Pulsed Flyback Generator
Research Summary

Over a period of three years a generator was developed to test the hypothesis:

'*That high voltage, or high current intensity pulses, delivered to a battery, can result in a Coefficient of Performance (CoP) greater than 1 and that the whole electrical system can operate in an 'open' manner and harvest energy from the local environment*.'

The functional components of the device and the build are laid out in figures 1 and 2 below. Based on the principles of devices built by Nikola Tesla, and in recent times by the late John Bedini, the circuit has incorporated various developments but essentially serves to create 'flyback' pulses arising from the interruption of the current in a set of solenoids. This is achieved using either a rotor based switching system or a PWM unit with an adjustable frequency square-wave output.

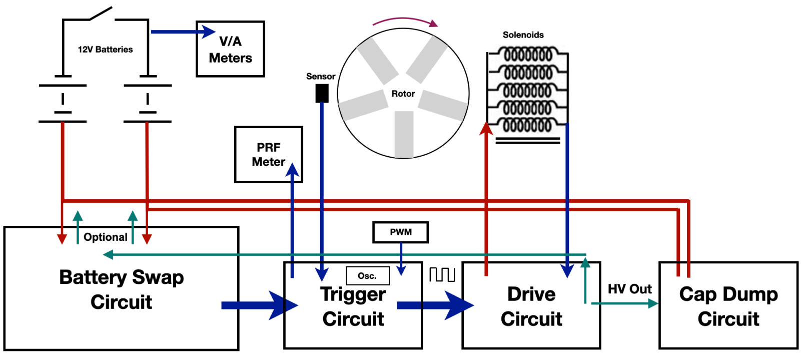

Fig 1: Functional Diagram

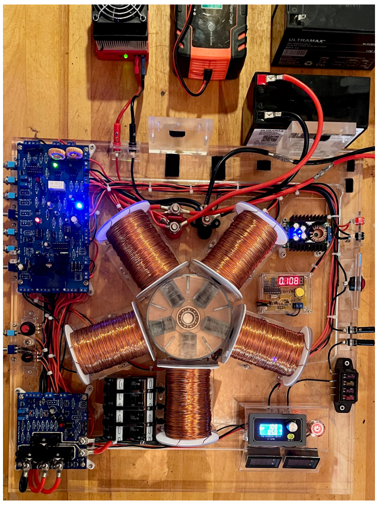

Fig 2: Generator setup

Essential to the system is a battery swapper so that while one battery supplies the energy for the circuit and external load, the other is being pulsed charged. Then, at a suitable interval of typically 15 mins, the batteries swap over their roles. In this way the harvested energy is not applied directly to a load but from the battery storage after pulse charging.

The trigger circuit, using either the rotor/Hall sensor or a PWM module, switches on the main power MOSFET/IGBT in the drive circuit on the rising edge of the input square wave and off again on the falling edge. At that point the collapsing field in the solenoids results in a high voltage flyback pulse that is seen at the Drain and is routed either directly to the receiving battery or to a capacitor storage system. In that case, at a set threshold voltage, a high current pulse is released from the capacitors to the receiving battery. The reverse polarity flyback pulses are in the 0.5 -1.7kV range, depending on the active components fitted, with a FWHM pulse of 20μs, (dV/dt = 8.5E+07 V/s) and where the limiting factor for the peak HV is not the coils but the 'avalanche rating' of the active device.

Testing the performance of this generator involves a method designed to accommodate the fact that the relative proportions of energy from the transients and any other source is unknown, as indicated in the graphic below, and involves four stages. Firstly, the measurement of a known quantity of energy dissipated through an electronic load from the 'receiving' battery, from a state of full charge. Secondly, the measurement of the energy delivered by the 'run' battery to the generator in operation. Thirdly, the return of the 'receiving' battery to its original energy state and voltage by the generator in a measured time. Lastly the calculation of CoP as the ratio of 'energy returned to the receiving battery' divided by the 'energy supplied to the generator by the run battery'.

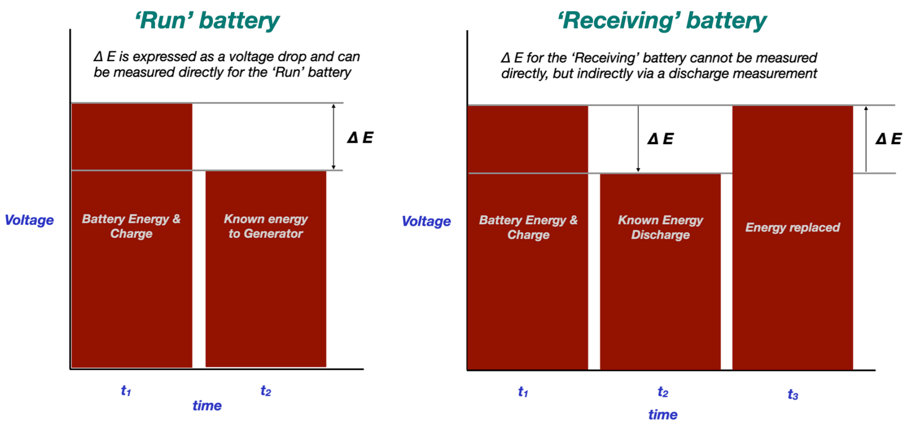

Fig 3: CoP Measurement Process

Tests over many months have involved the variables of PRF, duty cycle, coil voltage, swap interval, number of batteries in series, battery capacity and chemistry type. The maximum CoP value so far obtained is 25.5 ± 0.79, although the time taken to return it to full charge is also relevant to external power.

Applying HV pulses directly to the battery was found to be more effective for CoP measurements than when using high current low voltage pulses from the 'cap dump' circuit and so dV/dt appears to be of primary importance for the mechanism of energy influx. Output power tests have yet to be completed, with direct HV and with capacitors acting as an intermediary, but theoretical calculations based on the CoP results indicate 150-200W depending on the configuration and settings.

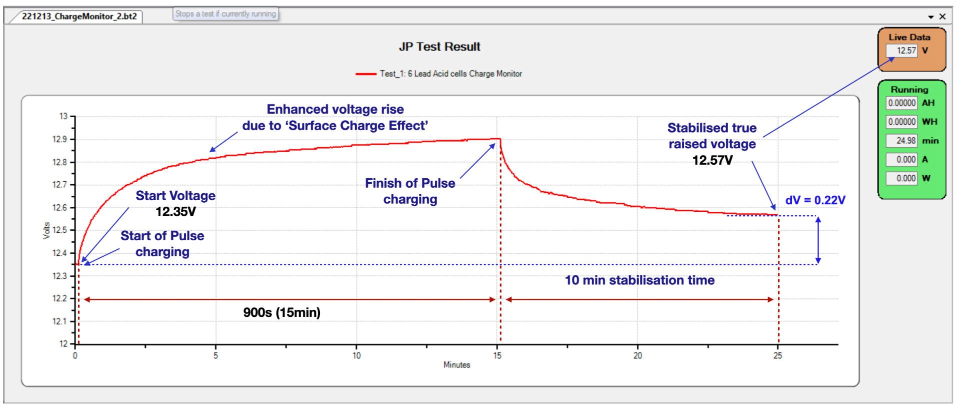

Fig 4: Vt graph during pulse charging

Figure 4 shows the voltage time graph while pulse charging a 7Ah Lead Acid gel battery using a pulse frequency of 108Hz and a peak pulse voltage of 560V. The battery voltage rises sharply and then the gradient lowers towards the end of charging stage, although extended charging will still continue to raise the voltage slowly. After switch off, a

10 minute stabilisation allows the surface charge effect to dissipate so that a voltage reading can be taken to give a realistic value for the change in battery voltage.

Although the primary role of the research is to provide repeatable evidence that there is an actual phenomenon of energy harvesting occurring, it is also pertinent to consider the mechanisms that might be involved.

Further tests, using a bank of capacitors in place of the receiving battery, produced results with a CoP in the range 0.35 - 0.41. In other words, there was no observable energy gain and with the capacitors effectively providing a measure of the conventional efficiency of the device in converting the supply energy into HV pulse energy. These tests showed that the observed energy gain requires the presence of the battery's electrochemistry to achieve a CoP>1 and further indicated that the energy gain arises from one of two possible pathways. One option is that the action of the HV pulses on the electrochemistry is causing some form of decomposition of the chemical bonds such that the electrode/electrolyte is acting as the source of the liberated charge that is subsequently stored and later released in the normal manner.

The second option is that the electrochemistry is acting like a diode or a one-way valve resulting in the 'capture' of an energy flux from the 'environment' as part of an open system. Further tests will be devised using the battery's 'Sate of Health' to help determine which is the most likely source. Additionally, the pulse history, that has been recorded for each designated battery, will be collated to identify any correlation between the accumulated pulse charging time and battery capacity and also to determine any links between the quantitive chemistry and the sustainable power delivered to an external load.

If it turns out that the most likely source of the energy gain is from an interaction with the local 'environment', then one obvious candidate is vacuum energy resulting from the presence of the HV transients that result in 'far from equilibrium' states. In such conditions, negative entropy may be involved, with chemical complexes acting as 'dissipative structures', as defined by Ilya Prigogine. Also relevant is the Geometrodynamics of John Archibald Wheeler, who developed aspects of QED involving coherence phenomena of the Zero Point Field in the local space-time metric. It is possible then that short bursts of charged particle influx are occurring with each pulse at the battery positive electrode.

It has also been suggested that a much weaker electric field can interfere with the recombination of pairs of polarised virtual particles resulting in a biasing of energy and charge 'outward' into another system e.g. a battery. Just as the 1st Law is being revised in the context of 'far from equilibrium' states, so too should the 2nd Law after many valid challenges over decades. Equally, other phenomena may be occurring that are not yet well described in the mainstream consensus. Nevertheless, identifying if the energy source is purely internal or involves the local environment to the battery will be crucial to the next stage of investigation.

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19th December, 2022