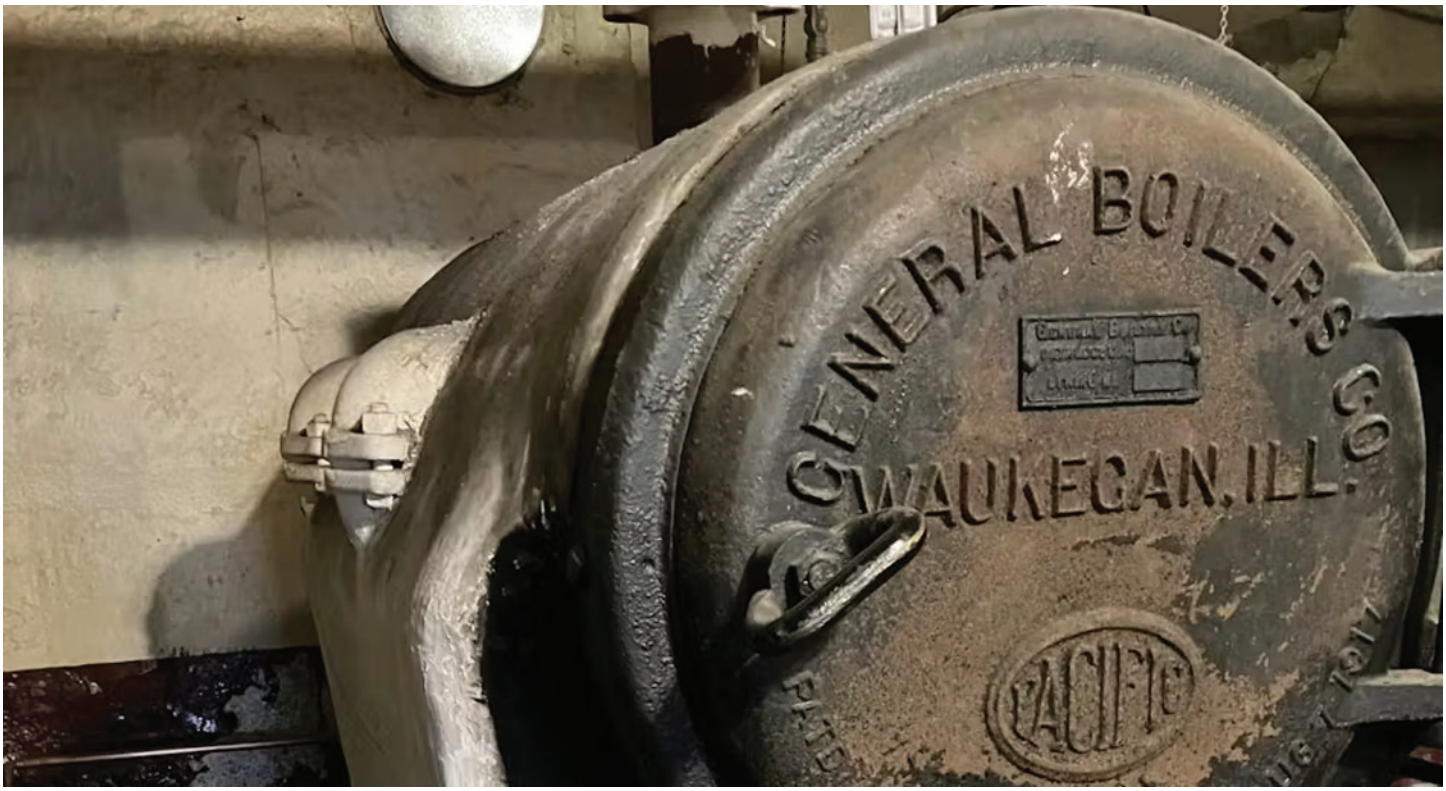
Hydonics & Radiant



A coal boiler that perhaps only saw occasional use–Patrick Linhardt explains.

Manual Modulation and Hydronic History

A hands-on homeowner experimenting with burner adjustments helps illustrate some timeless hydronic heating concepts.

Patrick Linhardt

Key Highlights

- A historic coal boiler vs. a modern gas boiler, comparing their shared history and operational differences
- The concept of modulation, from manual stoking and draft control, to modern automatic modulation
- Details about the construction, patent history, and dual-fuel capabilities of early boilers illustrate the evolution of heating technology

Within a couple of days I saw both of these boilers. **Photo 1** is a coal boiler, when it was being used. **Photo 2** is a gas boiler, always used since the day it was installed back in the 1940's or so when it probably replaced the original coal boiler that was there from the beginning, or about 1920.

I took pictures of both, not knowing if I was going to use them for the column, thinking each had a story to tell. It was weeks later, even before the deadline approached, that I came to the realization that they shared some commonality.

Sizing Things Up

I made it up the drive, up the porch steps, and down the basement steps on my crutches at the house with the gas boiler. At the time, I was under orders to not put any weight on the leg. Currently, I'm walking in the boot without crutches and two weeks away from getting rid of the boot.



Photo 1

The homeowner and a couple of guys from the heating contractor were there. One guy was upstairs measuring the installed radiation, since one of the reasons I was there was to help decide which size boiler would be right.

The homeowner (full disclosure) is an engineer and was explaining how he could predict what size he needed by some measurements and calculations to his gas usage. I'm not smart enough to understand exactly what he was doing, but when I calculated the installed radiation, our estimates weren't that far off.

Changing Times, Changing Demands

The radiation figure was higher than the gas usage figure, which figures. Since the radiators were installed over a hundred years ago, the house's heat loss has decreased with newer high efficiency windows and some attic insulation. The radiators' potential for heat output now exceeds the heat loss of the house.



Photo 2

As an engineer, the homeowner understood this and experimented with the gas input. First, he found that the existing boiler's gas input was too high by shutting down or off some number of the gas burners, while still satisfying the thermostat. You can see the seven burners just above the gas manifold at the bottom of the boiler.

The boiler looks naked without a steel jacket, but the homeowner said it's been like that for quite a while. The light color is semi-fresh furnace cement to seal up the flue passages. He is very hands on. Boilers don't have to have a jacket, but without an insulated one, the heat lost from a cast iron block to the basement is significant.

Back to the burners, he was telling us how he comes down and adjusts them depending on the weather, or the outside temperature. He also was keeping track of the water temperature, which he told us was up to 150°F on the cold nights. The less than 180°F water temperature also figures with the now oversized radiation.

Actually, we don't know what water temperature was used in the original selection of the radiators. Designers back then used temperatures from 150°F to 180°F. Some calculated with the windows open because of the flu pandemic of 1918-1920. An unusual time in the history of central heating.

DIY Outdoor Reset

The homeowner was applying the modern concept of outdoor reset to his older boiler by controlling the gas input by manually adjusting the burners. He was pleased to learn that outdoor reset control is built into all high efficiency boilers. I think I might be spending some time with him on the phone in the future.

The boiler tech was paying attention to the conversation and called out "manual modulation." I said "Exactly". The new modulating-condensing boiler will be measuring the outdoor temp and the system water temp every few seconds and making an adjustment to the gas input if necessary, increasing or decreasing the rate of fire on a single burner.

We decided that the boiler size should be one size smaller than what someone else recommended. The homeowner was already thinking that way and two sizes down seemed to close a call.

Keeping Options Open

The reason I commented that the coal boiler in Photo 1 might not have been used all the time is the odd habit of the neighborhood and the wealth of the people who built these houses back in the early 1900's, before income taxes significantly affected one's bottom line. It was also the time when coal could be cheaper to operate than gas or vice versa, so they put both a gas-boiler and a coal-fired boiler in their new houses.

I used to think that one of the reasons to put in the dual fuel option was the potential problems with gas delivery, but you have to remember that houses of that era and before were already using gas to light their houses and cook their food.

When I asked the homeowner with the coal boiler when the house was built, he replied 1913 or so. That seemed to make sense, and he seemed pretty certain, but when we were looking at the fire door of the coal boiler, we noticed a patent applied for date of Aug 1, 1917. I'm sure that this was one of the original boilers in the house.

Its supply fed into a header. There is a gas boiler sitting just to the left that also feeds into that same header. Both supply lines have an isolation valve. There is also a return header with isolation valves to each boiler. That way, the boilers could be operated separately, or together if ever needed.

Natural Modulation

When operating, a coal boiler is naturally modulating, since the coal fire cannot be controlled exactly. It really depends on the amount of coal being stoked into the combustion chamber and the position of the draft doors, which are both manually operated. The man servant was usually in charge of keeping the coal fire going and he did it all without electric controls.

On a cold night, he probably put some extra coal in the belly of the beast, that's the lower door. The fuel gases would pass through the upper chamber. The big round door is for having access to the flue gas passes. The lever on the left was used to help clean out the ashes and clinkers.

Patrick Linhardt is a forty-one-year veteran of the wholesale side of the hydronic industry who has been designing and troubleshooting steam and hot water heating systems, pumps and controls on an almost daily basis. An educator and author, he is currently Hydronic Manager at the Corken Steel Products Co.