Petrol Generators for Portable SSB Part 1 of 2

By G8MNY (Updated Jul 16)
(8 Bit ASCII graphics use code page 437 or 850, Terminal Font)

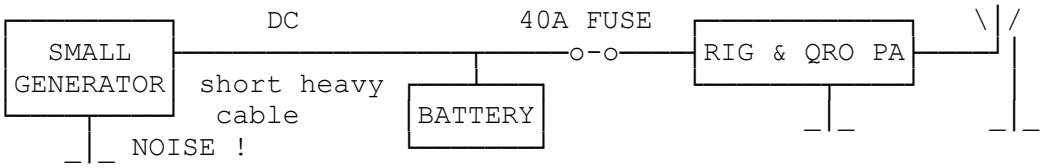
/P POWER NEEDS

A generating set capable of handling several 400W SSB stations at once is very uneconomical. This is because a typical constant RPM engine & alternator uses about 30% of it's energy just to overcome the mechanical losses, cooling etc, as well as the alternator exciting & cooling needs.

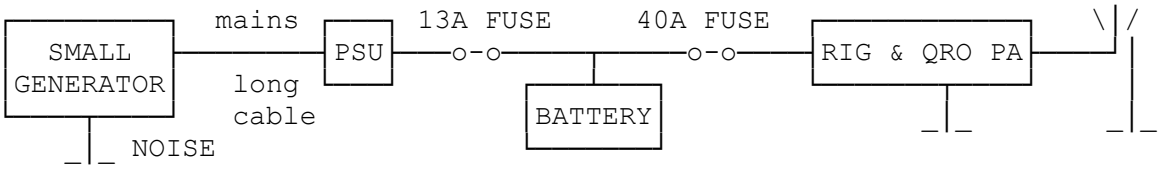
Using an under rated generator set, is far more economical, but obviously very prone to regulation problems on peak load.

LOAD SHARING/conditioning

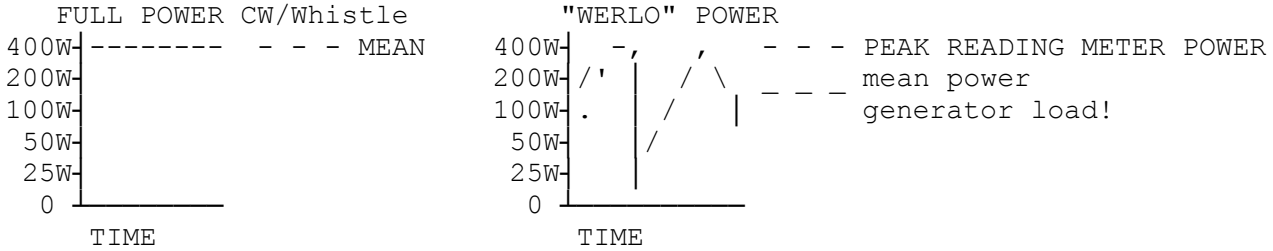
By floating a car battery on a small power source, very large peak power can easily be drained for SSB work. Using a small generator with an unregulated 12V output soon means lead loss is a problem if the generator is not located near the battery & rig. (See my bul "Regulating 12V Generator Output")



A 200W SSB Tx needs 35A peak, & regulated 10A PSU will be able to cope with that provided is well rated. But this is not so good for high power FM, but the battery will still recover on Rx.



Also ensuring that no Tx station sharing a generator, has to run full carrier power for tuning up valve PAs, so by use "werlos" (not whistles) & PEP METERS. This can solve excessive mains dips on heavily loaded generators enabling several 400W SSB stations to be run from a single 1.5kW peak rated generator.

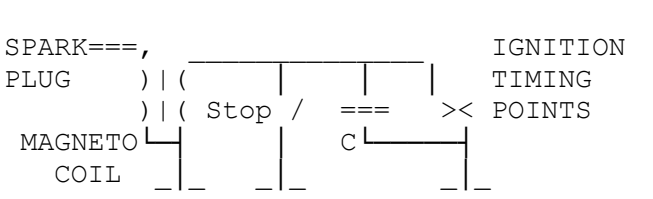


e.g. a 400W station needs at least 800W DC input (class B or AB2 valves) for full carrier tuning up, but only 450W DC for spoken "werlo" 400W PEP tuning up.

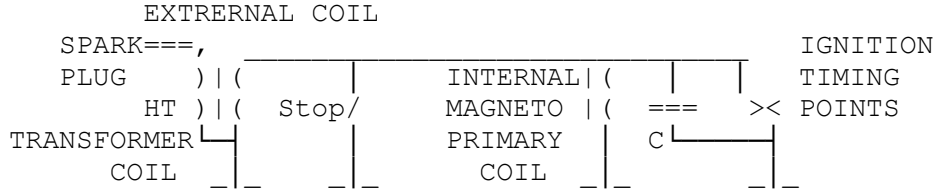
MAGNETOs

Small generators having no start battery, & use magneto ignition, which is housed in the flywheel. Powerful magnets built into the flywheel pass over a static coil.

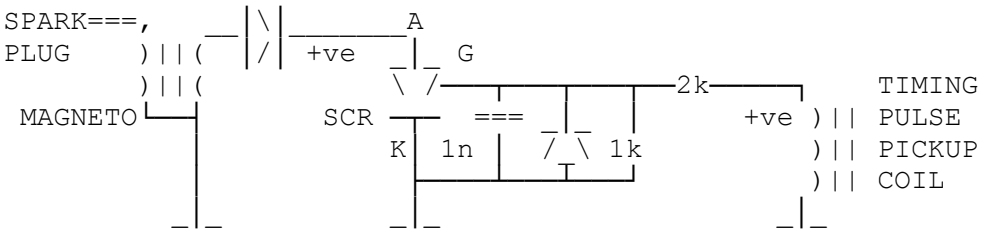
The engine axle has a cam on it that operates a set of shorting contacts called "points". Variable speed engines will have a movable cam, but not constant RPM generators. These points short out the coil primary with a condenser (0.5uF high voltage capacitor) across the points as well.



The points are arranged to open a few degrees before "Top Dead Centre", when the magnets are also across the coil. When the points open the magnetic flux is allowed to enter the coils, & soon produces a poerfull decaying oscillation with the condenser.



A second high voltage coil (that can be an external ignition transformer coil), produces 15-25kV to power the spark plug.



Electronic types replace the points with an SCR that suddenly shorts out the magneto +ve voltage as the magnets pass. Some use a separate induction timing pickup coil & small magnet on the crankshaft produce a precise timing pulse, resulting in the sudden change in the magneto primary winding voltage & the secondary then produces the high voltage. Ignition kill system on low oil is also common.

IGNITION QRM

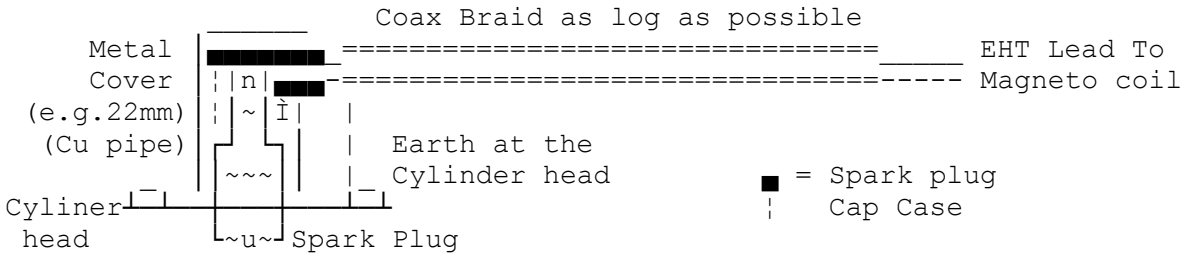
On a busy band (contests) it is undesirable to use Rx noise blankers to remove generator ignition noise, as this normally makes the larger band signals seem very wide.

The ignition suppression described here should reduce QRM by more than 40dB. This is greater than can be achieved with a resistive lead, or resistive plug cap or resistive plug together!

There are 2 causes of ignition QRM, radiation from the lead (Aerial) & radiation from the spark plug itself.

Suppress the lead with a large coax braid placed over the ignition lead & earthed only at the cylinder head! This stops all radiation from the lead, but not from the plug & cap.

For the plug cap, make a metal cover & use a resistive plug cap type. A thin Copper (from a pipe) or tin can, is ideal as it is easily soldered (the plug should not run that hot in service that the solder melts if painted mat black!) It should be shaped to be a tight fit on the plug hexagonal, & cover the top of the plug cap with a disk (coin). This must made water tight as any moisture here with stop the generator starting on a damp morning.



Suppressing plugs & screened caps are also available, but resistive lead as used on cars is not normally possible due to the magneto lead connection.

Mains lead pick up & re radiation of this QRM might be a route that can be suppressed with a mains filter at the generator, but in my experience the main culprit is nearly always the ignition system.

OIL ALARM

Many generators have this feature nowadays, it saves the embarrassment of a seized engine because you forget to check the oil level. But it is another reason why the generator will not stay running!
When the oil is too low a panel lamp may be lit, which happens when a vibrating oil pressure switch in the sump fails to see sump oil. If left after a few minutes it will kill the engine ignition or operate the shutoff switch somehow.

ECONOMY

This is very dependent on engine SIZE, FUEL, & LOAD, in that order. If the load can be kept to a minimum by using more efficient loads the better. e.g. changing a single 100W lamp for a 9W economy type, over a 36 hour period this could save as much as £25/e20/$15 worth of fuel! This is because unlike at your home where the power costs are a few pence/cents per kW HR, from a petrol generator the cost will be around £10/e10/$5 per kW HR. But on a 3kW generator with just the 100W lamp, cost could rise to £3/e4/$1 an hour as the large generator has to be kept spinning (about 1/3 - 1/2 the peak output of energy).

By comparison a modern 5kW welding generator set, uses a small 50cc petrol engine & runs (i.e. SCREAMS) at > 10,000RPM producing 8BHP output on full load, but ticks over at 500RPM between welds, making the small unit quite economical.

There are electronic inverter 230V 50Hz generator now using this principle, generating 340V DC from an alternator by a varable RPM engine, into a high frequency switch mode converter to make the accurate 50Hz 230V sine wave. But they are expensive, & the added complexity & power loss & possible VERY HF QRM, may make the advantage less in practice.

Using a diesel generator on farmer's reduced tax "pink" fuel, will certainly solve much of the running cost & also any electrical QRM. But at the cost of a heavier & MUCH ACOUSTICALLY NOISIER power source. Note also that not all engines run/start on the PINK fuel so well, but generators generally do once warm, & the same goes for ecofuels made from old vegetable oil! N.B. some oils rot the fuel line gasgets etc.

STARTING AFTER NON USE

Hand pull petrol generators can be really difficult to get going after a long spell of no use. There can normally be only 2 causes for this..

1/ No Petrol being vapourized, e.g. no strong smell of petrol in exhaust. This may be due to..

a) Fuel tap off?
b) Blocked carburettor jet?
c) Condensed engine oil in jet from engine breather?
d) Sticky dried up petrol in the jet? Not easily sucked up with low RPM.
e) Petrol blockage? e.g. tap/filter bowl blocked with sludge.
f) Water in petrol.

A quick cure is to strip off the air intake & squirt in a small amount of clean petrol (or use an "easy start" Ether spay) into the carburettor (choke off). On turning over expect a few back fires out the carburettor before the engine eventually runs & sucks through the old sticky low volatile petrol. If it soon stops you have a petrol blockage, & a good clean of the petrol tap filter, pipes & carburettor strip down may be needed.

Prevention is better than cure! Always drain the carburettor down with the drain screw provided on the carburettor bowl bottom, before storing!

2/ No Ignition. e.g. strong smell of petrol in exhaust. This may be due to..

a) Not switched on? (e.g. the points or plug is still shorted)
b) Oiled up plug?
c) Dirty plug?
d) Dampness in EHT wires?
e) Dampness in ignition coil/magneto?
f) Sticking points, or failed points cap?
g) Plug spark gap too wide for hand starting?
h) Low oil level? Engine killer on.

To test for a spark, remove the plug from cylinder, reconnect the EHT & connect the plug body with a large earth clip (e.g. the 1 used for earthing the genny!) Pull starter cord & look for a spark. If no spark, then use a meter to determine which part of the circuit has failed. A pulse of 30-100V should be seen at the magneto primary C.B. (or electronic version).

Plastic sprays like "Dampstart" can be useful on old engine electrics once they have been properly cleaned & dried out, so as not to seal dirt/dampness in!

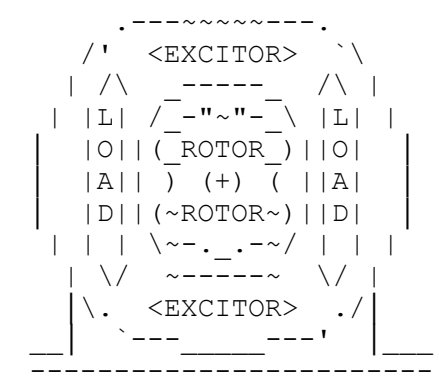
3/ Runs erratically e.g. revs up & down. Look at..

a) Blocked carb main jet? Giving a weak mixture when throttle opens.
b) Contaminated fuel e.g. Water. Drain off some from carb, any H2O droplets?
c) Spark Plug tracking? Clean or replace.
d) Arcing out HT/LT leads?
e) Governor or linkage faulty (loose or rusted up?)
f) Loose wires on Load socket/leads?
g) Failing Alternator Bushes?
h) Burnt out Alternator, coils framing out??

You have to check out all these possible causes just in case.

THE ALTERNATOR

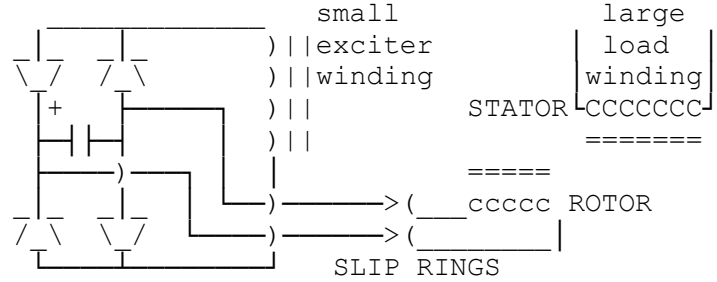
These all use a rotating electro-magnet called the rotor, this is inside a fixed outer laminations called the stator. The stator has the main output load winding & at 90° around the axis to this is the self exciting winding. This makes around 10% of the power available for the spinning rotor's powerful electro magnet.



If the rotor is shaped correctly & the stator windings are evenly spread the rotating magnetic field will produce a sine wave in the load winding. But this is not the most efficient use of materials, so cheap efficient single phase generators often do not produce a good sine wave waveform!

There are 2 types of rotor excitation used in small generators:-

The first uses a bridge rectifier on the stators' self exciting winding to obtain DC, which is smoothed with an electrolytic capacitor, & fed through 2 brushes & slip rings to the rotor's powerful electromagnet winding.

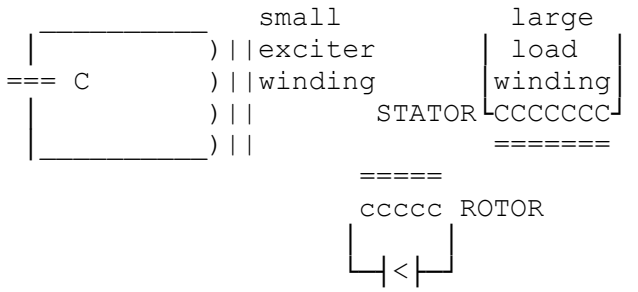


Some are more complex with an output voltage regulator placed in series with the DC rotor feed.

On starting the slight magnetic field left in the rotor is enough to overcome the bridge rectifier loss to enable the excitation to build up the rotor magnetic field. Sometimes to aid quicker excitation, waste engine magneto power can also be added with another diode.

The second method is brush-less & more reliable, but more difficult to explain.

The rotor's electromagnet winding has just a diode wired across it, & the stator self exciting winding has just a large AC capacitor across wired across it.



On starting the small residual magnetic field in the rotor produces a 90° leading current in the capacitor & self exciter winding. By transformer action this produces a voltage pulse across the diode in the rotor & charges up the rotor's magnetic field. As the rotor spins this occurs twice each revolution.

Some magnetic regulation of output voltage occurs in both types of excitation because, on high load currents some flux is repelled from the load winding & ends up going into the exciting winding that is 90° around the stator. This effect can produce some 10% increase in rotor excitation & hence 10% increase in voltage under load. If designed just right this increase balances the extra losses due to the extra load.

VOLTAGE REGULATION
ENGINE RPM
On modern engines this is normally 3,000 RPM for 50Hz, 3600 RPM for 60Hz. (even higher frequency on some cheap generators!) The speed is generally stabilised by a spinning bob weight governor that moves out weights under centripedal force to close the carburettors' throttle, against a speed setting spring that opens it. The basic problem with this feedback arrangement, is that the throttle cannot be opened, unless the RPM drops, often by as much as 10% (e.g. 50Hz to 45Hz) for full load, with a resulting frequency & voltage drop, & also less engine power & torque just when you need the power (watts) & torque (amps)!

For many mains items the correct voltage is necessary for the correct & safe operation. Over voltage is generally damaging, under voltage can cause many different type of effects, from frequency drift to Tx distortion, to computer brown-outs that can damage your HDD.

Some generators use overall voltage control feedback loop, affecting the throttle directly, &/or feedback that varies the rotor excitation level.

See part 2

Why Don't U send an interesting bul?

73 de John G8MNY @ GB7CIP