

Shay Fire - Burning Oil

Nelson Riedel Nelson@NelsonsLocomotive.com

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I've had no experience with generating steam so I read a lot, sought the advice of others and then ran a few tests. This page describes some of what I've learned and also describes some early tests of an oil burner nozzle.

With one exception, all the local guys I've met at the Mill Creek Central (MCC) track in Coshocton, Ohio burn coal. That's not surprising since Ohio has abundant coal supplies ---- the MCC track is located on land that was strip-mined 50 or 60 years ago. As a youth 50 years ago I witnessed the last few years of the steam locomotives hauling coal from the mines in southeast Ohio to the power plants along the south side of Lake Erie. There were several trains per day over the B&O single track that ran through my village ---- each train had about 100 cars pulled by two huge locomotives. I remember being held up at the tracks on the way to school. The strongest recollection is the immense size of the locomotives and the rails moving up and down as the trucks rolled over them.

Even though coal is abundant in the area there is a problem securing small quantities. There is no problem if one wants a few thousand tons but a 50 pound sack is hard to obtain. Coal is also very dirty. The ashes mix with the dripping water and oil into a dirty, sticky, grimy paste very similar to the deposits I find under my British roadsters (if an auto doesn't leak fluids, it ain't British). I have a board walk around the house that connects with the walkway from the basement workshop. The plan is to push the locomotive on the transporter-test stand out on the board walkway for testing. The spouse's reaction to a hole in the walk burned by hot ashes is something I don't want to experience. I've not seen any scale stokers for live steam locomotives so the operator must also shovel the coal. Being a novice, that's probably a distraction I don't need. Considering all this, I decided against coal, at least for now.

Kenneth suggests propane to fire the locomotive. I've never seen a propane fired live steamer. However, others who have think it's a great choice. It's clean and readily available. Kenneth said he built two shays at the same time, one oil fired and the other propane fired. He said the propane fired one had more power and was cleaner. The drawback with propane is that a car is required to carry the two propane tanks (I understand that dual tanks operating in parallel are required to deliver the necessary fuel without freezing. This is probably because the most economical tanks and/or regulators are designed for applications that require less fuel. I've had the regulator for my Sievert torch freeze up when using the largest burner for an extended period.) If one has a two truck shay, then an additional car is required for the engineer and that car could be used to haul the tanks. For my three truck shay, the engineer rides on the tender; I'd prefer to not have to haul another car just for the fuel.

Oil is the obvious choice in terms of size (oil tank), availability, ease of delivery (don't have to shovel) and lack of ashes. The problem with oil is to make it burn and to keep it burning. The only technique that I'm aware of to fire with oil is to mix the oil with steam to atomize the fuel. Compressed air can be used to atomize the fuel when initially building steam. The compressed air can also be used to in the blower to generate a draft when starting. A problem with oil is that the fire seems to go out from time-to-time. (This is not a problem with coal and apparently not with propane.) The flameout may be due a rapid change in steam pressure affecting the draft or the atomizer pressure. Many if not most the people who burn oil use a auto coil - spark plug combination to relight the burner after a flameout.

Randy Sutherland is the one individual I see frequently at MCC who burns oil. Randy has given me a great deal of information about burning oil, much of which is scattered through this page. The next photo shows Randy on his Mikado. The photo was taken in June of 2003. Unfortunately I was out of town in June and didn't see Randy and his Mikado in action. The photo shows three Mikados, that's Randy in front, Joe Scales on the second engine and Bruce Saylor is running the third engine Bruce's engine is also oil fired.



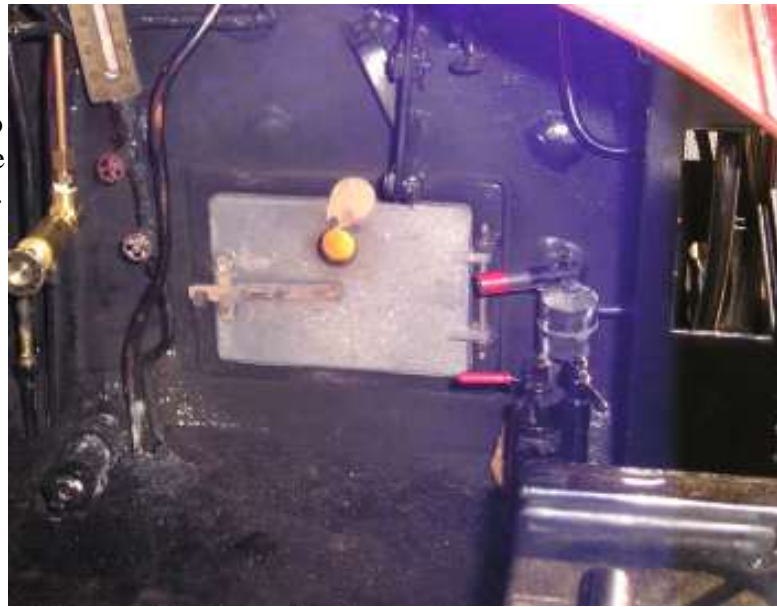
In late October I met Bruce Saylor from Pennsylvania and Dave Johnson from Virginia at MCC. Both Bruce and Dave burn oil. I had a chance to see them in operation and they seemed to run very well. I had a long chat with Dave pictured below.



Dave uses a small Clippard regulator on the atomizer line. He has a pressure gauge on the line and sets the regulator pressure to 8 psi. He has a small opening in the firebox door as shown in the photo on the right. The opening allows the flame to be observed. The hole can be covered with the little teardrop flap.

While chatting with Dave, his burner went out a couple times. He easily relit it by pushing a little switch that controlled a coil-spark plug arrangement. Unfortunately, I failed to observe the position of the sparkplug relative to the nozzle.

Dave located his fuel valve in the bottom inside of the fuel tank with the control knob on top the tank lid directly above the valve. A simple design worth copying.



Kenneth said he used the burner described by Chester Peterson in SO YOU WANT TO BUILD A LIVE STEAM LOCOMOTIVE. Bob Reedy describes a similar burner for his Three-truck Climax in the May/June 2003 issue of Live Steam. Reedy's Climax is a similar size to the my shay so I decided to follow his design. While waiting for the boiler to arrive in the fall of 2003 a number of small parts were fabricated including the burner nozzle.

After seeing Dave Johnson's oil burner I decided that I should test the nozzle and make sure it operated properly. I also wanted to become familiar with burning oil. So, put a valve in the bottom of the oil tank similar to that used by Dave, had some kerosene available for fuel and used a regulator in the compressed air line to supply the atomizer.



Following Peterson's advice, a auto type fuel filter was inserted in the fuel line ahead of the nozzle.



The nozzle, supported by the fuel pipe, was positioned in the back of a short section of 6" pipe. The clear plastic tube is the atomizer (air) line.

A propane torch was used to light the burner. Wow, what a flame! It sounded like one of those salamander heaters.

The photo below shows the flame output. That fire didn't do the ivy any good. The deer ate the ivy bare a couple weeks later so I was able to blame the deer for the fire damage. (The spouse has had eye surgery and now sees much better. It'll probably be really difficult to sneak things by her now.)



After savoring the delight of a really hot flame I tried adjusting the atomizing pressure and the fuel flow. The gauge on the air pressure was not accurate at low pressure so I didn't learn much except that the burner wasn't very sensitive as long as the pressure was above a few psi and less than maybe 20 psi. The burner was also relatively insensitive to the fluid valve. There was only an inch or so of fuel in the tank and the nozzle was only about an inch below the tank so very little pressure could develop.

The flame is very long. The hottest point is probably near the end of the flame. The pipe is 8" long so the hottest point of the flame is about 24" from the tip of the nozzle. The fire pan for the boiler is 8" long so if the flame goes along the bottom, up the back and then toward the front and out the tubes, the hottest point will be near the tube sheet. The flame might be shortened somewhat if the fuel is reduced some. Maybe the nozzle could be moved outside the front of the pan to give a little more length.

I had wondered whether the spark from an igniter like used in a propane grill would work to relight the burner flame. I purchased a replacement unit at the local hardware store to test. The sparking part was located at the end of the pipe. The fuel was turned off, flame went out, turned fuel back on and operated the igniter. The burner relit --- wow that was great. Decided to test various locations of the sparking part. Couldn't get the burner to relight again with the sparking part in any position including the original position that worked once. (And yes, the thing still sparked.) Peterson suggests placing the sparkplug about the middle of the fire pan but that was a larger locomotive. Decided to try to learn where others have placed the spark plug on small locomotives before fooling with it any more.

A last point on the fuel --- the choices are heating oil, diesel fuel and kerosene. I had been told that diesel and fuel oil have a much higher heat content than kerosene. I did a bit of research on the internet and found that heating oil and diesel fuel have 139,000 BTU/gallon while kerosene has 135,000 BTU/gallon. This ~ 3% difference is not worth worrying about. Heating oil is difficult for me to obtain by the 5 gallon can so the practical choices for me are diesel fuel or kerosene. I understand that there is some difference in the combustion byproducts of the kerosene and diesel. Kerosene is used in unvented space heaters so the fumes are probably not too toxic, especially since I'll be doing the burning outside. I think I'll use kerosene until I learn more about diesel fuel.

Update: I ended up using Diesel fuel because it is more readily available and costs less than kerosene even with the huge road tax.

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