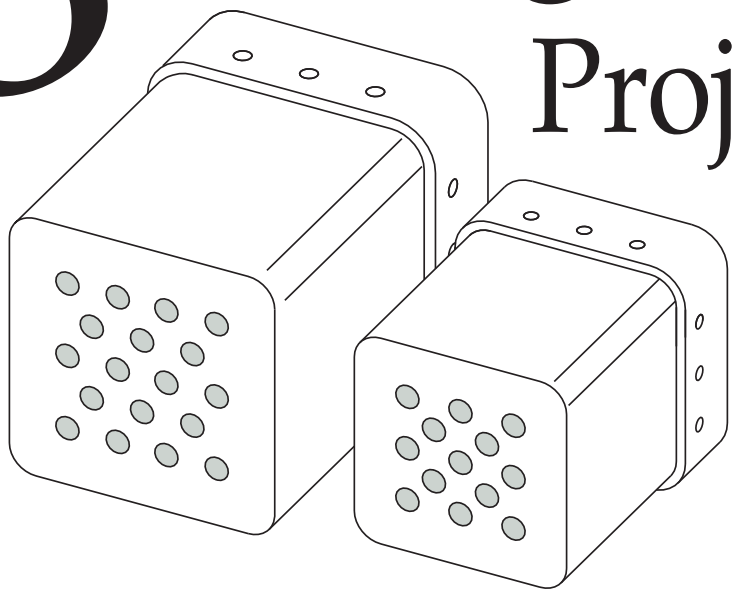
3 Design Projects:



Using The New Mini-Square Gibersons

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Addendum to the paper **"New Ideas for the Use of Small Burners in the Glass Shop, Foundry, Pottery, and Smithy, by Dudley Giberson."** This document illustrates and describes the construction techniques for making the following pieces of studio equipment:

1. A small foundry furnace (101.25 c.i.) for melting bronze or aluminum but which could also be used to melt glass (2450˚F maximum temperature).
2. A hexagonal 7.5″ i.d. glory hole with a 6″ retainer ring
3. A burnout kiln (1093 c.i.) for dewaxing molds for foundry or glass casting but which could also be used to fire ceramics (to 1800˚F in 5 hours).

Project One: The 4.5″ x 5″ x 4.5″ ID (101.25 ci) Foundry or Glass Furnace

The design principle behind this little foundry furnace is flexibility. It is made with a hand full of soft brick with the idea in mind that if you use it a good bit and things get worn you can easily, and at little expense, replace the worn brick by simply loosening a few bolts and twenty minutes later you have a new furnace.

Our design shown in figure 21 is a loose brick structure held together with interlocking metal tie-rods (***c***). The frame and tie rods are welded together so four pieces interlock. Above the furnace we have a movable door (***i***) on a pair of pulley wheels. The door is an IFB construction where the bricks are mortared into a metal frame. This kind of door will hold up for a decent amount of time, like several years of use, before it will need to be re-bricked. Again the cost of that is a couple of bricks and a half-hour's time.

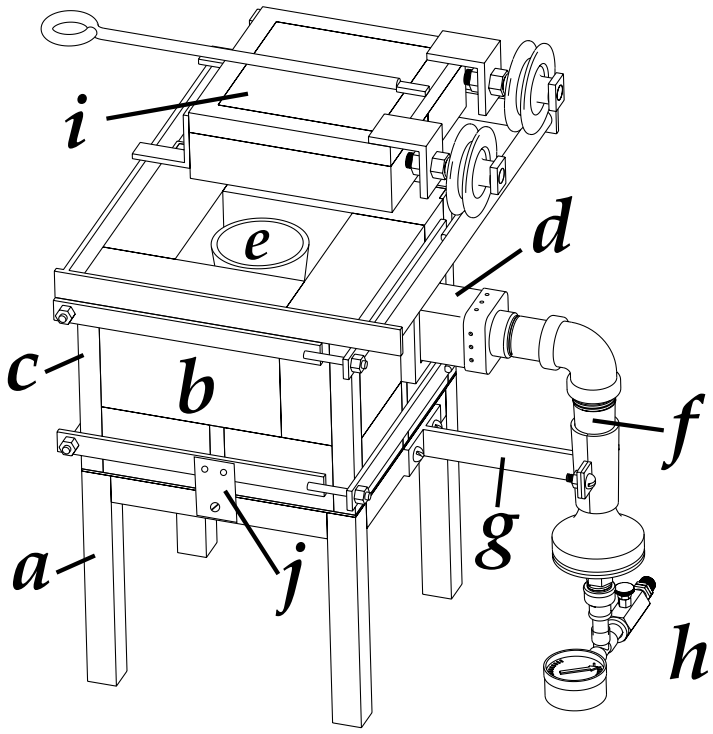


Fig. 21 The parts of the furnace: base with legs (***a***), the furnace body (***b***), the upper frame (***c***), the burner head (***d***), the crucible (***e***), the Ransome V100 venturi (***f***), the burner brace (***g***), the needle valve and gauge (***h***), the furnace door (***i***), and lastly, the positioning tab (***j***)

The base with legs can be structurally separate from the furnace (for that matter the base can be a couple of cinder blocks) or it can be attached by bolts to the main kiln frame as shown in figure 21 at positioning tab (***j***). The burner is mounted firmly in place by a rugged burner brace (***g***) which attaches to the venturi and supports the burner in position. The burner is controlled with the needle valve and gauge (***h***).

Figure 22 shows the frame connection system (also see "***c***" in figure 21). Here two of the four frame sections are being assembled. The idea here is to loosely assemble the four parts, then cut and fit the bricks into the supporting construct. For making these frame sections I would recommend working off a little jig made of plywood and #6 or #8 finish nails to hold the parts in position while they are being welded. I've found marinite works especially well if there is a lot of heat build-up. With these thinner parts of 1/8″ and 3/16″ strapping and angle iron I recommend using a thinner welding rod. Position the parts in your jig and hold them with a leather welding glove as you zap them in place using a 3/32″ #6013 all purpose stick.

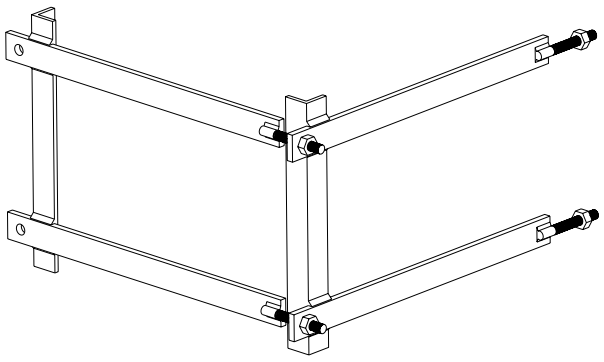


Fig. 22 This is a system of elephant trunk to tail assembly of frame sections. Four sections comprise the main framework necessary to hold the little foundry furnace together. First assemble all four frame sections and then fit the brick into them. To complete the body of the furnace tighten the bolts to lock everything in place.

The burner and the body of the furnace should be connected by a supporting brace (shown as "***g***" in figure 21). If you travel with this unit I would recommend removing the burner so the burner and burner block do not thump each other over every bump in the road. When you use the furnace, locate the burner on the quiet side of things. The most vulnerable part of this setup is the burner system. For example, you don't want to drop anything onto the pipework or burner arrangement. And you don't want to trip on the gas line so dedicate a little planning to this effect.

The basic brick used to construct this furnace is called an Insulated Fire Brick (IFB) and is widely sold by refractory supply companies. The IFBs are classified by the temperatures you need to attain. For example a brick that will withstand a continuous heat of 2300˚F is rated 23, so the AP Green brick of this class is called a G-23. The Kaiser was called a K-23 etc. A little known fact is the higher the brick is rated the poorer the insulation value. So if you are casting glass at 1650˚F use a 2000 degree brick not a 2800 degree brick. For this bronze casting/glass melting furnace which may attain 2400˚F I am recommending using the G-26.

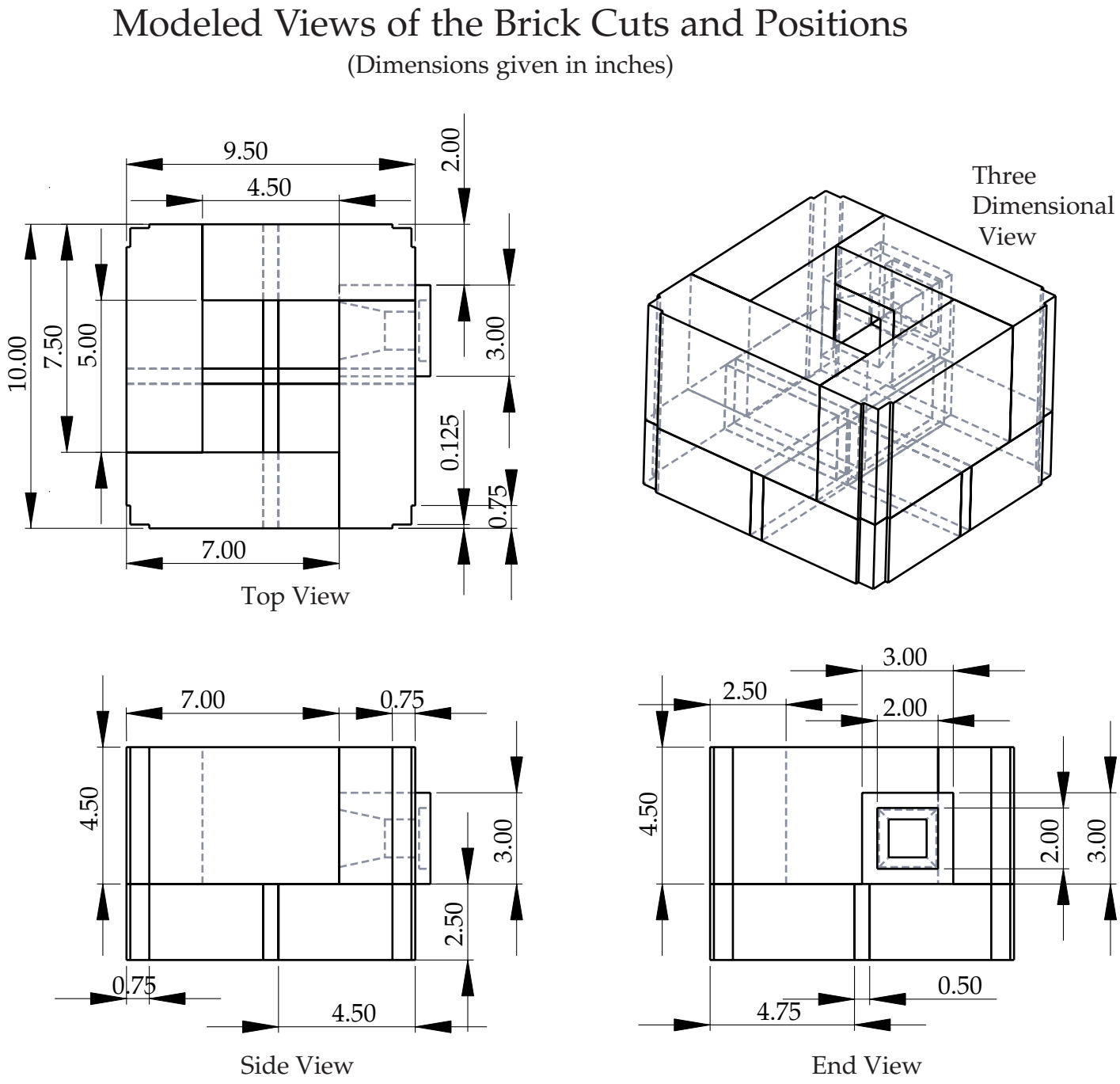


Fig. 23 These are the modeled views for the miniature foundry or glass melting furnace with internal measurements of 4.5″ x 5″ x 4.5. This furnace is made of IFB and all of these cuts and shapes can be easily made to the dimensions given above using a hacksaw blade and a wood rasp. It is recommended to build the metal frame work first, and grind, saw and rasp the bricks to fit into the framework according to the plan above.

A Simple Two Pulley Door Roller System

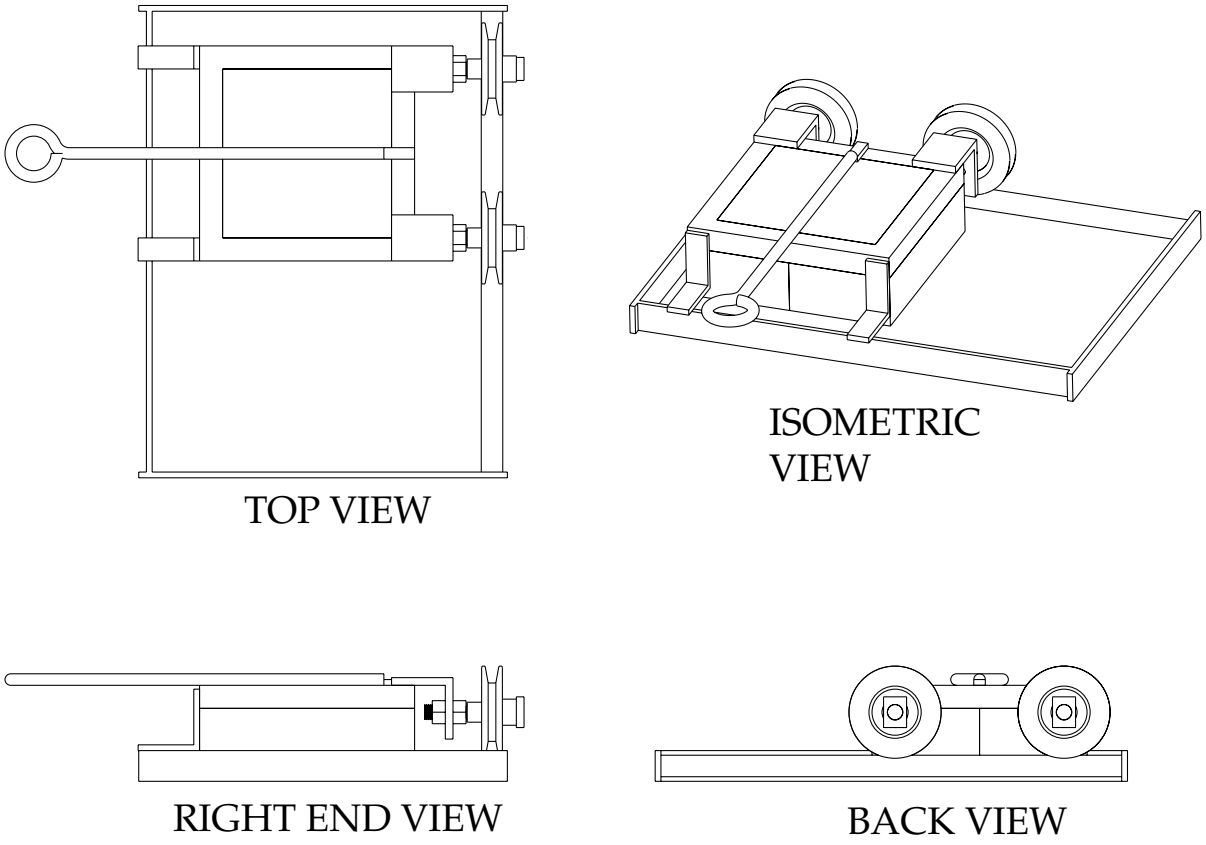


FIG. 24 Three views of the door and rack system and an isometric view. The frame or rack is positioned on the furnace and its elevation above the furnace determines the space between the door and furnace lip. When used as a foundry furnace the space should be set at 1/8″ but with a glass furnace it should be raised to maybe 3/16″ or even 1/4″ depending on how sloppy you are. In all cases the right leading edge of the door will always be a little open to act as a flue for the furnace. On minimum combustion the door will be open about 1/4 of an inch, but on full tilt it will need to be open to maybe 1/2″ or even 3/4″ depending on your combustion requirements.

There are two main parts to the door– there is the door made of IFB mortared into an iron frame on wheels, and then there is the rack/rail on which it rolls along. Figure 24 shows the larger picture of these components. The pulley parts are shown in detail in figure 25. You will be able to purchase these components at most hardware stores. The pulleys are standard V-belt pulleys. For years I made these with what was called idler pulleys which had an internal set of ball bearings which ran smooth in the cool state, but under the stress and heat of service they would sometimes freeze up. Now I just use pulleys and make sure there is at least 20 thousandths of an inch clearance between the pulley and the shaft on which it turns and it is a lifetime guarantee these will not freeze or fail in any way. Select a size that revolves nicely over a bolt. And assemble according to the general plan in figure 25. The angle iron tab (***c***) is welded to the door frame (***b***). To assemble this door you will need to do a little arc welding and light machining, like drilling [there is a hole in tab (***c***) where bolt (***g***) is mounted]. One part shown in the assembly is a spacer (***e***). I have made these out of small sections of pipe, or you may have to do a little lathe turning if you have that skill. When the rack is finished you will have to attach it to the furnace body with a brace or bracket not shown. Enjoy.

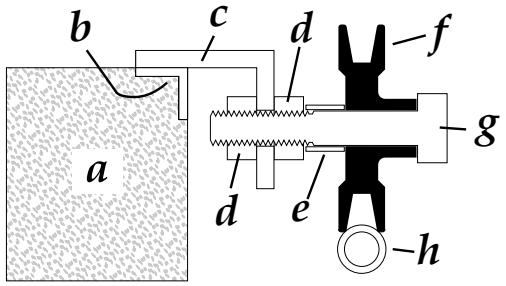


Fig. 25 Sectional drawing of the pulley roller wheel for the door, an inexpensive, lightweight solution. The parts: The IFB door (***a***) is mortared to the angle iron door frame (***b***). Angle iron brackets (***c***) are welded to the door frame (***b***). The pulley assembly which rotates around a bolt (***g***) is attached with nuts (***d***) to bracket (***c***). Spacer (***e***) regulates the distance between the pulley (***f***) and the first nut (***d***). The pulley (***f***) has both lateral and rotational clearance of about 20 thousandths of an inch. The pulley travels tangentially along a 1/2″ conduit pipe (***h***).

Project Two: A Mini-Glory Hole with 6" Opening

This is probably the most complicated of the three projects because it is not just thrown together like the Murphy fire bucket discussed in the first paragraph of "New Ideas for the Use of Small Burners in the Glass Shop, Foundry, Pottery, and Smithy." What we are going to build here is a quality piece of studio equipment which will be around for many years to come. The core of this piece is based on the decagon and will use ten G-26 IFB for the main glory hole shape. To make our cuts we will need to build a miterbox of sorts which contains our angles. And we will need to use a Swedish saw blade to cut the brick and a rasp to clean up the work.

The inside of the glory is going to be 7.5" inches wide with a main opening of six inches. This will give us a 3/4" retainer lip which is helpful for keeping some heat in the glory. Figure 26 shows a sectional view of the project and figure 27 shows the angles we will need to cut in the IFB.

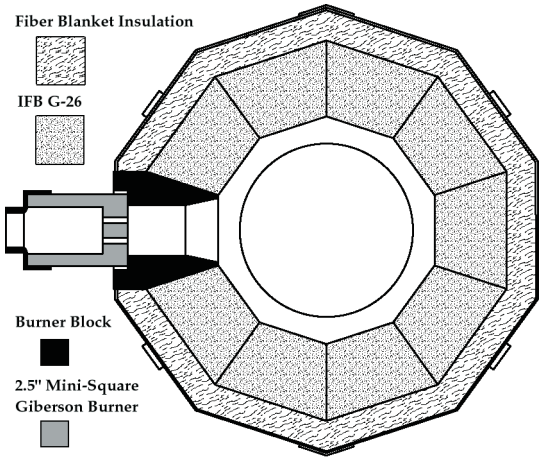


Fig. 26 A sectional drawing through the burner port of our glory hole project showing the I.D of 7.5" with a 6" door opening. the depth of the glory is 9 inches. The IFB liner is backed with an inch of fiber blanket.

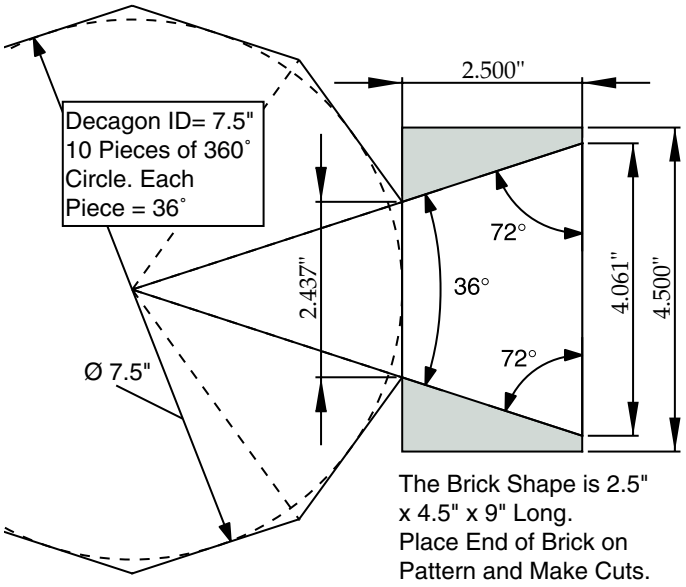


Fig. 27 How to derive the angles of a 10 sided glory hole with an ID of 7.5". This information can be built into a miterbox to facilitate the cutting of the brick, see fig. 28.

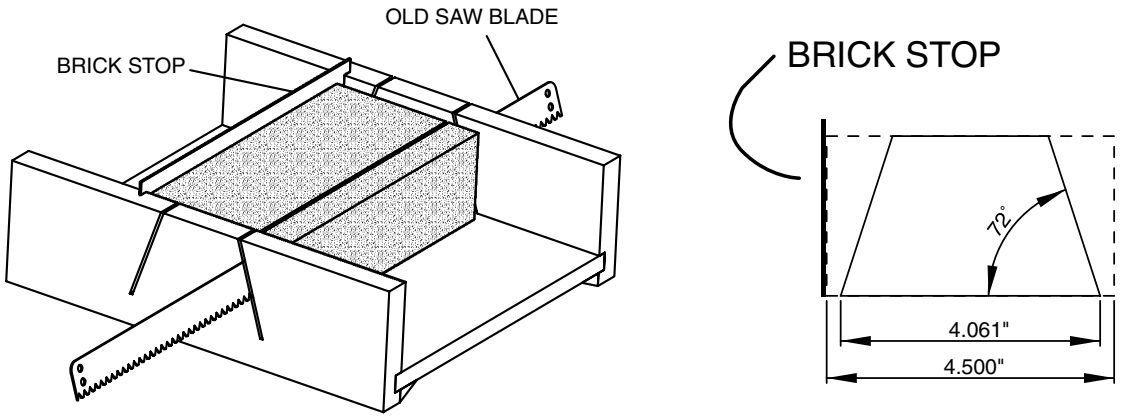


Fig. 28 Miter box containing the 72 degree edge cut for our liner bricks shown in figure 26 and 27. Build this out of 1" x 4" white pine. Accuracy is key to making this a one time success. The blade can be an old saw, a Swedish pruning saw or an old hack saw blade.

The Burner Port For The Decagon IFB Glory Hole

This little burner port is just about as complex as you'd ever want to make. I made my burner port mold from used pine boards. This provides a challenge to reuse pieces of wood from other projects or from stuff I find at the town dump. The external parts of this burner port fit into the same bunch of bricks we have already cut with the 72° angled edges. It is pretty much a matter of drawing the angles on a couple of boards and cutting them out with a band saw and nailing or screwing them together. Figure 29 shows the burner block in four views and figure 30 is a similar drawing of the mold.

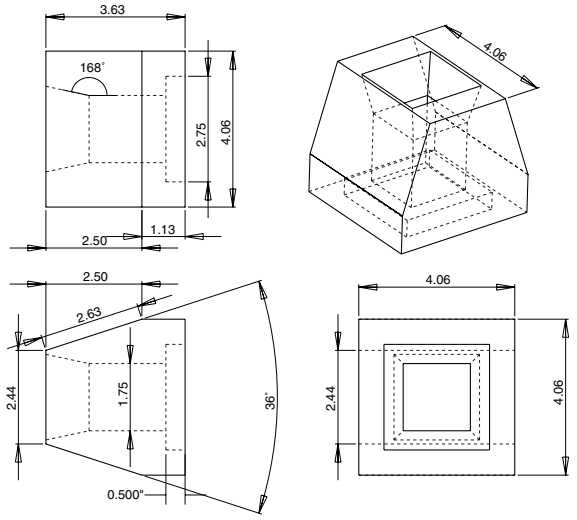


Fig. 29 Four views of the burner block used in our decagon IFB glory hole. This object can be cast in mold shown in fig. 30.

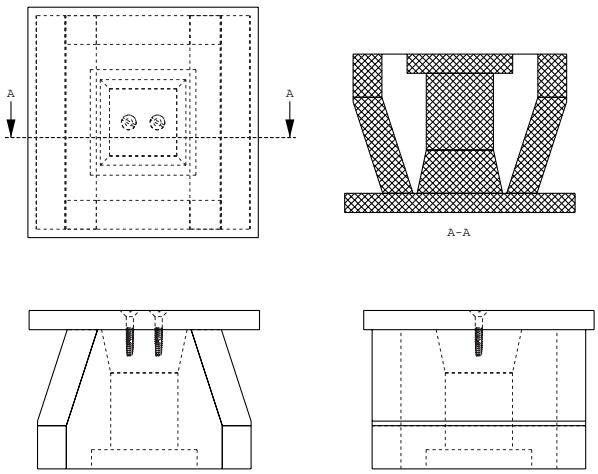


Fig. 30 This mold is made of pine boards. The core shown in the center of the mold is made of styrofoam.

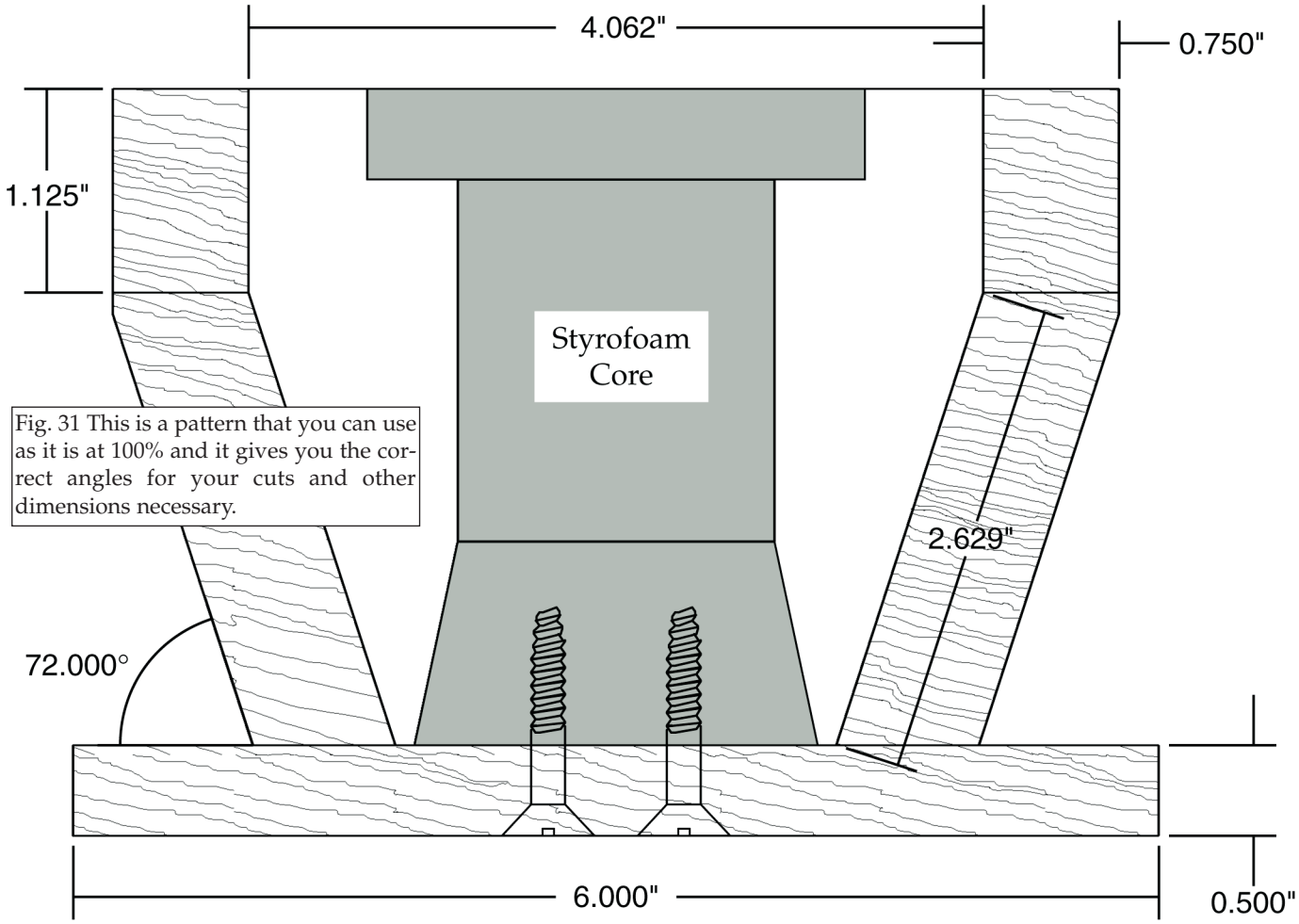


Fig. 31 This is a pattern that you can use as it is at 100% and it gives you the correct angles for your cuts and other dimensions necessary.

Our next step is to make a drawing of the external shell and the interior pattern for the liner bricks and lay this all out on the workbench. Bind the liner bricks with cotton string which will make it easier to work around without knocking things out of place. The string will burn out later when the glory is fired to temperature. With the use of a metal break and shears, manufacture the shell section. The shell is made in two sections so each half of the shell will have four bends of 144 degrees each. Work on it until the five surfaces match our pattern on the workbench. If you don't have a metal break you can make a primitive one using 2 x 4 s and a piece of angle iron. Clamp the work on the bend line and with your hands push evenly on the metal. For this piece I would use 18 gauge aluminum which will bend easily enough for this technique. If you overbend simply bend it back a bit. By carefully working with the metal and the pattern you should be able to make a close approximation of the target shape.

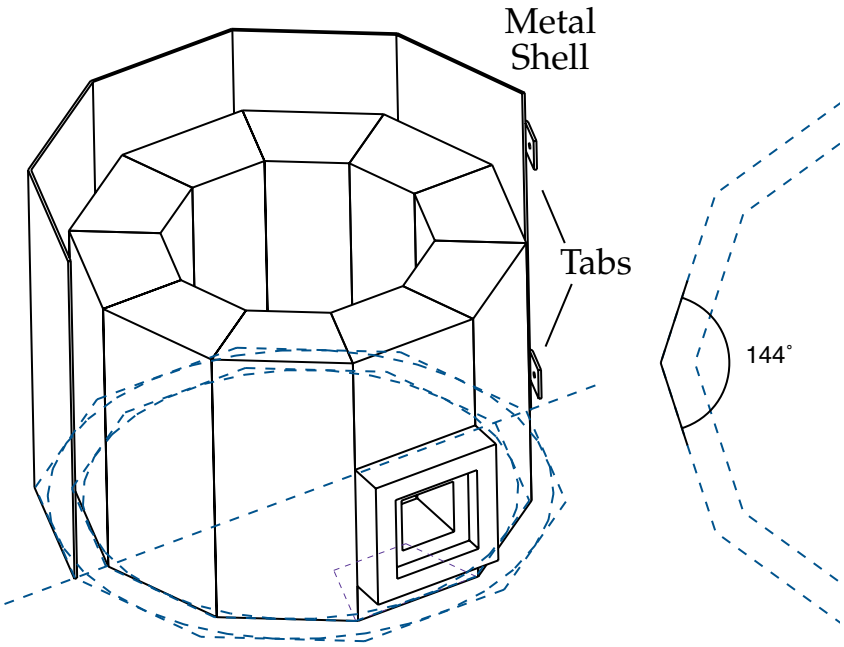


Fig. 32 Begin assembly of the glory hole by marking out a pattern on the workbench. Place the liner bricks including the burner block on the design. Leave a one inch space around the liner bricks for fiber blanket insulation. Bend the sheet metal to fit the drawing. Finally rivet tabs onto the shell sections and after installing the blanket insulation, screw the two shell sections together.

The burner block side is just a little bit more difficult to make as you have to replicate what you have already done for the first side but then you will have to cut a hole in the shell to accommodate the square burner block. Always cut the hole after the bending otherwise it will not bend correctly. There are a number of ways to cut the hole. The easiest is to use a nibbler which starts with a pilot hole. To make it cut nice and straight you need to clamp down a guide . Radio Shack sometimes sells a panel nibbler for under ten dollars. That works really well and you build hand muscles at the same time. Another method is to use a square hole Greenlee punch for the corners and use hand shears for the parts in between. After the burner port hole is cut, rivet tabs onto both halves (see "tabs" in figure 32 above).

At this point you are ready to install the fiber blanket. This is cut to fit up to the top of the bricks, like 9" wide. Test putting the shell together and if it fits loosely you will want to pack a bit more fiber into the space. This can be done by pulling layers of blanket apart so you have thin sections of blanket about 1/4" thick and maybe 6" x 6" square. This will make good stuffing. When you are satisfied the shell is full, screw it together (I recommend using at least a #10 s.m. screw.)

The next part of the project is to add a couple of inches of fiber blanket on top of the liner bricks. This will be the back end of the glory hole. Over this put a ten sided metal end cover with tabs as shown in figure 33. Once all this is screwed together it is ready to turn over so you can work on the retainer ring for the front of the glory. We are now a good bit past the half way point.

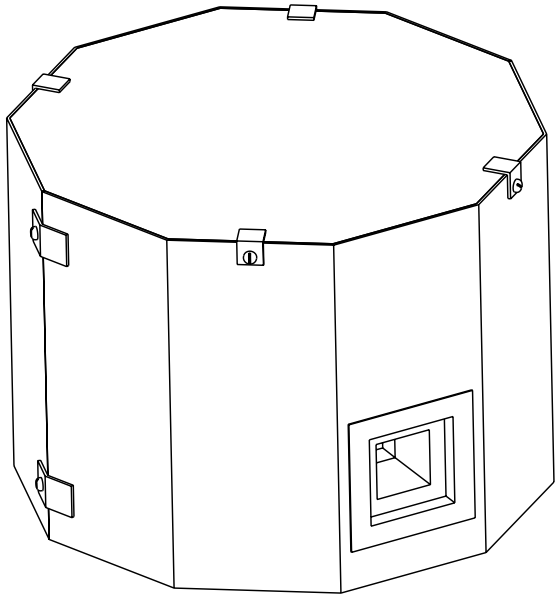


Fig. 33 After filling the shell with fiber blanket the metal end shell is screwed into place. Notice the burner block protrudes through the shell-

Designing A Base For The Glory Hole

I have designed a couple of bases for this unit. The first one was very wasp like, skinny in the middle and made it all look a bit top heavy. So probably the better approach is to make a base nearly as wide as the top so visually it would look more secure. The most direct approach is to make a simple table and set the glory onto the table using a set of adapter bars as shown below in figure 34. This makes a very strong connection between the glory and the table top.

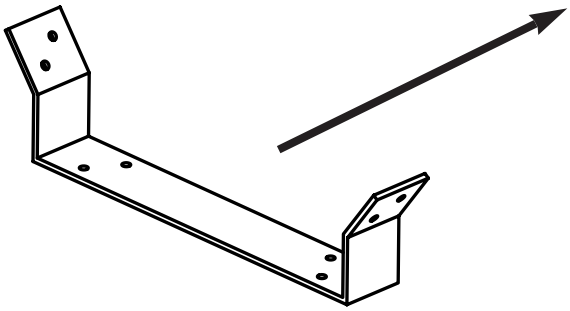


Fig. 34 This is a connection brace used to firmly attach the glory hole drum shell to the table top base structure. This is made of 16 gauge sheet metal.

The height of the table should be adjusted to your height and comfort. Much like a kitchen counter the pleasant experience of preparing food can be absent if the counter top height is a mismatch for you. Too low or too high and you have a sore back every time you prepare dinner. The rule of thumb I have used is to make the lowest point on the door opening about an inch higher than your belt buckle. Of course other things such as the length of your arms should also be considered. Perhaps build the glory up to the point shown in figure 35 only place the glory on a temporary pile of cinder blocks and bricks to get the perfect height for you. Then build your table to reflect this information.

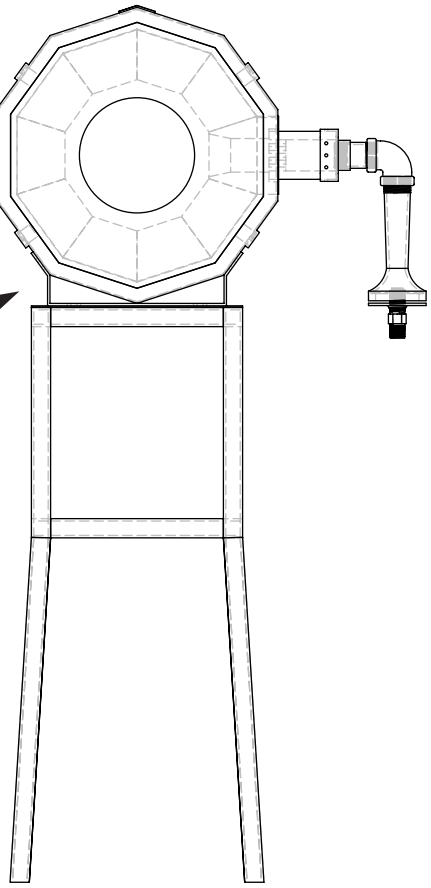


Fig. 35 The glory hole is attached to the base table structure using a pair of connection braces shown in figure 34.

The next part of the project is to make the door system which is in two parts: one is the rail system for the door to travel on and the second is the door. First I will address the design of the rail. I have found the perfect material for the railing which is 1/2" electrical galvanized steel conduit. Years ago I would use something like 1/2" CRS (cold rolled steel) but there is a hugh weight difference as the conduit is light as a feather and strong. If this is going to be moved around, this could be an important consideration. Again this door system is similar to what we have built in project one, only with a little different orientation– here the door is hung vertically. In figure 36 we have a side view of the door in position illustrating the major parts of the project. I have made this style door for many furnaces and glories; it holds up remarkably well over time. The door is made of Kast-o-lite 30 cast into an angle iron frame that is backed up with a wooden mold (see an example of this technique in *A Glassblower's Companion*, page 29, figure 2-19). After the door is cast the other metal parts are welded or bolted to the door frame.

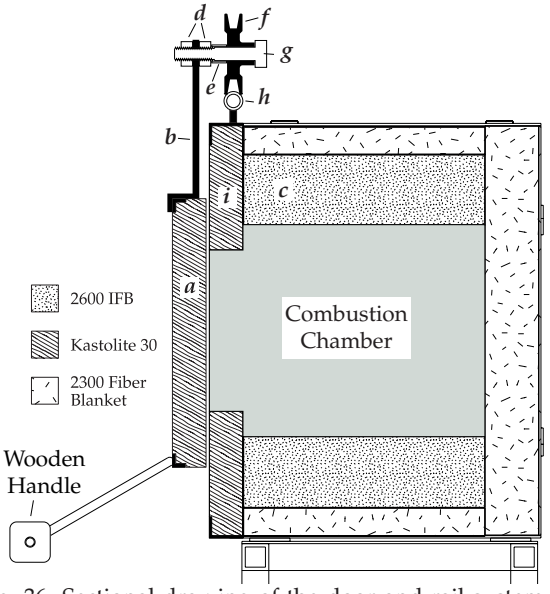


Fig. 36 Sectional drawing of the door and rail system. The parts as shown: The movable door (***a***) is hung by a metal bar (***b***) to the pulley assembly. The pulley (***f***) rotates around a bolt (***g***) and is attached with nuts (***d***) to bar. Spacer (***e)*** regulates the distance between the pulley (***f***) and the first nut (***d***). The pulley (***f***) has both lateral and rotational clearance of about 20 thousandths of an inch. The pulley travels tangentially along a 1/2" conduit pipe (***h***).

The Finished Product

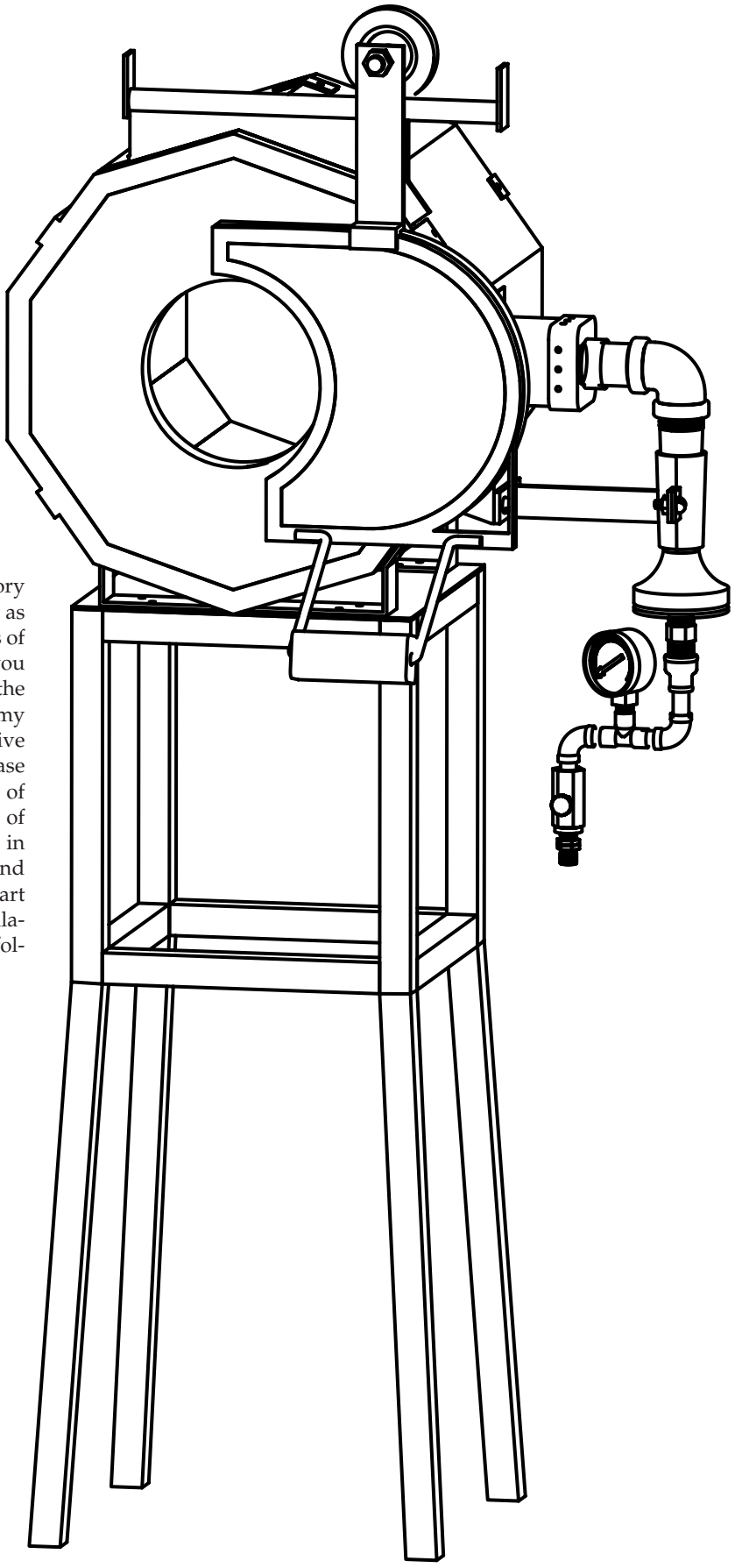


Fig. 37 Here is the finished 6 inch glory hole. It is a stout little beast and efficient as well and will perform for you many years of hard service. As you look at this design you may imagine the door opening from the other side or other types of changes. Be my guest. This design is meant to be suggestive only. When constructing **your** glory please reread the burner block section, page 5 of this paper and also reread pages 3-8 of "New Ideas for the Use of Small Burners in the Glass Shop, Foundry, Pottery, and Smithy" as that is the most important part of the Mini-Square Giberson Burner installation. If you get that idea, success will follow.

Project Three: A Mini-Updraft Kiln at .633 cf

The size of this kiln is rather arbitrary and I have chosen these dimensions as I am using it to burn out molds for my mini foundry project. This will also work for burning out wax for glass casting molds and for firing ceramics. The size of the chamber including the firing box below the first shelf is 9″ x 9″ x 13.5″ for a total of 1093.5 cubic inches or .633 of a cubic foot. In this particular unit the firebox takes up about 1/3 of the space. I mated this kiln with the 2″ Mini Square Giberson 7/32 x 13 head and a V100 with a #72 orifice. The first time I used this kiln I burned off wax from a bunch of castable refractory castings. We went from room temperature to 1700 degrees over 5 hours. In all, we burned 2/3 of a gallon of propane. Few burnouts would need that high of temperature. I think 1200˚F would work for Ludo and also for plaster silica glass casting molds. You would hold it at temperature with a neutral fire until you were sure the carbon was burned out. The point is with a BBQ size tank you would have enough juice to do 6 to 10 burnouts. And while we are on the subject of how much fuel is being used I would like to mention the little bronze melting project, Project One– that used about 1/4 of a gallon of propane. So back to the BBQ tank– it is estimated that one tank (which costa about $14.00 to fill) would last you three months if you did one burnout of several molds and three crucibles melts (bronze pours) per month. That would be a very reasonable overhead for your casting pleasure.

Another really cool thing about this project ensemble is the portability factor. I am not to excited about driving around with a propane tank in my car, perhaps call ahead and have a friend locate one for your destination, but the other equipment for these mini studios will fit into the trunk of your car. This could even be a portable glass furnace, annealer, and glory hole. Anyway it is all small stuff and it is fun to think about how compact this all can be. So back to our kiln...

The basic problem with an updraft kiln is where to locate the burner entrance and how to encourage the heat to migrate upward. In this case the ware firing chamber is defined as everything above the kiln shelf and the combustion chamber is the space below. The interior footprint of the kiln is 9″ x 9″ and the kiln shelf is 7.5″ square so that leaves roughly three quarters of an inch space around the shelf for the heat to rise and move up the walls to heat the ware chamber. The object is to heat the chamber evenly. From visual observation of the firing process I could see the combustion chamber was several hundred degrees hotter. As the firing moved along I softened the burner flame and introduced a little secondary air into the ware chamber. In the end though the firing chamber was hotter, the ware chamber looked remarkably even in temperature. Perhaps a shelf of 7″ square or even 6.5″ would promote a more even heat between the combustion chamber and the ware chamber but the results were terrific and the burnout was a total success.

The ideas expressed here are to get the wheels turning. Changes come with experience and experimentation, but nothing happens until you actually build something. So this project is what I call a sacrificial lamb and its purpose is to get the party started. If you are interested in making improvements on the design, please read Frederick L. Olsen, *The Kiln Book, Third Edition,* Chapter 6 Updraft Kilns. Every change you make will make a difference so keep good notes.

The burner port is at the very bottom and is dead center on one wall shooting across to the opposite wall just under the floor shown in figure 26 as the "kiln shelf." Our burner set-up is facilitated by the use of a burner block. Please use the burner block idea as it produces a vastly superior mounting system for this little burner.

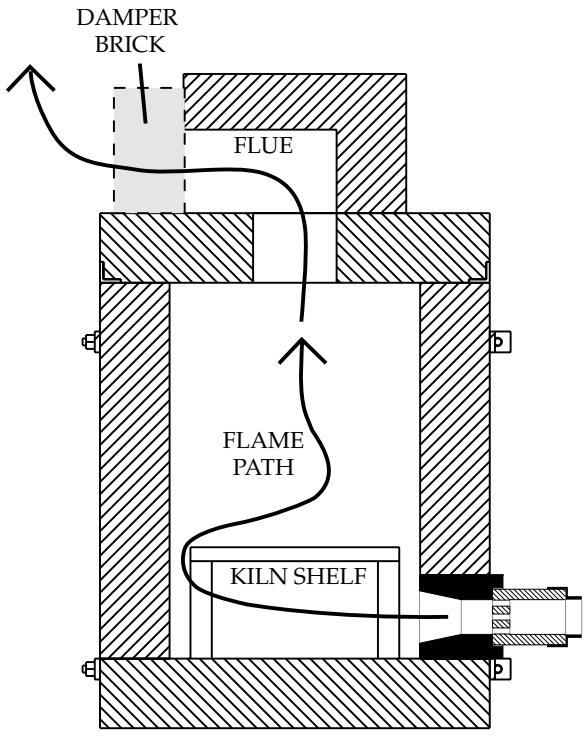


Fig. 26 A sectional drawing of the simple updraft kiln. This kiln design can be used to burn out wax molds for foundry work or glass casting and it can be used to fire ceramics. The overall height is 13.5″ from floor to ceiling. The firing chamber is 9″ by 9″ by 10″ or 810 cubic inches. Draft is controlled by the use of a damper brick. Secondary air can be introduced through small holes in the soft brick walls which are kept plugged when not in use.

The Mini-Updraft Kiln

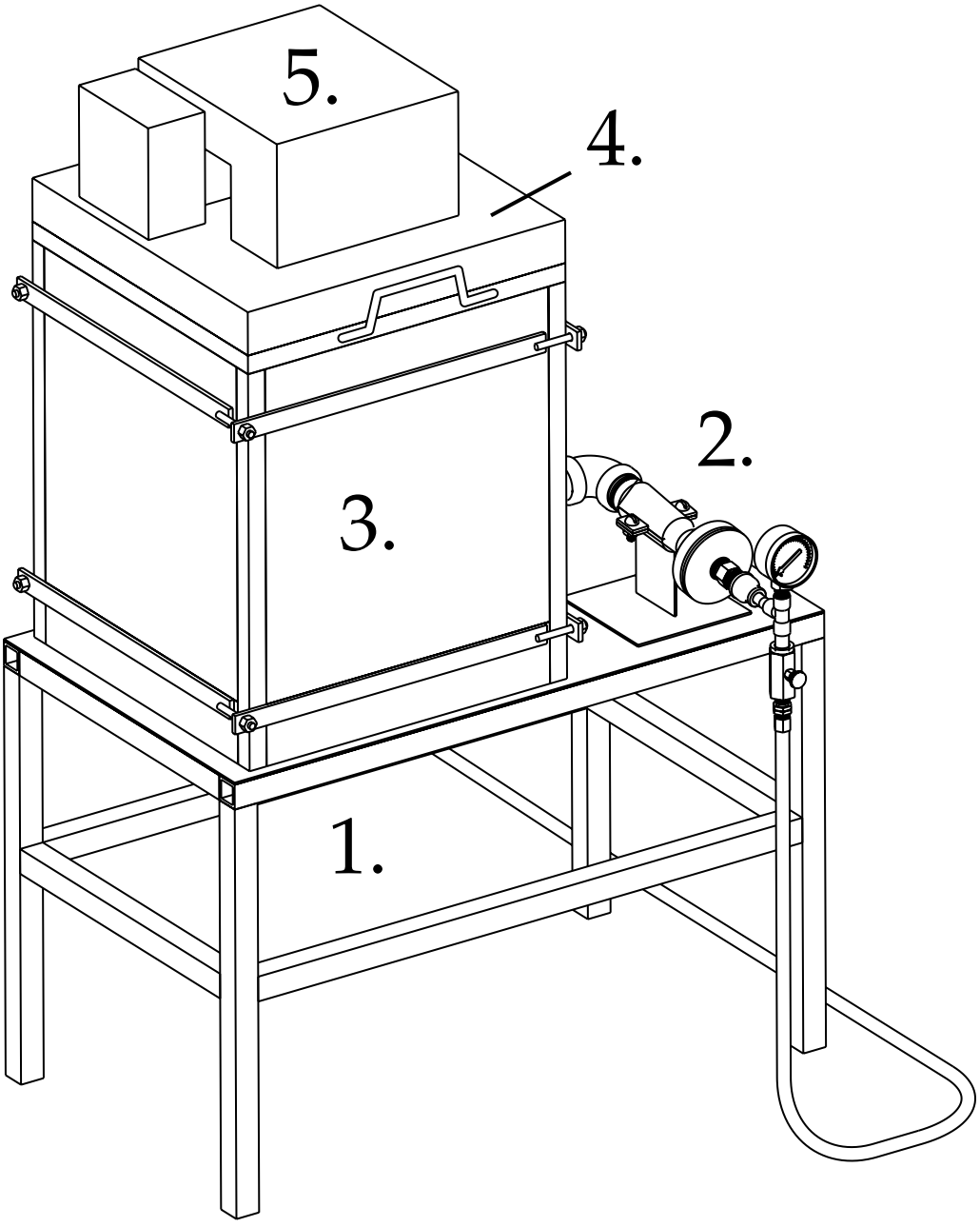
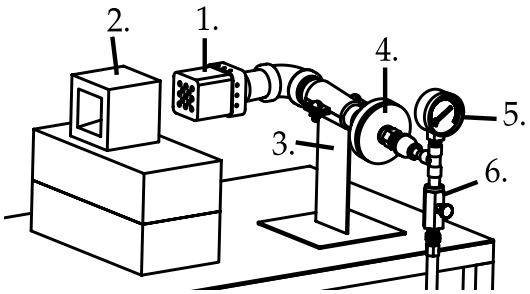
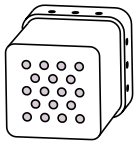
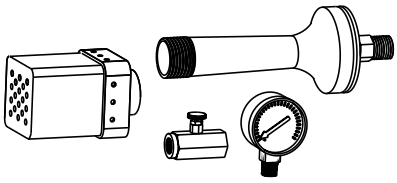
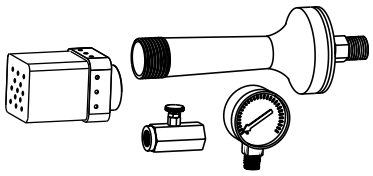
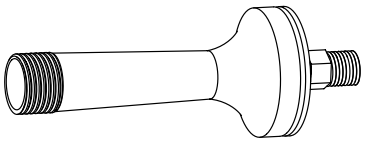
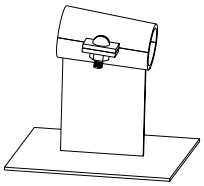
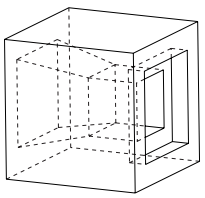


Fig. 27 A three dimensional view of the Mini-Updraft Kiln. There are five main parts to this kiln project: **1., The Table Base**; **2., The Burner System**, a 2" Mini-Square Giberson with a Ransome V100 Venturi with #72 orifice, with a needle valve and gauge; **3., The Kiln Body** with outside dimensions of 14" x 14" x 16" tall made of 21 pieces of G-26 IFB; **4., The Crown**, made of 5 G-26 IFB; and **5., The Flue System**, made of 4 or 5 pieces of G-20 IFB.

Components For Sale:



Related Items for Sale
1. Mini Square Giberson Burner Head (2 Models)– $125.00 and $145.00.
2. Burner Block– 2 Models – $30 & $35
3. Burner Stand– $75
4. V100 Ransome Venturi Mixer– $199.50
5. 0–30 P.S.I. Gauge– $16
6. Needle Valve– $23

Image of Items	Description	Price
	2.5″ Mini Square Giberson Burner (18 HOLES 7/32)	$145.00 ea
	2″ Mini Square Giberson Burner (13 HOLES 7/32)	$125.00 ea
	**The 2.5" Mini Square Kit:** Includes one 2.5" Mini Square Burner Head ($145.00), One Ransome V100 Venturi Mixer ($199.50), One Needle Valve ($23.00), One Gauge 0–30 p.s.i. ($16.00), **Total value of $383.50 (A savings of $20.50)**	Kit: $363.00
	**The 2" Mini Square Kit:** Includes one 2" Mini Square Burner Head ($125.00), One Ransome V100 Venturi Mixer ($199.50), One Needle Valve ($23.00), One Gauge 0–30 p.s.i. ($16.00), **Total value of $363.50 (A savings of $21.00)**	Kit: $342.50
	This is the **Ransome V100 Venturi**, an Air/Gas Mixer for high pressure propane. This is a very high quality venturi with a nicely machined air baffle with superior quality brass spud and orifice.	$199.50
	**Burner Stand at 6 Degrees** . This is the type of burner stand used in Figure 18 of this paper. It is made of 16 gauge sheet metal and painted gray. Fits the Ransome V100 also shown above .	$75.00
	Cast **Mini-Square Burner Block**. Made of 100% High Grade Castable Mizoo or better 3000˚F Plus.. This is a precision casting made to fit your 2″ or 2.5″ Mini-Square Giberson Burner Head	Fits the 2-1/2″ Head $35.00 Fits the 2″ Head $30.00

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