# EXCESS ENERGY (XS NRG™) CONVERSION SYSTEM UTILIZING AUTOGENOUS PULSED ABNORMAL GLOW DISCHARGE (PAGD)

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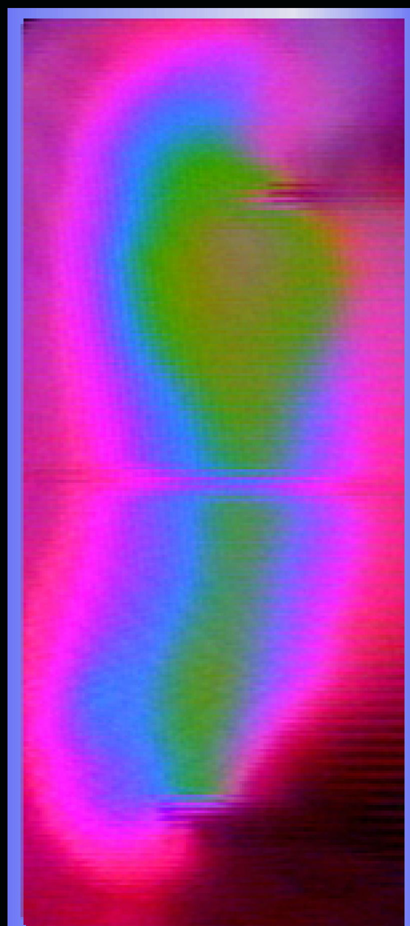

First Published in 1996 in the Proceedings of the International Symposium on New Energy

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UTILIZING AUTOGENOUS PULSED ABNORMAL GLOW DISCHARGE (PAGD)

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Abstract

By producing sustainable pulsations in a cold-cathode vacuum tube, the (XS NRG™) energy conversion system operates to generate electrical energy output well in excess of power input. After capture, the energy from the plasma reactor passes through the rectification circuit of the XS NRG™ System as DC output. An overall performance efficiency of 483% is reported in the data to be presented. The pulsations occur at a controlled frequency without the need for an external pulse forming circuit. The observed spontaneous auto-electronic emission occurs under conditions not anticipated by the Fowler-Nordheim paradigm, and appears to involve an anomalous cathode reaction force conforming to Aspden's Law of Electrodynamics, first enunciated by Dr. H. Aspden in 1969. High resolution metallographic results give evidence of the auto-electronic signature responsible for the anomalous PAGD (Pulsed Abnormal Glow Discharge) function we have identified.

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Introduction

Anomalous cold-cathode reaction forces were first reported in vacuum arc discharges (VADs) by Tanberg (1930) and Kobel (1930). Tanberg attributed the longitudinal force presented by the anomalous reaction to the counterflow of vapor particles ejected from the cathode, but K. Compton (1930) demonstrated that the vapor jet only accounted for <2% of its magnitude. Compton also suggested a different explanation for the phenomenon, attributing the electrodynamic anomaly to the rebound of gas ions hitting the cathode.

In the 1940's, little work was done on this continent on the presence of longitudinal forces in plasma discharges. The notable exceptions may have been the self-funded research of W. Reich and of T.H. Moray. Reich claimed to have discovered a spontaneous pulsatory activity of the space medium in cold cathode diodes sealed at high vacuum, and to have achieved oscillatory frequencies that reached >30 Kc (Reich, 1949). He equally claimed to have designed a motor circuit driven by the cyclic discharge in question, but all the details of the circuits were kept secret by Reich, and have remained so since the burning and banning of his publications by the FDA in 1956, followed shortly by his suspicious death in jail in 1957. M.B. King (1989, pages 8, 17) has suggested that anomalous lightning balls were produced in corona discharge tubes designed by T.H.Moray (1949), possibly by tuning the plasma diode to resonate with heavy ion acoustic oscillations (King, 1989, p.39), but again the details are scanty. To our knowledge, no one has reproduced the experiments of Reich or Moray.

German electromagnetic cannons were retrieved by the Combined Intelligence Objectives Sub-committee in 1945, which reportedly were capable of shooting out lightning balls into the atmosphere (Simons, 1947), and Dr. H. Aspden has drawn our attention to the efforts of Kapitza, in Russia, to drive the formation of plasma balls in vacuum tubes with an RF source (Aspden, 1983). Kapitza apparently realized that the energy densities of lightning balls were of the magnitude required to initiate nuclear fusion. During the fifties, the US fusion program also investigated the suitability of utilizing anomalous reaction forces in exploding wires subject to high current surges and in 'axial pinch' voltage reactors, to create alternative neutron sources (Bishop, 1958).

By the 1960's, it had become apparent that the presence of tremendous electrodynamic forces acting longitudinally in the direction of the discharge could not be accounted for by the Lorentz/Bio-Savart Law. The Tanberg vaporization hypothesis also could not explain the observed dependence of cathode reaction forces on gas pressure, nor the high velocity plasma streams emerging from the cathode (Plyutto et al, 1965, Kimblin, 1973). Plyutto's model of an ambipolar mechanism, where the electrons sweep the ions forward as a function of the anomalous rise of potential in front of the cathode spot, while the spot moves backwards, may well explain the dynamic relation of these forces, but not their initiation mechanism.

An understanding of the diverse experimental electrodynamic anomalies, and one that could unify disparate observations at that, would not be forthcoming however until 1969, when the Journal of the Franklin Institute published Aspden's seminal paper on his Law of Electrodynamics (Aspden, 1969):

$$F = (qq'/r^3)\ [(v'.r)v - (m'/m)(v.r)v' - (v.v')r]$$

where m'/m is the ratio of positive ion mass to electron mass. Analyzing the proportionality of the current quadrature phenomenon observed by Tanberg and Kobel in copper and mercury VADs, Aspden contended that if one took into account the mass ratio between electric particles of different q/m ratios, an 'out-of-balance' electrodynamic force would necessarily arise to act along the discharge path (Aspden, 1969). In 1977, Aspden would file a British patent application (Aspden, 1978) utilizing thermal conversion of the high anomalous acceleration of cathode-directed ions by electrons in VAD plasmas (Aspden, 1977a), but his circumstances did not permit him to pursue the work experimentally (Aspden, 1996). In the intervening years, anomalous electron-ion energy transfer in plasmas heated by ion-acoustic turbulence or electron beams had been steadily reported (Morrow et al, 1971; Porkolab et al, 1973; Sethian et al, 1978; Tanaka and Kawai, 1979). These phenomena were predictable from, and in agreement with, Aspden's Law - but this fact was ignored, even if the Lorentz's Law could not account for the experimental anomalies observed when a circuit was closed by distinct fluxes of charge carriers of different mass.

In the mid-eighties, Prof. Graneau and his group showed that electrodynamic explosions induced by kilovolt pulsed ion discharges in pure water were greater by three to four orders of magnitude than expected by established theory (Graneau and Graneau, 1985; Azevedo et al, 1986). As Aspden pointed out, these results again should be understood in terms of the m'/m scaling factor (Aspden, 1985; Aspden 1986). During the same decade, investigation of pulsed electrodynamic anomalies in Russia was in full swing, with the objective of harnessing a new source of power (Rand Corp., 1986) and, in 1989, the Novosti Press Agency released news of Prof. A. Chernetskii's design of a plasma reactor that operated with a "mysterious" regime termed by Chernetskii as the "self-generating discharge", and which appeared to serve as a source of overunity energy, as it played havoc with a one megawatt substation driving it (Samokhin, 1989).

More recently, G. Spence patented an energy conversion system exploiting the electrodynamic mass ratio difference of electrons and ions in a magnetic separator and accelerator chamber having a basic analogy with Aspden's patent (Spence, 1988; Aspden, 1978), but utilizing a different technique for the centripetal capture of the accelerated charge carriers, as based on a modification of the betatron principle that employs an homogeneous magnetic field. Spence's device suffered from periodic breakdown, usually after several hours of operation, owing to problems believed to be connected with the thermionic ion-emitter guns (personal communication of Dr. Aspden to Dr. Correa).

Our point of departure was a serendipitous observation - made while studying sustained X-ray production in parallel plate diodes - of quasi-regular discontinuities in glow discharges having a minimal positive column at very high vacua ($10^{-5}$ to $10^{-7}$ Torr) and at low to medium voltages (10-50 kV DC). These events, which were associated with X-ray bursts, spontaneously originated localized cathode discharge jets that triggered the plasma glow in a fashion quite distinct from the flashing of a photocathode or from an externally pulsed plasma glow. It would soon become apparent that these discontinuities were elicited by spontaneous electronic emissions from the cathode under conditions of current saturation of the plasma glow, and could be triggered with much lower applied DC field strengths. The discharge was distinct from the VAD regime in that the plasma channel was self-extinguishing, and the regime was pulsatory.

Pulsation of current saturated abnormal glow discharges (AGDs) was originally described by E. Manuel (1969), who utilized externally formed DC pulses or AC oscillations to drive the cyclic operation of a plasma discharge tube in the AGD region (see Fig. 1), but in the absence of auto-electronic emission. The pulsed plasma discharge regime we had isolated also operated in the AGD region, but it cycled autogenously between points F-E (Fig. 1) as a function of being triggered by spontaneous auto-electronic emissions from the cathode.

As will be shown, we found very strong anomalous cathode reaction forces associated with the autogenous PAGD regime, whilst autoelectronic emission was observed at unexpectedly low values of the applied field. Given the self-pulsed characteristics of the autogenous PAGD regime, the plasma tube effectively functioned as a DC inverter producing quasi regular large discontinuous "AC" pulses that, once filtered from the associated DC signal, could be directly utilized to power and control electromagnetic motors, relays and transformer circuits. This culminated in the patented design of basic PAGD motor circuits (Correa and Correa, 1995a). Patent protection for reactor design and pulse generating circuitry has also been sought (Correa and Correa, 1994). Finally, through the coupling of a secondary circuit to the PAGD reactor, now made double-ported, we succeeded in capturing directly as electrical power the anomalous energy deployed by the ion discharge pulses at the cathode. This was the basis of the XS NRG™ (Excess Energy) Conversion System, a patent for which was granted to the authors by the USPTO in 1995 (Correa and Correa, 1995b). It is thought that, through the self-extinguishing characteristic of the PAGD regime, electrical power is directly squeezed out of metal 'in vacuo', by virtue of a pulsatory interaction with the polarized 'vacuum' field energy.

## Results & Discussion

**The autogenous PAGD regime**. Fig. 1 is an idealized plot of the potential (on a linear but arbitrary voltage scale) between the principal electrodes of a vacuum discharge tube with increasing current (on a logarithmic scale in amperes). Curve A, below its intersection with curve B at point E, represents a typical relationship between current and voltage for cold cathode discharges, including auto-electronic emissions, whilst curve B represents a typical relationship for thermionic glow discharges, including thermionic emissions. The high-current intersection of the two curves at point E represents a transition into the vacuum arc discharge (VAD) region (curve C) with the establishment of a continuous low resistance plasma channel between the electrodes. With increasing current from very low levels, curve A presents an initially rising voltage or "positive resistance" characteristic, through the Townsend discharge (TD) region, a flat characteristic through the constant discharge (CD) region, a falling voltage or "negative resistance" characteristic through the transitional region discharge (TRD) and normal glow discharge (NGD) regions, to a minimum, before once again rising to a peak at F and then falling to an even lower minimum, equal to the sustaining voltage for a vacuum arc discharge, through the abnormal glow discharge (AGD) region. The rising potential over the first portion of the AGD region is believed occasioned by saturation of the electrodes by the glow discharge, which causes the potential to rise until auto-electronic emission sets in allowing the potential to fall again as the current rises further. In practice, the increasing interelectrode potential following saturation, and other factors such as electrode heating, leading to thermionic emission, will tend

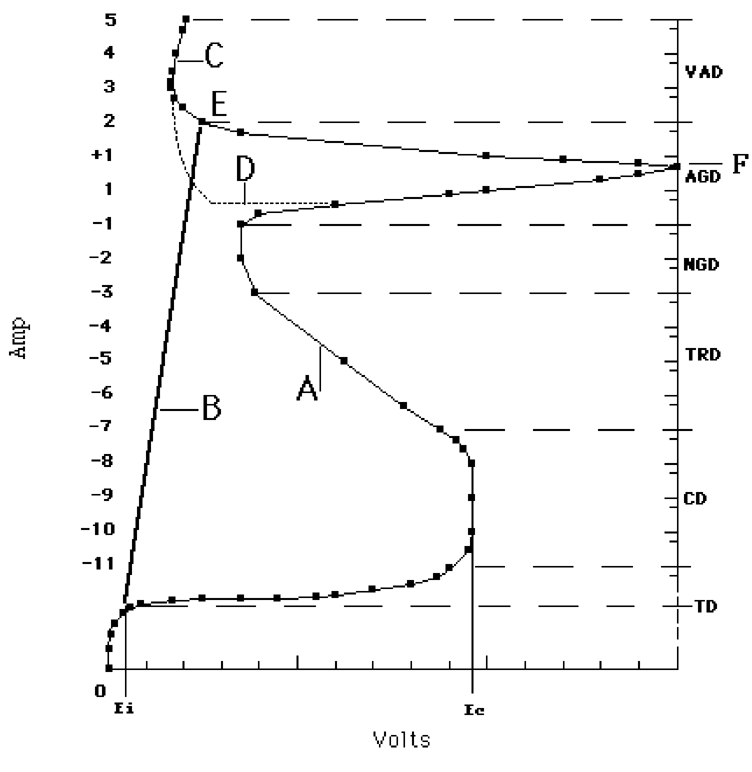



**Figure 1.** Volt-ampere characteristics of cold cathode and thermionic gas discharges.

in conventional tubes to result in a premature transition from the AGD into the VAD regime, following a curve similar to curve D shown in Fig. 1.

Essentially, the autogenous PAGD regime relies on the use of gas discharge tubes designed to avoid premature transition from the NGD to the VAD regimes, and capable of being operated in a stable manner in that region of the characteristic curve of Figure 1 extending between points E and F, within the AGD region. The peak F that characterizes the abnormal discharge region means that as the applied current is increased linearly within this region, the resistance of the 'vacuum' medium in the tube first increases with increasing current, only to subsequently decrease, still with increasing applied current, down to the minimum resistance value corresponding to the sustaining potential of a "vacuum" arc. Expressed in terms of resistance characteristics, the autogenous PAGD regime spans, as a function of applied current, a subregion in which a positive resistance characteristic changes into a leading negative resistance characteristic. The pulsed regime of the AGD is only sustainable when the intensity of the applied current is greater than that needed to rapidly saturate the plates, but not so great as to set up a VAD.

Fig. 2 plots test results for a single plasma reactor and shows the extinction or sustaining potentials of the tube together with the breakdown potential required to initiate the autoelectronic discharge. Actual values of current and voltage will vary with different reactor physical parameters, but the volt-ampere characteristic retains its shape. It should be noted that the $V_b$ breakdown curve shows two discontinuous portions X and Y, corresponding to the vacuum arc and abnormal glow discharge regimes respectively. The intersection of curve X, and curve Z representing the sustaining ($V_s$) or extinction potential ($V_x$) is illustrative of the difficulties inherent in extinguishing a vacuum arc discharge, since a decrease in current is accompanied by a decrease in breakdown voltage until it equals the VAD sustaining voltage ($V_s$) which does not vary greatly in this region. On the other hand, the combination of a fairly high and constant breakdown voltage (curve Y) combined with an extinction potential which rises with decreasing current in the region E-F (see Fig. 1) of the PAGD regime means that the pulsed abnormal glow discharge will be extinguished if the current

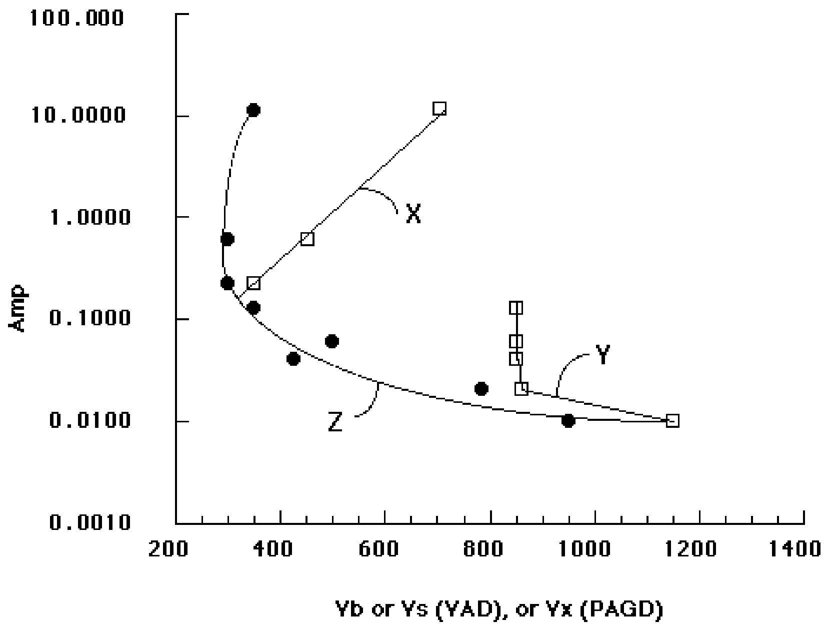
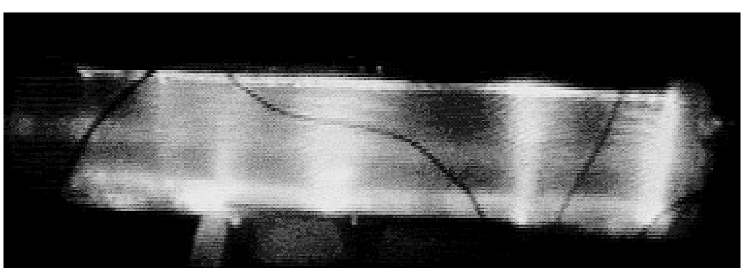



**Figure 2.** Experimental Volt-ampere characteristics of the VAD and PAGD plasma regimes.

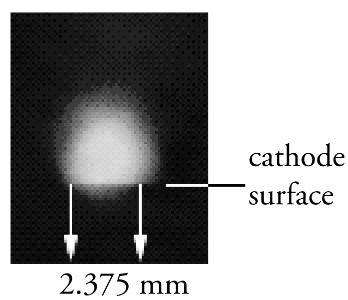
source ceases to be able to provide the increasing current required to maintain the discharge as the potential between its electrodes drops, at some current below the intersection of curves X and Z. If the effective internal resistance of the source is above some critical level, then as the current through the tube rises, the proportion of the source potential developed across the tube will fall until it intersects the curve Z at a current below the intersection with curve X, at which point the abnormal glow discharge will self extinguish, and the current flow through the tube will drop abruptly until the current through the tube combined with the potential between its electrodes again intersects the curve A in Figure 1. This permits reestablishment of a rising current through the tube traversing the abnormal glow discharge region as the potential across the tube rises to the peak F and then again falls to a point short of E. At low pulsation rates the autogenous PAGD cycle can be easily observed: the cycle begins with an expanding and intensifying glow (charge phase), followed by its contraction, under electrodynamic compression, to a transient plasma channel (discharge phase) shaped as a cone inverted over the cathode (see Fig. 3A). At the apex of the discharge channel, a plasma ball forms over the emission focus (see Fig. 3B).

**Metallographic studies.** Extensive autographic studies were conducted of primary and secondary craters formed at the PAGD auto-electronic emission foci. In polished Al surfaces,each primary emission site has a multiplicity of satellite craters in its periphery, the cathode plasma ball occupying the entire area comprised of the two types of craters (see Fig. 3B). In hardened Al surfaces only the primary crater is apparent, but the the area occupied by the plasma ball covers the 'boiled off' periphery of each crater, clearly visible as a ring of protuberances surrounding the raised lip of the craters (see Fig. 4). The core of the craters is hollowed out and often occupied by a molten metal spherule. The embossed spiraloid imprint of the entire formation (lips plus concave core) indicates that the tip of the PAGD channel, where the cathode plasma ball sits, is the apex of a vortex that burrows into the cathode surface. It also suggests that the entire PAGD channel has an associated spin.

With the data obtained by the metallographic method of crater measurement, we estimated the volume of metal ejected from an H34 Al cathode, by assuming that the crater represents a concavity analogous to a spherical segment having a single base ($1/6\pi*H\ [3r^2+H^2]$, where H is the height of the spherical segment and r the radius of the sphere), while disregarding the volume of the occasional central droplet leftover from the emission. The following are mean ± SEM crater diameters (D), crater depths (H) and volumes (V) of extruded metallic material for two types



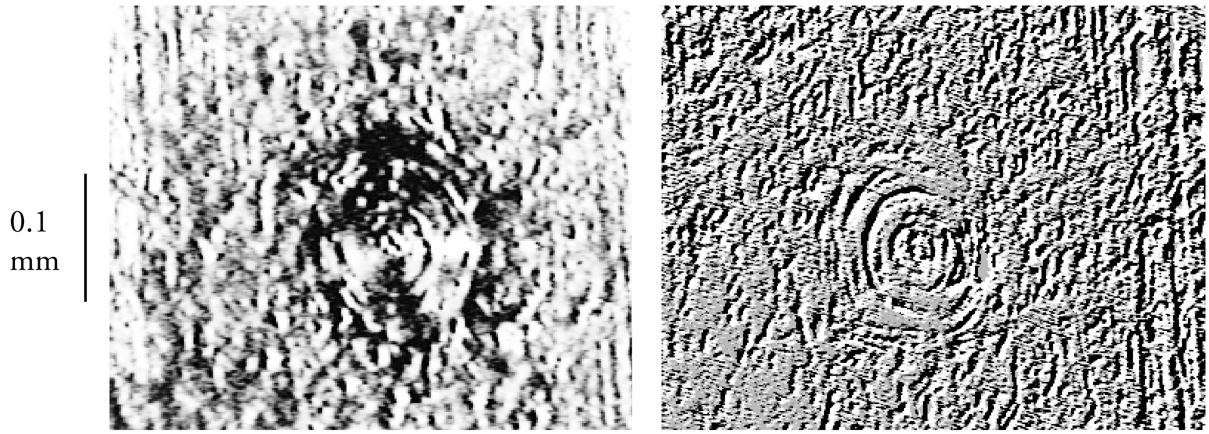
**3A**




**3B**

**Figure 3.** **3A** - Single video frame of 5 diachronic PAGD channels; H34 Al $128cm^2$ area plates, 5 cm gap; Vb=700V; Vx=480V; P = $10^{-6}$ Torr; 130 PPS.

**3B** - Cathode plasma ball over a PAGD emission site. The plasma globule has a core diameter of 0.24 cm and an estimated area of 0.044 $cm^2$. The current density at the ball's largest cross-section is $1.25*10^5$ $A/m^2$. P = $10^{-6}$ Torr; 30 PPS; Alzak plates (IR filter on).




**4A** **4B**

**Figure 4.** **4A** - Dual transmitted/oblique light micrograph of a primary PAGD emission crater in H34 cathodes. **4B** - Differential interference contrast emulation micrograph of another primary crater.

of aluminum cathodes, Alzak and H34 hardened aluminum, subject to a high input current (1.6A) PAGD:

1- Alzak: D-0.028cm±0.003; H-0.002cm±0.0002; V- $6.2*10^{-7}cm^3$;

2- H34: D-0.0115cm±0.0004;H-0.0006±0.0001; V- $3.1*10^{-8}cm^3$;

**Low field emission.** Unlike prior art planar or coaxial electrode discharge devices which utilize short gap and high field discharges (typically >100,000 V/m) in the absence of an unexploited electrode area effect, the PAGD reactors are essentially low breakdown field devices with large gaps, and which advantageously employ the voltage reduction electrode area effect to substantially decrease the field strength (Correa, 1994). The breakdown field values typically span from 5 to 30 kV/m. Field-emission theory requires a very high breakdown field value, greater than $2*10^9$ V/m, for auto-electronic emission (eg in a VAD). But the autoelectronic emission process responsible for the PAGD regime does not obey the Fowler-Nordheim field-emission theory, as may be seen from a Fowler-Nordheim plot (see Fig. 5): whereas the VAD curve has an expected negative $I/V^2$ slope, the slope of the PAGD curve is positive, indicating that auto-electronic emission can occur at much lower input currents and much lower field strengths ($>10^5$-fold lower) than required by the Fowler-Nordheim paradigm.

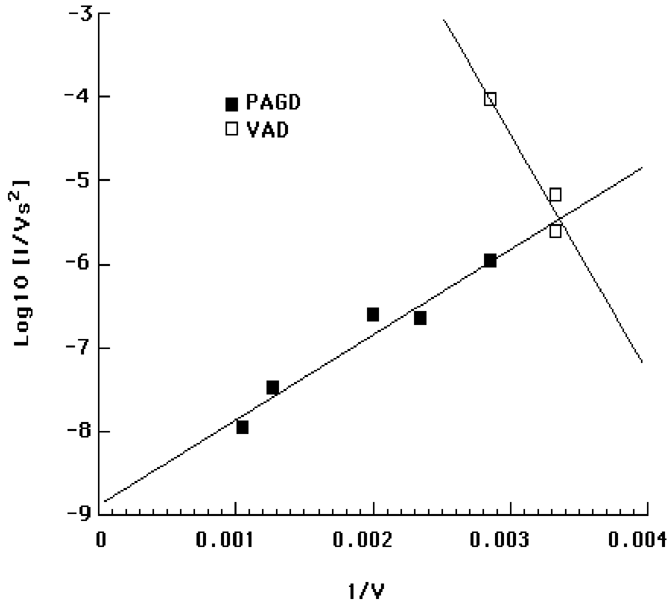



**Figure 5.** - Fowler-Nordheim plot of the extinction voltages (Vs for VAD, Vx for PAGD) for the PAGD and VAD regimes in the same vacuum sealed parallel plate reactor.

**Rate of PAGD and factors affecting it.** PAGD pulse rates increase with increasing electrode area, becoming displaced to regions of greater negative pressure, as well as increase with increasing applied voltage (the reader is referred to Fig.s 8 and 12 of Correa and Correa, 1995b). Other factors that affect pulse rate are range of negative pressure, the work-function of the cathode, the magnitude of the input current, reactor geometry and the presence of parallel capacitance. Figure 6 illustrates a shift of the PAGD regime to higher pressure regions during pumpdown with a rotary vacuum pump in an argon atmosphere, as a function of a 500-fold increase in applied direct current (1 vs. 500 mA), at the same starting voltage of 860 VDC and utilizing the same 128 $cm^2$ H34 aluminum plate pulse generator in separate tests. In either case, PAGD frequency has a modal distribution varying continuously as a function of increasing negative pressure, increasing to a peak rate, and then decreasing to zero, when a higher field strength becomes necessary to elicit PAGD production.

**Anomalous cathode reaction forces in the autogenous PAGD regime.** Determinations of the anomalous cathode reaction forces in the PAGD regime was carried out utilizing the reactor pulse

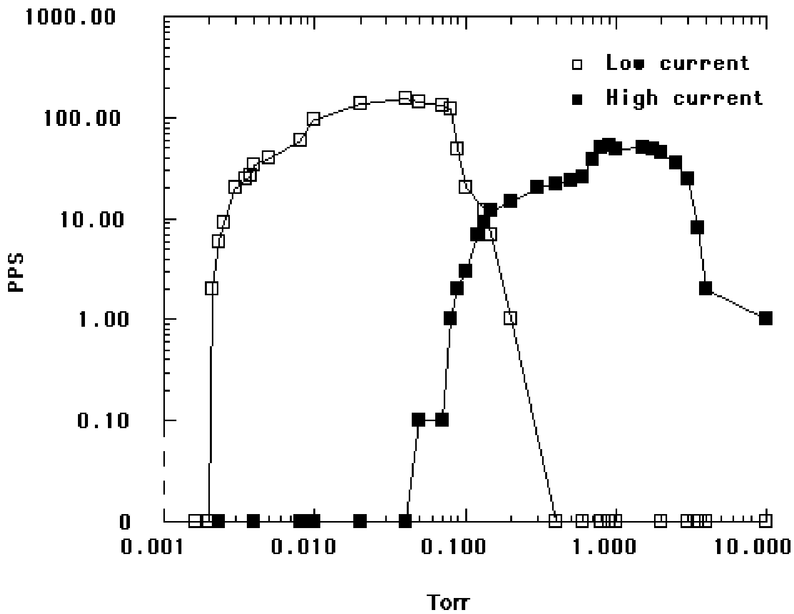



**Figure 6.** Pressure and input current dependence of autogenous PAGD frequency in the same reactor.

energy or the pulse output energy, together with the metallographic data or by measuring the force in a reaction balance. The kinetic energy of each pulse was determined either directly, by integration of oscilloscopic pulse profiles, or indirectly, by long-term resistive discharge measurements of the battery stored output power. The cathode material utilized for these experiments had an experimentally determined density of 1.86 $gm/cm^3$. For a mean *net* pulse output energy of 86.4 J (Net energy out = output reactor energy - input reactor energy), or 24 mWh, and a mean volume of cathode metal ejected on the order of $3.1*10^{-8}$ $cm^3$, a single PAGD releases $5.8*10^{-8}$gm of metal in ~50 msec, or $1.3*10^{15}$ Al ions. From oscilloscopic and long term battery resistive discharges, the total kinetic energy of the ions striking the cathode per second under these conditions is on the order of $2*10^{10}$ erg/sec.

Without knowing the mass of the ions striking the cathode per second, we may not ascertain the kinetic energy of each incident ion. However, we know the experimental mass ejected per PAGD, and we can therefore determine, from the *net* pulse output, the apparent energy density of the Al cathode subject to the PAGD regime.

$$d_{EPAGD} = (1.73*10^{10} \text{ erg/sec})/(1.15*10^{-6} \text{ gm/sec}) =$$
$$= 1.5*10^{16} \text{ erg/gm} = 2.8*10^{16} \text{ ergs/cc with } d=1.86 \text{ gm/cc}$$

Hence, the *net* excess energy obtained per PAGD Al atom ejected from the cathode is on the order of $6.7*10^{-7}$ erg ($4.2*10^{5}$ eV per atom). The energy density of the Al cathode being operated in a PAGD reactor, is then of the order of $2.8*10^{9}$ J/cm$^{3}$, only three orders of magnitude less than the energy density value of the energy priming the vacuum, as calculated by Aspden (1975, page 61). For an anomalous cathode reaction force F of 143.6 dynes, utilizing Tanberg's formula F= m*v/1.39, the corresponding velocity of the ejected Al ions would be $1.7*10^{8}$ cm/sec. Determination of the anomalous ion force by reaction weight measurement, under similar conditions, yielded 245.2 dynes. Anomalous cathode reaction forces >300 dynes have been observed in other PAGD experiments (with pulse output energies of 25 to >100 mWh). In referring to the anomalous reaction forces present in VADs (Tanberg and Kobel's results), Aspden (1969, page 183) recognized their electrodynamic origin, in that they were of the order of $100*i^{2}$. Here, the Gaussian units express force in dynes with the current i in abamps. Aspden's paper gave a justifiable foundation for his case that the out-of-balance electrodynamic force responsible for the cathode reaction is "the product of the constituent ion current component squared and the ratio of the ion mass to the electron mass" (Aspden, 1969, ibidem).

Graneau's group (Graneau and Graneau, 1985; Azevedo et al, 1986) have utilized a figure of merit k for the strength of the electrodynamic explosions they observed, in their calculation of the acceleration force for water-plasma arcs: ($F = (\mu_o/4\pi)(k*I^2)$, where the force is in Newtons, $\mu_o$ is the permeability constant of the vacuum in H*m, and current I is in amps. As the product of Graneau's figure of merit k by the current in amps squared times $10^{-2}$ is identical to the product of the current squared in abamps by the proportionality factor ($F/i^2$) proposed by Aspden, k defines the very proportionality coadunate with Aspden's Law. As may be seen from Table 1, where current is shown in Abamps, the k values of the PAGD are very high (100x higher than those observed in VAD studies, cp VAD groups # 1 to 3 with PAGD groups # 6-8, Table 1), and comparable to those calculated by Graneau et al for water-plasma arc explosions. Yet, the PAGD input current values are the lowest of all groups. Following Aspden’s Law, the PAGD k values are found to be in the range prescribed by the ion/electron mass differential for Al ions (49,185), which lies in the $10^{4}$ range.

**TABLE 1**

| No. | i abamp | $i^2$ | F dyn | $k = F/i^2$ (dyn/abamp$^2$) | $ki^2$ | Proportion | Source |
|---|---|---|---|---|---|---|---|
| 1 | 1.6 | 2.56 | 258.6 | 100 | 256 | $10^2i^2$ | Tanberg |
| 2 | 1.9 | 3.61 | 356.1 | 99 | 356.1 | $10^2i^2$ | Tanberg |
| 3 | 3.5 | 12.25 | 1470 | 120 | 1470 | $10^2i^2$ | Kobel |
| 4 | 1270 | $1.6*10^6$ | $0.9*10^{10}$ | 5,799 | $9.4*10^9$ | $10^4i^2$ | Graneau |
| 5 | 2540 | $6.5*10^6$ | $4.3*10^{10}$ | 6,658 | $4.3*10^{10}$ | $10^4i^2$ | Graneau |
| 6 | 0.16 | 0.026 | 143.6 | 5,600 | 143.6 | $10^4i^2$ | PAGD |
| 7 | 1.6 | 0.026 | 245.2 | 9,570 | 245.2 | $10^4i^2$ | PAGD |
| 8 | 1.6 | 0.026 | 154.5 | 6,015 | 154 | $10^4i^2$ | PAGD |

**The excess energy (XS NRG™) converter system.** Several two-ported circuits have been designed and tested for the capture of a substantial part of the PAGD reactor output, either for direct electromechanical or electromagnetic applications where the reactor functions essentially as an inverter (Correa and Correa, 1995a), or for direct conversion of the axial electrodynamic ion discharge action to produce electrical power (Correa and Correa, 1995b). The basic unit of the XS NRG™ System is shown in Fig. 7, and it involves two lead acid gel cell battery packs, the driver pack (DP), at the input, and the charge pack(CP) at the output. The protocol for a typical test of the circuit involves a series of steps:

1) before a PAGD run, a resistive discharge was measured across either pack over periods of 1 to 3 hours, followed by a 15 to 30 minute open circuit voltage relaxation;

2) next, PAGD production run(s) were performed and the corresponding open circuit relaxation voltages were measured after cessation of run;

3) finally, resistive discharge measurements, obtained under identical conditions to those recorded before the PAGD run, were carried out for either pack, followed by concomitant battery voltage relaxation rate measurements.

Under these experimental conditions, power measurements could be taken from an analysis of the actual battery discharge curves before and after the PAGD run. Based on a comparison of the integrated curves of the pre-run resistive discharge of the drive pack with those of the post-run resistive discharge, the

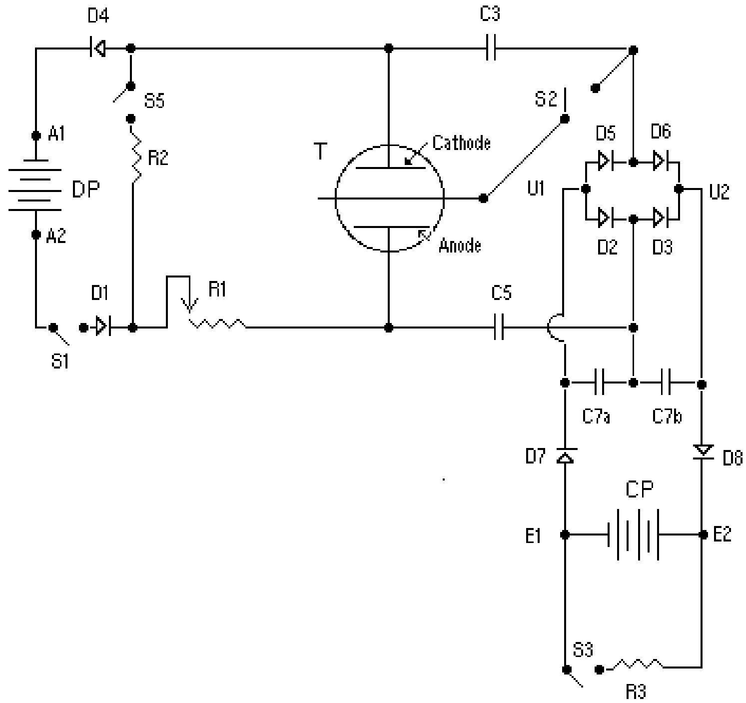



**Figure 7.** Basic unit of the XS NRG™ Conversion System (Correa and Correa, 1995b) utilizing a PAGD reactor in either diode or triode configurations.

effective power drawn ($P_I$) from the drive pack during a PAGD run, was ascertained. This represents the actual power that must be matched for breakeven efficiency ($B_E$=100%) to occur. Similarly, a comparison of the charge pack pre-run and post-run resistive discharge curves identified the effective power ($P_O$) added to the withdrawable capacity of the charge pack. This quantity represents the electrical energy recovered during the run. The relation for the two quantities is expressed by the breakeven efficiency equation:

$$B_E\% = (P_O/P_I)*100$$

If the breakeven efficiency is <100%, then the apparatus registers a net loss in electrical energy in the CP with respect to the DP. Conversely, if $B_E$>100%, then there is a net gain in electrical energy in the CP, as compared to that lost in the DP. For purposes of this analysis, a limit to the minimum withdraw-able capacity was placed, from experiment and in agreement with the load current curves of the manufacturer, at 115W for the driver pack (average current of 0.250A, minimum current of 0.230A), and at 90W for the charge pack (average current of

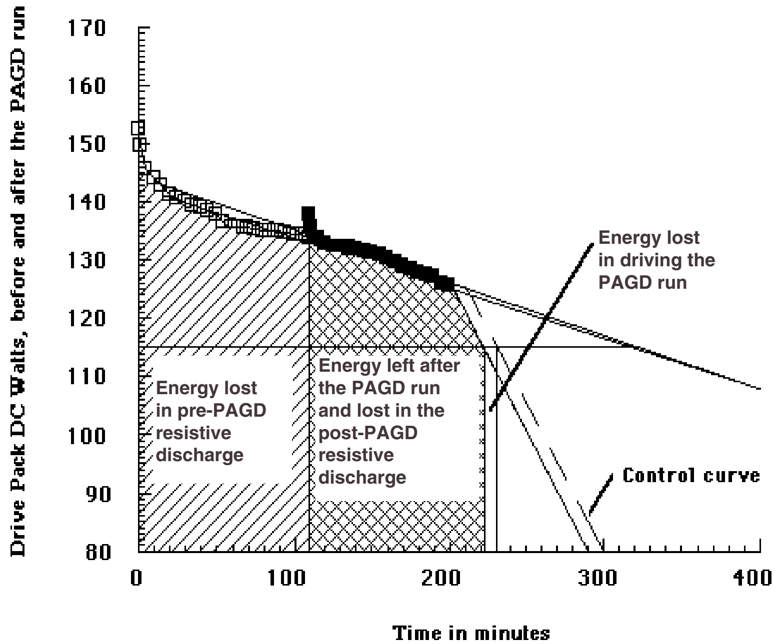



**Figure 8.** Resistive discharge slopes for a drive pack before and after a PAGD production run. R = 2,083 Ω.

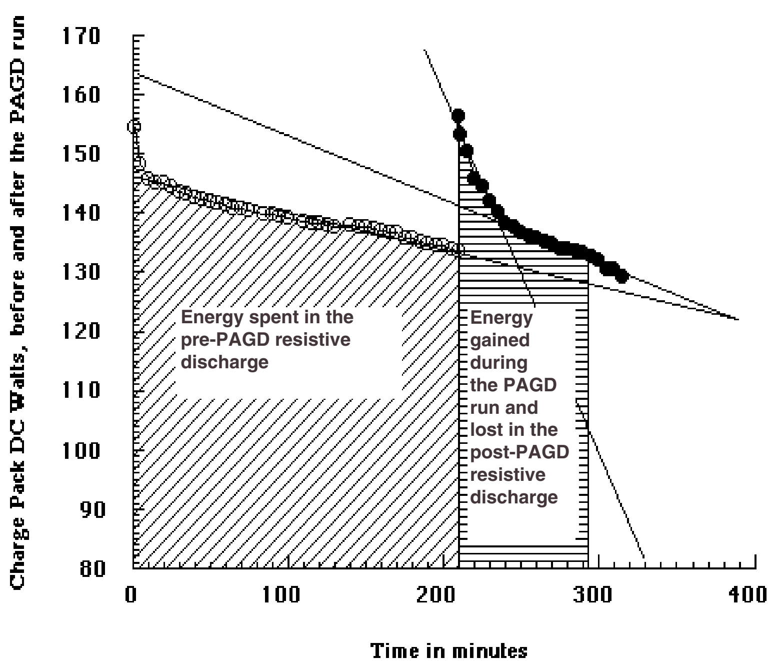



**Figure 9.** Resistive discharge slopes for a charge pack before and after a PAGD production run. R = 833 Ω.

0.375A, minimum current of 0.334A), as a function of both their total cell size (respectively, 46:29) and the difference in the resistive loads employed for the discharge measurements. More than twenty such experiments have been conducted to date, an example of which is shown in Figures 8 and 9, respectively for the DP and the CP (in both figures, the open symbols represent the pre-PAGD run discharge curves, whereas the closed symbols represent the post-PAGD run discharge curves). This data is extensively discussed in Correa and Correa, 1995b (see Table 8). Suffice it here to say that the percent $B_E$ for the run shown in Figures 8 & 9 was 483% = (182Wh/37.7Wh)*100, as calculated from integration of the discharge curves and comparison with the control curves (for these, see Fig.s 15A and 15B of Correa and Correa, 1995b). The reactor was operated at 0.8 Torr in the diode configuration, for 1h 14min., with a net output of 117 W.

Analysis of driver pack losses and charge pack gains by the extensive load discharge measurement method in other such experiments led to the determination of the gross and net gains (respectively, without and with losses included) per pulse or per unit time, for each PAGD frequency being varied as a function of decreasing pressure . Net pulse outputs ranged from 1 J at 110 PPS, 42 J at 1.5 PPS, and 162 J at 0.2 PPS, utilizing H200 Al cathodes. Similar results have been obtained with a manually operated free-standing system (see Fig. 12, Correa and Correa, 1955b), and these results will be presented shortly (in preparation). Even though the gross and net gains of power per pulse were observed to increase with decreasing frequency, the gross power gain per unit time increased with increasing frequency. However, this last trend does not necessarily translate into a higher net gain per unit time, because the losses in the driver pack also increase significantly with PAGD frequency. These losses are in all probability related to increased heat generation at higher frequencies when plasma extinction becomes incomplete (see Aspden, 1977a, page 163). We expect net gains to reach optimal thresholds for any given type of circuit configuration set of values and pulse generator dimensions.

## Concluding Remarks

By the Fowler-Nordheim paradigm, observation of auto-electronic emission under our experimental conditions would require theoretical field-enhancement factors on the order of $>10^6$. Suppression of these tremendous fields as a function of defined physical factors, can only be ascribed to an energy input from the "vacuum" field, akin to that which supports the consistency of lightning balls (Aspden, 1983; Aspden, 1996). Aspden has suggested that the PAGD regime relies on 'vacuum spin' for its energy storage function (Aspden, 1977b, 1996). The essential key to the development of the anomalous cathode reaction forces in the PAGD regime is the pulsation of the discharge, which is autogenously triggered by auto-electronic emission. This spontaneous segmentation of the discharge, which is absent from the VAD regime, permits the full extinction of the pulse channel and the electric capture of the excess energy. During the glow phase, the reactor functions as an energy accumulator by setting up 'vacuum spin' conditions. Upon initiation of auto-electronic emission, the energy "stored in the spin state as aether input energy becomes available as electric field energy, which can be tapped by drawing power from the electrodes of the Correa tube, just as if the glow discharge were a capacitor" (Aspden, 1996, p.22).

## Note on Methods and Materials

The reader is referred to Correa and Correa, 1994, 1995a and 1995b, for extensive description of the materials and methods employed in the experiments presented herein.

## Acknowledgements

The authors wish to acknowledge the moral and scientific support of Dr. H. Aspden who kindly reviewed this manuscript, as well as his helpful suggestions.

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