Significant Features of Rocket Mass Heaters

1. The emphasis is on **human comfort**, not on heating a building.

2. The Rocket Mass Heater has two conjoined parts: The Combustion Unit, which burns briefly but very hot, and the Thermal Battery, or heat storage in a heavy mass, where it can be released when needed for hours or days after the fire has gone out.

3. The insulated high-temperature chimney / afterburner, which generates the draft to supply combustion air, is inside the stove itself.

4. The firewood stands upright and burns at its bottom end only, feeding the stove by gravity as it falls into the fire.

5. They offer extraordinary efficiency, both in extracting heat from the fuel and in delivering heat for use when and where it is needed.

6. They are easy to construct from inexpensive materials, without special tools.

7. They have the capacity to push heated gases through long horizontal passages in floors, beds, or benches.

8. Note the concept of separating the Combustion Unit from the use of the heat so produced, and particularly, storing that heat for hours or days in inexpensive built-in furniture.

9. By attaching the Rocket Stove to a heat storage device, we are able to soak up the heat from the exhaust gases and store it while the stove is burning, then release it slowly as needed, over quite long times (and long after the fire has gone out).

Combustion & Heat

HOW WOOD BURNS

The air we breathe is about 20% oxygen. Oxygen is super-reactive and combines at the right temperature with almost anything and burns it, releasing heat. Different materials catch fire at different temperatures. For instance, phosphorus burns just by exposure to air at room temperature, but steel needs to be heated to thousands of degrees to burn. When wood is first heated, the lignin and cellulose that comprise most of its bulk break down into a wide range of simple to complex chemical gases. When each reaches a certain temperature, it ignites and burns combining with oxygen and producing flames, in a process known as *combustion*.

Watch a piece of firewood throughout its burn cycle, from when heat is first applied all the way to ash. First (a), you'll notice steam and pale visible gases squirting out as they reach boiling point inside the wood. Then (b), there will be smoke, blue or grey or sometimes black, difficult to breathe, smelling toxic (it is). Gradually (c), as the outer parts begin to glow, the smoke catches fire. Then finally (d), glowing coals, no smoke, no big flames, only little blue ones as those coals burn.

You just watched (a) the wood heating up and drying out, and (b) the volatile oils boiling out as cellulose and lignin *pyrolyze* (break down under heat) into other chemicals, hundreds of them. The charcoal that remains begins to glow as it too burns (c), giving off carbon monoxide (CO). When conditions are hot enough, the smoke catches fire with long yellow flames, turning itself into carbon dioxide (CO_2) and water vapor, and of course also giving off heat. When (d) the smoke is all gone, coals remain, glowing. Those short blue flames you see are the CO burning and thus bonding with oxygen to create CO_2 and produce again more heat.

If there is not enough oxygen, combustion will be incomplete, producing smoke and CO and, of course, less heat. The same happens if the burn zone is too cool. Campfires often smoke at first for lack of heat, but they also smoke if you restrict their airflow with wet leaves or by shoveling dirt on, etc. The perfect stove has just enough oxygen, dispersed through the smoke gases, and a high enough temperature that everything burns down to only water vapor, CO_2, *heat,* and a little ash.

Given the notoriety of CO_2 as a greenhouse gas, people are sometimes shocked to hear that the Rocket Stove generates CO_2—yet any woodstove, even burning cleanly, will produce CO_2, as will a coal-, oil-, or gas-burning power station, or a car using gasoline. But the cleaner we burn wood, the less wood we need, because we're burning it more efficiently, thus creating less CO_2. To be responsible, we need not *to stop* burning hydrocarbon fuels, but *to reduce* their use. This is a good reason not only for clean-burning woodstoves but also for smaller houses, passive solar homes, snugger spaces, heating our bodies directly by contact, and not heating anything that we don't need to—empty parts of the house, or the atmosphere, for instance.

For a detailed, readable further discussion, see *The Woodburner's Encyclopedia* or *Heating Your Home with Wood* (see Recommended Books).