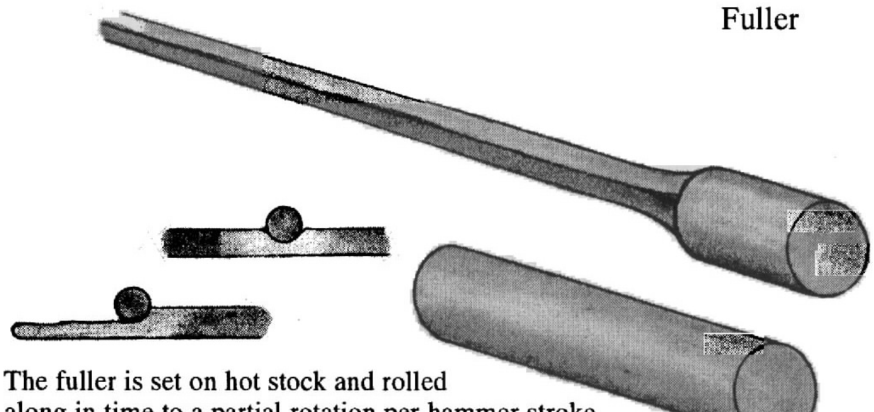
Cut part way, flip the bar and finish the cut. Light, repetitive blows with total control.

Here are three very useful and happily, very easy to make power hammer tools. These tool styles are centuries old. They are built to cut stock hot, fuller metal and to set shoulders and smooth-out surfaces.

They can be made of almost any tool steel you are familiar with. The process used to make them is basically the drawing process.

Their size is relative to the size of the power hammer they are used with. One rule of thumb that seems to be a constant in well made historic examples, is that the handle is somewhat flexible (to help minimize shock to the hands holding it) and there is a pronounced fillet at the shoulder between tool 'head' and handle. The fillet prevents cracks between head and handle.

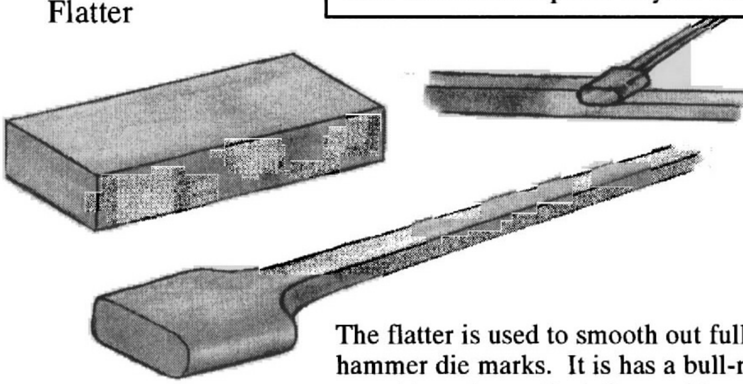
Fuller



The fuller is set on hot stock and rolled along in time to a partial rotation per hammer stroke.

NOTE: If the tool and the stock are not firmly set and held on the bottom die before the first stroke, they will be after it.....at the expense of your safety.

Flatter



The flatter is used to smooth out fuller and hammer die marks. It is has a bull-nose on one side and a vertical face, with very rounded shoulders, on the other. This allows it to be moved easily across stock (when the bull-nose leads) or clean up a shoulder (when the vertical face leads).

Making these tools is one issue, using them safely is entirely another story. Realize that a power hammer can severely injure the operator.

So, before you go off alone, get instruction.

Learn a safe approach to power hammer use, either with tooling or without.

And......
Wear Safety Glasses!

Gas Forge Supplier Tip;

From: "forgeman" <forgeman@home.com>
To: "Larry Brown" <lnbrown@con2.com>
Subject: kaowool supplier

I am in the process of building a gas forge and needed to buy some kaowool. I looked in the phone book under refractories and found this company

Kraemer Gunite Inc 227-8097

I called and expected to be told I had to buy a whole roll, but to my surprise they said they could help me out.
I only needed 18 in. wide by about 31 in. long. We looked around the garage and couldn't find any small pieces so the guy opened a new box and cut what I needed.
I asked for extra and ended up with a 24 in. wide by 6 ft. strip for a price of $20.
Mcmaster Carr wants $82 for 1 in. 8 lb. density 24 in. wide X 25 ft, so I think I did ok.
The guy was really nice and tried to help and made suggestions on how to assemble the forge.
Bill Futer
Glassboro NJ

Noisy Anvil Tips from The Forge List;

Subject: RE: [TheForge] JHM anvils
Author: rackersr@one.net at GATEWAY
Date: 1/30/00 12:56 PM
I don't have a JHM anvil, but as far as quieting the ring from my anvils I can offer a comment. I placed two roofing shingles under my anvil for the sole purpose of absorbing the slight unevenness on the base of the anvil. The first time I used the anvil I was shocked. Instead of a ring, it sounds like a thud. Almost like I was hitting wood instead of metal. If it had any affect on the rebound, it only increased it. Cut the shingles to the shape of the anvil base and you don't even notice they're there. It's got to be one of the simplest and most inconspicuous ways to quiet a ringing anvil I've found.
Bob

To: theforge@qth.net
Subject: Re: [TheForge] JHM anvils
Take a leather strap that you no longer use and a large coffee can. Fill the coffee can with premixed concrete that you can get at the building supply store, place belt in can hang this over the horn when it dries it will help with the ringing (But it will not do anything for the voices, you do hear the voices don't you)
(GRIN) Bowie

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