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Recently I received a communication from Robert Green out in California suggesting that my analysis of his Green Steam Engine was inaccurate and that I should consider doing a re-write. He sent me a reference to his 2012 patent 8,096,787 showing improvements that he had made on the original design.

Commentary on Mr. Green's engine is important because he has a good website that has done extensive advertising and publicity on steam engines. He is the only person in commercial production here in the US of A that I know about and so this is a relevant subject; one to be addressed properly. He describes his engine as being 'modern and efficient'.

And so here is my update of the original description and critique of his engine. It may not be as good as one would hope. I am keeping in mind the legal constraints on interfering with a commercial enterprise and so I will try to keep my comments to the mechanical motion and the thermodynamics of the valve design. The old design had a flexible shaft to act as the 'Z' crank mechanism and had two cylinders. The new design has four cylinders and a more conventional 'Z' crank wobble plate that transfers reciprocating motion to rotary motion. This new design is somewhat similar but not nearly as good as the General Electric steam engine that is shown in this website and is in my collection.

The work that the Green company has been done indicates the need for a good commercial steam engine. As with the original design the cylinders wobble around a pivot point that is a ball joint near the cylinder head. The advantage of this design is claimed to be straight line thrusting of the piston which is always aligned with the cylinder bore. Thus there is no side loading of the piston skirt against the cylinder walls.

Old-fashioned steam engines dealt with this problem by having a lubricated cross-head. This could be either a flat surface, a cylinder, or some kind of an angle iron surface. The cross-head took all of the side loading that happens as the connecting rod rotates around the crank throw, keeping the piston lined up in the bore. Conventional IC engines deal with this by lubricating the piston skirt. This approach has worked satisfactorily on a few billion internal combustion engines.

The basic problems that I mentioned in my original critique continue because of this cylinder wobble around a ball joint. First of all there has to be some vibration from all of that rotating and out of round motion. It is not the kind of rotary motion that can be easily counter-balanced. Secondly, the ball joint has to take the full load of that end of the cylinder, the full force of the steam pressure against the piston, so there is wear, while, at the same time, needing to be steam tight as steam passes through the end of the ball.

The basic problem is that this design can only have one passage for steam inlet and exhaust. First of all this is a fairly long, by steam engine design criteria, passageway increasing the clearance volume which is always a dead loss in steam engine design. Then, and because only one of these can be installed because there is only one center of

the cylinder to rotate around, both cool exhaust steam and hot inlet steam have to pass through the same passageway. This cools off the inlet steam, another dead loss as that heat can never be used to do work.

The new design offers a very slight simplification of the mechanical motion of a conventional reciprocating engine and at the cost of excessive wear points, imbalance of moving parts, high clearance volume, and poor heat management of the incoming steam. It does improve the original design in avoiding bending friction losses in the wire flexible cable.

In the abstract, I am glad that some people are working on modern steam power and making engines and marketing them and, even, continually improving them. It would be nice if they would start with a good basic understanding of what a steam engine needs to do to be efficient.

I have not checked the claims for the new engine, however, the original engine claimed to be designed for the use of saturated steam. Usually a steam engine designer does not make that claim. Saturated steam is never as efficient as super-heated steam, in the first place, and no one, under any circumstances, has to design an engine for the use of saturated steam. That works automatically in every possible kind of a steam engine, and equally not well. The perceived advantage of using saturated steam is that the resultant water droplets in the cylinder during the expansion phase lubricate things.

Water lubrication is always a good idea. Or, more precisely, water lubrication is always a good idea if it works. Cyclone Power out of Pompano Beach, Florida has been working on water lubrication for years putting a great deal of money into the perfection of this manner of lubricating things. They are using some of the more exotic high temperature plastics with water injection points in the cylinder and they position the rings low in the piston skirt to keep them away from the high heat that is nearer the piston head. Expanding saturated steam to make water droplets for lubrication purposes causes high thermal inefficiencies because the vapor of water that is the source of pressure on the piston head condenses so there is not much vapor to be used as an expansion force.

If the cylinder motion was in only two dimensions; that of a flat plane such as a trunnion engine operates, then it would be possible to put in two valves, one for intake and one for exhaust. This would allow for very small clearance volumes and widely separated intake and exhaust functions, thus preserving thermal efficiencies. The late Jay Carter offered a paper design for just such a trunnion engine at one of the steam club meets. He had a clever way of piping steam to the moving cylinder head. There was something to say for the simplicity of an engine that did not have a wrist pin bearing to lubricate and having the possibility of a double acting engine without needing a cross-head. This engine was designed for cheap construction and for use in a back yard electrical generating plant where the length of the engine was not important and neither was the slow rotational speed.

I find it interesting that Mr. Green has never attended a steam club meet where he could talk to experienced steam people. The meet attendees are more than happy to share their information and opinions. In fact, some of them are so happy to do this that it is difficult to shut them up. Our steam club is the original ‘open source’ for technical information. Everyone wants to tell everything they know, everything they have opinions on whether real knowledge is involved or not, and everything they have done, and better yet, how exactly everyone else can design their things better. The knowledge is free but at the cost of some personal sensitivity.