Build a homestead forge and fabricate your own hardware

By Leland Edward Stone

Building a forge is more than acquiring a new hobby—it can be an important addition to your workshop. Its usefulness increases in direct proportion to your distance from the nearest hardware supplier.

It's not practical to start making nails or staples, perhaps, but what about a new bracket for the toolroom? A latch for the cow pen, or a special hoe for the garden? Mending a chain, making a special tool, or building a gate that no mold could duplicate are a few of the jobs best suited to the forge. You will soon discover—or create—many new tasks for this versatile workhorse.

Taking stock

The requirements for the homestead forge are simple, having changed little since Colonial times. Some of the tools you'll be using are called "new" because they were developed during the Dark Ages; a smith returning from the dawn of the Iron Age would instantly recognize your forge. You'll be pursuing a craft that was ancient when Alexander ruled the Earth.

One thing has changed, however, and you'll hear the same advice from many other sources: ***wear safety glasses***. When you're building your forge, or later when you're using it, you can't afford to injure your eyes. Get a comfortable pair of glasses or goggles, and ***use them***.

The basic principle behind a forge is simple: you need fuel, a fireproof container to burn it in, and a way of forcing air through the burning fuel. Blowing on the coals in your fireplace or barbecue demonstrates perfectly the process which you will later duplicate on a larger scale.

Forges are typically built with masonry or steel outer shells; inner components of either shell may be steel. Building a forge from steel can be done quickly (often using recycled scrap), and its lightweight construction makes a steel forge portable. But an electric welder or acetylene rig is required to build one efficiently.

If you don't have access to welding equipment, building your forge from masonry is a logical choice. The metal pieces you'll need are simpler, and welding isn't needed to make them. Although it isn't portable, a masonry forge achieves the same temperature produced by one made of steel.

Rock solid

Ancient blacksmiths devised the first forges which were just clay-lined pits in the ground. The *blast* (or air supply) was provided by the lungs of several apprentices, or later with crude bellows (those included at the end of the article were devised in the Dark Ages). This arrangement works: I've used a wood fire in this type of forge to heat half-inch stock to a bright red heat. Of course, you'll want to build your forge higher than ground level.

Building a forge from masonry is a time-consuming and low-tech option, but if you're using salvaged bricks or field rocks, it's also an economical choice. It's going to require a lot of room, but it'll be around almost forever, so take the time to do it right.

A masonry forge needs a foundation no less than 24" square, preferably concrete and extending below the frost

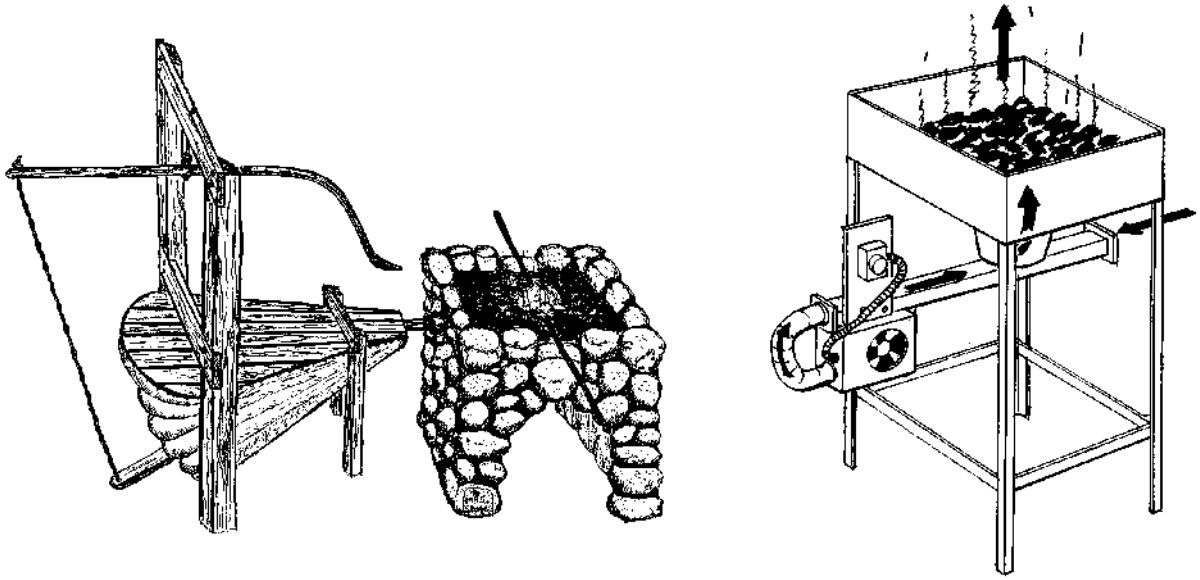


Figure 1. A finished stone forge with an old-time bellows alongside a modern steel backyard forge.

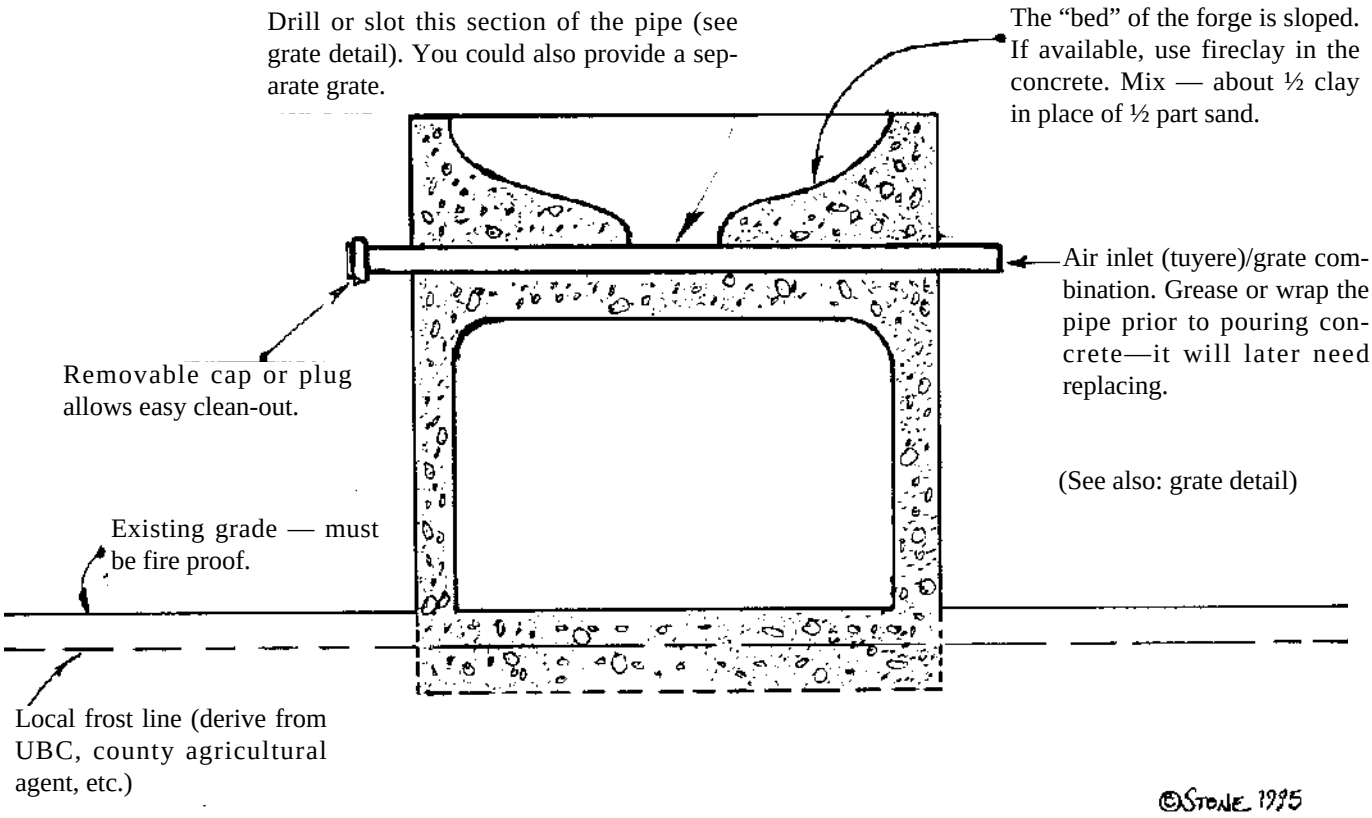


Figure 2. Section view of masonry forge. (not to scale)

line. If you're using a mixer, consider building your forge completely out of concrete. Figure 2 illustrates a typical example; use your judgment when placing forms and re-bar. If you'd rather use bricks or rock for the sides (instead of piecing concrete forms together), use the drawing as a guide.

The bed of the forge is built to a comfortable height (usually waist-high for the intended smith). It slopes—like a hopper—so fuel has a tendency to self-feed into the fire. At the bottom of the hopper is the grate (Figure 3), which is an outlet for the air supply, the blast. When the blast is fed through burning fuel, forging heat is produced above the grate.

When your forge is built, plan on replacing the grate; it "burns" away quickly. Figure 3 shows a simple air pipe (called a *tuyere*) and grate combination; it's just a piece of scrap 2" or 3" pipe. Embedded loosely in the forge, it can be easily replaced. A more sophisticated system uses a separate grate and tuyere; the added difficulty of building it pays off with a longer work life and easier grate replacement.

You will require a chimney if you've decided to build this forge indoors, but masonry is a poor choice in earthquake country. It's also an expensive option. Sheet metal duct work is just fine. I'm not going to recommend that you install a chimney without a permit, but I do recommend at least consulting the Uniform Building Code. Appropriate chapters were written to keep people from accidentally incinerating their buildings. Look into it.

Solid steel

If sophisticated metal-working equipment is available, then building a steel forge makes sense. You could build it using a drill and a hacksaw, but you'd go through plenty of elbow grease in the process. An arc or gas welder/cutting rig, a portable grinder, and a metal shear or chop saw will make the job much easier.

The skills and materials available on your homestead will determine the shape of your forge; use the drawing of my steel forge in Figure 1 as a guide. A small wash tub, a round steel drip pan (the type you drain the oil from your truck into), or a discarded truck rim are all potential forges. Take a look at your scrap pile and you're almost certain to find something suitable.

Used drums or tanks might seem like an ideal choice, but they require careful handling—especially before cutting or welding them. They can contain residual amounts of flammable chemicals—even after thorough cleaning. ***NEVER*** use an acetylene

torch or abrasive blade to cut into a salvaged drum or tank. (Pro welders use special neutralizers or fill old tanks with water before starting.) The old timers scoffing at this warning just haven't had their luck run out...yet. You might not live that long. ALWAYS use caution with salvaged materials.

As with the masonry forge, a chimney is required for indoor use; but unless you are ***very*** confident in your ability to run a Class A chimney through the roof of your shop, build your forge outside. You can add a sheet metal cover and walls later on; having a flame-proof shed that's dedicated to metal working is well worth the investment. Besides, it's a lot cheaper than replacing a barn that burned down.

Even outdoors, though, providing a hood is a bright idea. It will help contain sparks and keep the smoke out of your eyes. On a portable forge, making the hood as a separate attachment will simplify transportation.

You don't need to make anything fancy; a suitable hood can be easily cobbled together from sheet metal using bolts, rivets, or tack-welds. And you're absolutely right if you think this would work for a hood over the masonry forge.

Regardless of what your forge is made from and where it's located, take a few common-sense precautions against accidents: Don't allow children or pets near the work place. Don't set up anywhere that heat or sparks would present a hazard. And always keep a fire extinguisher or a garden hose handy. I've never set an unintentional fire; by paying careful attention to safety, neither will you.

It's a breeze

Fire is the heart of your forge, but it burns best only when supplied with air, and plenty of it. Most people are surprised to learn that I don't use a bellows (except for historical demonstrations). They are a romantic bit of blacksmithing nostalgia, and a grammatical paradox. But they're also laborious to operate and take up a great deal of room. If you're determined to use a pair of bellows, follow the instructions in the sidebar that accompanies this article.

You should choose a more modern "blast." If you lack electricity, even a hand-operated blower will be more efficient than a pair of bellows. But an electric blower is the better choice.

Because this job demands a large volume of air at low pressure, your air compressor won't handle it. Instead, use a fan salvaged from an air conditioner or the squirrel cage from an automobile's heater. It must be capable of producing at least 50 cfm. Look again at my portable forge in Figure 1; it uses a bathroom vent fan. Attaching

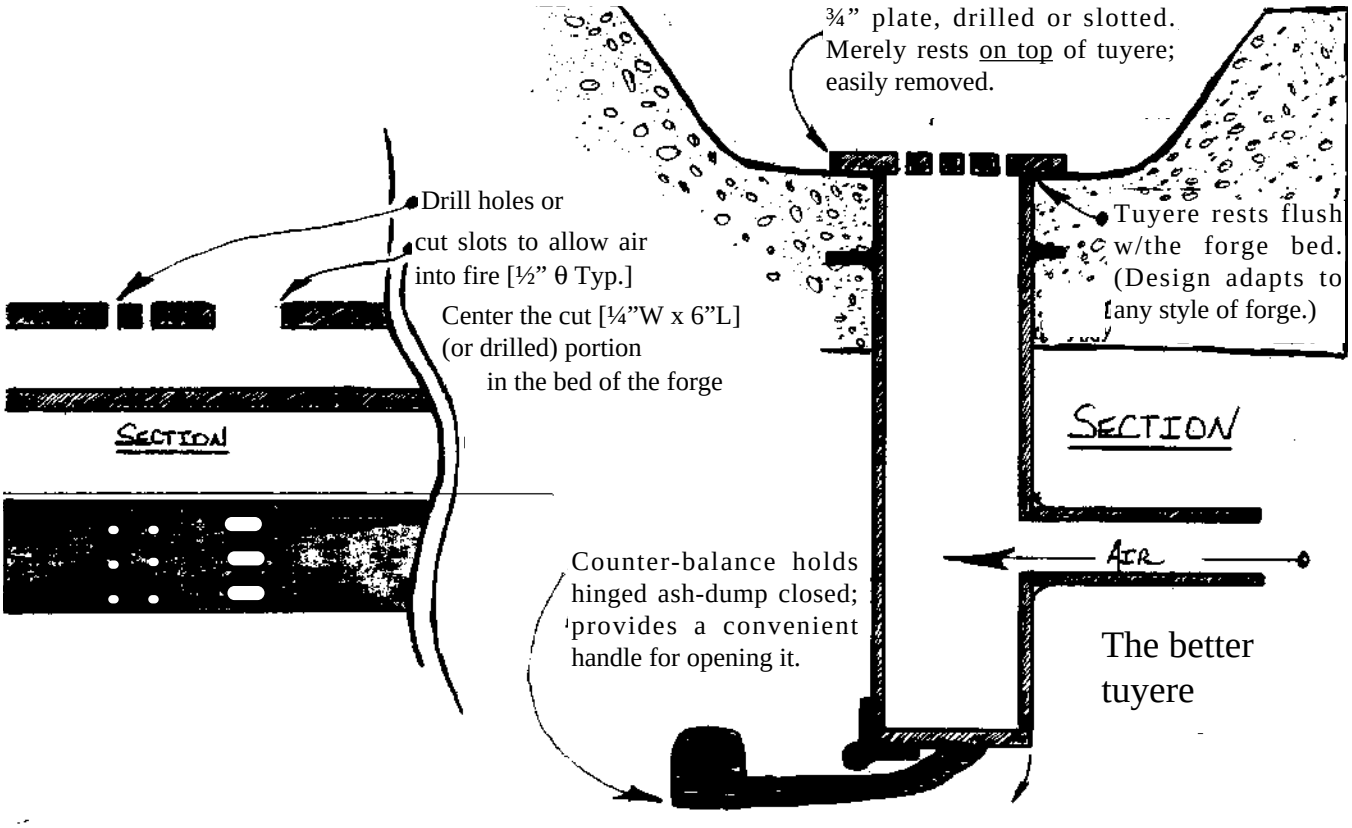


Figure 3. Grate detail

the fan or blower to the tuyere is done with steel ducts and sheet metal screws; once again, available resources will determine the exact details.

Wire the fan through a rheostat rated for its voltage and amperage (mine is wired through a 120V/15A dimmer switch). Be certain that your wiring conforms to MEC guidelines and make sure that the fan's motor is properly grounded.

Fuel

Your choices in feeding the new forge are pretty narrow: gas or coal. You haven't read how to build a gas forge in this article because I don't use one. While gas burns more cleanly than a coal-fired forge, it's not as hot. A gas-fired forge also requires more maintenance and, unless you're plugged into the local utility grid, it's more expensive to operate. That leaves coal.

As you know, coal is the impure remainder of ancient life laid down in beds throughout the world. Left in place for more time than we have to spare, it will become diamonds. But when mined from the earth and set on fire, it becomes a fuel that burns reluctantly. Fed with the "blast" you've built into your forge, it will melt steel.

Not just any coal will do, however. You want *anthracite*. As far as coal goes, it burns cleanly and with minimal waste. It also *cokes* quickly, which means that heat purifies the rock-like coal, changing it into a spongy mass of burning carbon. Generally sold as *blacksmith coal*, it's mined primarily in Oklahoma and Pennsylvania, then shipped to dealers nationwide.

Your local feed or hardware store may carry coal. If you're able to locate a source of coal in its "coke" form, it's an option worth investigating. Whatever form you purchase, examine it carefully before buying; good coal crumbles easily in your hand, while "coke" crushes into a gritty powder.

Some impurities will be found in all coal, regardless of its quality. If you're lucky, you might find a fossilized fern leaf or bone fragment. Most of the time, however, the impurities are simply wastes that combine with heat, oxygen, and metallic oxides to produce *clinkers*. A type of crude glass accumulating near the grate, they must be periodically cleared

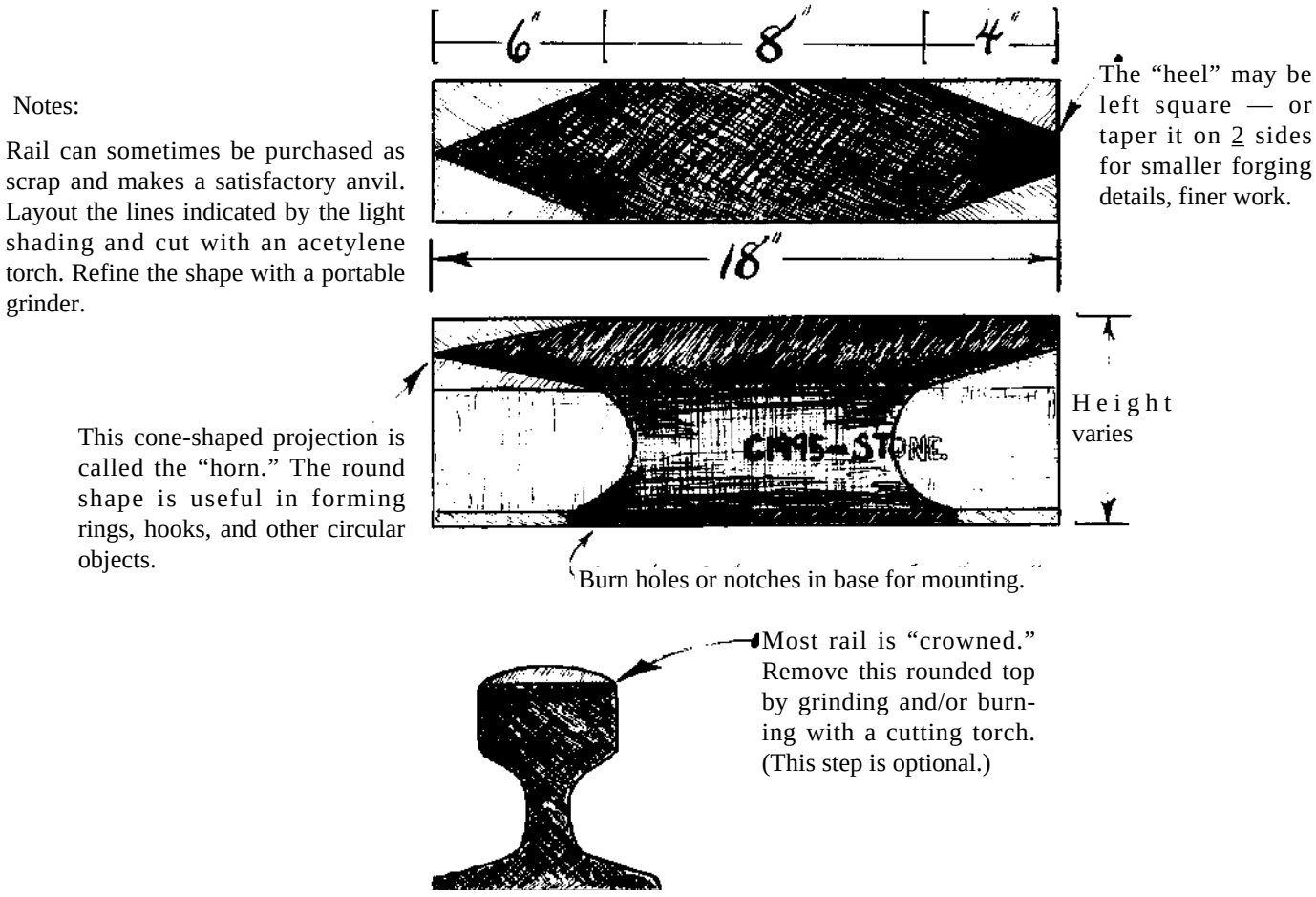
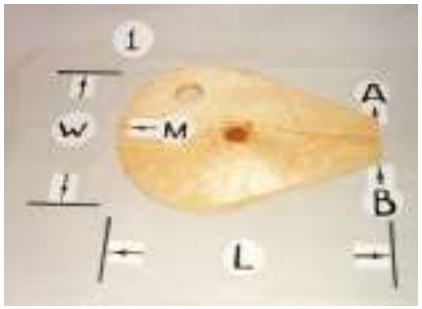


Figure 4. Rail anvil (no scale)



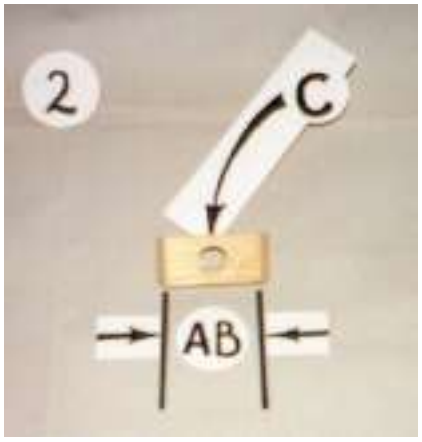
Photograph #1. The bellows leaves

away. But more on that in the next article.

You just might be looking at that stand of oak and thinking about burning down a mess of charcoal. After all, smiths in the Western Hemisphere used charcoal well into the 1700's. And it still works today, providing a clean fire with little residue; all of this from a fuel that grows on trees.

But creating charcoal requires wood that is first burned in an oxygen-starved fire. Compared to coal, its BTU-to-volume ratio is poor, and it burns very quickly. Mineral (or *rock*) coal was introduced to Western smiths from China in the 13th century—good thing, too. Europe was running out of trees to burn. Coal remains the best choice.

If you've been thinking about building a forge on your homestead, now's the time to get started. There's plenty here to keep you busy until my next article (especially if you're building a pair of bellows). Lighting and managing the fire will be discussed, and basic forging skills will be demonstrated. There will even be a sample project for your homestead, and you'll learn all about the "tools of the trade." So until then—unless you get a *really good* deal—don't run out and buy yourself an anvil.



Photograph #2. The nosepiece

Making an anvil

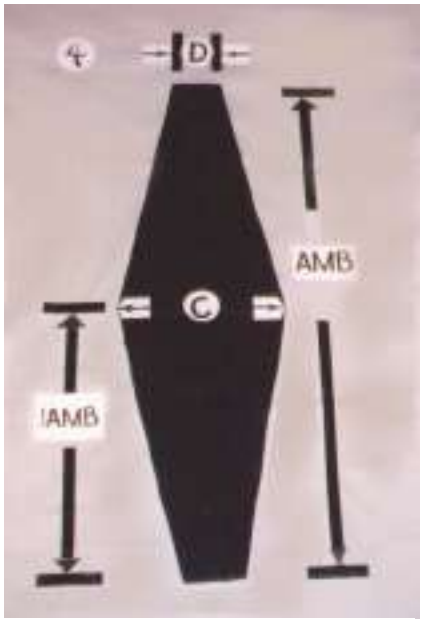
Nowadays, anvils are expensive. But a practical and inexpensive anvil, that can made from a section of railroad rail, is detailed in Figure 4. By following the simple instructions in the figure, you to can make a suitable anvil.

Photograph #3. The bellows handle

Building the blacksmith's bellows

Electric fans or blowers have provided the blast for every forge I've built for commercial use. They're inexpensive, readily available, and easy to work with. Granted, making a pair of bellows is a fun woodworking project. I've even got a small pair that I use for the barbecue. But if you're determined to use a bellows with your forge, you'll soon learn why running them was the job of the apprentice.

The parts to a pair of bellows are simple: two ***leaves*** (the sides) and a ***nosepiece*** made of wood; a ***nozzle*** (which is attached to the nosepiece) made of steel pipe; and a ***skirt*** made of soft leather. Stationary bellows also need one wooden handle and a *frame* or *cradle*.



Photograph #4. The bellows skirt

Photograph #1 shows the shape of the leaves. Cut them from plywood or edge-joined stock. (The bellows in the photographs is just a model; yours will be larger.) Dimension "W" needs to be a minimum of two feet; "L," four feet, and "AB," 8". Both leaves are center-marked at "M" and—except for an off-center 3" hole in ***one*** of them—they're identical. The first leaf becomes a pattern for the second one.

Photograph #2 shows the nosepiece. Its ends are angled to match the slope of the leaves, and a hole is bored in the center of its face. The inside diameter of the hole equals the outside diameter of the nozzle, which is ideally 1½" steel pipe about 18" long. "C" is a countersunk hole drilled perpen-

Photograph #5. The completed bellows

dicular to the nozzle bore; it's for a screw to secure the nozzle in place.

Drill a pilot hole in the nozzle and attach its end flush to the inner face of the nosepiece. Using glue and screws, attach this assembly to the leaf with the hole in it. On what is now the inner surface of that leaf, cover the hole with a square of leather. Sheet metal screws with washers in each corner work well, but it's not necessary to stretch the leather taut. This is the air inlet (you've just created a diaphragm valve), and it needs a little bit of slack to operate.

The handle marked "H" (photograph #3) equals the length of the bellows; it is fastened to the rear third of the second leaf with screws driven from the inside. A 2x4 makes ideal stock for the handle. This leaf is designed to move; after the handle is attached, it's assembled to the nosepiece with a continuous (or *piano*) hinge.

Spread the leaves apart to about a 25° angle, and measure the "D" and "C" dimensions. If the leaves are plywood, the leather must be wrapped around the edge and tacked to the faces, so add 3" to these dimensions. If the leaves are solid stock, then the skirt can be tacked to their edges; add 1½". Referring again to photograph #1, measure line AMB, adding 6" for selvage. Transfer these measurements to the leather stock as in photograph #4. Measure everything again before you do any cutting.

After you've cut the skirt, secure it to the leaves with upholstery tacks—they're made with large heads that won't pull through the leather. Starting with the stationary (or fixed) leaf, align the skirt's "point" with the center mark "M." Turning the leather down to form a hem on the inside, tack it every 4" to 6" OC, to the leaf's edge or face as required. A vise (pad the jaws with leather scraps) or a helper (jaw padding not usually required) will come in very handy at this time.

Cut the ends of the skirt, leaving about ¾" on each side for a hem, and tack them to the nosepiece. Make sure the jointed leaf has enough slack to move. If necessary, you can later add an *apron* (a leather piece wrapped and tacked around the nosepiece to seal any gaps). Remember, though, that this is a low-pressure device; air would much prefer escaping through the nozzle (and into your fire) than seeking a gap in your well-made bellows.

Photograph #5 shows the completed bellows. Mount your new bellows in a cradle, with the handle hanging down. Rig a lever above it to pull the leaves together; gravity pulls the lower leaf—weighted if you wish—into position for the next stroke. For a nice touch of tradition, fit a cow's horn to the end of the lever.

Just as with your lungs, air rushes into the vacuum created by the opening bellows; then, when you pump, it's forced out to enrage the roaring flame within your forge. The rhythmic hiss and blow of this ancient cycle murmurs to you gently of days long past and since forgotten. Say, maybe this wasn't such a bad idea after all. Δ