The British Columbia Society of Model Engineers develops a successful

Propane Burner

by Lindsay McDonnell

DRAWINGS BY KEN MOAN

The British Columbia Society of Model Engineers' propane burners have become very well accepted and it is felt that the design ideas should be shared with others in The Hobby.

First of all, why use propane instead of oil or coal for firing locos? Good clean-burning, non-clinkering coal for steam locos is almost impossible to come by and, if you are going on an extended trip with your engine, you have to carry large quantities with you. Cinders are a worry, especially in dry areas where fire is a problem. Oil (diesel or stove oil) is easily obtainable but I have seen so many oil burners that didn't work well. Even the best is noisy enough to practically drown out the exhaust sound when turned up near full. Oil burners only work by trial and error. Some are acceptable but many have problems. There are many variables such as secondary air holes in the ash pan and whether a pot burner or vaporizing type should be used. Along with that is the polluted air (often containing sulphur) that the engineer has to breathe when he is sitting right near the stack. Some builders can get oil burners to run well but many are far from perfect and I have been to meets where you could hardly talk near the station for the din of roaring oil burners.

Propane is a much quieter, cleaner, simpler firing system, and less likely to snuff out when running than is oil. It has the advantage of being clean. Tubes or flues don't get plugged or even need cleaning, passengers don't get cinders rained down on them to burn their good clothes (and demand replacement), and it can be shut down immediately or else left to simmer for long stops such as a meal break. The boiler on your engine will be treated to a more even heat than with an oil or coal fire and this should extend its life as there is less thermal stress. It is also better on your lungs and, therefore, your health. That's why three of our club locos (CN 4-8-4, NYC 4-6-4 and CN 2-6-0) run on it day in and day out for 110 days a year. We keep our old faithful *Royal Scot* as a coal burner for occasional use. We have a 150 Imperial gallon (187 U. S. gallon) tank at the track site with a hand pump to fill our own propane bottles, which I can recommend to a club as cost- and time-effective. If there is a criticism of propane it is that the engineer doesn't have as much firing to do to keep pressure up as with oil or coal. For public running that can be a blessing.

The burner we use is like a gas burner in an oven. It is based on a design by Alan Von Rueden of Seattle, Washington. A torch-type burner is inefficient and noisy and the heat too concentrated and usually not capable of sustaining a sufficient steaming rate under heavy load. The drawing shows a typical burner designed for a 7-1/2" (or 7-1/4") gauge loco with a narrow firebox 10" long x 5.5" wide. The other shows another layout that works well in longer and wider fireboxes. It is possible to make them for 3/4" scale locos too, but you cannot just shrink the design in half as I will explain later.

MAKING THE BURNER

It is best to use stainless steel for the burner tubes (steel can be used) of no less than 3/4" diameter. The tubes can have either slots or two rows of holes (#56 drill) cut in. Slots work well in smaller fireboxes up to 60 square inches, but holes seem to work more evenly in larger burners. Slots can be cut using a .040" cutoff saw on a mandrel in the lathe. Holes can be drilled evenly in a vertical mill. The tubes can be TIG welded or bronze welded to a manifold. Silver solder can let go if the burner malfunctions, especially if it is left on full without the blower on. The mixing or venturi tube can be copper as it's cooler there and can be silver soldered to the stainless manifold. We use a venturi off home natural gas central-heating furnaces and modify the jet size. However, you can make your own to a simpler shape as shown and play around with the position of the jet and the adjustable primary air intake. We run our burner at a higher pressure (20 psi) than some I've seen, but this stops it snuffing out, especially if you have it set on LOW (simmer) setting and forget to turn it up as you take off and then spin your wheels which pulls a great rush of secondary air through the firebox.

An easily-removable gas nozzle or jet made of brass of about #60 drill size would be a good starting point. You might make another one and experiment, opening out as needed. The smaller the jet the higher the pressure needed. The nozzle ideally should be shaped like an injector steam cone to induce primary air to flow with the gas stream. We use a regulator that is adjustable from 5 to 35 psi. The pressure gauge needs to be of a scale from 0 to 50 psi. approximately, and located on the pressure regulator or downstream from it, maybe in the cab. Full pressure in the tank can be up to 180 psi, so avoid ruining the pressure gauge by putting it in the right place.

An ash pan should enclose the burner and slots cut under each tube for air, the slots being about 3/8" wide. They can be made by cutting the metal and bending it up to the desired opening. It may only need a 1/4" opening so try that, but it isn't critical and burner noise shouldn't be a concern. Another way is to fasten 1/8" thick steel bars to the underside of the open ashpan, leaving the air gaps under each burner tube. This seems optional as we have an engine with no ash pan at all. The pan at least keeps the fire contained if you should leave the flame high and forgetfully turn the blower off, which causes flame to lick down and around the paint on the outside of the firebox. One way to avoid that happening is to put two blower valves in the cab, one being a small bypass valve that would keep a small amount of steam going to the smokebox,

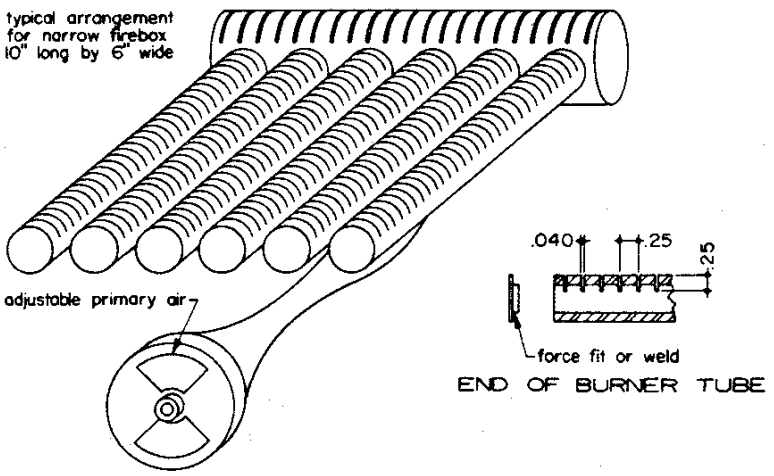
even if the main valve was closed. Keep the burner tubes 1/4" apart and the outer ones at least 1/8" from the sides of the firebox. Get the top of the burner tubes as low in the firebox as the mud ring (foundation ring). For smaller scale locos, you must still use 3/4" diameter burner tubes, just have fewer. You get a better mix of gas using the large tubes and, by using slots, more heat.

LOCATION OF THE TANK

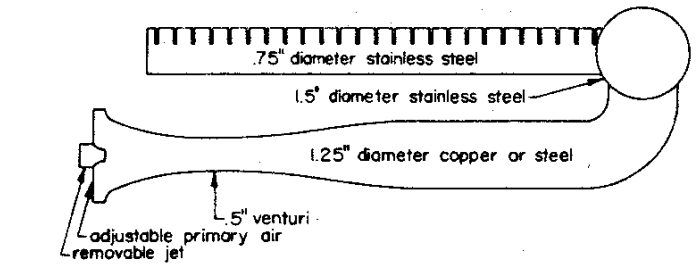
We supply the engine from a propane boxcar that has 3 standard upright 20 lb. tanks (cost about $22 each) joined together by approved pressure hoses that feed through Ts into the pressure regulator (reducing valve). Our CN 4-8-4 with 3" bore cylinders is run off this set up. It will steam us for 2 days (12 hours) of heavy pulling with 12 cars, 36 passengers. Using a single 20 lb. tank on its own supplying a good sized engine, freeze-up occurs after about 3 hours running, taking gas, not liquid out of the tank. Taking liquid out requires a different type of tank internally and heat to vaporize the fuel. Heating a tank can be dangerous and an unnecessary complication. Three tanks won't freeze up. A member, Vern Johnson, who has a 2-6-0 with a 10" x 5.5" firebox, has built a tender to house a horizontal 20 lb. tank and has it nearly immersed (not the pressure reducing valve) in the tender feedwater. He can run, as can the 4-8-4, even in below-freezing air temperatures, all day. Many sizes of tanks can be used but some cost much more than others, so shop carefully. You have to decide on how much running you expect to do in a day, how much space you have and where, before purchasing the tank you want.

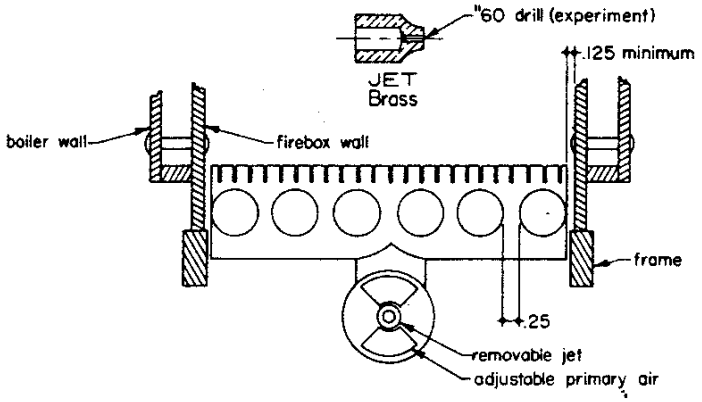
CONTROLS

We screw the regulator to the propane tank and a pressure gauge to it, then run the hose to the tender through a copper 3/16 O.D. pipe to the front of the tender, and then by screw-in commercial hose to the loco under the cab where we have an ON/OFF valve (preferably a needle type commercial gas valve supplied by the gas distributor). Then we pipe it to our control valve which is a needle valve under the floor with the stem sticking through the floor and a small handle like a Westinghouse brake handle on it and this is just at floor level. You can see the setting of your gas then. We file a tiny groove in the needle taper to allow enough gas through so the burner will stay on simmer when we close the valve. This is so you can't accidently turn it off. That's done under the cab floor or at the tank. When setting up the burner, the flame should burn a blue color with a slight tinge of yellow because, when you work the engine hard, there will be excess secondary air coming in. You adjust the air intake at the mixing tube until you get the right flame. Do it in the simmer position first and then check with the blower on full and the flame turned up. Check it out on the run and, if an unburnt propane smell is present (especially when coasting with throttle closed), adjust the blower setting, the volume of gas and the mix until it is clean burning.



PROPANE BURNER FOR 1.5" SCALE STEAM LOCOMOTIVES



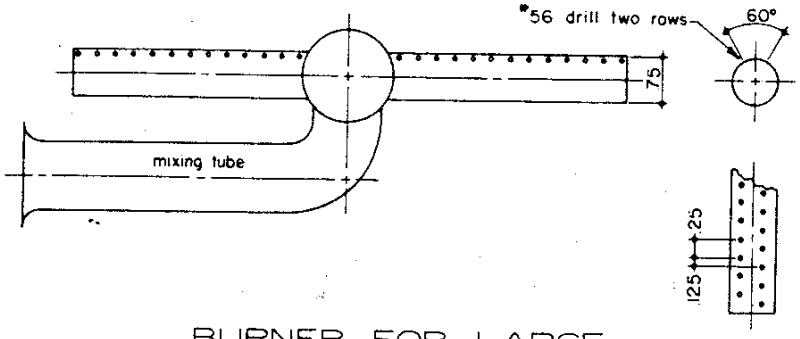


APPROXIMATE BURNER POSITION

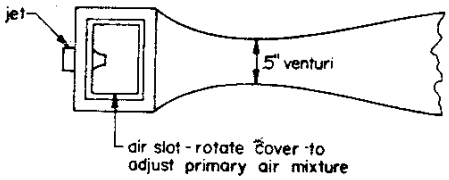
LIGHTING UP

Steaming up is done usually by connecting an air compressor to a fitting under the engine somewhere inconspicuous, and this line is connected to the blower line. You need a control valve at the fitting to regulate the air and shut it down when steam is raised. Most club tracks have compressors. Some use Schraeder tire connections but most use a standard snap-together type air fitting with the male on the loco. Otherwise a fan in the stack will work, maybe a battery-driven one for total portability. A lot of draught is not needed with propane as you can cut the flame so it doesn't stink at the stack. It won't fire quicker if you turn it up above the point of good combustion; it will only waste gas and pollute the air.

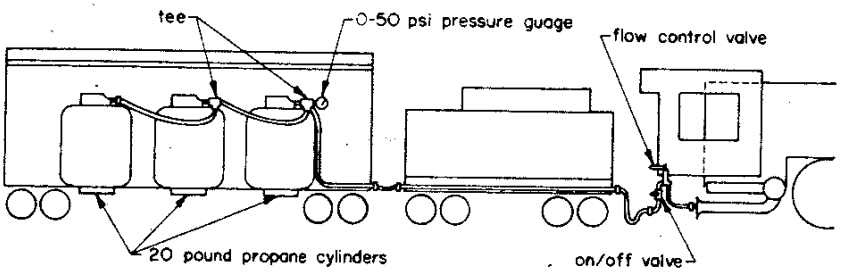
Lighting the burner is easy if you follow the correct procedure: Turn on the blower air (or fan) lightly, check to see your on/off gas valve on the loco is off, check to see your burner control valve is a simmer. Crack the valve on the propane tank, check that the gas pressure is about



BURNER FOR LARGE 7.5" GAUGE LOCOS



ALTERNATE TYPE OF MIXING TUBE



LAYOUT OF PROPANE BOXCAR

20 psi., then light your long-stem match or barbeque lighter, put it beside a burner tube in the firebox and turn on the ON/OFF valve. The burner should light immediately with hardly a pop. If it goes out for some reason, shut off the ON/OFF valve and wait a minute for the blower to scavenge the unburnt gas out of the firebox. Then start over. Remember, propane is heavier than air and will settle below the firebox if you don't have the blower on. In fact, the blower should always be on slightly when running. Failure to observe this sequence might result in a situation of "Look Mom, no eyebrows!"

The burners we have built will stay on at simmer even in a wheel slip situation and you should aim for this as you don't want raw propane floating around.

Having said that, I do not consider operating with the fuel anymore dangerous than with oil or coal, and I have seen some potentially serious accidents and fires from overturned locos burning oil. Shutting down the burner is best done at the tank valve so the line empties. Our many years (14) of safe running has proven to us propane is a safe fuel if you respect it and keep an eye on hoses and fittings for leaks, (which can be checked by brushing soapy water around them.) We have many engineers running these engines and we have not had any incidents. So go ahead and try propane firing, you'll like it!

O&E/B
Odds and Ends for Beginners

Swirling Chips

by John L. Ditman

Have you ever been annoyed by the ever-growing chip you have swirling around when you are drilling steel or aluminum on the drill press? It threatens to cut you, you have to stop to untangle it from the drill, and it makes really cussed trash.

Here is a tip: every few seconds, when the chip has grown to 2" or 3" in length, relieve the pressure for an instant. Not enough to raise the drill, just enough to interrupt the chip.

You will find that life will now be much more pleasant.