My IC conversion
From leccy head to petrol head (perhaps)

I fly electric. How many times have I been asked at the field when I will start to fly real planes? Once or twice. However I have watched people battling to tune their glow engines while I hook up the battery, carry my model to the runway and take off. And no dead stick landings, except if my battery runs out, though telemetry means that that is unlikely.

Fact is, though, I like the look of engines, and the sound of a perfectly running one is great, though of course I could put a speaker in my model. It seems to me that the only engines that rarely need fiddling with are the petrol ones. You can start them with a flick just like my old AM25 diesel. RCM&E magazine has carried a few articles recently about petrol, which got me interested. One writer said, ‘When did you last adjust the carburettor on your strimmer? That’s right, never’. RCM&E was also to blame for starting me with FrSky and I have been very pleased with that.

So I decided to take the plunge and experiment. I bought a cheapish engine from Hobby King - an NGH GT17 17cm^3 two-stroke one - together with all the specialist bits needed for petrol. Specified power is 1.8HP (1.35kW) so I’ll need a substantial model. I followed the maker’s instructions, and the advice from other sources, which was a bit of first. I always make notes when I try something new. In case any of you glow or leccy heads are thinking of a switch to petrol, I decided to put the notes into this document.

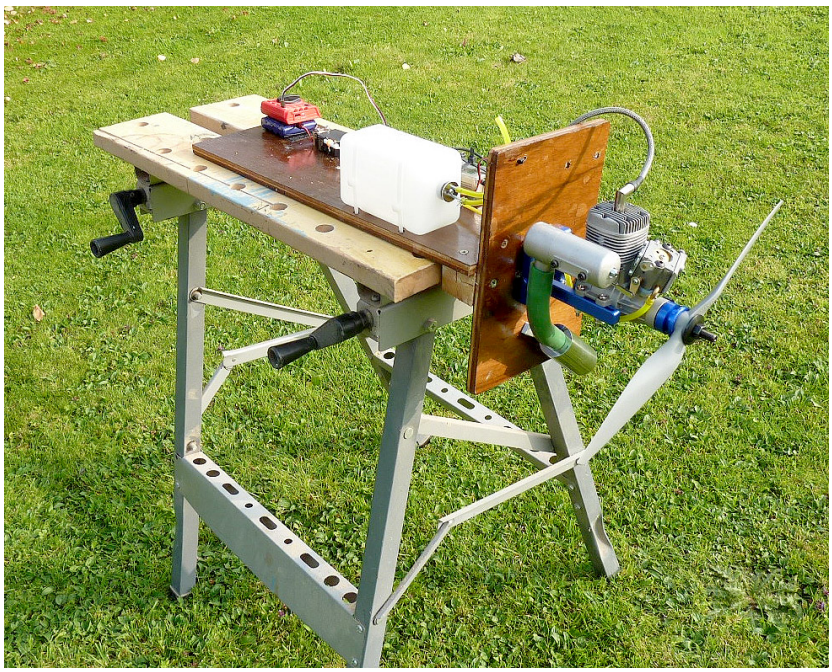
Here is my engine. The finish looks very good. I bought a 4.8V NiMH receiver battery for the CDI (capacitive discharge ignition) box. Eventually I will probably use a small, lighter Lipo with a 5V BEC. The blue propellor boss is held in position by a Woodruff key. I must be careful not to lose it when removing the boss. I’ll have to buy a few spares. The well-regarded but large Walbro carburettor is on the front so there doesn’t have to be so much room in front of the firewall compared with engines with a rear-mounted carb.

The suggested running-in propeller is a 13x8. This is the smallest recommended size for the engine so it lightly loads it. Filters are crucial it seems, as the jets in petrol carburettors are very fine and easily blocked. So I have a fine petrol filter between the filler pump and the tank, and another on the clunk. I might switch to a felt clunk filter as apparently it holds fuel and can keep supplying fuel if the clunk is thrown out of the fuel during manoevres.

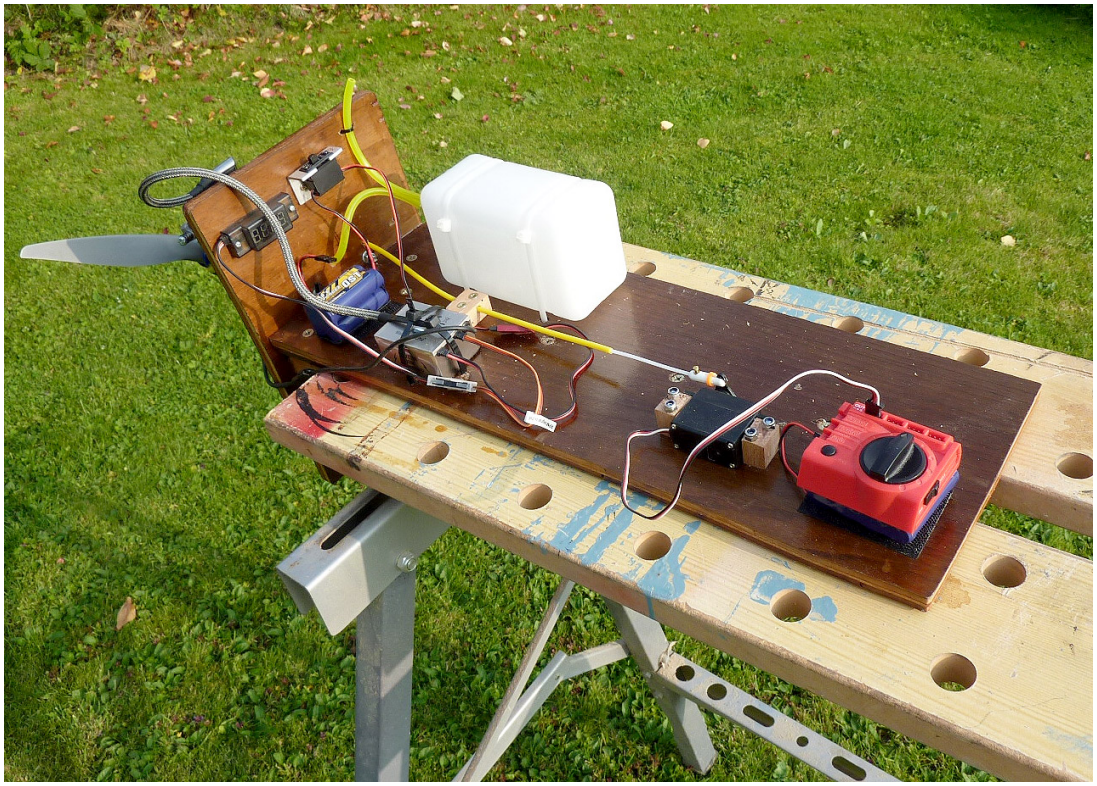
I needed quite a few other bits – chicken stick, second silencer, silencer extension pipe, tachometer, battery, fuel tank, filtered clunk, line filter, petrol fuel pipe, power switch, mixer bottle, oil and metal tie straps.

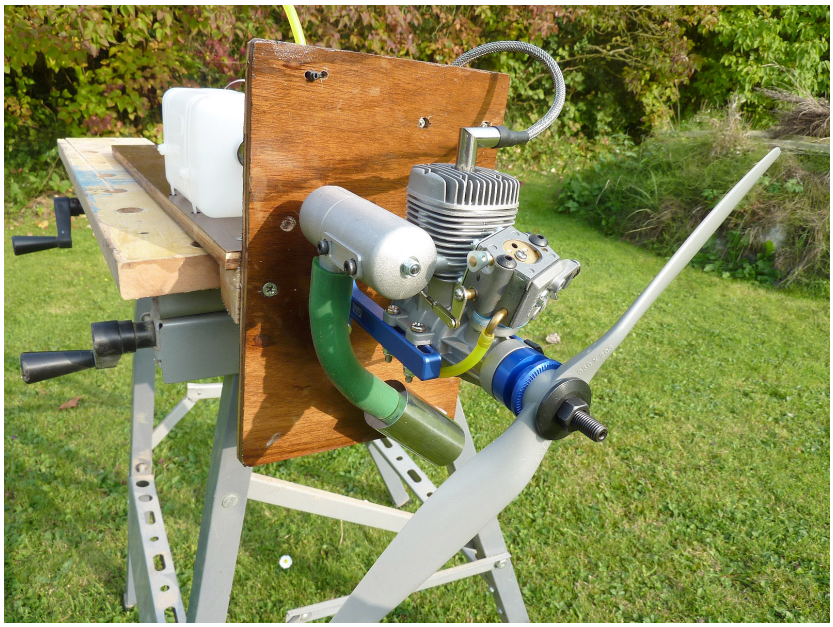
The maker advises running the engine in for 60 minutes with a 20:1 mix of synthetic oil. I used Castrol Fully Synthetic Racing 2T oil. A leaner 35:1 mix is recommended after that, which is richer than other engine makes. I ran it in in my garden so I fitted an extension pipe and extra expansion box. I like my neighbours.

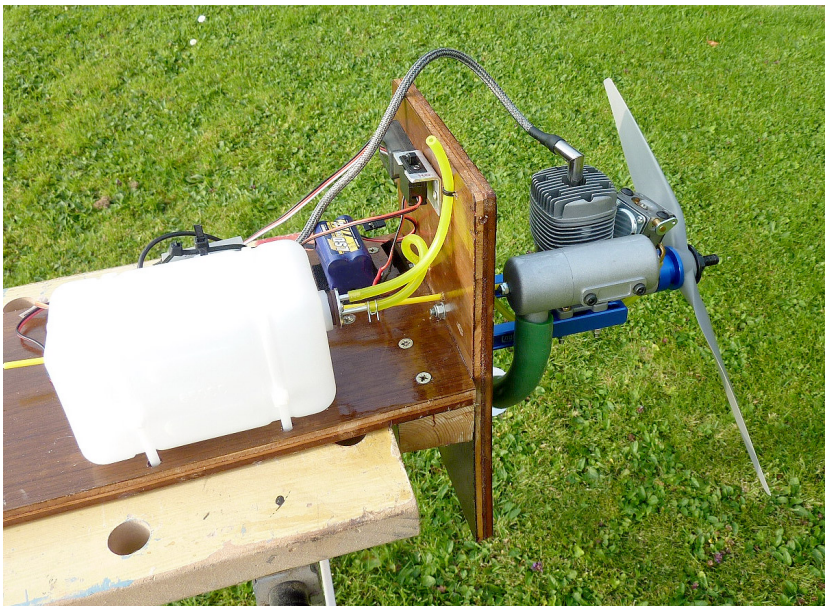
I had to make a ply and pine test rig to hold the engine and all the other bits while I played ... er experimented. I gave it a couple of coats of yacht varnish to stop the fuel soaking in.



This is the rig mounted on my portable workbench, which is held in place by a peg in the ground when in use.







In a model I will use an electronic kill switch on a receiver channel to cut off power to the ignition box, rather than a manual switch. The Taranis allows me to flag this with an ‘engine off’ voice message.The secondary silencer is held on with stainless steel tie bands. These work the same as plastic cable ties but will stand the temperature.

I also came across a useful tool. This is a tapered reamer called a ‘knife edge reamer’ from Hobby King (OR013-02101 £7.25). The good thing about this version is that it has a screw-on cover that protects the blades so you can take it to the field for when you break a prop and need to open out a new one. A step drill does an even better job but you need a drill press for it.

Tightening the spark plug
On my bikes I use a torque wrench for alloy threads, so I searched the torque setting for the spark plug, which was difficult. In the end I found that DLE Engines specify 7 – 8 ft-lbs which in proper metric units (1.36 larger) the mean value is 10 mN. I tried 10 mN and stripped the thread so I had to buy a replacement head, fortunately cheap. What on earth head alloy does DLE use? I now follow the advice of an expert, 'Finger tight then a quarter turn more'.

Cowls
Petrol engines run hotter than glows. That must be why they are more fuel efficient. Remember Sadi Carnot's Equation for a perfect heat engine cycle? For those asleep during Physics it is:

Thermal efficiency = (T1 – T2) / T1 (x100 for a percentage)
where T1 is the maximum gas temperature and T2 the exhaust temperature.
T1 and T2 are absolute (kelvin) temperatures
The higher T1 is the higher the efficiency.

Cowls must be designed with this in mind. To ensure good cooling the outlet area must be larger than the inlet or the hot air gets trapped. People disagree about how much larger varying from a bit to three times.

Specific energy for different fuels (MJ/kg)

Petrol	44
Methanol	22.7
Nitromethane	11.3

If like me you were baffled why nitro appears so energy poor yet, as we know, is so effective, the fact that it contains oxygen (CH_3NO_2) means it requires one eighth of the atmospheric oxygen to burn compared with petrol. A given cylinder can therefore burn eight times as much nitro as petrol so it generates 2.3 times the power.

What I learned
1 There are lots of advantages to CDI ignition. It gives an excellent spark and you can have an electronic kill switch that cuts power to the CDI, whch works similarly to the function in electric systems.
2 The electronic nature of the CDI box allows a simple, small and cheap electronic digital tachometer to be added, even into the model. A connecting lead is provided, attached to the NGH CDI box.
3 There is no need to put in any After Run Oil with petrol engines, as there is no nitro to produce nitric acid.
4 You need an additional control connection for the choke if the engine is enclosed.
5 Because the carb has a pump there is no need to pressurise the fuel tank, so piping is simpler and the tank can be further away from the engine, perhaps at the centre of gravity.
6 The CDI box needs to be as far away from the receiver as possible to avoid interference. I wonder if aluminium foil glued to a suitable former would help to shield it.
7 Pay attention to cooling.
8 For spark plug tightening I follow the advice of an expert, 'Finger tight then a quarter turn more'.
9 Don't flick props with an unguarded finger. I had set the angle and was testing it by idly flicking when the sharp trailing edge sliced open my finger. Happily it was still fixed to me though, so just a pool of blood and a few days of sticking plasters.
10 As a bonus, learning about small petrol carbs meant that I was able to tweak my Ryobi strimmer, which has never run well. See paragraph two above and modeller's note below.

Suppliers
For NGH (and Turnigy, O.S., RCGF and TorqPro) petrol engines: Hobby King
(NGH spares from Hobby King can only be bought from the Hong Kong warehouse)
Stainless steel ties: trsales on eBay
For NGH engines and a wide range of other petrol and glow accessories:
http://www.justengines.co.uk/

Modeller's note (classified 'restricted')
By not having to buy a new strimmer I saved almost enough to pay for all the petrol engine gear. For the younger members it is worth noting this. When challenged by SWMBO about how much you spend on aircraft all you have to say is, 'The manual skills I learn for my aeromodelling mean that I save us loads of money in repairs at home'. Of course the downside is that you must do some repairs, but hey we all have to make sacrifices.

So how did it go?
I followed the maker's starting instructions, which say:
1 Ignition off. Full throttle. Close choke. Flick until fuel reaches carb – about five times.
2 Ignition on. Choke closed. Throttle just above idle. Flick prop until engine starts and then dies.
3 Open choke. Throttle still just above idle. Flick until it starts and runs.
4 During running in, limit the speed to 3500 rpm with bursts of higher speeds. Stop periodically to cool down.

I mixed the recommended 20:1 mixture.
I initially set the H and L jets to 2 turns which was the highest recommended.
I used a chicken stick to flick. It was quite tricky to avoid the carb.
It took a while to fire for the first time probably because the engine was dry from new.
It then started but was laboured so I stopped it and reduced H and L to 1.75 turns.
I needed to start on a throttle setting a bit higher than just above idle.
It then ran better but with lots of smoke no doubt due to the high oil ratio.
It gradually ran more smoothly just below 3500 rpm
After about five minutes I tried a few short bursts of higher throttle.
It went up to 7000 but it wasn't very smooth and made lots of smoke.

Now I need to have it running for longer periods until I get to about an hour.
Then I will switch to the specified 35:1 mix and find the best settings for idle, H and L.
The secondary silencer brought the sound down to a sensible level for garden running.

After about six sessions of running in totalling about 40 minutes:
Able to run fairly stably at about 3500 rpm
Burst speed up to about 8000

Starting procedure:
From cold and empty:
About five choked priming flicks
Half throttle
Switch on
Starts quite soon
From cool:
One choked priming flick
Half throttle
Starts first or second flick

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