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Steam engine lubrication

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Don't Slip Up with Oiling!

On the whole our small engines run quite well without major problems but annoyingly they do sometimes suffer from odd "failures" of ancillary items that prevent us from enjoying our runs. A typical problem is lack of cylinder lubrication and although using wet steam on soft packed gunmetal slide valve cylinders without oil is just possible, when the oil supply to cast iron pistons and valves is interrupted, they soon protest and any attempt to ignore them tends to result in damage. I have had my share of "no oil" problems when using what might be called the "traditional" oscillating ratchet pumps, a design dating back to the time of LBSC (the person, not the company) at the dawn of our hobby. I think that we are all familiar with them as they are available from many suppliers and can be quickly obtained and fitted at the last moment when completing an engine.

A small tank has a pawl & ratchet-driven oscillating cylinder with a plunger that sucks in oil and then forces it out through a check valve on the down stroke. These pumps can be quite reliable but have their drawbacks, one being a tendency to overfeed and another is the need to feed oil via a second check valve which limits delivery to only one point! Any attempt to split the feed between two clacks results in the first valve that opens taking the minute flow thereby preventing the other one from opening. The ratchet wheel must advance a minimum of one tooth per engine revolution, so a 30 tooth wheel will pump one swept volume of oil every 30 revs, typically every 40 or 50 ft run, an amount that I have found to be quite a lot! One way round this is to replace the pawl & ratchet with a one-way slip-clutch driven with a short stroke taken from a small eccentric or via reducing levers. Another inconvenient feature is getting a drive to the pump which, needing to be accessible often ends up in front of the smokebox; but the movement originates from back behind the cylinders.

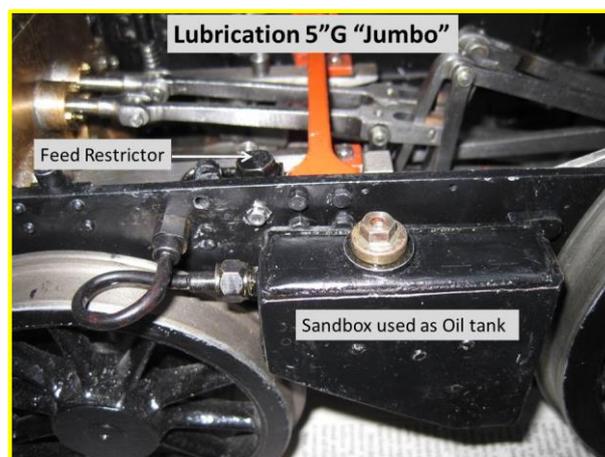
Like full size engines, ours will run quite happily with very little oil as long as they are supplied continuously, big engines survive on one or two drops per minute and ours are about the same (scale drops). In the absence of a sight glass most drivers watch for a tell-tale oily look to the soot inside the top of the chimney, probably an indication of more oil than actually required but it is reassuring, does no harm and is not terribly expensive on oil: more than this becomes very messy and should be avoided (expensive on shirts). From experience I would estimate "tell-tale" consumption to be about $\frac{1}{3}$ cu inch per hour on passenger hauling stop-start duty. A much improved pump is the version with a fixed cylinder, a design attributed to Jim Ewens in which an eccentric acting in a Scotch yoke moves the plunger up and down in a straight line. It draws in oil through a port on the up stroke and forces it back until the plunger passes the port on the down stroke, thereafter the remaining trapped oil is delivered via the clacks. The advantage of this design lies in the ability to set the volume per stroke by adding or removing spacers to raise or lower the plunger so that the pump delivers just the required quantity.

I have used several traditional pumps from different sources on various engines and my experience has been "mixed" as some have worked reliably for more years than I care to remember while others have been pests. Actually, the majority of failures have not been with the pumps themselves but rather the check valves; these are just like the usual water variety but fitted with a spring to ensure that the ball reseats positively in all orientations. When the check valve develops the slightest leak steam passes back to the tank emulsifying the remaining oil and lubrication ceases. Some of my valves have given quite short service, particularly those purchased more recently, and as I have been unable to repair them by cleaning up the seat, I have a feeling that the material used is susceptible to corrosion by the oil.

Another failure is due to wear of ratchet teeth; once the pawl skips a tooth there is no more rotation. This is not a criticism of the type of lubricator but rather of the quality of manufacture. Supplying oil to only one point is no problem with the good old British inside cylinder engine as it has a single steam chest but with outside-cylinder and multiple-cylinder engines things are quite different as they have several steam chests and might well end up with a pump and feed for each. One way round this is to feed oil at a place in the pipework delivering steam to all chests. Experience has shown that if oil is introduced there, it will reach all cylinders and the beauty of the arrangement is that when the chimney top has the oily look you know that all cylinders are being lubricated. Of course, this is not possible to arrange in some cases and multiple pumps may be needed. However, there is one snag in as far as the failure of just one pump is not evident at the chimney, so frequent peeks at the tanks are needed for complete peace of mind.

Alternative systems of lubrication are available, one of which uses condensed steam to push oil out of a tank into the steam chests. This is usually called "hydrostatic", but not actually so in the simplified model form. In full size there were various arrangements on this principle of which the Swindon pattern in particular is very cleverly designed, I suggest you look it up sometime. They are all arranged to have sight glasses in which drops of oil float up showing the rate of lubrication.

This can also be done in miniature although some skill is needed in getting things to work if made to scale. Model sight glasses are not really necessary and I have engines with just a pressurised tank for which proof of delivery is provided by keeping an eye on the chimney, just like with a pump. The whole thing is quite simple with no moving parts: an oil tank is located in a position accessible for filling and provided with a steam supply at the bottom and an outlet for oil via a needle valve at the top. The tank must withstand boiler pressure and have a drain plug below and a filler plug on top, it should be big enough for all the oil needed per running session as it cannot be replenished under pressure.



Steam is taken via a shut-off valve in the cab and delivered by a long thin pipe, 3/32" dia. is fine as there is almost no flow and it provides a good surface to condense the steam before reaching the tank. The oil is delivered by the differential pressure between boiler and steam chest, a tiny amount of the oil floating on the condensate escapes past the valve and is replaced by more condensate.

Note that no check valves are needed so two steam chests can be fed by dividing the flow into identical branches close to the cylinders both of which get lubricated (as on my Hunslet).

I have even come to regard needle valves as an unnecessary complication as once the feed has been set no further adjustment is required (other than resetting after being accidentally disturbed), so my latest engine has a fixed restrictor sized for a suitable rate, nothing to get knocked and easier to make. I did a bit of experimental work starting with a 0.020" hole and found that oil really raced through it but I wasn't keen on the idea of much finer drilling, also the problem of dealing with a blockage crossed my mind. I needed something that could be unscrewed and cleaned out fairly easily and I finished up using a fitting with just a 1/8" reamed hole almost filled with a plug a couple of 10ths of a thou under diameter and 1/4" long that can be removed for cleaning, if necessary, by opening a threaded cap. The area is roughly equivalent to a 3 thou. hole and it seems to deliver sufficient oil to show nicely at the chimney.

The only inconvenience with this type of system is the need to remember to shut off the steam supply when the engine is going to stand around for 5 minutes or so, to avoid an accumulation of oil; it's just a question of discipline and you soon learn! Of course, a GWR model will do this automatically via the arm on the regulator used in full size to control the atomizing steam, otherwise connect it with the drain cocks BR-style if you are forgetful, but want to keep your face clean.