

Buckley Rumford Company

## RUMFORD...

The Fireplace That's More  
Like It Used To Be Than  
Ever Before

*by Jim Buckley*



Rumford fireplaces are more popular now than at any time since 1850. The traditionally tall Rumfords look appropriate in today's popular, classically designed homes with tall ceilings. The legendary heating efficiency of the Rumford is attractive to those who are building energy efficient homes and are concerned about air quality.

Building codes across the country have been changed, where necessary, to permit the tall and shallow Rumford fireplaces. The biggest clay flue liner company in the country, Superior Clay Corporation, in Uhrichsville, Ohio, is manufacturing Rumford fireplace components and marketing them through masonry building materials dealers nationally. A California brick manufacturer, McNear Brick, is testing Rumford fireplaces for heating efficiency and emissions in a test lab set up by Dr. Dennis Jaasma of the Virginia Polytechnical Institute.

Rumfords used to be very popular in this country when people heated their homes with fireplaces. Thomas Jefferson built Rumfords at Monticello, and George Renick (who introduced shorthorn cattle to Ohio in the 1790s, creating Route 22 in the process) built them in Chillicothe, Ohio. By 1854 Henry David Thoreau, in *Walden*, listed Rumford fireplaces along with plaster walls and Venetian blinds among the comforts taken for granted by civilized man. By mid-century everyone had Rumfords and the word "Rumford" was synonymous with "fireplace."

Trouble was not all Rumfords were equal. There were variations and interpretations of what constituted a Rumford fireplace right from the beginning. Jefferson wrote a couple of letters and made some drawings in an effort to improve the Rumford design, but he didn't seem to understand streamlining (or "pneumatics" as Rumford would have put it) and neglected to round



Rumford wrote two essays detailing his improvements on fireplaces in 1796 and in 1798. He was well known and widely read in his lifetime, and almost immediately in the 1790s his "Rumford fireplace" became state of the art worldwide.

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## Why Rumford Fireplaces Work

Rumford understood that the only useful heat generated by a fireplace was radiant heat. The air that the fire heated was mixed with smoke and went up the chimney. So he made a fireplace that had a big, tall and wide opening and was very shallow with widely splayed covings or jambs to reflect as much radiant heat out into the room as possible.

Rumford wanted to "reflect" the heat directly out into the room. He saw no advantage of absorbing the heat and re-reflecting it. Heating up the firebox only served to heat the air that came into contact with it which just was lost up the chimney. He advocated plastering and whitewashing the firebox to keep it clean and reflective. He was vehemently opposed to cast iron firebacks because they only absorbed the radiant heat and got hot which in turn heated the air which was mixed with the smoke and was lost up the chimney.

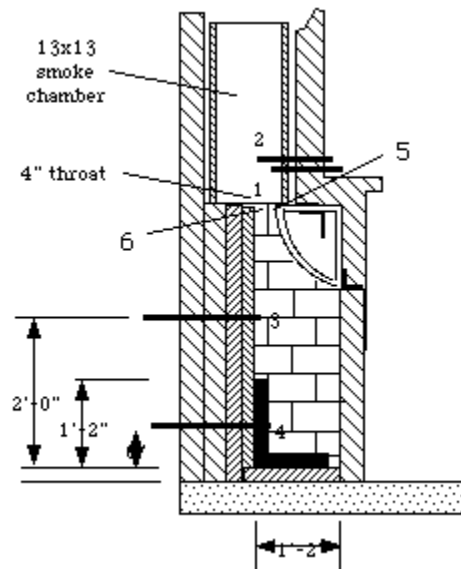
Modern physicists, familiar with Planck's Law, argue that what really happens is that the firebox, whether it's whitewashed or not, does absorb heat and re-radiates it out into the room. There isn't a significant difference between whitewashed plaster and soot-covered brick, they say, in the infrared range. Both are pretty good "black body radiators."

Whatever. The objective remains to reflect or re-radiate as much heat out of the face of the fireplace as possible. It doesn't hurt to whitewash the firebox or to insulate behind the firebrick. It does hurt to cover the opening with glass doors, which cut about 80% of the infrared radiation.

Tall, wide shallow fireplaces tend to smoke. The other half of Rumford's genius is his intuitive understanding of fluid dynamics - way ahead of his time. By rounding the breast to "remove those local hindrances which forcibly prevent the smoke from following its natural tendency to go up the chimney..." he essentially created a venturi, a nozzle, like an inverted carburetor, that shot the smoke and air up through the throat into the receiving smoke chamber.

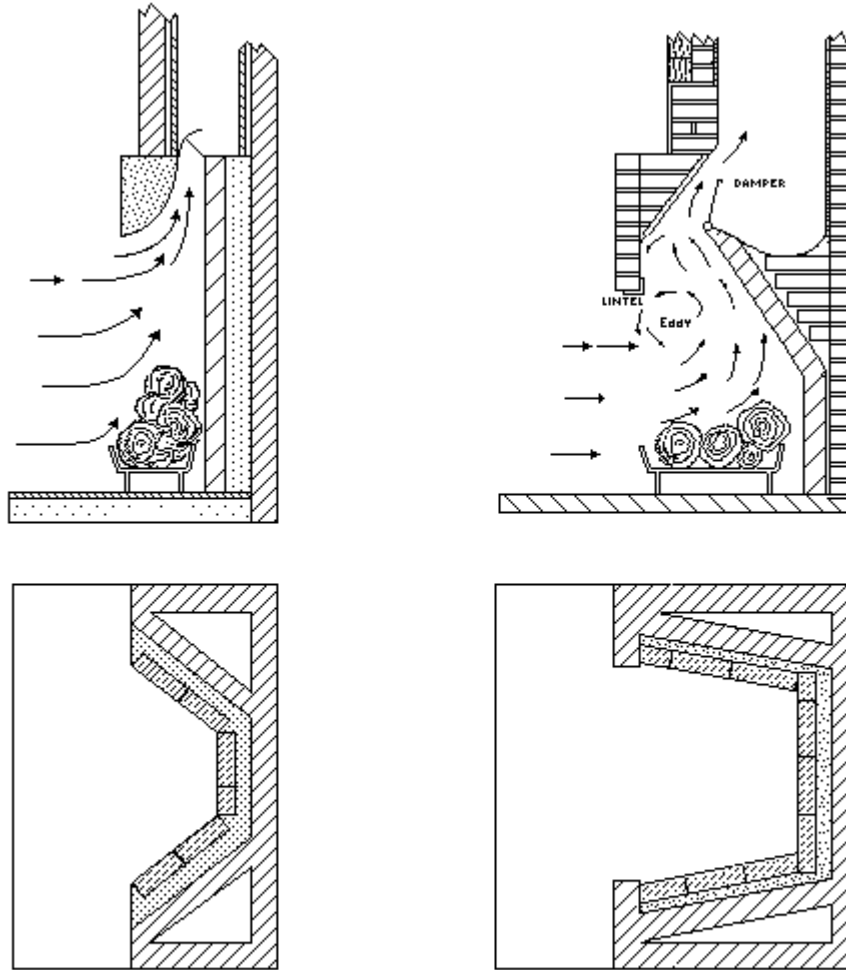
Rumford may not have known how ingenious his "rounded breast" really was. In our testing at McNear Brick we built a Rumford fireplace studded with thermocouples just to see what the temperatures were at various places. We wanted to see if the flow through the throat was laminar, so we placed two thermocouples at the narrowest part of the throat, one near the curved breast (5) and one a couple on inches farther back near the fireback (6). To our amazement, with an established 1700 degree F fire, we recorded only 75 degrees F near the rounded throat at 5, and, only two inches away near the back at 6, we recorded 730 degrees! The flow through the throat certainly is laminar. The room air coming in over the fire doesn't mix with the hot

products of combustion, but goes up with them through the throat. It's like a sheet of clean room air that acts like an invisible glass door to keep the smoke behind it as they both go up through the throat together.



This revelation has even more interesting implications. Most engineers who are trying to come up with clean-burning designs to meet EPA emission standards assume it can't be done with an open fireplace because the excess (or dilution) air mixes with, and cools the gasses too much to achieve secondary combustion. What we've found is that the excess air doesn't mix turbulently with the products of combustion in a Rumford fireplace with a streamlined throat. The products of combustion stay isolated and hot behind the sheet of clean room air. Because the Rumford firebox is tall, the gasses driven off the fire in a Rumford fireplace stay hot for a long time - long enough to attain secondary combustion. We've found that the Rumford burns cleaner yet if we place the firewood on end, leaning against the fireback, tipi style. Smoke typically pours out of the ends of the logs as they get hot and, in a log cabin style fire, some of this smoke finds its way around and over the fire into the flue. In a tipi style fire, however, the smoke coming out of the ends of the logs stays in the fire and gets burned up. Tipi fires raise the height of the fire taking advantage of the tall Rumford firebox. The "residency time" (the time the smoke and volatile gasses are in the fire) is increased and so the smoke is burned up, the fire gives off more heat and burns cleaner.

Most masons, used to building modern fireplaces, have trouble believing a Rumford will draw until they see it happen. The rules are different. In a modern fireplace the fireback is usually sloped or rolled forward casting the products of combustion forward. The incoming room air spills over the sharp edge of a steel lintel and mixes turbulently with the smoke. Most masons will tell you that you need to "cross over" or drop the lintel about eight or nine inches below the damper to create a pocket for this smoke and in-coming room air to "roll" or the fireplace will smoke.



### RUMFORD FIREPLACE

### MODERN FIREPLACE

(Adapted from Rumford's 1795 Plate Nos. 3 & 14) (From 1979 ASHRAE Equipment Handbook)

Of course all this inefficiently turbulent rolling smoke and air needs a huge throat to get through. By keeping the fireback straight and rounding the breast to get streamlined air flow instead of turbulence, we can build Rumford fireplaces with openings almost a foot taller than regular fireplaces and with throats less than half the size of a modern fireplace. No wonder Rumfords are more efficient. They radiate more heat and waste less heated room air to carry away the smoke. If you think that's amazing try to imagine how much horsepower it would take to ram a small airplane through the air with a square wing. Believe me, it helps to round off the corners of the wings.

Rumford devoted Chapter II of his 1796 essay on fireplaces to "Practical Directions designed for the Use of Workmen, showing how they are to proceed in making the Alterations necessary to improve Chimney Fire-places, and effectually to cure smoking Chimneys." Essentially, it's laborious and anyone can read it for themselves. Rumford apologizes to his readers "for having been so very particular in these descriptions and explanations, but it must be remembered that this chapter is written principally for the information of those who had few opportunities of employing their attention in abstruse philosophical researches..." Suffice it to say Rumford's

method is to get the basic shape right, with a plumb bob and a special device he suggests for marking out the 135 degree angle for the covings. His masons built with brick or stone and plastered the surfaces to make a clean reflective surface and used plaster to round off the breast.

Because Superior Clay Corp. has been so successful in manufacturing vitrified clay Rumford throats and smoke chambers I think one of the footnotes in Rumford's 1796 essay is especially interesting:

"I have of late been much engaged in these investigations, and am now actually employed daily in making a variety of experiments with grates and fireplaces, upon different constructions, in the room I inhabit in the Royal Hotel in Pall Mall; and Mr. Hopkins, of Greek Street, Soho, Ironmonger to his Majesty, and Mrs. Hempel, at her Pottery at Chelsea, are both at work in their different lines of business, under my direction, in the construction of fireplaces upon a principle entirely new, and which, I flatter myself, will be found to be not only elegant and convenient, but very economical. But as I mean soon to publish a particular account of these fireplaces, with drawings and ample directions for constructing them, I shall not enlarge further on the subject in this place."

Rumford never did publish the results of these experiments. Even though he wrote another essay on fireplaces two years later, in 1798, and had the opportunity to discuss these experiments in his essay on Kitchen Fireplaces, he never did. From the difficulty Superior Clay had in manufacturing a big Rumford throat that wouldn't warp or crack in the drying and firing process, I suspect Rumford's potter was unsuccessful. Our "potter," the Superior Clay Corp., may have only just accomplished what Rumford envisioned two hundred years ago.

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