The Rumford Compromise

A Safe Modification For Victorian Fireplaces

by Jim Buckley

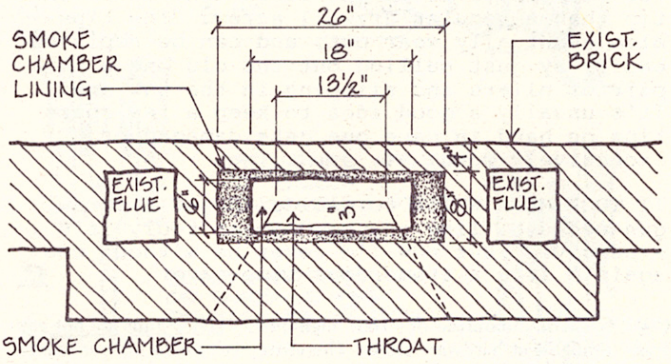
WHEN WE BOUGHT our 1880 house, its five coal-burning fireplaces were all in terrible shape -- and that's including the ones that hadn't been bricked up or used to vent gas space heaters in the bad old days when our home was a rooming house. Our insurance agent looked things over, shook his head, and wrote a special clause in our fire policy, one that voided it if we used the fireplaces.

THE NEXT FEW YEARS were very frustrating. Fireplaces dominated every room, and it offended us that they weren't functional. To make them safe and bring them up to modern building codes, they'd have to be made deeper, which meant obliterating the original hearths and plaster mouldings above the mantels.

THAT OPTION was unacceptable to us. There seemed to be no way out, until a friend of mine brought me The Collected Works of Count Rumford. I read it, and in a blinding flash I had the solution: Rumford fireplaces. They're tall, graceful, and above all shallow. They'd fit perfectly within my fireplace openings; all I'd have to do is change the insides of the fireboxes.

COUNT RUMFORD, an American, developed his fireplace in England around 1795. He understood that fireplaces produce radiant heat, and came up with a design to take advantage of that effect. His fireplaces were shallow, with widely angled covings and light-colored masonry materials. He experimented with the shape of the throat "to find out and remove those local hindrances which prevent the smoke from following its natural tendency to go up the chimney."

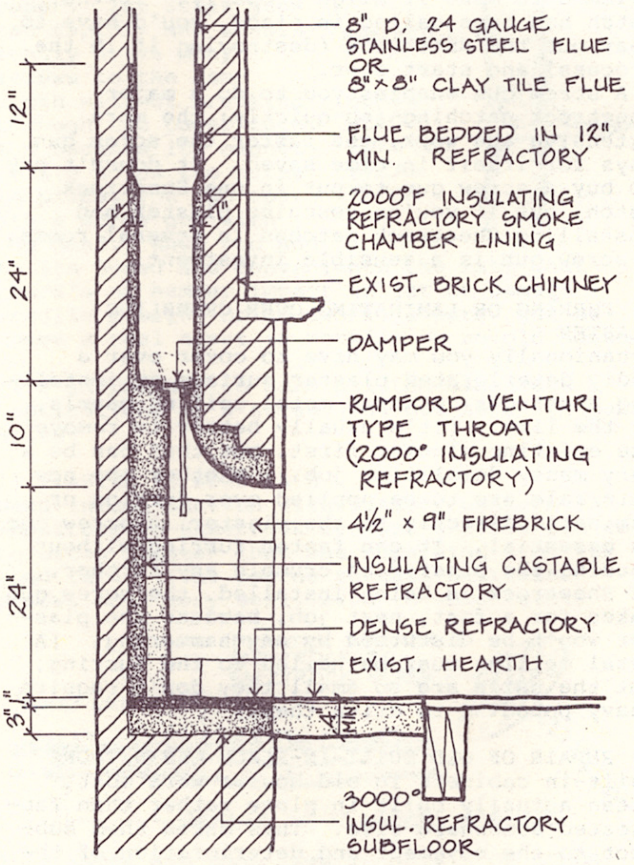
RUMFORD ROUNDED THE BREAST and reduced the size of the throat to a narrow slit. The throat is streamlined, measuring only about 1/20th the size of the fireplace opening. It forms a nozzle through which the smoke and air flow at an increased speed, and acts like a check valve against backdrafts.



PLAN ABOVE DAMPER

"We live in an 1880 vintage Queen Anne Stick-style brick Victorian Italianate house, if you can imagine that."

THE ACCEPTED AUTHORITY for fireplace design today is the American Society of Heating, Refrigeration, and Airconditioning Engineers Handbook. This book states that a modern fireplace requires a flue at least 1/12th the size of the fireplace opening. If a damper is



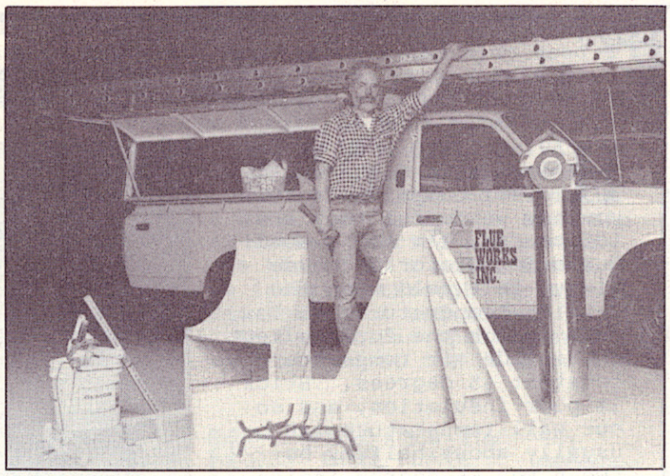
SECTION

used at the throat, the ASHRAE Handbook recommends it be twice as big as the flue -- that's about four times as big as a Rumford throat. No wonder modern fireplaces are inefficient: With their square lintels and sharp angles, they have to be deep and have gaping, oversized flues to keep them from smoking.

How To Rumford-ize A Fireplace

THE MORE I READ RUMFORD'S WORKS, the more convinced I became that they offered the definitive fireplace design. So I went ahead and built a Rumford in my house. I've since done many more, and want to share what I've learned with the readers of OHJ. Construction requires several refractory materials that are not commonly used by homeowners or home-improvement contractors, but they're generally available from firms such as Plibrico and A.P. Green. I use a 2000-degree, insulating castable refractory cement for casting the throat and smoke chamber, and 3000-degree refractory for some fireplace subfloors. I've found that I can mix refractories in a 5-gallon plastic bucket, using a 1/2-inch drill with a drywall mixer blade. It pours easily with the aid of a metal scoop.

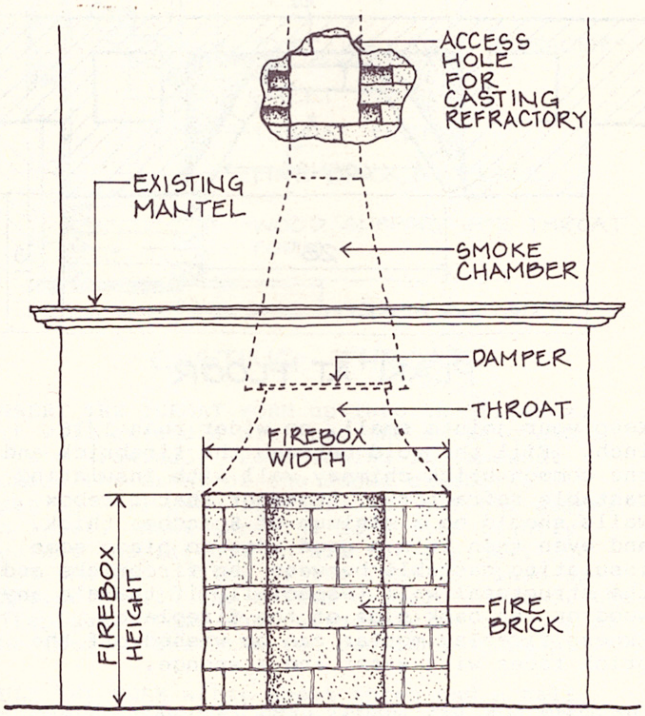
I ALWAYS DIG OUT the firebox floor and replace it with 3000-degree castable refractory. Refractory cement is made in a wide range of insulating capacity and density -- the more insulating capacity the cement has, the softer it is. So, if there's any wood within 4 inches of the hearth extension, I pour a fireplace subfloor of softer 3000-degree refractory cement, then pour a denser refractory floor over that. The finish floor of the fireplace needs to be relatively hard, because it will be subjected to such abuses as pokers and falling embers.



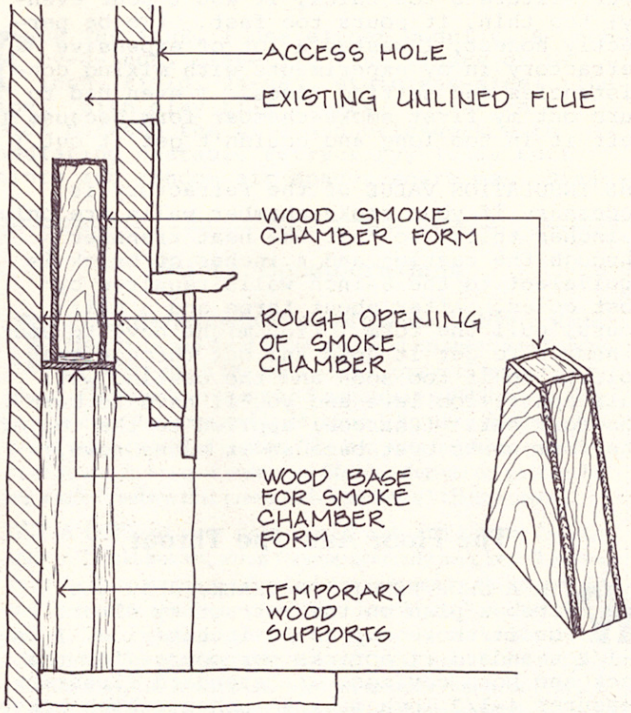
Author Jim Buckley poses with the tools for the job. Left to right: half-inch drill with drywall mixing blade, bucket of refractory mortar, throat form with wooden blocks, firebrick and grate, smoke chamber form with bottom and legs, and 8-in. stainless steel flue pipe with metal-cutting saw.

POUR THE SMOKE CHAMBER NEXT, because you have to be able to get the form out the bottom. My plywood form is fitted to the inside of the firebox; it is about 18 inches wide at the base, 24 inches high, and 6 inches deep. It forms 1-inch-thick front and back walls in an 8-inch rough smoke-chamber opening (a standard size here in Columbus). A platform that just fits the rough opening (usually 8 inches by 24 inches) holds the form in place on wooden legs, 10 inches above the firebox lintel.

USING THE METAL SCOOP, pour the 2000-degree, insulating refractory through a hole in the wall, located just at the top of the form. The mixture has to be wet enough to fill voids, but not so wet as to compromise its



ELEVATION



SETTING SMOKE CHAMBER FORM

Life With Rumfords

HAVING LIVED with Rumford fireplaces for a while, I feel compelled to tell you how wonderful they are. (Of course, I'm not biased!) Our brick Victorian house always felt cold when the outside temperature was low, even though the furnace kept the inside air temperature a constant 65 degrees. Brick is poor insulation, and so our wall temperature was usually about halfway between the 65-degree inside temperature and the cold outside temperature. When it got to be zero outside, the walls would be only about 35 degrees, and we'd feel cold.

RUMFORD first articulated the concept of radiant heat: "One must never forget that it is the room that heats the air, and not the air which heats the room." In other words the radiant heat from the fireplace heats people and surfaces such as the wall across the room. Supplementing our heat with fireplaces that warm us directly and keep our walls warmer, we now can feel comfortable even at 60 degrees. It's like being in the sun on a 60-degree spring day. It feels warm, but step into the shade -- or in this case, the next room -- and 60 degrees feels cold.

PEOPLE OFTEN want to compare fireplaces with stoves. Stoves are basically air heaters, so you rely on convection to help heat adjoining rooms, or you can use fans to circulate the warm air much like a warm-air furnace does. Fireplaces, however, heat only what they 'see'; you can't pump 60-degree, warm air to help heat a 60-degree, cool adjoining room. On the other hand, you can't lose radiant heat through infiltration or convection.

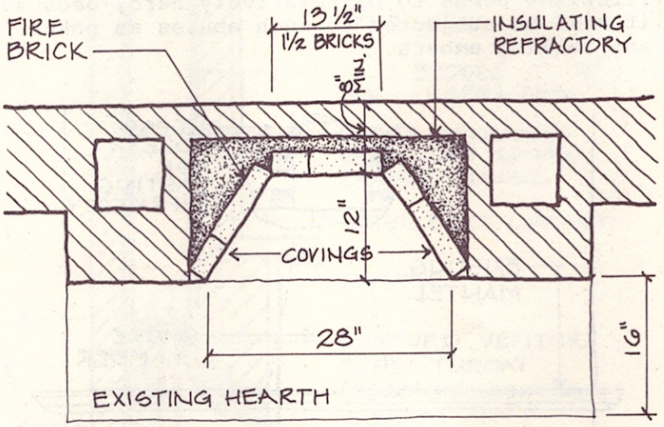
SO IF YOU LIVE in a big, drafty brick house with high ceilings, and the kids and cats are going in and out all the time, a Rumford or two (or five) may be the secret to preserving your wintertime comfort.

strength; try making it just a little too wet to make a ball and hold in your hand. The material should be just barely pourable: If your mixture's too thick, it won't pour evenly; too thin, it pours too fast. (To be perfectly honest, I wasted a lot of expensive refractory in my experiments with mixing consistencies and setting times. I even had to burn out my first smoke-chamber form because I left it in too long and couldn't get it out.)

THE INSULATION VALUE of the refractory is necessary if your smoke-chamber walls are only 4 inches thick, so that the heat transfer through the casting and 4 inches of brick is equivalent to the 8-inch walls required by most codes. After about three and a half hours, pull the form. (You might have to use a hammer to get it down and out through the hole.) Do it too soon and the casting will fall apart; too late and you'll have to burn the form out. (Charcoal applied to the top of the form works best because it burns down.)

The Floor And The Throat

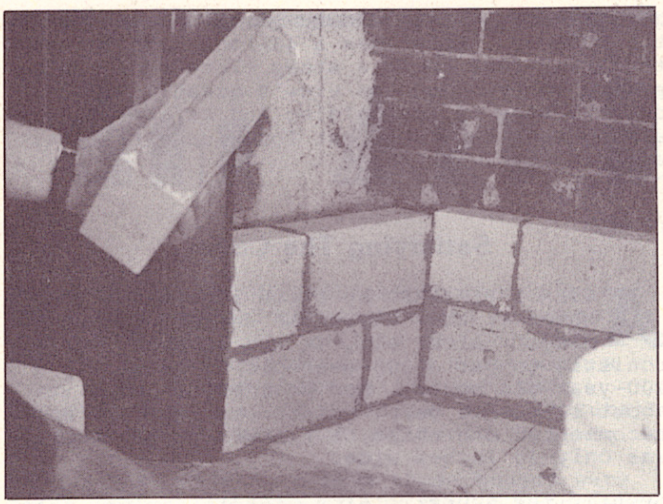
WITH A SHOP PENCIL OR CHALK, draw the firebox plan on the refractory floor. For fireboxes up to 28 inches wide, I use 1-1/2 standard firebricks per course for the back and both covings. (A standard firebrick measures 4-1/2 inches by 9 inches, which makes each course 13-1/2 inches long.) Using a level, lay the firebrick with fireclay mortar.



PLAN AT FLOOR

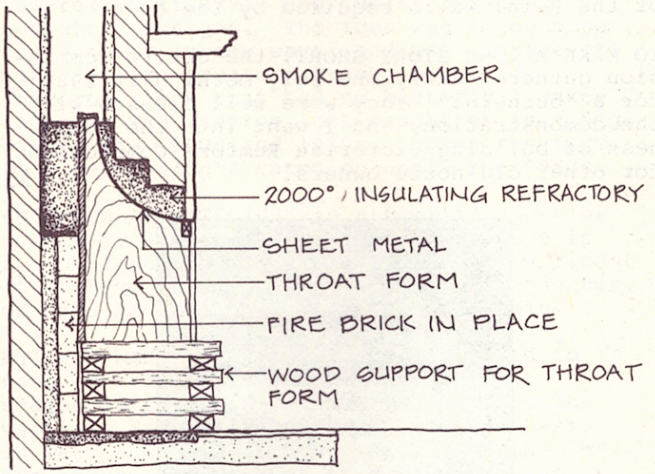
Keep your joints small, no wider than 1/16 inch. Fill the void between the firebrick and the common brick chimney wall with insulating castable refractory. Remember that firebox walls should be a minimum of 8 inches thick, and even then it's a good idea to place some insulating castable between the firebricks and the structural wall (especially if there's any wood on the back side of the fireplace). Excess fireclay mortar can be washed off the brick faces with water and a sponge.

THE FORM FOR THE THROAT uses 24-gauge sheet-metal for the curved part. (Construction of this form is time-consuming because of the



The firebox requires only 1½ firebricks for each course. Note the thinness of the joints; the excess fireclay mortar will be washed off after the firebox has been completed.

relatively complex geometry.) For the smallest part at the top, the throat must be 1/20th of the area of the fireplace opening. For a 20-inch-wide fireplace with a 13-1/2-inch back, the throat is 13-1/2 inches wide by about 2 inches deep. For a 28-inch-wide fireplace (still with a 13-1/2-inch-wide back), the throat is 13-1/2 inches by about 3 inches. The form must also be short enough so that when its supporting platform is taken away, it can be dropped down about a foot and removed.

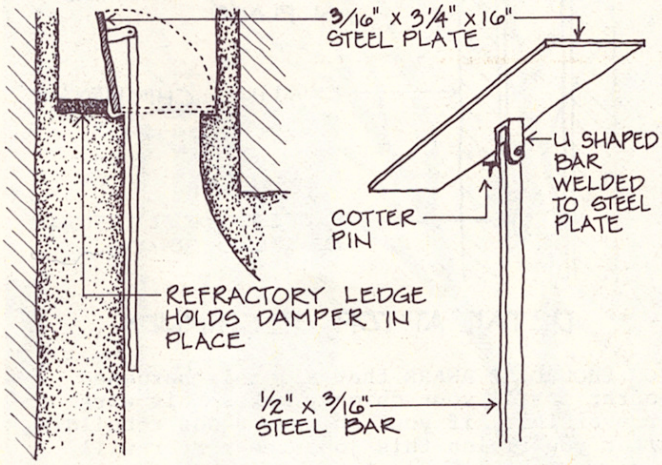


CASTING THROAT

INSERT THE THROAT FORM up into the firebox. (It will extend a bit into the smoke chamber -- see drawing.) Positioning it somewhat toward the front of the smoke chamber's opening will make it easier to get the damper in later. Make sure the form fits tightly against the firebox on all three sides, and that the the bottom of the form is lined up precisely with the bottom exterior edge of the fireplace. Pour the refractory to the top of the form so that the two castings overlap.

PULL THE FORM after about three and a half hours. Sometimes it's hard to get the refractory to fill the entire breast area, or it fails when the form is removed. But it usually can be patched with the same refractory, using a trowel. The casting may also need a little cutting and trimming with a trowel to make a smooth transition with the firebox and to make sure the throat is well formed.

MAKE A DAMPER out of a 3/16-inch-by-3-1/4-inch-by-16-inch steel plate; fasten a steel bar handle to it with a cotter pin. (You can also have a metal worker fabricate a conventional damper, one hinged to a metal frame). The damper can be inserted through the throat and a mortar ledge formed of refractory cement, so that the damper can open up and back, as if it were hinged at the back to the smoke shelf.



DAMPER DETAILS

Flue Facts

FOR THE FLUE, I use either modular, 8-inch-by-8-inch, clay-tile flue liners or 8-inch, rigid, 24-ga., stainless-steel flue pipe. With clay-tile liners, I like to fill voids between the tile and brickwork with insulating castable refractory; leaky butt joints and random air spaces scare me. Stain-

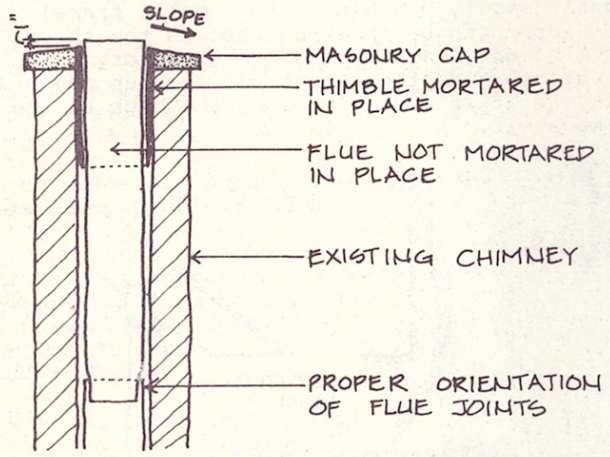
Safety Considerations

THERE are three national model codes in the United States. Most state and local codes are based on them, and they're all pretty much the same when it comes to masonry fireplaces. They aren't written with Rumfords in mind (because they require deep fireboxes and large throats), but they should be followed in safety-related matters. The law, your insurance coverage, your house, and maybe even your life may depend on your building a safe fireplace that meets code and gets a building permit.

GET A COPY of your state or local code and become familiar with it. In old houses, wood framing generally isn't kept 2 inches away from chimneys, as is now required; smoke-chamber walls and sometimes the firebox walls and hearth aren't as thick as required. The original gas-burning fireplaces in some houses are totally unsafe for woodburning. (I have found wood joists running into the flue, tile hearths laid right on wooden floorboards in the firebox, and paper and wood trash behind the masonry.)

– Jim Buckley

less steel makes an excellent flue because it's smooth and round, and has lapped joints. Just make sure you get the male ends down so that any creosote dripping down the pipe stays inside the flue. As an added precaution, because wood framing is often right up against old chimneys, I pour insulating castable refractory around the outside of the pipe, filling the voids.



DETAIL AT TOP OF CHIMNEY

YOU SHOULD BE AWARE that all this hardened mortar inside your chimney makes this work irreversible; if your chimney needs rebuilding after you finish this job, the mortar will have to be chipped out by hand -- a nearly impossible job. Whichever liner you use, fit it to the top of the smoke-chamber casting through the pour hole, brick up the hole, and pour more refractory from the roof (or the upstairs fireplace, if available), seating the flue at least 1 foot deep in refractory.

I'M VERY FAMILIAR with insulating castable refractories, and I don't use the poured flues that are currently being franchised under various names. Most unlined chimneys here in Ohio are only one-brick-square (8 inches by 8 inches), and I need an 8-inch flue. A poured flue wouldn't have sufficient wall thickness to have structural integrity; besides, I'd have to pour the refractory overly wet to make sure I didn't have any voids in such a thin casting.

I ALSO DON'T USE flexible stainless steel because it's much thinner and more expensive than rigid pipe. Most bends in old chimneys occur so downstairs flues can go around upstairs fireplaces, but you can usually gain access to these bends through the upstairs fireplace opening by taking out part of the side of the firebox. Stainless-steel flues should be riveted together with stainless-steel rivets.

WE BROKE A FEW mortar caps because the stainless-steel flue pipe expands when it gets hot. So now we use a standard 8-inch thimble as a sleeve. Run the flue pipe through the sleeve and mortar the sleeve to the brickwork. Saw off the stainless-steel flue pipe about 1 inch above the masonry cap, so you don't see it from the street. Cut the stainless steel with an electric circular saw with a metal-cutting composition blade.

YOU CAN USE A CLAY CHIMNEY POT to finish off the chimney. Sometimes a 40-foot-high chimney that's 12 feet above a steep slate roof can be pretty scary. But the view's great! Figure out the type of scaffolding and safety harness arrangement that's safest for your situation, and use it.

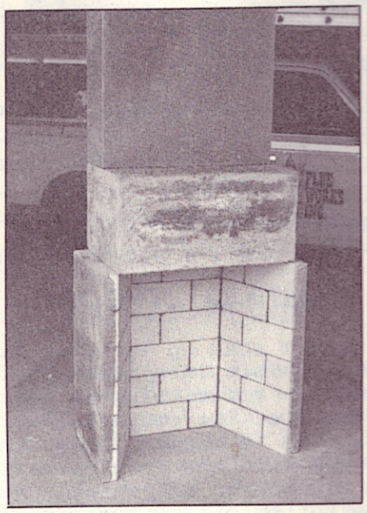
Satisfying The Codes

AFTER I FINISHED my first fireplace, I named it the "Victorian Rumford Compromise." After all, it was somewhat anachronistic to put a 200-year-old fireplace in a 100-year-old house. And besides, I built it about 12 inches deep, rather than Rumford's recommended one third of the width, because it was only 20 inches wide.

DESPITE THE BENEFITS of Rumford's design, most building codes require fireplaces to be 20 in. deep. I did some research and learned that this requirement was adopted in the 1940s, more or less arbitrarily, as a guide for the builders who rarely had engineers or architects designing their fireplaces.

TO GET the required building permit, I had to appeal to the Columbus Building Regulation Commission. First I had to satisfy them that I understood the code and that my fireplace complied with all the safety-related issues. Then I argued the differences in the Rumford design, showing that the heat transfer through my insulating, refractory-lined smoke chamber and 4 inches of brick would be as safe as that of the 8-in. walls required by the code.

TO MAKE A LONG STORY SHORT, the entire Commission gathered early one July morning in 1982 for a "burn-in." They were well pleased with the demonstration, and I went into the business of building Victorian Rumford Compromises for other old-house owners.



Since writing this article, Jim has begun building modular components of the Rumford fireplace in his shop, to reduce the time and labor required for installation. Now these all-masonry Rumford components (firebox, throat with damper, & smoke chamber) can be custom built and shipped with detailed installation instructions to contractors and homeowners anywhere. Call or write Jim Buckley at Flue Works, Inc., 86 Warren St., Columbus, OH 43215. (614) 291-6918.