Two Strokes are Special

By Jerry Van Loo

It all started a while back with the announcement of multiday trip in Canada, which I hadn't heard of in a long time. Six days on the Ontario Northland, from North Bend to Hearst, nearly 600 miles. It had been many years since I had been on a long trip, they were rare now compared to back in the 90's, so I signed up, but it was full. Not wanting to just sit home, I looked into other trips in Colorado, and signed up for those instead. However, there was a cancellation at the last second on the Ontario trip, and I was asked if I still wanted to come. That added considerable expense to the trip, but how do you say no. So it was game on, for a 1500 mile outing over the Nevada Northern, Craig branch, Leadville, Antonito and La Veta pass. On a 1940's Fairmont open M19 supplied by Janet Steeper, with the RO-B engine. As the details of the trip would consume a whole magazine or two, I will stick to the mechanical challenges that had to be overcome on this trip, and the wildly successful performance of the Fairmont two stroke.

I only had two weeks to prepare the car, which seemed like lots of time, but it wasn't. Fortunately the car had an extensive overhaul back in the 90's, and it was done right. However, 25 years is 25 years, and there were a lot of issues. The wiring was in bad shape, the brake light wasn't working, and it all looked shoddy, but there wasn't time for a rewire. So I found opens in three places on the wire to the light, and repaired them. The big issue was the alternator bracket, which is fabricated piece because Fairmont used generators, and the shorter alternator needs totally different support. The angle iron bracket holding the alternator was only made of 1/16" thick angle iron, and it was nicely done but too light, so it flexed and could not hold the belt in alignment. This severely wore the belt. I didn't have time to fabricate a new one, but found there was room between the alt and engine to weld in a short piece of square tubing to stiffen it up. Lots of grinding for bracket clearance, but it worked great. The belt had to be changed, and that is no small feat as I tried to get the flat belt pulley off first, but there isn't room. I eventually pulled the engine out, which was equally as difficult; maybe there is an easy way to do it but I missed it if there is.

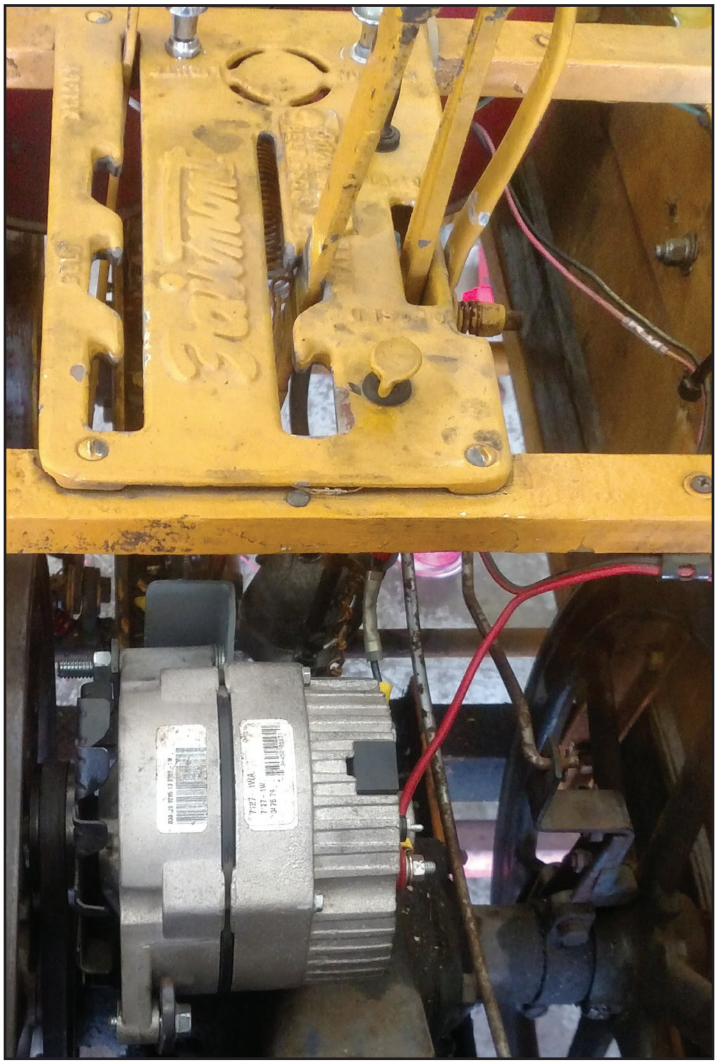
Next was the exhaust, which was the factory flex pipe that was broken in two places, wrapped with something in an attempt to patch it, just a disaster. In spite of all these troubles, the car still ran ok, it had been run this way a long time. I had run the car at the local museum on a very short track, and it performed ok, except for hard starting if the car sat for more than 30 minutes between runs. The carb was leaking fuel, so I pulled the carb off and replaced (made) new gaskets for all of the joints on it, and in doing this, I made the discovery that is most of the reason for this article. The carb has a bronze seat that threads into the float bowl, with a steel needle. There is a sealing washer to prevent fuel from bypassing the float through the threads, so I used Teflon tape on the threads just in case the washer leaked, and on the float pin caps. I checked the float level by attaching a short hose to the inlet and blowing through it to see where the float stopped fuel flow, and it never did completely shut off. That was why the car would restart easily if it had just run, but difficult if much time passed because that was the time it took for the leak to overfill the bowl and flood the engine. The fix is lapping the valve by rotating it with a dab of compound on the very tip of the needle. When it stopped grinding, I added more and did it again. At last it was all cleaned up, it passed no air so the leak was gone. That was the last time I ever had to drain the crankcase, turn the fuel off, or ever had to give the crank more than one firm pull to start in 1500 miles of operation.

Getting back to the exhaust, backpressure is very critical to any two stroke because the gasses exchange in the cylinder when all ports are open. And there has been much written about it, some amazingly complex theories to such a simple process, but the goal is to get the burnt gasses out and the new mix in without too much bleed over into each other. Fairmont is one of a very few manufacturers that put a deflector on the piston to aid in this process, and was never done by any two stroke manufacturer again to my knowledge, so I question its effectiveness, but that's another topic. The trick is for the exhaust to be low pressure when the ports pop open, readily accepting the gases coming out but not too open to draw out too much. And when working hard at higher rpm's, a rise in backpressure meeting the increased flow, but not too high to restrict it. Not terribly complicated, really. With that in mind, and needing a quick and dirty way to get an exhaust on, I ran a solid pipe out the back of the car mounted on two rubber hangers so it could move when it needed to. A 2" pipe fits snugly into the exhaust port of the engine, and I welded it so it would line up parallel with the frame to go out the back, almost touching the axles. On the end, a Harsco spark arrestor with a 2 1/4" outlet just to be sure it didn't create too much backpressure. The results were shocking, as in all my years, I have never seen one run with the four stroke cars fairly competitively.

I believe equal to the exhaust success was the ignition, which was already on the car. I do not know what voltage the coil is, but it was the right choice with no plug fouling issues. Also found out not all oils are equal by a long shot. I used a racing oil in the gas, a fairly heavy one it turns out. Through a miscalculation, I ran out on this long trip, and found out that performance two stroke oils are very hard to find on the road. So I had to settle with what I could find- a high performance synthetic, but very light in viscosity as so many two strokes run oil injectors now that seem to require a lighter viscosity oil. When looking at a two stroke oil in the bottle, be aware that it can never be any thicker than it is, only less in a hot engine. So if it looks and acts like water, there is no magic that is going to change that in the engine. On the most demanding ascent of the whole trip, I had water for oil, and the inferior ring seal nearly defeated the climb. Everything matters when pushed to the operational limits but it made it, and I won't be caught without the right oil again.

Ignition timing is the key piece of information, likely the most important, as well as the least understood. Combustion is not instantaneous. Though often referred to as an explosion, which also is not instantaneous, combustion takes time. If the engine is idling at 400 rpm, the piston speed is calculated in feet per second based on the stroke length. When the mixture is ignited, it builds pressure to force the piston down. At this rpm, the speed of the burn completes its combustion and hits peak cylinder pressure by the time the crank has turned 90 degrees from TDC, when the plug is fired at TDC. Taking off in the car, I tighten the belt and open the throttle, maintaining the 400 rpm with the belt tension. Soon as the car speed matches the rpm, I put the tensioner in the notch to not allow slippage. Now, by the time the engine picks up speed to 500 rpm, already the piston speed has increased enough that the peak cylinder pressure isn't happening before or at 90 degrees, it's happening later, and the power is dropping off. So the timer lever has to be advanced so the spark lights the fuel before TDC to keep the peak cylinder pressure close to 90 degrees after TDC. And as the car accelerates, this situation happens again, and more advance is needed to match the ever increasing piston speed. At top speed, the advance lever may be fully advanced for the most power, but it's not always a given, as many things can affect the burn time of the fuel. This is all fully verifiable, and this is the other reason for the article. So what line of reasoning could ever back up running an engine at full advance at all times? There is one.

Anytime the advance lever is moved forward, the engine speeds up if it can. And I believe the line of thinking is that if some is good, more must be better. Idling an engine at full advance means that the early ignition is building its peak pressure before TDC instead of after. This puts undue stress on the rod bearings for no reason, at a time when the en-



gine is cold and cannot lubricate properly until the engine warms up. Cold starts are very hard on any two stroke, although the roller bearings in modern two strokes will handle the situation better than the plain bearings of Fairmonts. The power bursts are forceful but only fire every second or third revolution, missing way more than hitting, but every revolution pulls in fuel whether it's burnt or not, so this unused fuel works to wash oil off of the rotating parts rather than deposit the oil. So the urge to give too much advance has to be tempered by the basic math of the situation. Never let the engine ever miss if you can help it, and keeping the idle speed as low as possible will save a lot of fuel and prevent overheating. Just always be sure the engine is good and warm before working it hard.

There is another way to look at proper timer position, a pie chart. Every BTU of a fuel charge has to be accounted for, and the chart is perfect. I'm not sure what the numbers actually are, so I just approximate the horsepower as 30% of the total available BTU's. The other 70% will be split between the exhaust pipe and the water, and what is given off the surface of the block and head. I would think the exhaust is going to be the largest percentage of the waste heat, so I'll give it 50%, which leaves 20% to the water. If the timer position is advanced, and HP falls to 20%, the lines in the pie chart have to shift to account for it, and they shift toward the water. The extra BTU's are boiled off in the cooling system, the head and piston temperature will go way up too, which leads to the next problem of overheating. Fuel has a flash point; it's the temperature where the fuel spontaneously ignites on its own. The average combustion temperature can be calculated as the average of the outgoing exhaust temp and the incoming air temperature, minus horsepower and the cooling water BTU's, and what's radiated off the block and head. When this temp gets too high, control is lost through pre-ignition or spontaneous combustion (detonation), and in some cases the engine will still run with the ignition turned off. But usually, it just dies, as the operator has succumbed to the misunderstood consequences of too much advance.

Lastly, fuel mixture is also very important, and another misconception I see is thinking more fuel means more oil, and that being too lean will ruin the engine. Absolutely false; the only way to get more oil to the engine is by adding it to the fuel tank, and any fuel in excess to the best power approaching from the lean side can't be burnt, and will wash the accumulated oil off of the parts. With a timer lever to adjust to any operating conditions needed, there is no excuse for this. As proof of these claims, the car averaged 35mpg if not higher, and 40mpg on one occasion. I do not recall enjoying a trip more than this one, the challenge of the Fairmont engine is extremely rewarding; I've probably missed some things here. I am still thinking about the mechanical challenge it was to get that car road worthy for this trip, and can't stress enough the importance of making sure the car is good shape so there are not problems. A trouble free trip is not just the luck of the draw…luck tends to favor the prepared.

Many other technical articles on the Fairmont 2-stroke engines are found at:

https://www.narcoa.org/newsite/tech.htm