

VIKING BELLOWS

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Objective

My objective with this research and construction project is to use period sources to make the most historically correct bellows that I can for future use in a period forge set up.

The intention for this build is to use entirely period materials, and to avoid power tools as much as possible. While some concessions may be made in this build to accommodate physical limitations, I need to be able to justify every decision made.

Desirable outcomes are that bellows be made to a high standard and that the research should stand up to review.



Carving of Sigurd and Regin, Hylestad Stave Church, Norway. 12th Century CE. The scene depicts Sigurd and Regin (who has a beard) at the forge, mending Sigurd's broken sword.

Research

Existence and Use of Bellows

There is a lack of physical evidence of bellows from period. While there are hearth-stones, tools, and the results of the forging process aplenty, I have been unable to find the physical remains of bellows themselves.

With this limitation, I made the decision to find other period depictions of bellows.

One of the most prominent uses of bellows in the Viking Age period is in the Icelandic *Völsunga* saga, and many of the carvings and other pictorial depictions of bellows and forges are related to the stories of this saga.

In the tale, Sigurd, who is described as one of the best swordsmen, was urged by his foster father Regin to seek Fafnir the dragon's treasure.

Regin forged a sword with Sigurd at his side, who provided assistance by keeping the fire going and providing water to cool the blade.

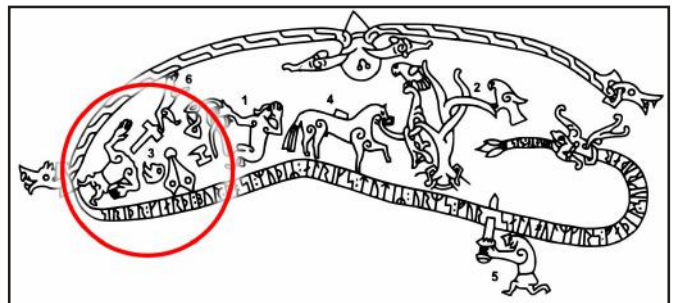
When the sword was completed, Sigurd tested the sword by striking it upon Regin's shield. The blade broke, which prompted Regin to forge another sword out of the broken pieces of the first one. When it was completed Sigurd tested the blade once again on the shield with Fafnir's image, and this time it cut through the shield and also cut off the horn of the anvil.

With such strong imagery of the crafting of a legendary blade, it's easy to see why so many of the depictions of this story feature the forging of the sword heavily.

To the left is a depiction of Sigurd and Regin from 12th Century Norway. Of note are the two bellows being worked into the hearth-stone.

Below, the Ramsund carving, which carved into a flat rock near Ramsund, Sweden around the year 1030, depicts (in the section highlighted, labeled in the diagram as '3') Regin's corpse beside its own head, his smithing tools scattered around him.

Note that among these tools appear to be a double bagged bellows. This is a depiction of double bagged bellows in the correct time and place for my purposes, and lends supporting evidence to the depiction from the Hylestad Stave Church.



The Ramsund carving, Sweden, c.1030 CE

While there are slightly earlier pictorial depictions of Sigurd, most are badly eroded and I haven't been able to find an earlier clear depiction bellows.

Aesthetic

A common thread with the depiction of double bellows is a single arm mechanism which appears to be rigged so that the operator of the forge is able to pump the bellows from where they are standing, reducing the number of people required to operate the forge. While this is an excellent innovation and I'll definitely look into it at a later date for my own use, the Hylestad Church carving that is serving as my major informative inspiration clearly depicts two people working the forge.

In order to find detailed depictions of the finish of the bellows, I've had to go slightly later period and through illuminated manuscripts from a variety of cultures. Unfortunately the depictions that I was able to find from earlier than the 1300s depict the bellows too simply to be able to pick out details on how they were finished.



A woman blacksmith in The Holkham Bible (British Library MS Add. 47680), c. 1327-1335

This image depicts two bellows working on the one forge. The bags appear to be attached to the rigid tops and bottoms, with heads of the nails or rivets visible.

This is one of the earlier depictions I've found of the bellow bags seeming to be suspended and operated by an arm at the front of the forge.



Manesse Codex (UBH Cod. Pal. germ. 848, fol. 46v), 1300-1330 CE

This set of bellows appears to depict a timber frame, leather bag, protruding nozzle and leather 'boot' that covers the join of the nozzle to the bellows. Note also the visible nail or rivet heads along the edge of the bellows.



Vulcan forges the arms of Aeneas, Virgil's Aeneid (BNF Latin 7939 A, fol. 156), 1458 CE

This image appears to depict two bellows with one curved side and one straight side each, which meet in the middle. The resulting shape is similar to the bellows depicted elsewhere, but has been split down the middle.

After reflection this is the shape that I have ultimately settled on, with aspects from the other depictions included. It is a practical style and, I think, aesthetically pleasing.

Carving

People in Viking Age Scandinavia carved extensively on pretty much every wooden surface available to them. I decided to put a small carving on the bellows as a finishing touch.

In choosing a carving to adorn the bellows, I wanted something that was both period appropriate and associated with the smithing theme.

While researching this I came across the Snaptun Stone, from Denmark. While the original was carved into stone, I believed that the simple lines would translate pretty well to a wood carving.



Snaptun Stone, Denmark. c.1000 CE

The Snaptun stone is an example of the hearth-stones that were used in period for forging. The hole under the carved face accepted the nozzle of the bellows, which directed air flow to the coals on the other side.

The figure is identified as the Trickster due to his lips being sewn shut, considered a reference to a tale recorded in *Skáldskaparmál* where sons of Ivaldi stitch up Loki's lips, following a bet in which smithing played a major role.



Snaptun Stone, Denmark. c.1000 CE

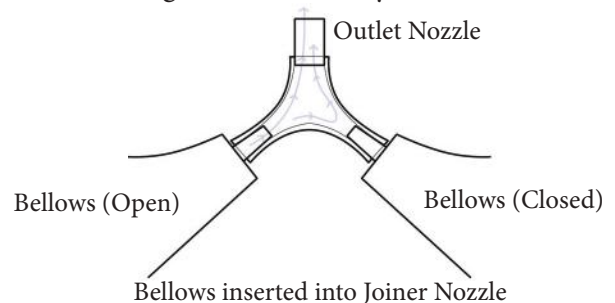
Now the dwarf wanted to cut the head off Loke, but Loke said that the head was his, but not the neck. Then the dwarf took thread and a knife and wanted to pierce holes in Loke's lips, so as to sew his mouth together, but the knife would not cut. Then said he, it would be better if he had his brother's awl, and as soon as he named it the awl was there and it pierced Loke's lips. Now Brok sewed Loke's mouth together, and broke off the thread at the end of the sewing.

- From the *Skáldskaparmál*

Joiner Nozzle

As the intention for these bellows is for them to be used in a period forge set-up, they will need to be joined to function for this purpose - to use a hearth-stone similar to the Snaptun Stone, the two nozzles must be combined into one. This will also aid in directional air flow. A similar concept is shown in the Ramsund carving (page 2 of this document.)

Unable to find any appropriate detailed period examples, I have designed the below system.



While one bellows is open (either drawing or expelling air), the other is closed, essentially creating an open/closed valve system. This prevents the second bellows from drawing air being expelled from the first bellows.

I decided that the best way to fashion a joiner nozzle would be from a fork of a tree, hollowed out to accept the nozzles of the bellows, and in turn expelling air through a singular copper nozzle.

Construction

Tools Used

I have attempted in this project to stick as closely as possible to period tools. Below is a list of tools used, with their period justification. Unless otherwise stated, illustrations are taken directly from the Mästermyr Chest Catalogue, as reprinted in *The Mästermyr Find: A Viking Age Tool Chest from Gotland*, Skipjack Press.

Additional to the tools listed, a utility knife was used to cut stencils and leather, a small amount of wood glue and clamps were used to ensure a tight join near the nozzle. Copper pipe was used for the nozzles.

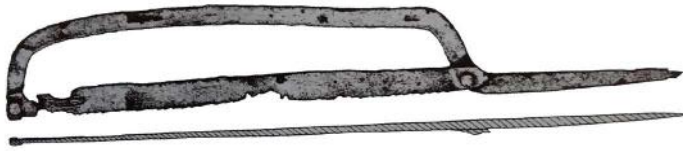
Rasps

Mästermyr Chest Catalogue #37



Coping Saw

Mästermyr Chest Catalogue #36



Rip Saw

Mästermyr Chest Catalogue #41



Small Hammer

Mästermyr Chest Catalogue #70



Pliers

Mästermyr Chest Catalogue #44



Chisels

Mästermyr Chest Catalogue #59



Brace Hand Drill

Gimlet found York, illustration from *Wood and wood-working in Anglo-Scandinavian and medieval York* by C.A. Morris.



Consumables

Pine

Cheap, good to work with, and abundant in period. I used timber left over from another project, and based on the size of the bellows around the pine that I had available and the size of leather scraps that I had.

Leather

I have a suitcase full of leather scraps and it's nice to have an excuse to use some of it.

Copper Alloy Upholstery Tacks

To emulate those seen in the illuminated manuscripts. I selected the material as it is common in small metal decorative and functional attachments in period. Clouts were also used to attach leather hinges.

Linseed Oil

I selected linseed oil as a finish, as it's likely that linseed oil would have been in common use. It is a normal by-product of flax cultivation, which was grown and processed in period in order to produce linen.

Sandpaper

The speculation is that leather either soaked in salt water or in conjunction with loose grit could have been used to substitute modern sandpaper. I didn't use it in this project, but am looking forward to experimenting with it.

Beeswax

Beeswax was applied prior to attaching the skirt as well as afterwards, to produce the best possible seal. Various beeswax candles have been uncovered in grave finds, and beeswax has a multitude of uses.

Process

While not exactly a step-by-step guide, my hope is that in documenting my process the reason behind decisions made would become clearer, and that anybody hoping to make a similar set of bellows will find it to be a good resource in making their own decisions.



Step 1: Laying Out the Design

Before starting the build, I spent time selecting the materials, tools, and Once I'd settled on a shape (see the Aesthetic section of this documentation), I made a stencil and traced the shape onto some pine. The stencil was sized to maximise effective use of the pine board.

I also designed and made a stencil of the handles that would later be attached to the bellows. I wanted something that would look like a natural fit for the bellows and add to the aesthetic rather than detract from it.



Step 2: Cutting Out the Shapes

The shapes were roughly cut with the rip saw, then refined with the coping saw and rasped into shape. Finally, the edges were smoothed with sandpaper.

In future builds, I think it would be a good idea to apply the timber oil and do any carvings at this stage. It would make access to the timber easier, as well as reducing any possible stress on the leather.



Step 3: Attach the Nozzle Blocks

One square end was cut off from each bellows and glued onto the other board of the pair. This square, when glued and set, would be drilled out to receive the copper pipe nozzle.

Installing the copper pipe nozzles without using modern glues or epoxy can be a time consuming task - you want the fit to be very snug without being tight enough that it will rip the entire construct apart. I drilled the hole initially, then used a rasp to widen it incrementally until it was almost perfect, and then used sandpaper wrapped around a pencil to get it just right. A few firm taps with the hammer seated the nozzles in place.



Step 4: Attach the Handles

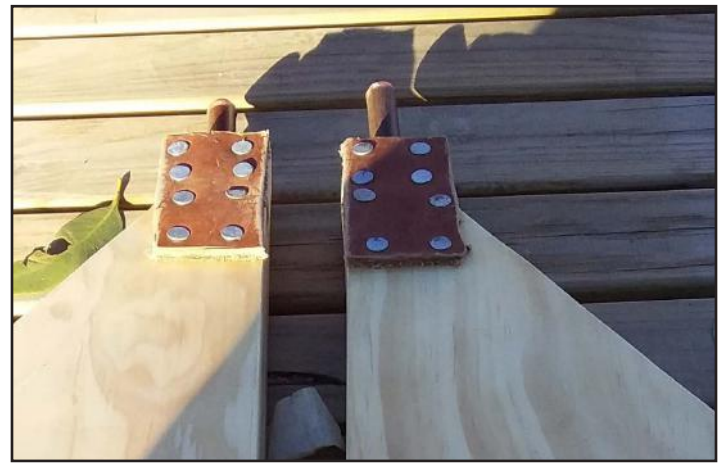
While these were drying, I took the handles and attached them to what would become the top board of the bellows using a small amount of wood glue, my brace drill, and some dowel. Unfortunately at this point I had a split appear in one of the handles, and as it was the last hole I decided to use timber filler to repair the split rather than trying to disassemble the handle completely.

After the build was complete, I went back with a chisel and rounded these handles for ease and comfort of use. This would be an ideal time to do this.

Step 5: Create and Install One-Way Valves

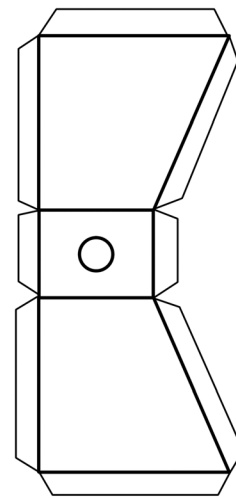
Taking the top boards, I drilled a hole to act as an inlet to allow air in. To prevent air from escaping through this hole during operation I created a one-way valve from leather. A 4cm x 4cm square was cut and placed over the hole with the grain side towards the hole, with two corners towards the front and the back, and two corners towards the sides. The two corners towards the sides were tacked down with the copper alloy upholstery tacks. A rectangle 12cm x 4cm was then cut and placed over the smaller square, with the long edges facing the sides of the board.

This was repeated for the second top board.



Step 7: Create and Install the Boot

Using a piece of paper I traced around the bellows to the point where I wanted the boot to terminate, and then measured the length of the nozzle block, hole for nozzle, and allowed room for the leather to be folded and tucked for a more finished look. The end result was something like this diagram.



I then cut the shape onto the leather, folded down the end pieces, applied some beeswax to leather to help maintain a seal, and tacked the boot onto the timber with the upholstery tacks.

Step 6: Create and Install Leather Hinges

When the nozzle blocks were finished drying, I used a thick piece of leather cut into a rectangle to create a hinge which the top board would pivot on for operation. Using clouts I attached the hinges to both the nozzle blocks and the top board.



Step 7: Create and Install the Skirt

Using much the same method used to create the boot, I created the skirt. Laying the bellows on their flat edge along a piece of paper, I opened them to their full width (dictated in my case by the size of leather I had available), folded the paper around the bellows, and then traced the entire shape to create one large skirt stencil. Allowing room for folding as in the boot, I cut the skirt out. I again applied wax and tacked the skirt into place. Pliers were useful to hold the tacks during this step.

I found that the best way to get a clean result was to hammer the ends in, then the corners near the handle, and then place a tack half way between these, and then continue to halve the spaces between tacks. Using this method I was able to attach the leather with only one pleat.

I tacked down the leather around the nozzle last.

It was at this point that I did the carving.



Step 7: Create and Install Joiner Nozzle

If I'd been making a set of small bellows (or even a large one), they would have been done by now! But I had chosen the more involved style.

Now that I had completed two bellows, it was time to join them together to create one set that was appropriate for their intended purpose.



Selecting a tree fork, I cut it to an appropriate size. I knew that this fork would be the primary anchor point of the bellows to the future forge, so it needed to be sturdy while being long enough for that purpose.

The natural grain of the timber added a large amount of strength to the Joiner Nozzle.

I'd previously been using this particular fork to rest work on while shaving or carving it - it was a shame to say goodbye, but it's in a better place now (on my bellows).

With some creative clamping I was able to drill the fork out with my brace drill. I started with a small, long bit, eventually sizing up until the holes were the correct diameter to accept the copper pipe.

Just as in the bellows, some gentle tapping was enough to secure the pipe firmly in place.



The remaining two holes were made a little wider to be able to receive the bellows and then remove them, for the purposes of demonstration. I intend to wrap the bellows nozzles in leather when it's time to permanently attach them - this will stop any air escaping, and keep them snugly in place.

Although perfectly functional, I was a little unhappy with the finish of the Joiner Nozzle, and decided to put a copper plate on the end of the nozzle to complete the look.



As the only copper I had was copper piping, I cut a section from the length and then cut it again vertically. I unfolded it with my pliers, and hammered it flat.

Shaping it to fit the end of the nozzle, I attached it, and then polished the whole thing.



Conclusions

I used skills with this build, particularly leatherworking skills, that I'd never used before. Fortunately, many of them carried over from costuming.

I was happy with my research into period tools, and for sticking to them. I learned a lot just by limiting my active tools, and using the same tools for several purposes.

While wax has been an effective sealing method for this build, I plan to do more research into rabbit skin glue, and employing this as a sealing method for future bellows builds.

The scale, I believe, is a little small. While I was trying to match the operative length shown in the Hylestad carving, the bags in that depiction could open much wider than the bags in mine. While I believe my bellows are ideal for small pieces (such as making hooks, brooches, etc.), anything much larger would probably require larger bellows.

The valve sizes on my bellows are possibly a little small. They are actually larger than what I've since read is recommended for this size of bellows, however I believe that the small valves increase suction and 'lift' the entire bellows a little with each raise of the handles.

Next time I make a pair of bellows I will incorporate a hook into the lower board, so that it can attach to a branch or piece of dowel in the period forge when that is constructed. I believe that this will provide additional leverage for the bellows to pull up against. I may add hooks to the bottom boards of these bellows at a future date.

I think that this was an extremely valuable build for developing new skills, refining old ones, and for building a great period asset for our camp.

The things I am proudest of with this build are designing and building the Joiner Nozzle, researching the tools, working out how leather one-way valves work, and doing my first ever work with copper.

I look forward to constructing and using the rest of the period forge.