# Re: Compressed air might blow the oil−gas−petrol profits

***Source:*** http://sci.tech−archive.net/Archive/sci.physics/2006−02/msg00245.html

- *From*: The Ghost In The Machine <ewill@xxxxxxxxxxxxxxxxxxxxxxx>
- *Date*: Fri, 03 Feb 2006 05:00:05 GMT

In sci.physics, Hero.van.Jindelt@xxxxxx
<Hero.van.Jindelt@xxxxxx>
wrote
on 2 Feb 2006 16:23:45 −0800
<1138926225.443661.260680@xxxxxxxxxxxxxxxxxxxxxxxxxxxxx>:

> http://www.theaircar.com/aboutmdi.html
> Enjoy
> Hero

I wouldn't bet on that. Compressed air is merely an energy conveyor; something has to pressurize the tank.

What is that something?

It turns out the link is referring to some sort of hybrid vehicle using compressed air, a small electric motor, and standard petrol/gasoline. The pistons are moved using an unusual camshaft arrangement, the details of which aren't available (trade secrets). It is not clear whether the air tank is prepressurized or whether it is used as some sort of buffer, compressed by the action of the engine during operation.

I also see no numeric claims of fuel consumption. How many mpg would this engine get, were it placed in a car and compared against a standard reciprocating piston engine of equal power?

The FAQ suggests that the engine refills the tanks (by running in "compressor mode"), taking about 6 hours. That is a huge buffer, from an engineering standpoint. The pressurization is 300 bars (30 million Pascal). If we assume a 100 kW engine, dedicating 10 kW to pressurization, we might get a workable engine, for a small−to−midsize auto.

Assume an air reservoir of size V, initially at pressure P (with respect to vacuum). The engine does some work dW, and we then get V at pressure P + dP. In the usual setup we get V at pressure P and dV at pressure P_0; the work is then done by a piston pushing against the air. Therefore, (P + dP)V = PV + P_0 dV unless temperature effects are considered −− and ideally they would be, as one discovers after pumping up a bicycle tire with (in my case) a unit standing on the floor; that pump's metal casing gets fairly warm. However, I don't know how to compute temperature issues in gas compression at this time.

If (P + dP)V = PV + P_0 dV then V dP = P_0 dV.

If we assume a piston with area A, the pressure P yields a force on that piston of F = (P − P_0)*A, and dV = A dx, or dx = dV/A. dW = F dx = F/A dV = (P − P_0) dV = V(P−P_0)/P_0 dP. Integrating from P_0 = 10^5 to P_1 = 3 *10^7 Pa, we get

(V/P_0) * ((P_1^2 − P_0^2)/2 − (P_1 − P_0))
= V * 1.4999832 * 10^7

6 hours = 21,600 seconds. Therefore, the amount of power (call it W_p) dedicated to tank pressurization is such that

W_p * 21600 = V * 1.4999832 * 10^7
V = W_p / 694.44

Considering that a midsize auto might have a few cubic meters of cargo space this is highly unreasonable, and therefore I've overestimated the amount of power (W_p). Maybe 100 watts, yielding a 14.4 liter air tank. Of course it is still going to take about 2.16 megaJoules to fully pressurize that tank, no matter how one does it.

Which leads one to the 1.5 euros estimate. A liter of gas is about 35 megajoules or thereabouts, and may cost 3−4 euros. (It costs $2.50 or so a gallon around here, but the US taxes are lower.) This indicates that 1.5 euros is a gross overestimate of the cost of that energy; a more realistic estimate would be 25 "eurocents", unless I assume a 86.4 liter tank −− a possibility, but it will sap 600 watts of power.

There is some good news. 86.4 liters of 300 bar air would be such that;

n = PV/(RT) = 3*10^7 * (0.0864) / (8.314472 * 290) = 1075 moles
or 31 kg.

86.4 liters of fuel, by contrast, would weigh maybe 73 kg.

−−
#191, ewill3@xxxxxxxxxxxxx
It's still legal to go .sigless.
.