



Differential Stroke Pistontrain

Merit prize winning abstract from NASA/Emhart *Create the Future* Contest

Yan Engines is a small company based in Detroit, MI committed to bringing the D-Cycle engine to market by assisting the internal combustion engineering community in evaluating the feasibility and benefits of the engine.

In entering the NASA/Emhart Create the Future Contest, Yan Engines wanted to showcase the benefits and potential of the D-Cycle Pistontrain, the mechanism that enables the D-Cycle engine to complete 4-strokes in every crankshaft revolution.

Out of nearly 600 applicants, Yan Engines is proud to have been selected as a merit prize winner.



The Differential-stroke-cycle pistontrain (**D-cycle**) is a novel design that enables the conventional engines to complete the 4 strokes in every revolution, plus much more (see www.yanengines.com). It makes the heavy compression/power strokes function like conventional pistons. However, unlike the conventional, it is lifted from its skirt to complete the light exhaust/intake strokes by a piston cam or electronics via a pistontrain. The returns of this revolutionary design are doubled torque output, emissions savings, and higher return on both material and financial investments.

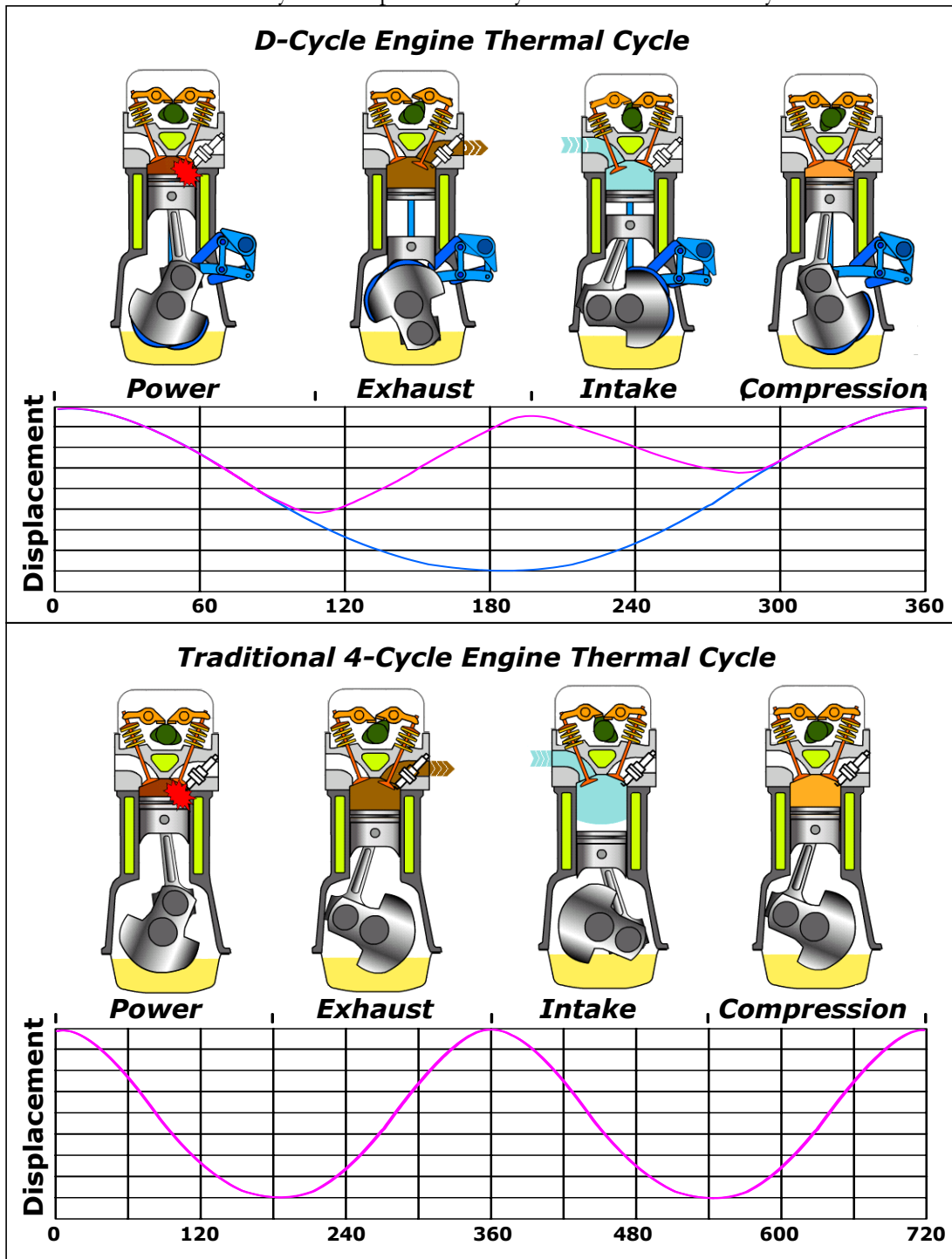
The D-cycle piston frees its strokes from the conventional identical displacements and periods. Besides doubled torque output, it enables optimal combinations of conventional 4 piston strokes. The strokes can be optimized in the design stage with the piston cam and/or dynamically during engine operations with electronics. Beneficial strokes include extended power strokes beyond compression for efficiency, burnt-gas-retention strokes below the top-dead-center for emission, tuned/faster induction strokes for higher intake volume/turbulence to

enhance combustion (combustion at slower engine speed), shortened intake strokes (charged/intercooled for higher power demand) to reduce/eliminate gasoline engine throttling for efficiency, and enhanced compression ratio for higher efficiency and easier cold starting in diesels.

The D-cycle piston is applicable to all piston engines large or small including gasoline, diesel, gas, hydrogen and the like. The benefits are doubled driving power, substantially increased gas mileage, cleaner engine-out emission, low investment, and immediate marketability. For example, a semi-truck or SUV engine aftermarket can be retrofitted to save fuel at lower rpm and with ample spare driving power. A 4-cylinder engine can be retrofitted to drive like a V-8 engine with easier under-hood packaging. A 3-cylinder D-cycle engine running at 2,000 rpm can replace a 4-cylinder conventional engine running at 3,000 rpm. With a smaller engine, lower operating speed and optimal stroke combinations, our estimate of gas mileage saving is about 30% to 50%, maybe more depending on duty cycle operations.



Figure 1.
Thermal Cycle Comparison D-Cycle vs. Traditional 4-Cycle





Existing facility/tooling can be used to retrofit or produce the D-cycle pistontrain. Aftermarket engines can be retrofitted and installed in original vehicles without packaging changes. The D-cycle pistons can be manufactured from aftermarket pistons or designed for new production. No major investment is needed for this high volume and high return venture. It is worth noting that D-cycle pistontrain can also retrofit aftermarket marine 2-cycle engines (with valvetrain) for much cleaner and more efficient operations, and somewhat more power with supercharging.

The D-cycle piston is a thin-wall lightweight crown with rings and a piston stem attached from underneath. The piston stem slides along the cylinder axis in a piston guide through a piston seat, which is an integral part of the piston skirt. A piston lever attached to the stem lower end operates the stem in a slot provided by splitting the con-rod leg. A piston

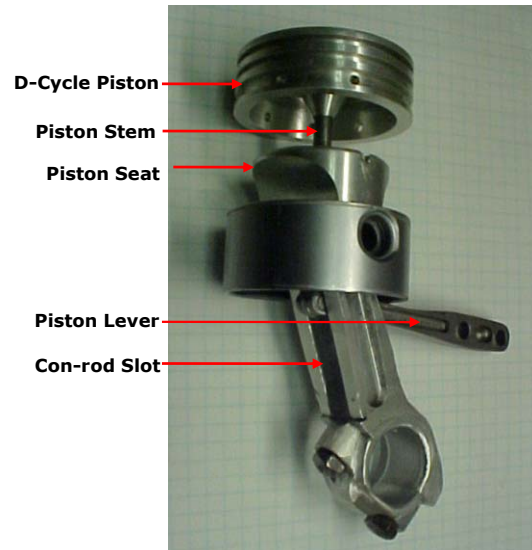


Figure 2. D-Cycle Piston

cam operates the lever at the outer end via a pistontrain, like the valvetrain operates the valve. The difference is that the piston seat is moving with well-defined positions, while the valve seat is stationary.

For more information, please visit:

www.yanengines.com

Or contact:

MJ Yan, PhD, PE mj.yan@yanengines.com

Lu Yan, lu.yan@yanengines.com

