FORGING THE PARTS FOR A FLINT LOCK

To make a flintlock from scratch may seem like an insurmountable task, but if the project is taken in stages it becomes a simple exercise in hand forging and filing. Before we begin to make the pieces we need to look at wrought iron as a metal. It would be a mistake to assume that all wrought iron is this or that or that it behaves in a certain way at a given temperature. The truth is that wrought iron is a hand made material and the variables of each piece of iron are almost always different from the next piece of iron. The exact location of the iron ore origin plays a huge role in how the metal behaves both hot and cold. Norway iron. Charcoal iron and Spanish iron were always considered to be superior to English or Welsh iron. These views had to do mostly with the fact that different geographical regions have different chemical makeups and the iron carries these trace chemicals which alter the metal's characteristics. Since there is virtually no commercial production of wrought iron in the 21st century we will be using all recycled iron from unknown sources. The second most common variable has to do with the degree of refinement. Bigger pieces tend to be less refined and will have more internal "shakes" or separations while smaller pieces are usually more refined by virtue of the fact that they were reduced in size under a hammer and with enough heat to carry out the reduction. The amount of heat is usually referred to as welding heat and it hovers around 2300 to 2600 degrees F. As the iron is deformed at these high temperatures the fibers are constantly refusing with the neighboring fibers. At lower temps the fibers move together and as the temperature decreases further, fibers let go of each other and the metal splits. Even though the metal is still glowing red, you have hammered too cold, This temperature is different with different pieces of metal so experience is your best teacher.

WELDING

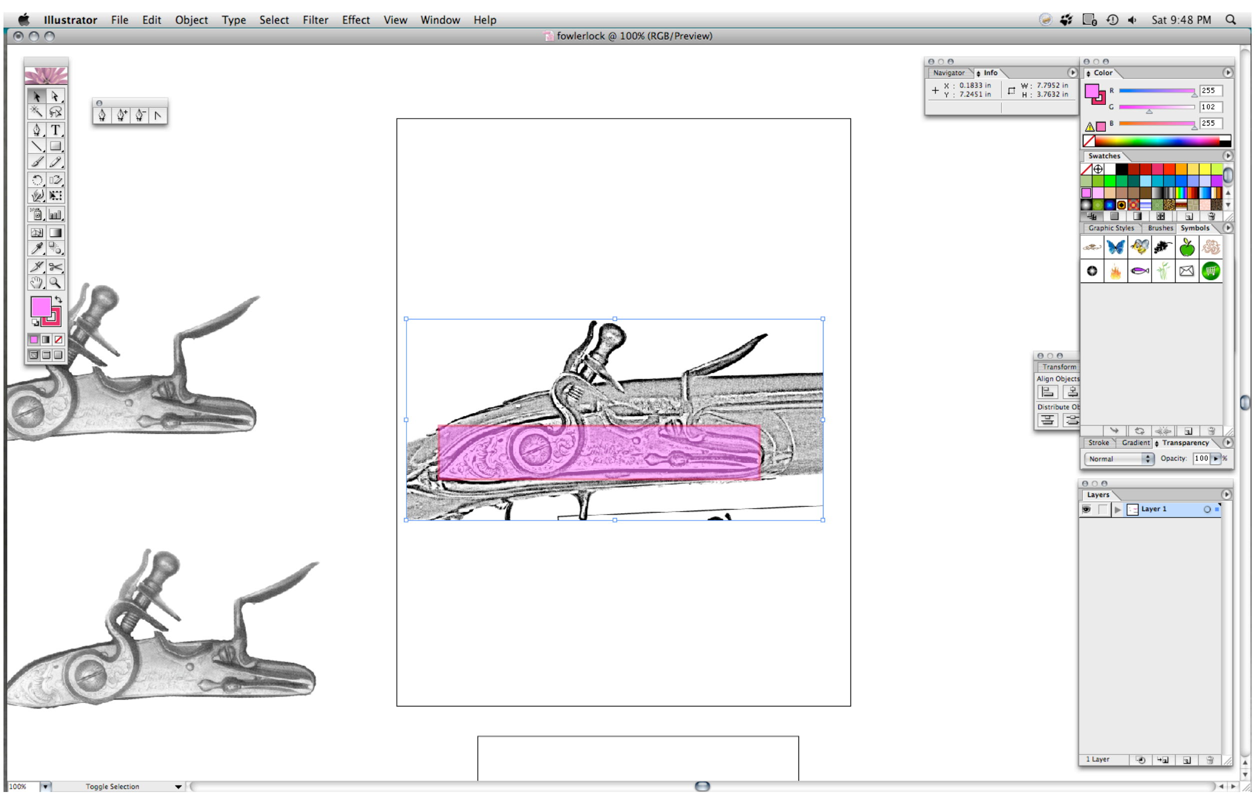
Many people have trouble with welding in an open fire. I think that the main issues are too much heat and too much flux. Over heating gives the smith a sense of insurance but it damages the metal and creates so much oxidation and surface damage that the weld is impossible. Too much flux will choke your fire with clinkers and it will give you the false impression that the metal has surface melted. The surface may look runny but what you are seeing is molten borax swimming around on top of the metal. In order to "get" the welding process, take two small size bars 1/4 or 3/8” square and heat them together in the fire with no flux. You don’t want to stare into the fire but you want to keep a pretty close eye on the two pieces. Do not blow hard on the fire, just roll the blower over and LET the metal get hot. You must never try to force a piece of metal to heat up, the heat needs to carry through the piece so that it will stay hot while you walk over to your anvil and hammer them up. When the surface of the metal begins to run, you're ready to bring them out of the fire. Bring both pieces out of the fire and lay the piece in your right hand on the anvil. At the same time place the piece in your left hand onto the first piece at a right angle, pick up the hammer and give the joint two or three hammer blows. Quickly flip the piece over and hit the backside to finish the weld. That’s it. As you touch the pieces together watch them. You need to carefully observe the surface of the metal and the effect of each hammer blow You should see bubbling metal and you should be able to watch the edges of the two pieces blend together

If you see a large spray of sparks and the weld seems flimsy, it means that you had too much heat and probably way too much air. Cut this weld apart and do it again and again. You should practice this weld until you get as close to 100% as possible. You may have noticed that I have not talked about scarfing at all yet, we will get to that later.

I am intentionally focused on wrought iron because it is the material used by lock smiths into the 19th century. It is also much easier to shape with a file than steel. Some people just cannot get wrought iron and I will say that all of the forging and filing operations described here can be executed in mild steel.

MAKING A FLINTLOCK

It is important to have a drawing of the lock that you want to make. Scan a photo or get a picture of the lock you want to build and open the picture in a draw program. I use Adobe Illustrator t.m. but there are many others, some of them free. Draw a square the length of the lock plate you want then resize the picture to fit the square. Delete the square and print the picture. Now take the print and trace all of the external parts onto a blank sheet of paper.



The pink square in this picture is five inches by one inch. The photo was resized with constrained proportions to fit the length of the pink box and printed. At this stage of the project we want to make a sheet metal pattern of the lock plate and the flint cock. I make mine out of 1/16 thick copper, brass or even aluminum is just as good. If you print on bumper sticker paper or sticky back something paper you can rough cut the shapes out and stick them onto the sheet metal. Cut the shapes out with tin snips and a saw then file TO THE LINE. The lock plate should be cutout for the internal bolster and I like to make a pattern with and without the bolster cutout.

I am making lock plates from old tobacco barn hinges which are about 3/8 by 1-1/4 inches. There is five or so inches between the fastening holes so I cut the hinge between the holes. Set the plate aside and hammer out a piece 1/2 by 1/2 by two inches long and another piece 5/8 by one and a half inches wide. The 5/8 by 1-1/2 is left on the bar and will become the pan. The first weld is made to attach the pan onto the outside of the lock plate. It is handy to refer to the drawings and mark the position of the pan on the plate. I do this with two thin grinder nicks so I can see them the every thing is hot. A tapered scarph is hammered on the edge of the plate, where the pan will land and a fan scarps is hammered onto the end of the pan bar.

A light sprinkle of borax will help to eliminate scale, When using borax, sprinkle it on hot metal and reheat the piece. When the flux has melted and looks transparent, scrub it off with a hand brush. This should get rid of most of the scale and leave the metal looking slightly wet. Sprinkle a new very light coat of borax on and bring the pieces up to welding heat. The pan is welded onto the plate with a couple of sharp blows from a light (one pound) hammer and the edges of the weld, on the face side of the plate are quickly and lightly tucked into the surface. The back (inside) of the plate may show a gap, but the bolster will cross over and close everything up.The bolster is then welded on to the inside of the plate, using the pan as a guide. In order to preserve the pan and prevent it from squishing, the bolster weld is hammered over a shallow swage. I try to use common blacksmith tools for as much of the forging as possible, but it makes sense that lock shops would have made special swages in order to get forgings that required less file shaping.

Before the pan is shaped up I like to put the welded plate back in the fire and bring the heat back up to a light weld. Once the high heat is attained let everything cool slowly in the fire. At this point I have to say that there is a certain amount of voodoo to welding but if you think about it most heat treating operations with iron and steel have to do with time and temperature. Hardening usually involves "soaking" at F 1460 and tempering involves low temperature heating for a certain amount of time. All of these time factors have to do with the changes that occur in the metal at different temperatures. Think of putting a raw roast beef in the oven and check out the results after different elapsed times. One of the changes that occurs at high temperatures is called grain growth which sets up a condition where grain boundaries are weakened and individual grains of metal become enlarged. You don't need to understand it, just how to fix it. You can actually see it if you over heat a piece of high carbon steel and quench it while it is still overheated. Snap the quenched piece with a hammer tap and you will see a very irregular sparkly surface. Continue to break off small pieces and you will see a finer and finer grain structure as you get into the metal that wasn't subject to the higher temps. To repair the overheated parts they need to be reduced in size by hammering. This hammering operation is done at lower more normal forging temps and will happen as we continue to shape the lock plate.

Once you have the pan and the bolster welded on, cut the pan bar off, leaving about an inch and a quarter of ‘pan’ sticking out of the top of the lock plate. We will be working in a vise for the next few operations in order to rough out the pan and bolster configuration. Begin by heating everything up and grabbing it in the vise with the pan sticking up. The pan needs to be hammered down and thinned out but we need to leave metal standing up to form the fence. Looking at our drawings , we can see that the surface of the pan will end up slightly lower than the back of the lock plate by 1/16” -

almost 3/16”. The change in level brings the flint strike up higher on the frizzen and keeps the flint out of the touch hole blast. rough shaping the pan may take 5 or 6 heats because the vise will pull a lot of heat out of the forging. By the time you are ready to make a close examination of the lock plates the vise will be pretty hot so don’t lean on it. A lot of rough measurements can be taken hot, but as you approach the target shape, it is useful to let the plate cool and examine it carefully. It is always best to forge things a little oversize and file them down to shape. Right about now the plate itself should be 3/16’ - 1/4’ thick and have enough metal to saw the shape of your pattern. The lock plate

is now flattened on both sides and the shape is roughed out. In the old days there were certainly jigs and special flatters to assist in smoothing things out, as well as trained young men with sledge hammers to help things along. At this point I cannot stress enough that the locksmiths of old, began training around the age of ten, they were instructed by men who spent their lives making locks and discipline was very strict. It would be impossible to recreate this system of instruction in The United States today. To over come our lack of expertise and spare ourselves hours of grueling labor there are electric power tools for relatively quick and accurate removal of excess metal. The thickness of the plate can be reduced with a right angle grinder or even a milling machine. Whatever machine is used, the surface needs to be refined by filing. Sounds like a lot of work and it is, but the correct files will make the job go quite easily. Vixen files are designed to flatten out and smooth large steel surfaces and they cut wrought iron very easily. Once the flat surfaces are under control, the pan surface is filed flat and

square to the plate. With the top of the pan flattened, that surface becomes a base line for the rest of the lock. Using our pattern the back or top of the lock plate can be filed very closely to the finished line from there we can locate the exact position of the flint cock.

VIXEN FILES

Used by auto body specialists to smooth out steel surfaces. They cut wrought iron very well and are very effective in flattening lock plate surfaces.

Continental lock plate

Generally, British ironwork has lots of forge welding while french and German iron work has more splitting and chiseling. These basic differences are reflected in lock making and the most obvious reflection of this is in how the continentals formed the flash pan. It would be a mistake to say that all continental pans were detached or that all English pans were welded, but as a description of basic types we will use that distinction. It can be said that the German style is an easier forging, It is after all largely a flat plate with a raised boss for the frizzen screw. Since we don't have the extra metal of the pan to hammer around we can pay more attention to hammering the shape of the pan more closely. It may be observed that iron as a commodity was fairly expensive in the 18th century and waste kept to a minimum. Small scraps can easily be gathered up and welded into larger pieces. Stub twist shotgun barrels are a perfect example of this scrap recovery.

To hammer this lock plate I will start with a piece of iron 1/2" by 7/8". The free end of the bar is heated and fullered to a little over 1/4" in thickness. By fullering the bar the iron is lengthened more than it is widened and the width is tapered towards the end of the bar. The bar can be flattened up to the bolster and cut off about an inch and a half ahead of the bolster. The forward portion of the plate is fullered out and flattened, leaving a raised block about 1/2" square. The metal below the block is beveled to the

thickness of the plate and the block is cleaned up with a 1/2” bolt header. Now the plate is compared with a sheet metal pattern and adjusted to accommodate the shape of the lock plate.

Forging the Pan

To forge the pan for this lock, I used the same 1/2” by 7/8” bar and began by making a hardy cut close to the end of the bar.

The cut portion is then flattened out and constrained to a little over 1/2” wide
By holding the flattened portion in a vise the bar can be upset and the ‘cut’ squared up.

We now have a short bar with a flattened finger and a square corner. After the pan is squared up it can be cut to length. A surface one inch long will give you plenty of room for the pan and the frizzen bridle. The flat pan area is now reduced in thickness and cooled for inspection.

WANTED, LOCK FORGERS AND FILERS

Hand forging used to be the way virtually all iron and steel goods were produced. There also was a very busy cast iron industry but cast iron is a brittle metal and completely unsuitable for products which were subject to bending moments or shear. Although, with practice, forgings can be made with close accuracy, many forged items were filed to the final geometry and size. All of the lock parts I make are filed to the final shape. Many gun stockers have bad memories of filing cast steel trigger guards or butt plates. Castings are made of steels that flow easily. 41 series steels or 60 series are very fluid and most of those steels have a measurable amount of carbon in them. After the metal is poured, the mold itself may draw heat out of the steel fast enough to induce a certain amount of hardness. These cast steels are designed for toughness in the first place and are not enjoyable to hand work. Wrought iron, on the other hand is soft and very easy to cut by hand. I would say that there is a noticeable difference between even mild steel and iron. Filing iron should be prefaced by soaking the parts in vinegar. The soak should last for a day or two, depending on the ambient temperature. The purpose of the soaking is to remove the fire scale which is an oxide. Oxides are always harder than the

parent metal and can be difficult to get under. After the vinegar soak I rinse the pieces and wire brush them on a bench mounted wheel. You may notice a very light etch which reveals the grain of the iron and can be very interesting.
The first thing to do with either style of lock plate is to flatten the inside and out side surfaces. A few quick swipes from a coarse file will show the high spots and these spots are ground down with a 4-1/2” angle grinder. As you approach a flatter condition, switch to the vixen file and smooth things up. Now is the time to trace the lock plate out line onto the forging and rough cut the shape of the lock plate.

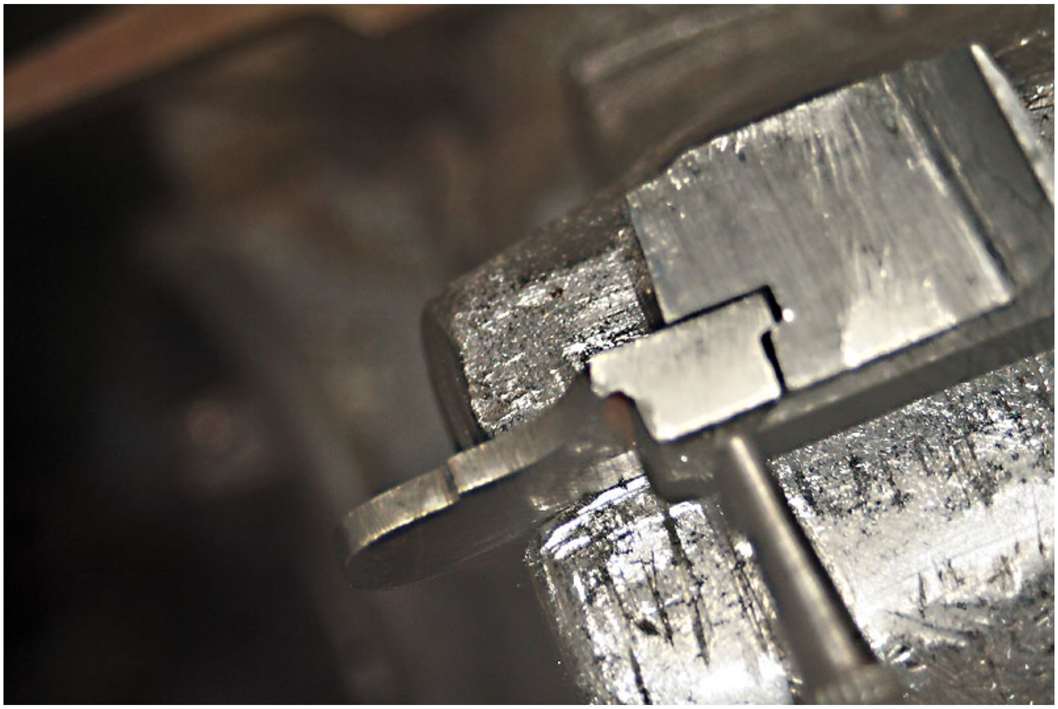
Detached Pan

Although there was no hammer welding in making the continental style lock plate, we have a detached pan that needs to be attached. To start we will make a saw cut along the bottom of the pan, parallel to the end tab that was hammered out.

We also need a parallel saw cut along the bottom of the pan which will be the thickness of the plate from the first cut. These cuts should be about 1/16” deep and should follow the shape of the pan into the frizzen slot and up to the fence.

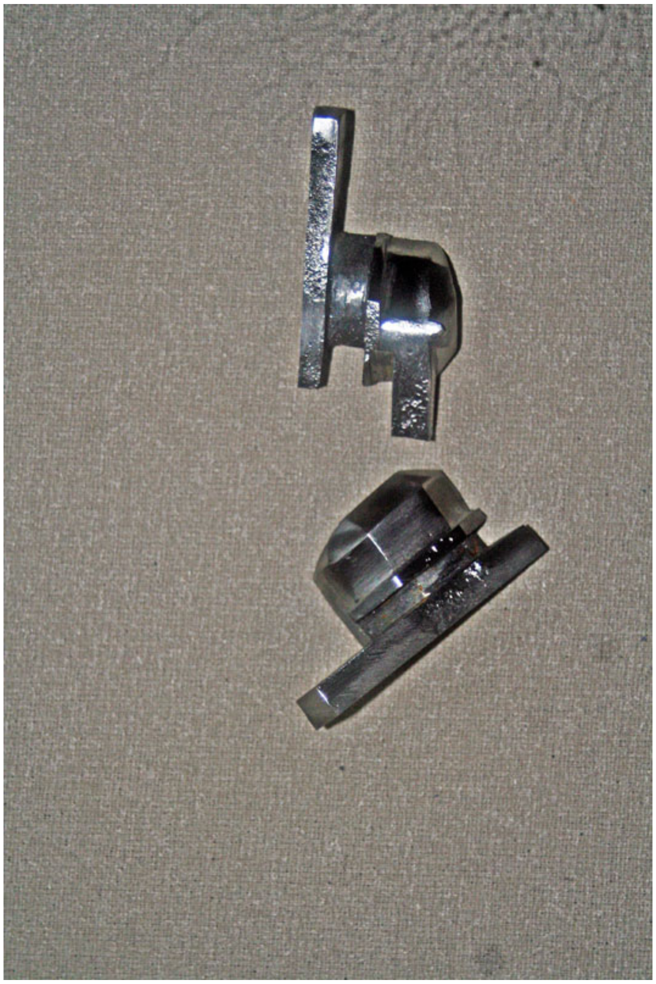
The metal left between the two saw kerfs can be removed with a small cold chisel and smoothed up with the edge of a file.
The plate is rough cut to accept the pan and the fit is perfected with prussian blue or inletting black. I use the contact medium on one of the pieces, then switch the blue to the other piece and back again. Obviously when you switch both pieces need to be cleaned before you proceed.

The bolster of the plate and the forward leg of the pan need to be cut at an angle so they lock together. This cut is made by eye and is part of the contact fit up. This operation is a little reminiscent of fitting a butt plate, but it’s much smaller and actually goes pretty quickly.



If you can make out the center pinch in this picture, you can see that the frizzen screw is going to miss the frizzen bridle. In my rough cut stage, I cut the bridle too short so I am now going to cut the bridle completely off and use a french bridle. More about that later.

The bottom edge of the bolster in now cut to line up with the pan bolster and the pan is ready for drilling and tapping. I use a #8 screw to fasten the pan to the plate and I drill close to the rear edge of the pan.



As the final shape of the pan is cut, we are going to leave a raised border around the bottom and the back of the pan. This border parallels the slot we cut to fit the pan. The border can be seen on most French and German locks and is a handy feature used to hide any gaps between the lock plate and the pan.

The pan can be snugly screwed to the lock plate and the molding caulked down tight to the plate.

The caulking is achieved by pushing the raised border, under the pan down onto the lock plate using a radiused punch and a moderately light hammer. After the edge is hammered down, the pan can be removed and the molding is dressed with a needle file.

Finish

You should now have two lock plates ready to carry the rest of the parts (eight pieces) to assemble into a finished lock. The reason I keep urging more than one piece is that something may go wrong with one of them. More importantly you are in uncharted waters and as you go through the process of forging and filing you will learn things and you may say to yourself “aha!, now I want to try making it like this” and there sits your second forging. I like to make locks three at a time and keep all three progressing together. Each of the locks will be similar, but with enough differences that I have choices about the style of gun each one might fit best with. We now understand that a lock plate for a flintlock rifle is not such a simple thing after all and as interesting as it may be to hammer one out, it may not be as interesting as our next piece.