

FORGOTTEN INVENTIONS OF LENR

Part 3: Recent Inventions

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Introduction

Mass media portrays science as an uninterrupted victory march, led by heroic researchers. Reality is the opposite. Very important discoveries in physics and medicine are buried alive, as illustrated by the history of LENR-based electric energy generation machines. The crucial years were from the Russian uprising of 1905 to the outbreak of World War I (1914). In those years there were half a dozen observations of transmutation in gas discharges,¹ the reversal of electric fields in carbon arcs (by Mitkevich), and the discovery of quasi-particles on floating dust particles (by Ehrenhaft). Independently on a different continent, in the U.S., two disruptive inventions were born: by the best electrical engineer ever, Nikola Tesla, and the teenager T.H. Moray—electric energy generators without moving parts, and without fuel, in the traditional sense.

These were perhaps the golden years of creativity, including: the airplane; Hertz and longitudinal Tesla wave radio; the first gas turbine; the metal filament lamp; the triode; ball bearings; color photography; bakelite; catalytic ammonia production; the automatic telephone switchboard; Einstein's special relativity theory; the photoelectric effect as quantum effect; Zworikin's electronic TV; Ford's assembly line, and the birth of general relativity.

Yet most people remember only the Titanic catastrophe or the Tunguska meteorite. The birth of LENR is *not even a footnote*. One aim of this long paper is to set history right, because pollution-free electric energy generation is as important as AC current or airplanes. While the development of the automobile, airplane or radio was "in the air," LENR was not for the masses. Unfortunately it was done in secret only by two people, consequently it remained a secret until now, a century later. Why?

My guess is: in plasma oscillations, LENR is a complicated, three level autocatalytic process but at that time there was no plausible science behind it, like behind radio waves or manned flight.

The history of electric energy producing LENR devices is a real tragedy for mankind, because the lack of it led to resource wars, a degrading environment and immense human misery.

We had it and we lost it. It is high time to set that right.

One can't give credit to an effect or inventions if it has not been discovered or developed independently about three times. Antibiotics, airplanes and the telephone were discovered at least six times before they were accepted and manufactured.

Electricity/oxy-gas/mechanical energy-producing LENR

devices surfaced more than ten times, all as dusty plasma and surface edge effects, in different machines by different inventors working independently of each other. Here is a list of them:

1. Tesla around 1905, during radio and carbon discharge lamp development. All subunits were patented, but not the energy-producing tube construction.
2. Moray in 1910, during crystal radio experiment, probably by fiddling with a corona discharge tube—as a condenser.
3. Colman (discussed later) in the 1950s.
4. Chernetzky, during plasmotron development in the 1970s.
5. Correa, during electrode surface cleaning by pulsed sputtering in the 1980s.
6. Jekkel, during a welding machine development, using corona discharge in water in the 1980s.
7. Gray, fiddling with wire mesh discharges in the 1970s.
8. Papp, corona discharge experiments in the 1960s (mechanical energy).
- 9-15. Underwater arc discharge: Horvath, Meyer, Graneau, etc. in the 1960s and 1970s. Oxy-gas and mechanical energy of droplets (We shall not discuss them, as their practical merits on an industrial scale are doubtful.)

Kenneth Shoulders is not mentioned here, because his result is rather a discovery, but not a practical invention, since it has no straightforward application.

Apart from the above inventors, there were a number of physicists at the cradle of LENR, all involved with transient gas discharge experiments. Among the inventors only Tesla observed transmutations.

The "death rate" of discoveries in LENR is unusually high, much worse than usual. Why? Why is it so difficult to observe, and repeat, LENR-driven effects? In the vast amount of books and papers about transient discharge, there is not a hint about excess energy, or about transmutation. Not even a footnote...

Where is the secret, if there is a secret at all? Of course, inventors want an economic return. They are unwilling to disclose their trade secrets while waiting to see if a patent office is willing to accept it. For LENR (or cold fusion, or under any other name) the answer from a patent office is usually "no." Probably many more inventors found these effects, but when their applications were turned down, the results were not even published.

For scientists in academic research, repeatability is important, and therefore the circumstances must be clear.

However, hidden and unknown parameters influence repeatability. Further, the safe detection of transmutation requires sophisticated laboratory equipment, like a mass spectrometer, EDX, etc. None of them existed until about the 1960s. Thus LENR research for the inventor was based on electric energy balance tests, and “trial and error” as an experimental method.

By now we can learn and summarize whatever is left from the forgotten electric energy-producing inventions and transmutation experiments.

In Part 2 the Moray invention was analyzed. We shall continue now with more details about the devices of Chernetzky, Correa and others, and in the Appendix in Part 4 will cover the fuel cycle, as an LENR-driven process.

In Part 2 the two crucial mechanisms were described: slow neutron synthesis on rough metal surfaces and on/under the surfaces of dust particles. Preferably both mechanisms should be present, helping each other.

Important Forgotten Inventions and Effects

Self-generating discharges of the Chernetzky group

An interesting, strong series of self-generating oscillations was discovered by accident in 1975 by Alexander Chernetzky and his fellow workers, D.D. Lichnikov, J.A. Galikin, V.V. Ribakov, V.A. Richkov, A.A. Temeev, N.A. Popov, and Chernetzky's wife, C.M. Chernetzkaia.

Chernetzky was the author of an advanced level textbook on plasma physics, co-author of several Russian language papers on this subject, with access to high quality plasma physics labs. His discovery met only a moderate resistance: he was fired only twice, and not even exiled, like his friend and co-worker Andrej Sakharov.

When they discovered the powerful oscillations in plasmatrons (high power atmospheric industrial plasma dryers), they noted in some cases the direction of the current and voltage is reversed simultaneously: that is the discharge *generates* electric power, and does not dissipate it. They also noted half-heartedly that *hydrogen is necessary* for the effect, and the current density at the electrodes is important, and restricted to a narrow range.

Their discharge tube was run at an input power of between 400 and 1000 W, pressure was between 1.5-2 mercury mm, and the electrode was made of molybdenum.

The electrodes were cylindrical, the diameter was usually 5 mm, but there were successful experiments down to 2 mm in diameter. The distance between the electrodes was the same as the diameter. The volume of the tube was small (shown later).

The critical current density for the nearly self-sustaining oscillations was estimated at about 500 A/cm². It is important that erosion (sputtering) is less intense in the long self-generating oscillations, when hundreds of continuous energy-generating oscillations were observed, as shown in Part 2 (Figure 4 b, Issue 135). Figure 4c from Part 2 shows a time dependent parametric oscillogram of tube voltage and current indeed reversed, and the discharge oscillation was in the generator mode. It produced excess electric energy without a visible or obvious energy source.

There are a number of known discharge tube oscillations, and instabilities, but they always *dissipate* energy, and do not

generate energy.

A discharge tube is seldom part of an oscillating circuit in technical applications, because they are usually used as lighting, and filled with neon or high pressure mercury. Therefore smoothed AC is used for this purpose, electrodes are small and far apart, and the pressure is intentionally selected far from oscillating mode parameters. When Moray, Chernetzky, Correa, etc. made their tubes as part of an oscillating circuit, it was quite unusual, and their tube construction was also unusual so it is easy to get into uncharted territory in gas discharges.

After years of searching in the labyrinth of gas discharge papers and textbooks, I found only one on this subject by V.J. Francis, *Fundamentals of Discharge Tube Circuits* (Methuen & Co. London, 1947). There were papers about the subject later, but only about how to mitigate resonant oscillations in gas discharge lamps.

There are dozens of books devoted only to arc discharges, and hundreds of textbooks on gas discharges in general. I have found *nothing* about excess energy generation or transmutation, not even a footnote because, as we shall see later, the specifics of these discharges are way off the beaten track. (I don't consider here books on fully ionized plasma and MHD.)

Maybe the only exception was a half sentence about transient arc behavior by an experienced engineer at GE. He wrote: “The erosion of cathodes (sputtering) is treated as an annoying side effect, but considered useful for silicon chip manufacturing. The surface effect is not mentioned, but the semiconducting thin surface layer effect (Malter effect) is mentioned to reduce the work function of cathodes.”²

Chernetzky published only a sketch about the nature of the self-generating oscillating discharge, shown in Figure 1. It is not specified whether it is voltage or current, but in the negative region, the reversal is important, which he and Galkin discovered. In fact, this sort of oscillation is what Tesla described as “oscillations of aether, which are not static but dynamic.” Mitkevich described it as “reversal of electromotoric force in a voltaic discharge.” Moray described it as a “rush and backrush effect of a resilient medium...”

Figure 2 shows two different oscillating circuit block diagrams. Figure 2a shows a relaxation oscillator driven circuit. Figure 2b shows an audio frequency driven improved oscillating circuit, where the discharge tube is noted as V1, and a tunable capacitor is C1; the load resistor is labeled R3, R1 which is the ohmic resistance of the transformer. There were

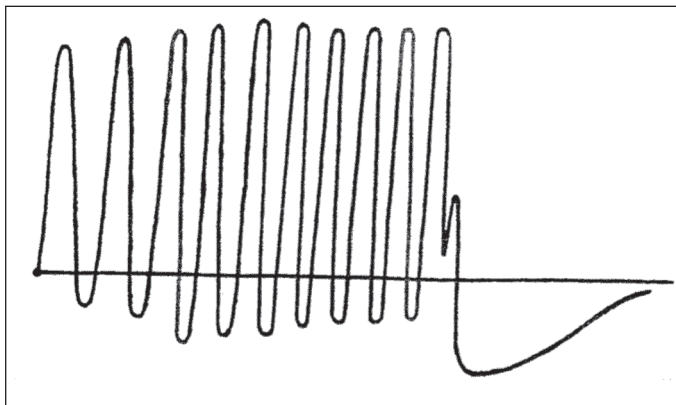


Figure 1. Chernetzky self-generating oscillating charge.

other similar oscillating circuit layouts, but the essence is the same as the crystal radio of Moray: two coupled circuits are used with different frequencies to drive the discharge tube. The first here is with a lower audio frequency, the second is with a higher frequency with a possibility of tuning the circuit frequency.

Chernetzky stressed the importance of critical current density, and focused his experiments exclusively on transient arc discharge. In the circuits of Figure 2, his arc frequency was 3-4 MHz, R0 ohmic resistance was 3 Ω , and the relaxation charging frequency was 10 Hz - 10 kHz, when C1 varied between 10^{-4} F and 10^{-9} Farad.

The peak tube current reached up to 800 A, while the average input current was not more than 20 A. The peak voltage was around 500 V on the C1 condenser, while the voltage was much higher in the arc tube, which does not exist in ordinary discharge tubes. The experimental tube is shown in Figure 3, and several Chernetzky tubes which we built are shown in Photo 7 of Part 2 (Issue 135). All of them are cold cathode vacuum arc tubes but after running for awhile they became hot cathode tubes with different tube characteristics due to heating. (Note that we found: the self-generating effect is not present with brand new, unbroken surfaces.)

The input energy—as they noted—was small. On the secondary of the transformer, shown in Figure 2b, was 1.3 kV, and the duration of discharge 10^{-7} sec, then input energy is a 10 micro Joule/pulse. With 1 kHz frequency, the average input energy is 10^{-2} W. However, with the R3 Load, the dissipated power was more than 1 kW.

The potential difference on the discharge tube was 50% more than the potential on the charging capacitor C1.

They put a tungsten filament lamp into R1 and R3 as resistors. While R3 was lit, R1 was not, showing that the discharge tube produced energy.

The Chernetzky theory

Being practical minded theoreticians, Chernetzky and Sakharov figured out that the energy source must be the

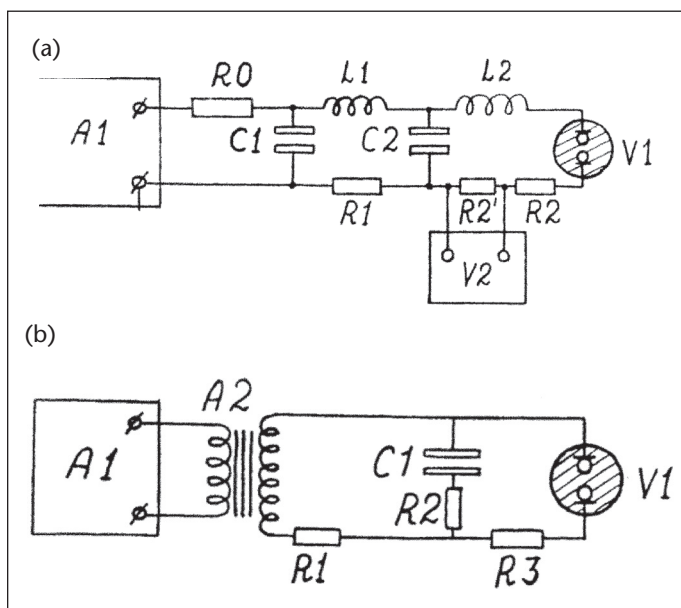


Figure 2. (a) Scheme of an oscillating circuit with relaxation oscillator or audifrequency oscillator. (b) Layout of a very high frequency oscillating circuit.

energy of vacuum fluctuation. Since hot fusion was ruled out by Sakharov, (he knew only ${}^2\text{D}^1\text{-}{}^3\text{T}^1$ hot fusion), and a violation of the conservation of energy, tapping the energy of vacuum seemed to be logical. Indeed, there is a vacuum and it has a spectrum of energy fluctuation (not like a black-body spectrum).

John Archibald Wheeler (and others) estimated an extreme energy density for these fluctuations, but no feasible technical method was found to extract it. Chernetzky gathered that the magnetic field of the transient arc makes the electrons swirl periodically, and that in turn polarizes the vacuum, and electron-positron pairs jump out of it, producing unlimited energy. He made a sophisticated mathematical model to describe this theory but only an error in the sign made excess energy.

All physical models assume tacitly from the start, conservation of energy, and consequently no model can lead out of it. However, Chernetzky tried something like it, and stuck to this idea.

They never tried to commercialize the device. It was always meant for academic research. In 1989 Sakharov died, and Chernetzky died soon after. During the stormy years of the Yeltsin era, the research group collapsed, their lab was

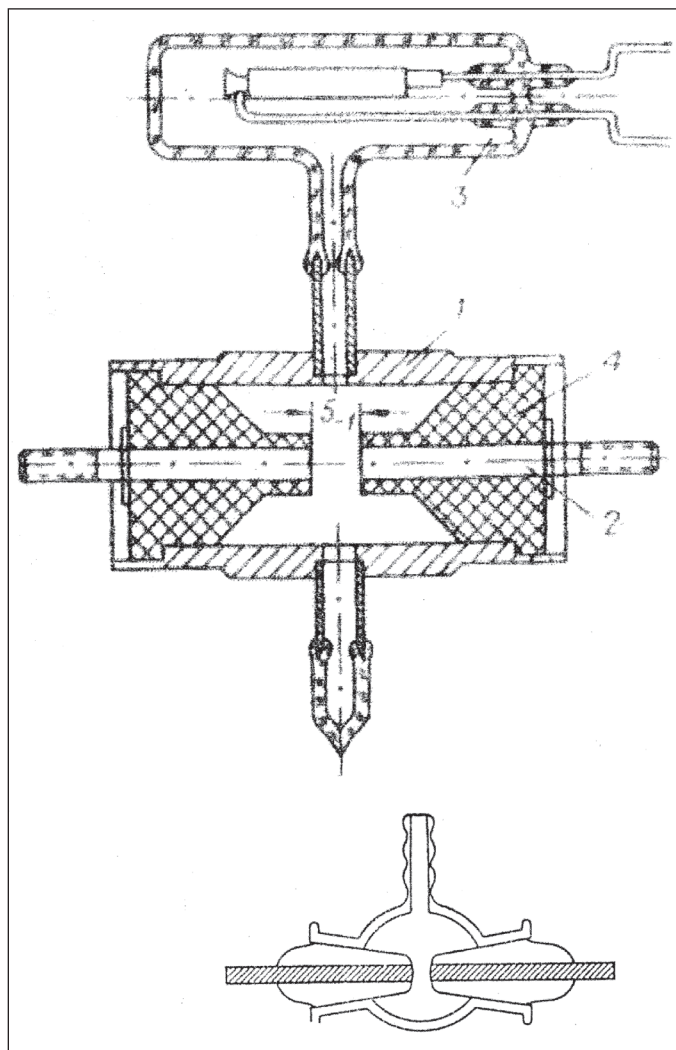


Figure 3. Layout of two Chernetzky tubes. The simple tube is detachable. The lower tube is of variable pressure. Titanium hydride is heated to vary the pressure.

closed, and no one continued their work—except us in Hungary years later, in the mid-1990s.

Our experience

We built the Chernetzky experiments based on his collected publications, and later with the technical advice of Lichnikov. The results were mixed at best. It took several years to reach the necessary technical level; nevertheless we prevailed with a five member team. (I was responsible for overseeing theory and experiments.)

Here are the results in a nutshell: The energy-generating long series of oscillations was found, as shown in Figure 4b-c in Part 2 (Issue 135). The overall electric efficiency of the process seldom increased above 100%. True, an arc discharge is meant usually for lighting or welding, and all the input is radiated away as light or heat (95%), so anything above 20% is a sort of miracle. The periods above 100% were short, and seldom exceeded 200%. We were unable to repeat the above-mentioned claims with the electric lamps. Worse, there were very long periods of oscillation analysis, where there were just noisy “bursts,” with no long series of energy-producing oscillations.

Even worse, the erosion was high, and the tiny surface of the tubes quickly eroded, covering the glass tubes.

Chernetzky's theoretical model proved to be useless. I was unable to see the connection between this theory and the oscillating circuit.

There was always a “break in” period for a new tube. The oscillations started only with slightly eroded surface. The effect worked more reliably in the presence of hydrogen filled, closed tubes, or when damp air was present. There were no oscillations in baked out tubes and an argon atmosphere.

All in all, small area oscillating arc tubes were just like electrochemical LENR. It worked for awhile, but in an unreliable manner. The 12 year arduous effort yielded a meager result. The Mitkevich-Moray effect was verified. We even traveled to Moscow to meet Chernetzky's co-workers, Lichnikov and others. They helped us to manufacture a professional hydrogen filled fixed tube but it was no better than our detachable tubes. The assembly of condensers, high current inductivity, with a vacuum system took nearly a year to complete, and it was quite expensive. In the end, the project was like the development of a flapping wing airplane, or my previous efforts using electrochemical thin layered Ni-Pd cold fusion cells: much work, with industrially useless results, due to its extreme unreliability.

Chernetzky used hydrogen in his tube not as a fuel, but out of convenience. Hydrogen can be absorbed by a titanium alloy and by heating it the pressure can be increased. Thus the tube pressure can be changed without expensive and fragile, cumbersome diffusion pumps, valves and Pirani pressure gauges. We usually used argon as the plasma carrier gas, because it is a non-invasive inert gas. This could have been one problem with our results. The other problem was that we were unable to manufacture a reliable high voltage (up to 2 kV) tunable audio frequency power supply. Only a DC power supply was used with a capacitor to supply a relaxation oscillation. This alone limited the length of self-generating oscillations.

The lack of a clear theoretical model was the real killer; without it there was no clear path to see what action should

be taken to improve the result. Trial and error gave us usually nothing but errors. Arc discharge, even in a hydrogen/deuterium atmosphere with a proper audio frequency power supply, is unreliable. Arc eventually heats the tube, thus pressure and tube current rapidly change in an unreliable way. Resonance cannot be maintained, only behavior like floating.

Pulsed anomalous glow discharge:

The Correa invention

The Correa invention was published in *IE* Issues 7, 8 and 9 (1996). The Correas were granted three U.S. patents: 5,416,391; 5,449,989 and 5,502,354, in 1995-96.

It is the most detailed disclosure on the pulsed plasma/excess electric energy subject. In Part 2, I briefly described my personal experience. We shall discuss it in more detail now, based on the detailed W094/09560 description.

One (of several) electric layouts is shown in Figure 4a, (Figure 22 of the patent). It is essentially a relaxation oscillator, with a large surface cold cathode (~100 cm²) glow or arc discharge tube, shown in Figure 4b.

No oscillating circuits, no electrical or acoustic resonance is mentioned in the claims and no hydrogen isotopes such as plasma gas, no dust or surface roughness as necessary conditions for operation. The device is described as an energy converter, but without disclosing the source of energy.

The cited input/output energy test results are spectacular. In Table 5/2 of the patent, the breakeven efficiencies range between 218% and 563% in electric energy (heat is neglected).

The average is around 300%, which is outstanding. The discharge tube potential is reversed here too, as described by Mitkevich, Moray and Chernetzky. In Figure 4c tube transient potentials are shown as a function of tube pressure, (Figure 20 of the original patent). The reverse of potential, the reverse of “electromotoric force,” or “backrush effect,” is shown here. Between a thousandth and hundredth mercury mm, the peak value of the reversed voltage is in the order of -200 V, while the initial tube voltage is 50-100 V. (This is not the time dependency of the pulses; those are not disclosed.)

The energy-generating bursts are referred to by the Correas as “cold cathode auto electronic emission.” The devices may work in a pulsed manner both with an anomalous glow discharge, and a cold cathode arc discharge, though the latter function with forced arc interruption, just like Mitkevich did.

The discharge tube is quite different from any usual industrial application because it has a large surface. In its simplest form as shown on the cover of *Infinite Energy* #7, there is a long tubular glass, just two electrodes (diodes) with long rectangular Al electrodes. Though it may work as a triode for easier ignition, or coaxial cylinders for better ignition voltage control, there are striking similarities in its physics with the previously discussed electricity-producing inventions.

In my opinion, the Correas did more than simply re-discover the forgotten transient electric energy-producing effect, but much more because their strangely-shaped discharge rotated around its own axis, which is not textbook electrostatics.

Transient dusty plasma LENR as a family of effects

Even the shape of the discharge was unusual:

a) Ball-like plasma sphere at the cathode and a conical dis-

charge channel approaching the anode. The cathode surface was covered with crater shaped melted metal rings under a microscope. Only Kenneth Shoulders realized that transmutation took place there!

b) With the rotating discharge column, a new group of rotational electrodynamics effects, first partially described by Ehrenhaft, and later, partially by Shoulders.

c) Completely unknown, spooky effects, termed loosely as aether, vacuum/orgone (of Reich).

The Correias flatly denied the transmutations, neglected the second, and endorsed only the third. This is the trail which we followed too, but it led nowhere.

Having more than ten years of hands-on experience, the sobering truth is that the potential reversing (auto-electronic emission) effect doesn't take place if:

a) The *electrode surface is new* and smooth. The effect may start after roughening by thousands of sparks, as later disclosed in the patent. Thus surface quality and dust volume density are important, but unclaimed parameters. (It is not mentioned in the claims of their patent.)

b) The *tube is baked out* when the glass is "dried out." It is not known generally, but water slowly diffuses into vacuum tubes through the glass walls and along the feed through electrodes, in a sneaky manner. After bake-out, within two to

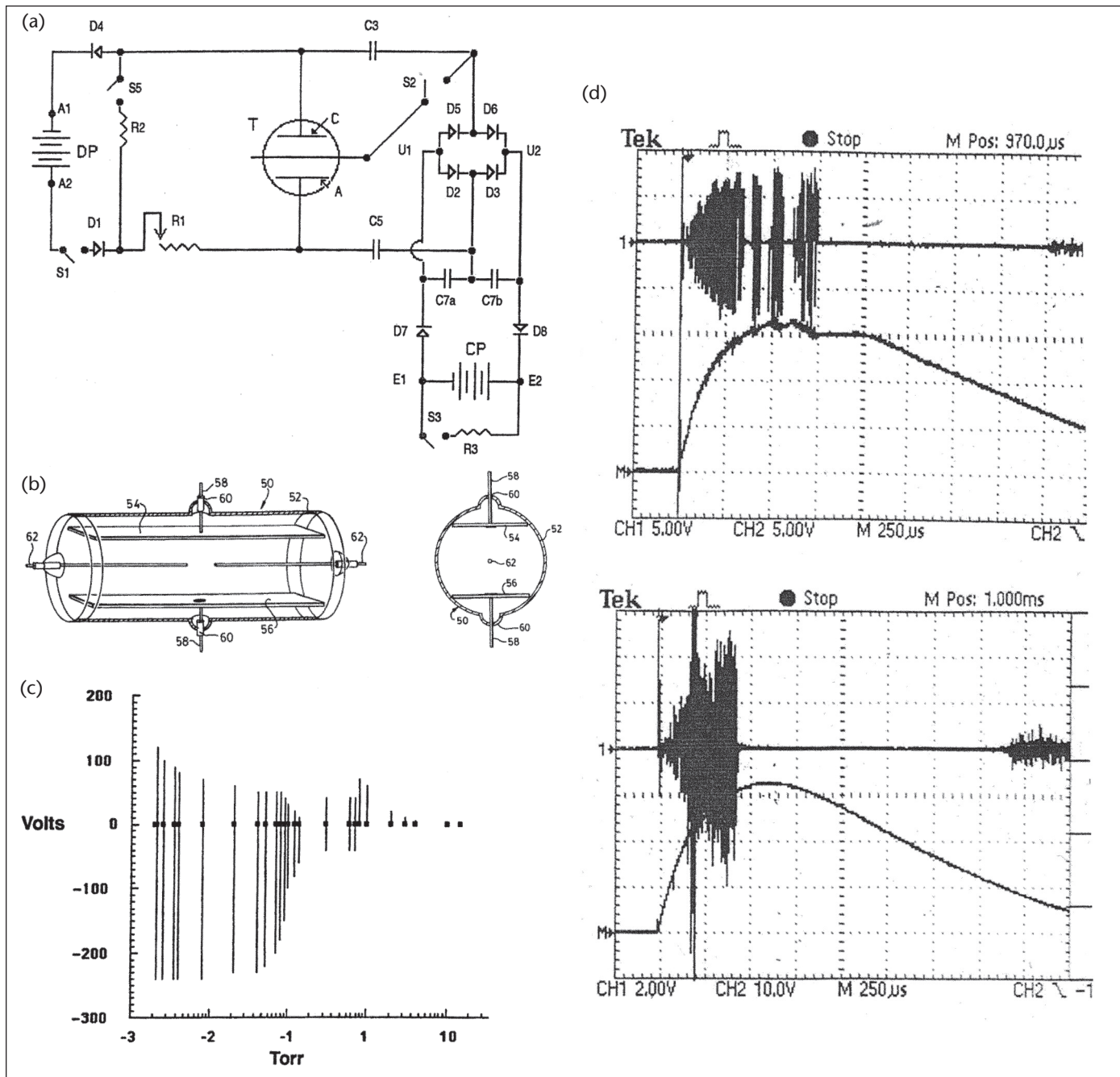


Figure 4. (a) One possible layout of a Correa circuit. There is no resonance effect, only pulses. (b) A large surface discharge tube. (See photographs 2, 3 in Part 2.) (c) Tube potentials as a function of pressure. Note the reversal of tube voltage, which is noticeable under 0.1 Torr, sometimes over -200V. This is the power generation effect. (d) High amplitude voltage oscillations in our Correa tubes. The more craters on the surface, the higher the amplitude of tube oscillations.

three days the water vapor appears again so water (hydrogen isotopes) is there in an uncontrolled manner.

Where is the effect of vacuum fluctuation in the absence of a rough surface/dust or water? Obviously nowhere.

I met the Correas in their lab, in Toronto in the mid-1990s. Both of them are very bright, devoted, hard-working, and highly intelligent. So were Tesla, Moray, Chernetzky, etc. I was deeply convinced and committed to the vacuum energy extraction model, until the ugly facts crushed my view.

Indeed, at the first (and second) glance Pons-Fleischmann electrochemical cold fusion and pulsed discharge tubes are two worlds apart but there is a barely visible bridge between them: underwater transient arcing, which will be mentioned later.

The Correa project, which was rightly and enthusiastically endorsed by Eugene Mallove, is over now. It proved to be an extreme financial burden on the Correas and their supporters. In my opinion, it was not mature enough for immediate industrial applications. I think the Correas fell into the same trap as all previous inventors, like Tesla and Moray, but also Shoulders, Papp, Jekkel, etc. (to be discussed later).

Their physical model was not correct and they overestimated their own financial/stamina resources. As such a group of problems requires the cooperation of hundreds, or maybe thousands, of developers—like the radio, airplane, or nuclear energy, etc.—but the Correas shut the doors instead of throwing them wide open. The tragic fall became inevitable. Their curiosity driven inquiry didn't move the fantasy of the LENR group, to say nothing about the mainstream.

This was more a re-search than a prototype. It has not solved five important “bottleneck” problems, which are relevant for reliability (and they were not aware of previous similar inventions, at least to learn from their mistakes):

1. The fuel problem; that is the ratio of hydrogen/deuterium, as LENR was out of their sight.
2. Pressure oscillation amplitude inside the tube—acoustic resonance design was never considered.
3. Ion and dust density control which also influences electric

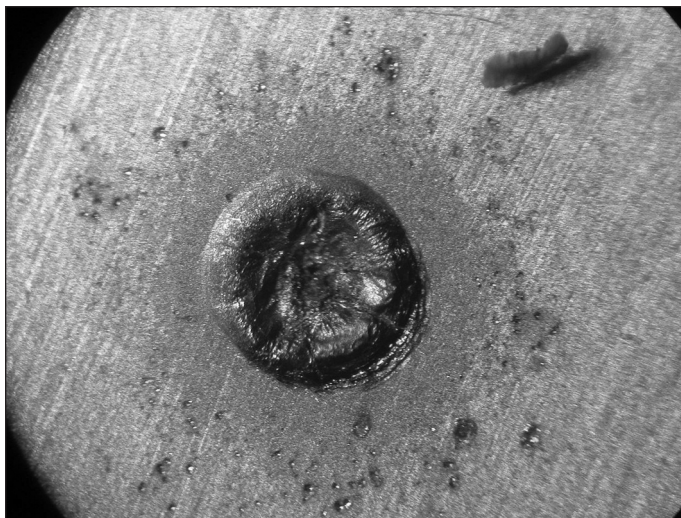


Photo 1. One of many circular craters on a Chernetzky cathode. There is no mainstream explanation for their circular shape, and sharp edges. Sometimes they were as sharp as needles.

energy output, that is, electrode/distance and sputter control. They considered sputtering only as an annoying side effect.

4. Electrode surface quality maintenance, tube longevity, tube reliability, amortization, electrode material selection. They were empirically aware of the importance of edges (craters) on the surface, but not the fundamental LENR effect— ${}_1n^0$ synthesis.

5. Electric circuit design—the lack of high frequency resonant oscillating circuits, but the coupled circuit solution was there.

The Correas never investigated heat output, or possible transmutation of electrodes. The cathode morphology was on their agenda, and they excelled there—discovering circular molten craters, which are the problem of a lifetime for an ordinary researcher because, based on official electrodynamics, they should not be there at all.

Based on the electric circuit of the patent disclosure, the excess energy claims were not verified in general, only sporadically, with a very low probability. The excess generating “backrush” or “autoelectric pulses” were weak, and sporadic. The teachings, the disclosure of the patent is simply inadequate, to have any profitable prospect in a published form. The IVAD (Interrupted Vacuum Arc Discharge) regime was favored in the disclosure but it was useless in practice. The PAGD (Pulsed Anomalous Glow Discharge) is better but still impractical as described in the patent for the above five reasons. (See Figure 4d for our test results.)

The maturity of the tube design did not match the status of Moray, who had repeatedly demonstrated several hours of 5-10 kW gains. (Interested readers are encouraged to go through the three very long patent descriptions mentioned above.)

Blindness to theoretical models and experience

There is always discussion or a heated row within science. There are sometimes rifts between groups. In the LENR community, light water electrolysis of James Patterson versus heavy water for the rest was such a rift. However, Patterson was not excommunicated or made a pariah. The Ohsawa type carbon to iron transmutation was a landmark, yet it is sheer heresy even within the LENR community.

It is a tragedy, that the Correas never really considered LENR as a framework to their effects, but rather as a threat. It is a tragedy, because they were the first to have such an opportunity. Tesla or Moray would have jumped on it. They speculated widely about the stability of matter. For me it is a wide open question, when and why we have fusion as LENR and when/if fission. Only experimental tests can decide the issue, which the Correas declined.

The LENR community went a long way ahead of the original Pons and Fleischmann solution. Spiral cathode, bulk palladium cathode, steady state low temperature operation, heavy water electrolysis, D-D reaction are only history by now.

Our Chernetzky/Correa/Moray project collapsed for several reasons. For Moray, there was little theory, but as Chernetzky, Correa and even Tesla said the same about aether oscillations, at least it seemed reliable.

Doubt emerged when baked-out glass discharge tubes stopped oscillations, and smooth surfaces never allowed oscillations to occur. I decided to try the Shoulders effect,

and made a multiple grid of sharp needles, to serve as cathodes (see Photo 1). I hoped that it would provide a dent in the transient current but according to the engineer in charge, I. Csonka, nothing happened.

However, I learned ten years later that he never executed the experiment. Out of jealousy? Laziness? Gut objections?

Nevertheless those ten years were just a sequence of nightmares. Small, short, unreliable excess energy oscillations amid just plain textbook discharges with useless noise-like fluctuations. My colleagues blindly insisted on the sterile, unproductive “aether oscillation” model. They had a very powerful counter argument against my inclination for LENR. “Show me just a single test result, where nuclear process, transmutation was described in a textbook or journal article.” I was silenced because I was not aware of the transmutation results of J.N. Collie, H.S. Patterson and I. Masson, etc. carried out in the 1910s. Had I know them, we would surely have switched to hydrogen gas, despite its technical difficulties.

I made some half-hearted attempts to try it with titanium getter rings to absorb and release hydrogen, but my colleagues sabotaged it because they preferred to use safe argon. That alone has meant excess energy as just a side effect, a function of damp air seeping into the discharge tubes. No doubt, we were still in the first death valley.

The three death valleys of inventors

There are three traps, or death valleys, for any inventions, which strive for mass market penetration:

1. Secure the effect, make it sure and reliable. Secure funding for basic academic research.
2. Make a reliable prototype based on the effect. Secure funding for practical development.
3. Simplify the device, find the optimum design, solve problems of reliability in manufacturing. Secure funding for manufacturing tools.

In my opinion, most LENR field projects are still in the first death valley. Heat-producing projects have an upstart obstacle: they must outperform heat pumps in terms of economy.

The Correa and Chernetzky electricity-producing project was buried in the first valley. They were unable to get funding to develop a reliable prototype. To my best knowledge, only a few of the LENR projects reached and vanished in the third valley: Tesla, Moray, Papp and maybe Gray.

Only Papp and Gray had patents and a reliable prototype; Moray was unable to secure a patent despite decades of attempts.

In my opinion, LENR requires more footwork and more secure theory (or practical experience) to replace the present polluting, worn out technology.

That would require immense cooperation and a wider scope and deeper knowledge of past achievements. This is one of the purposes of this review. The other is to call the attention of the LENR community to past, forgotten inventions, where electrical mechanical and chemical energy was produced. We shall soon continue with a Hungarian invention, a “water driven car” of Janos Jekkel. In fact our lab was established to revive this invention, which perished in the second death valley. However, in order to grasp its physics

and the following Gray invention as well, a fundamental physical effect, relevant to these technical solutions, must be known. It is about the formation of tritium on thin wires with pulsed dusty plasma in a deuterium atmosphere. It is an irony of fate that Tom Claytor *et al.* published their important results in the same issue in *Infinite Energy* where the Correa invention appeared.

The pulsed wire tritium fusion experiments of Tom Claytor et al.

For mainstream science, the idea is unacceptable that tabletop, inexpensive electric/mechanical/chemical energy-producing devices have been demonstrated over and over.

T.N. Claytor, D.D. Jackson and D.G. Taggle of Los Alamos National Laboratory published their results at several ICCF conferences about generation of tritium from deuterium in a pulsed dusty plasma/rough surface environment. Unfortunately these groundbreaking results didn’t get the full attention of the LENR community, to say nothing about the mainstream, because the results of the Claytor team, and V. Romodanov’s team in Russia, are the bridge between applied physics and the forgotten LENR inventions.

It is a sad irony that Correa flatly denied the possibility of LENR in his invention, while the pulsed wire experiments clearly proved the firm link. Tesla, Moray, Chernetzky and Correa speculated widely—and in vain—about the source of energy. U.S. (and other) patent offices usually denied any claims in reference to cold fusion/LENR, but “pulsed corona” type work is the “smoking gun” which is the simplest setup for reliable LENR. Some forgotten inventions directly use the Claytor effect.

As we shall see, Jekkel used an amorphous blob of thin silver wires as electrodes, and Gray used two concentric cylinders made of thin wires as electrodes along with 20 kV driven pulsed plasma.

In a sense, the Claytor team was also lucky to find tritium formation in the pulsed discharge mode. They chose a pulsed mode discharge for cooling reasons, not because they expected quasi-particle assisted neutron generation on the edges of the craters, or on the sputtered dusty plasma. They did not try DC current for loading deuterium into Pd, out of fear of melting the thin Pd wires. With pulsed current they have created the right technical environment for LENR. Their pulsing parameters are really modest compared to the parameters of economic inventions, but their work was meant to be academic research, not a technical development.

About a hundred years ago, Collie, Patterson, etc. did make transmutation of light hydrogen into helium and neon but they were unable to identify unambiguously when transmutation did happen. (To answer why was really out of reach for them). What Collie missed in the 1900s, Claytor and co-workers did answer. *They established the conditions for repeated, reliable transmutations of deuterium into tritium.* (This transmutation is among the steps for tabletop energy-producing inventions.) However, they were not fully aware of the hidden advantages of pulsed discharges, which are listed below:

1. A pulsed discharge, which produces: a) dust; b) sharp edges on the cathode after prolonged use; c) acoustic waves in the plasma.

All of them are necessary simultaneously for economic neutron synthesis. The Claytor papers do mention already in 1996 the presence of sputtered cathode dust and sharp edged craters on the surface of thin wires.

Unfortunately they made no performance comparison of tritium yield for flat cathode surface versus a broken, crater covered cathode wire. The tritium yield was low and it took about 100 hours to have a significant (5-sigma) amount of tritium. Nevertheless this was a groundbreaking experiment, unduly neglected by the LENR community.

2. They noticed the importance of cathode material and its preparation, that is, the crystal structure of the cathode.

They were unable to come up with a reliable technology, but identified this as one "bottleneck" for tritium production. It would be an arduous task to map this large "swamp." This work suits Germans and Japanese who excel in painstaking mapping of parameters. Moray developed his own alloy for transmutation, but no one ever researched its properties. Correa favored aluminum plates with an oxidized surface. Chernetzky was aware of sputtering, but silent about surface quality; he used only tungsten and molybdenum. Jekkel used a thin silver wire alloy. Papp knew very well the importance of the electrode material. It was one of his many secrets, taken to his grave.

3. The gas of the plasma must contain hydrogen isotopes.

Correa missed this completely. Chernetzky was just lucky. Moray used water along with inert gases. Gray is completely silent about it, as well about the wire material.

It was already clear to Pons and Fleischmann that the cathode material, and its technical preparation, are important. They underestimated the required amount of R&D work in this field. Inventors were just lucky to figure it out.

Claytor made an additional important observation: when they let some CO₂ into the discharge tube, the *tritium yield increased*. In my opinion part of the CO₂ in the plasma separated into carbon particles and oxygen. Maybe the additional carbon dust boosted the tritium yield? Important problem: It is a question "to be solved," but dust mediated fusion is likely. The Claytor/Romodanov results test only one possible part of the transmutation chain for hydrogen, that is, the Storms chain.

It seems to me that they expected D-D "hot" fusion into ${}^4\text{He}^2$, which sometimes yields tritium and neutrons also—in $\text{D}+\text{D}\rightarrow {}^3\text{T}^1+{}_1^1\text{n}^0$.

Nevertheless their work is high tech, based on the reliable detection or the radioactivity (beta decay) of tritium.

In my opinion, based on the Storms chain, the ideal plasma ingredients would be a mixture of light hydrogen and deuterium, with some methane, say: 90% ${}_1^1\text{H}^1$; 5% ${}_2^2\text{D}^1$; 5% CH_4 .

"Ordinary" inventors never heard of deuterium, to say nothing of tritium. At the time of the "wizard" Tesla and the "sage" Moray the very word "neutron" was unknown, and of course nothing was known about fusion/fission.

Since inventions are about economy we must mention the problems of electric parameters. The Claytor parameter range and discharge chamber construction was way off the technically useful range. The length of Pd wire was just 30 mm long, while for Jekkel and Gray it was tens of meters. Correa used a large surface with several hundred thousand

craters. The peak pulse voltage for Claytor was 2 KV, while for Moray it was about 50-80 KV, for Jekkel 20-30 KV, for Correa and Chernetzky about 2 KV, but Gray produced about 30-60 KV from an inductive kick.

Inventors were better off usually about hundred times at each "bottleneck parameter," and the same is true for the pulse repetition frequency. For Claytor it is 50 Hz at 20 mil-sec pulse duration, which is not necessary. Moray and Chernetzky used a MHz range; Jekkel used 20-30 kHz with higher harmonics and Correa was also in the kHz range. Note that tritium yield (or any transmutation) is a nonlinear function. What took the Claytor group 100 hours to observe a greater area, frequency, peak voltage, tube pressure/resonance might have yielded even a million times higher yield, to say nothing of the surface quality question.

What sort of transmutation took place in the pulsed wire experiments? The easiest answer is ${}_2^2\text{D}^1+{}_1^1\text{n}^0\rightarrow {}^3\text{T}^1$. Where did the neutrons come from? One possibility is that neutrons were formed from the ${}_1^1\text{p}^1+{}_0^1\text{e}^{-1}+0.7\text{MeV}$ reaction. The protons might have come from the small amount of H impurity: 0.005%. The other feasible possibility is that it was a result of fission: a deuteron separated into a proton and neutron. If so, it is also an endotherm process but it is not a net loss, if the neutron is not leaving the discharge tube, but fuses into tritium.

As far as Claytor went in his paper (published in *Infinite Energy* #7), no neutron or He detection was sought. Obviously with this discharge tube construction and discharge parameters there was no point of measuring the energy balance.

The Claytor/Bolotov group found the "secret door" to economic transmutation/energy production, which should have been a turning point in renewable energy production. Unfortunately, the LENR community stuck to uneconomic, low yield electrochemical cells, despite the repeated warning of Bockris, Preparata and Biberian about surface, pulses and plasma over-potential.

Now we can continue with lucky and ignorant inventors, because only those inventors who were ignorant about physics had a chance. Mainstream physicists "knew for sure" that tabletop electricity/oxy-gas, etc. devices are impossible to make.

The water car (oxy-gas machine) of Janos Jekkel

This machine was perhaps the simplest LENR device, based on the water splitting capability of excess heat.

The device was invented in the 1970s by a Hungarian backyard inventor, Janos Jekkel. I never saw the machine in action. All the technical details came from the inventor, but he was interested only in its technical development, not the physics behind it which were unknown and unexplored. He was just plain lucky with this water splitting effect. He was about to make a homemade oxy-gas welding machine. His background was electric motor development, in an industrial electric R&D lab in Hungary. Thus he asked a colleague to make a simple pulsed high voltage power supply for him.

The "soul" of his water splitting device is deceptively simple, a T-shaped glass tube (see Photos 2 and 3).

There were two electrodes at the horizontal ends made of very thin silver wires, in the form of irregular blobs, each containing at least 1 m of about 20 micrometer diameter wires. These wires were used as fast acting fuses for high cur-

rent applications.

The superheated steam comes to the horizontal tube through the vertical tube, via an orifice, of about 20 mm by 1 mm. The oxygen and hydrogen left the horizontal tube after passing through the electrodes, as separated gas. Jekkel claimed that he was able to separate the gas with a permanent magnet. The horizontal tube was surrounded by a coil, assumed to be part of the resonant high voltage, power supply. The coil was separated into two parts, as shown in the photograph.

There was no data about the number of windings of this coil, apart from the fact that it was standard lacquer insulated copper wire.

At first sight, this is the Claytor-Fowler effect in its simplest form, even without dust. Jekkel never changed the parameters of the power supply, or the structure of “silver wire blob” electrodes. He was satisfied with just the water splitting effect. All his development effects went into separating the H_2 from O_2 , as in their mixed form they were dangerously explosive.

According to Jekkel, the pulsed power supply had about 20 kV peak voltage under load, and when superheated 2 bar steam passed into the tube. As the T-shaped glass tube was

under a heat insulation cover, there was no visual or acoustic observation during its action. The peak voltage of the power supply without the load—steam—might have been up to 100 kV. The geometry of the T tube was also sketchy. The diameter of the horizontal tube was about 30 mm and it was 120 mm long; the vertical had the same 30 mm diameter, and about 100 mm in height.

In the middle of it there was an electrically heated superheating coil (shown in the photograph).

Only a small part of the fuel—water—was evaporated with a floating heater, regulated by the power demand. It was synchronized with the superheating resistance as well.

The horizontal tube might have been an acoustically resonant cavity since the superheated steam entered into the horizontal splitting tube via a narrow orifice.

The water splitting effect is ostensibly partly due to the high field-charge shielding and partly neutron formation due to collective electron surface waves on the silver wire.

In fact, the effect was discovered separately for pulsed fields on sharp wire tips by Shoulders, but apparently it also works with thin wires. The mechanism of Shoulders and Claytor are essentially identical—a pulsed field edge effect, detailed in Part 2.

Shoulders investigated this charge cluster effect for many gases; Claytor-Fowler looked only for deuterium but early investigators before World War I found transmutation in ordinary hydrogen—typically in over 100 kV pulsed discharge (see Part 1).

Obviously the most important issue is the economy. Jekkel drove a Moskvitch 407 car from Budapest to his hometown of Medgyes, a distance of about 250 km, and nearly back. Initially, he had a fully charged truck battery, which remained fully charged, when on the way back the main crankshaft broke, due to the fast combustion of oxygen.

Apart from ordinary water, no other fuel source was involved. The water car behaved like its gasoline driven former “self.” That is, it gave about 30 kW at peak power, and 15 kW on average. The steam production, overheating and the high voltage power supply required about 500 W - 1 kW; this was provided by a truck dynamo, stronger than the standard unit originally used in a Moskvitch 407. It is not known how much superheated steam went through the T-shaped splitting tube without utilization. Obviously only a small part of the superheated steam was split in the gas discharge (plasma chemistry) and it is unknown how much of the hydrogen underwent transmutation into deuterium or tritium (see Part 2 for the possible fuel cycle).

One may speculate about the spectacular efficiency of the simple T-shaped water splitter. The following parameters may arise as “efficiency boosters”:

a) Acoustic resonance in the horizontal tube.

This is unlikely, as the pulse repetition frequency was about 20 kHz, with a “shark teeth” voltage oscillation superimposed on each triangle shaped or sawtooth shaped pulse. This is too high a frequency to induce a distinct acoustic resonance.

b) Cavity cathode.

This is a more feasible hypothesis. Water splitting and ionization of hydrogen isotopes are more efficient, when a blob of wire generates ionized hydrogen isotopes. Unused pro-

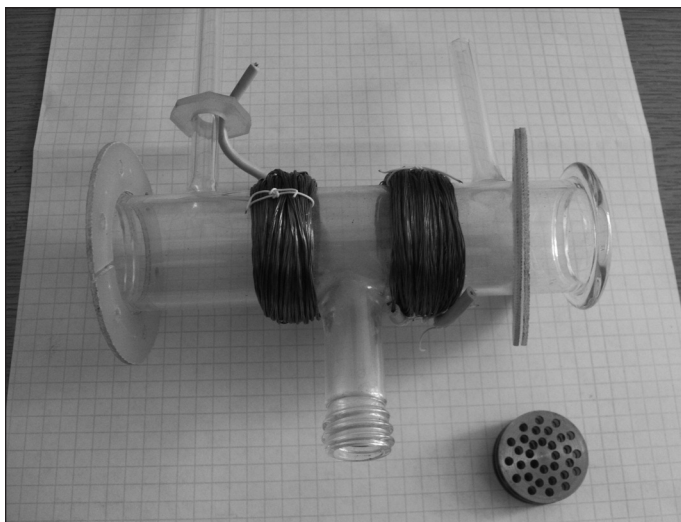


Photo 2. The T-shaped tubes of Jekkel. Note the incorrect flat stainless steel electrodes with holes.

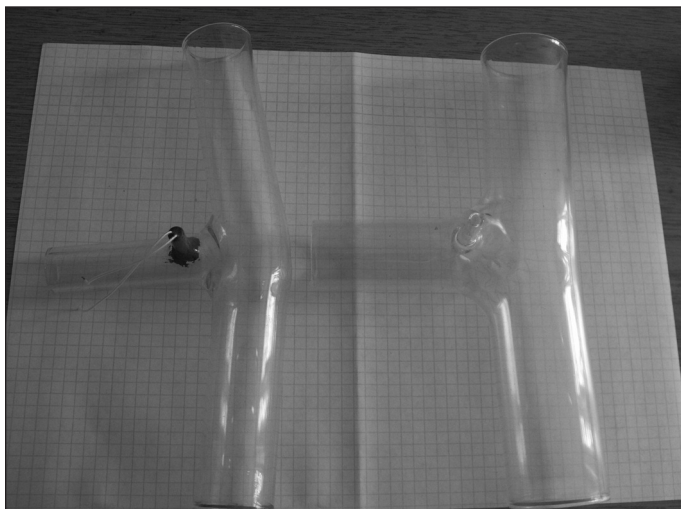


Photo 3. The T-shaped tubes of Jekkel.

tons (hydrogen ions) can be utilized on any other surface points of the cathode.

Can protons diffuse under the surface of the silver wires at these high potentials? Will they be buried there permanently, ready to form neutrons with the massive mass of electron waves on the silver surface? This is quite likely, but they were never investigated. Unfortunately the even simpler Shoulders and Claytor effects are not detailed enough, and were not investigated down to the smallest details.

c) Electromagnetic (MHD) effects.

At first glance the external coil on the perimeter of the splitter tube is of little practical use. The magnetic field yields very little Lorentz force on heavy ions but it is effective for the electron cloud circling along the splitter tube hitting the silver wires at a low angle. Thus it generates a cloud of secondary electrons, and consequently the cavity cathode (and anode) action is more enhanced.

The edge effects discovered separately by Shoulders and Claytor are not economic in themselves. Even the large surface, multi-cratered cathodes of Correa are not yet economical. However, the auxiliary effect of secondary electron generation in a "cavity cathode" may bridge the gap between an uneconomic, but fundamentally important transmutation process and a useful device.

It is strange that Shoulders never generalized his discovery to long and thin wires, but he believed he had found a technically useful application, an invention. Correa and Chernetzky fell into the same trap. An economic LENR device requires an extremely high density of low energy free electrons in the plasma.

It is an important "bottleneck," but few inventors were aware of it. Moray was clearly aware of it; his multi-walled power tubes and metal compositions are good examples of efficient electron production in cavity cathodes (see Part 2).

The last invention to be discussed is from an Englishman, Colman; it is yet another technical solution for efficient electron generation with the help of the Malter effect, multi-edge geometry and cavity effect, when the available cavity size is about the same as the mean free path of the electrons.

The separation of hydrogen and oxygen

Obviously, the direct generation of electricity is far superior to oxy-gas generation. Though fuel cells, the so-called "hydrogen economy," was a favorite topic for the George Bush era, it is an utterly unrealistic target, due to difficulties in storing hydrogen either in an adhesive medium or in liquid form.

Jekkel devoted most of his effort to separate and store oxygen and hydrogen. He claimed to me that hydrogen gas is somehow compressed in presence of permanent magnets, like rare Earth magnets. There might be some truth to this claim, as I found other (independent) sources stating the

same. This claim is not about ionized hydrogen (protons) but hydrogen as bi-atomic molecule.

He stated that using a slab-shaped permanent magnet made of a rare Earth made it possible to separate oxygen from hydrogen, when the slab was placed under the cathode (but outside of the T-shaped tube). This separation claim really puzzled me from the beginning. A strong electric field separates ions by their mass (time of flight spectrometers are based on this effect) but I don't see any useful role of a magnet apart from the above-mentioned uncharted, unrecognized effect.

The separation of oxygen from hydrogen was a must for him, as his previous machine, based on unseparated gas, blew up twice. The first accident shattered one of his eardrums, making him deaf in one ear. In the second explosion, all the windows and doors were broken in the courtyard where he lived.

The plasma in the horizontal (LENR-based) tube simply reignited the oxy-gas, which he stored in a large vessel.

Jekkel conducted the separated oxygen and hydrogen to separate vessels of equal pressure, carefully balance by a rubber membrane. The pressure is counterbalanced on the other side of the membrane by a nitrogen cylinder. A niche application for this type of LENR-based solution is perhaps rocket propulsion, since only water must be carried on board. (Nevertheless, takeoff still must be done by the traditional method.) For heating purposes, there are safer and simpler methods.

All in all this will be remembered (if at all) as a footnote for a forgotten LENR solution.

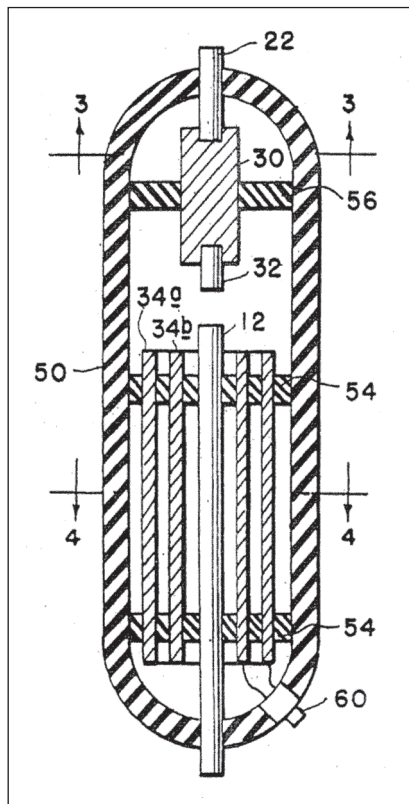


Figure 5. The layout (cross section) of the Gray tube. 34a,b are the electrodes made of fine wire mesh.

The Gray pulsed electrical energy inventions

There are only some photographs and eyewitness record about E.V. Gray's invention (U.S. Pat. 4,661,747) which also uses thin wires as electrodes. In this regard alone, it is similar to Jekkel's solution. Both of them are based on Claytor's pulsed thin wire fusion/transmutation effect. (See Figure 5, from the Gray patent.) The title of the patent is "Efficient Electrical Conversion Switching Tube Suitable for Inductive Loads."

The description does not dwell on the dangerous details. What is the source of the energy, and the efficiency (over unity) of the device? Only some eyewitnesses reported that it apparently ran without fuel.

I will describe only my impressions of the complex series of actions within the discharge tube. I leave the analysis of the electric circuit to the reader. In fact, the tube is driven by a pulsed Ruhmkorff's coil, like that of early researchers such as Collie, Patterson and Masson, rediscovered by Krivit.¹

There is no resonant RLC circuit as such in the design. However, the inductivity and two capacitors do produce serially connected oscillations.

The novelty of the pulsed tube is the combination of an

arc discharge (Chernetzky's method), and Correa's IVAD (interrupted vacuum arc discharge) with a wire glow discharge. The latter resembles Jekkel's previously described wire blob oxy-gas invention, in a cascade-like manner. This is turn resembles Moray's double discharge tube solution, when one high voltage corona discharge tube drove another—anomalous glow discharge tube. The discharge tube is cylindrical, with two coaxial cylindrical mesh electrodes. Their connection to each other is not clear from the description, maybe galvanically connected or maybe capacitively (not shown).

The most likely sequence of events is the following, using the patent's sketchy tube layout: A high voltage kick from the induction coil drives the outer mesh 34/a, and then the inner mesh, 34/b. Based on the physics described in Part 2, dusty plasma with excess charge rapidly generates neutrons and thus heavy hydrogen isotopes on the internal electrode 12 (termed a high voltage electrode by Gray).

After being charged, this internal electrode sheds its charge on the upper (32) "low voltage" electrode, with (oscillatory?) arc discharges. Maybe this cascade "double action" makes the tube useful. There is only one blurred photograph of the external view of the tube, but not even its size is clear.

Gray gives only unspecified generalities about the tube:

...the driving system will convert low voltage electric energy...to high potential high current energy pulse...

The system accomplishes the results by harnessing the "electrostatic" or "impulse" energy created by a high intensity spark generated within a specially constructed conversion element switching tube. This element utilizes a low voltage anode, a high voltage anode and one or more electrostatic or charge receiving grids. These grids...directly related to the amount of energy to be anticipated when the device is operating.

In this invention a high voltage high current short duration energy pulse is applied to the inductive load by the conversion element [that being the discharge tube]. This element makes possible the use of a certain of the energy impressed within an arc across a spark gap, without the resultant deterioration of circuit elements normally associated with high energy electrical arcs...

The intensity of the electromagnetic field is determined by the high electromotive potential developed upon the electrostatic grids and the very short time duration required to develop the energy pulse.

Upon cessation of the energy pulse (arc) within the conversion switching element tube, the inductive load is developed, allowing the electromagnetic field about the inductive load to collapse.

The collapse of this energy field within the inductive load is a counter E.M. force. This counter E.M. force creates a high positive potential across a second capacitor 38 which, in turn is induced into the second energy storage device or battery 40 as a charging current.

This is the principle behind Correa's double battery pack

system too. Gray notes further: "The anode material maybe identical for each anode, or may be of differing materials for each anode, as dictated by the most efficient utilization of the device..." It appears to me that he does not explain anything about the electrode materials, or their geometry, but notes that they are important.

To me, a patent is a bargain. The inventor discloses all the relevant information, necessary to operate the device, in return for intellectual property rights. This patent is the absurd misuse of this system, because in the description not a single parameter is described, which is vital for re-building the invention. The patent is a shame on the U.S.P.T.O., which let it through.

Gray even assumed he was the first who discovered the excess energy effect behind his invention: "In the opinion of the inventor there is no known device which provides the conversion of energy from a direct current electric source or an alternating electric current source..." (He wrote that in 1984, decades after Tesla and Moray, years after Chernetzky, but before Correa.)

To me, the Gray patents read like a crossword puzzle. One can't solve its meaning without knowing other, similar patents and research papers like the previously described Claytor transmutation results on thin wire with pulsed discharge.

Gray is worse than Moray, by his "saying much telling little" Byzantine style. The first claim is a typical opaque statement, where the essence of the invention must be clearly stated: of course connecting two discharges in series is pointless in mainstream thinking, due to the heavy losses. A corona and an arc discharge in series will dissipate 99.9% of all input of the energy. The invention makes sense only if there is enormous gain in electric energy. I was interested to know if there are any references in the claims that positive feedback makes much more gain in electric energy than only one type of pulsed (dusty) discharge. There is not a word in the claims about the advantages of using two simultaneous excess energy production aspects in the same tube, which is the essence of invention. Moray achieved it, but in two separate, pulsed tubes. Correa also did not use the self-amplifying possibility of two different discharges, but was aware that both arc and corona (anomalous glow) cause excess energy production.

Gray did use this technical advantage, but didn't claim it, although in my opinion this is the very essence of his invention. Instead, he writes this horrible description about the role of a grid in Claim 1: "What claimed is: An electrical conversion switching element tube comprising..." Here comes the description of arc gap, used like Chernetzky.

Now about the grids he wrote, "electrically conductive means (34b) positioned internally within said housing and extending circumferentially about the said second anode while being exposed there to but not conductively connected there to but, rather spaced there from for receiving an electrostatic charge from the second anode when a discharge current is triggered across said discharge area between said first and second anodes, said charge receiving electrically conducting means also being internally mounted to said housing..."

And in Claim 4: "...a second tubularly shaped charge receiving electrically conductive means (34a) positioned circumferentially about said first mentioned charge receiving electrically conductive means."

There is no functional claim about electric power gain

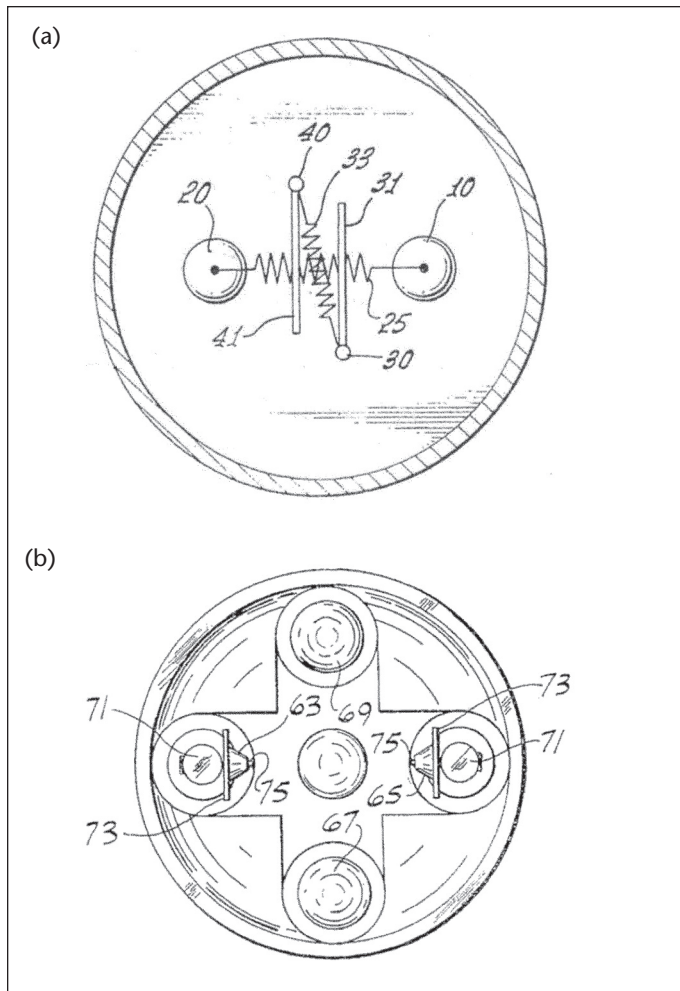


Figure 6. (a) Cross section of the Papp cylinder. Note the asymmetric arrangement of the two large flat electrodes. It is enhancing the edge effect, dust generation and plasma production. (b) Cross section of the Papp cylinder in his second patent. Note the conical electrodes.

amplification; that is, the essence of the invention is not claimed.

There are further open questions. Of course Gray is silent about the chemical composition of plasma gas, about pressure, and the volume of his isolated tube. I just assume that each “pulse” was a result of complicated interplays between grids, and the accumulated net pulse power was shot between the arc electrodes—in the center. Acoustical effects are not mentioned, though the relative positions of the grids are important in this context. I wonder if Gray ever used a four beam oscilloscope, to measure the time evolution of electrode potentials and currents. The parameter window where his device worked must have been very narrow.

I found no clue how Gray stumbled onto his invention because it would be informative. He died at his workbench suddenly at the age of 64. As far as I know everything disappeared after his death, just like for Tesla, Moray or Papp.

Moray knew more about the physics, about wire dis-

charge, acoustic and electric resonances in his “multi-walled” pulsed discharge tubes. Certainly Gray had to know about the need to “prime” both the grid system and the surface of arc electrodes.

He didn’t mention it in his patents. No wonder Gray, despite his achievement, is in the pantheon of forgotten inventors.

Thin wire pulsed discharges in acoustic chambers seem to be an inexpensive path for R&D. Jekkel’s oxy-gas device seems to be simpler but based on Gray’s method it will be easier to grasp.

The Papp pulsed plasma engine

The Papp engine is exceptional in two ways. It is the only one to produce mechanical energy in a reliable manner. The other is personal: among the reclusive, secretive LENR inventors Papp was the nastiest (his story was described in *Infinite Energy* #51).

Being of Hungarian origin, I heard (at gossip level) that his father discovered this effect at my former workplace, the Central Research Institute for Physics, in Budapest. Papp escaped the country after the 1956 revolt was crushed, and went to Canada.

There he allegedly made a mini submarine, and nearly crossed the Atlantic Ocean, but it sank near to the French coast. That was a Papp engine driven sub, but the nose cone was heated to red hot. It formed a thin layer of bubbles, which reduced friction considerably, making his vehicle incredibly fast. He wrote about this adventure in the book *The Fastest Submarine*. I give a 50% chance that this incredible story is true.

The Papp pulsed machine is a “3 in 1” solution. In my opinion he used three important sub-effects, where the effects amplified each other, as we saw with Moray and Gray. These are the following:

1. Large area cathodes with inclined surfaces compared to the plasma generating electric field, thus helping dust generation by enhanced erosion and sputter.
2. Broken surface with uneven cavities and sharp edges, thus boosting pseudo-particle production for neutron synthesis.
3. Adding a series of inert gases to create the “whip effect” to accelerate hydrogen ion isotopes.



Photo 4. Cylinder head of a Papp engine. Note the sharp, conical electrodes.

These simultaneous effects amplified each other, and made possible efficient energy generation. In fact it was later improved into a sort of acoustic wave driven machine, which is apparent in his second patent (U.S. Pat. 3,670,494 issued in 1984).

The third patent is useless in my opinion, loaded with misinformation. (U.S. Pat: 4,428,193).

There are a number of photographs and blurred VHS videos of his machines and his lab on the Rohner’s homepage [rohrnermachine.com]. Papp is perhaps the only inventor not to be completely forgotten.

The asymmetric electrode arrangement of his first patent is shown in Figure 6a. It is clearly as Moray advised, and it

boosted dust yield during plasma pulses. He kept this effect later, in a modified form, where he used four conical shaped electrodes. See Figure 6b taken from Papp's second patent. This conical electrode is seen in some photographs as well.

There might be an additional advantage to an inclined electric field on cathode surfaces: boosting the energy of surface plasma polaritons along the edges of its craters.

Though surface plasmon (polariton) research is in the mainstream, quasi-particles are no longer shunned as they were at the time of Felix Ehrenhaft. This area is "virgin" to my knowledge. There are a number of papers on this subject in *Applied Physics Letters*, but they generate polaritons with light

(EM radiation) and in more defined nano cavities. However, neutron generation in a hydrogen atmosphere is not on the research agenda (to my best knowledge). It seems that inventors like Moray, Jekkel and Papp found out this possibility.

And last, Papp's strangest idea: to use a chain of inert gases. This caught the imagination of amateur followers, who singled out this effect. Though useful, this linear momentum boosting effect is not the only one necessary to have an economic LENR here but adds a new color to the palette of our LENR picture.

Papp died of colon cancer at a young age in Florida. Richard Feynman mentioned his deadly encounter with Papp, at the first public demonstration of his invention.

Personally, I think electric energy-producing devices are more useful because there is no need for moving mechanical parts.

Pins of Ken Shoulders

The importance of sharp edges—and a high pulsed electric field around them—is supported by the invention of Shoulders as well. He obtained several patents. Shoulders used single needles and later a multiple grid of needle sharp metal cathodes to generate excess energy, in a strange form—"electron validum." In fact those were just small dust particles, filled with trapped electrons. Not in the patents, but later his website described transmutation effects (see Figure 7).

Though he has published a paper in *Infinite Energy*, Shoulders' work has not been closely followed or acknowledged by LENR researchers. Indeed even multiple point devices were unable to yield economic energy production.

As a research tool, it is a simple and very important device. I consider it as important as the pendulum was centuries ago. Nanotechnology—conductive carbon nanotubes in a grid—might lead to an economic application in a better world.

Colman's grain-filled tube

Last but not least, let me mention yet another invention of two completely forgotten British inventors. They used constrictive transient gas discharge and barrier discharge, in a grain-filled discharge tube. They disguised it as a high capacity battery, run by a low energy input high frequency power supply (Figure 8). Certainly the data in their patent application is just not enough to repeat this invention, but the sharp edges on the dust grains serve the same overall purpose as those mentioned previously.

The Colman/Seddon-Gillespie disclosure seems to be completely insane from the viewpoint of mainstream physics, but quite interesting and inspiring from the LENR viewpoint.

There is no clue how the inventors found this effect, and what happened with them and their invention. The "soul" of their device is a quartz discharge tube, 45 mm long, 5 mm diameter, with unspecified pressure and atmosphere. The patent mentions the appearance of α , β , and γ radiation after exciting the discharge tube, but α and β radiation is shielded by the quartz wall, and it cannot be detected outside of it.

The discharge tube is filled with dust grains in a very peculiar way. One electrode is connected to a layer of copper dust, the other is zinc dust. Note: oxidized zinc is semiconducting, and it is used as a rectifier. There are layers of dust (unspecified grain size) between them, made of the follow-

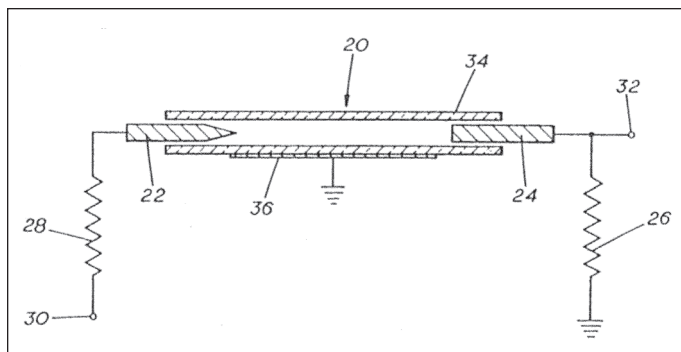


Figure 7. A typical arrangement of Shoulders' pin electrode gas discharge layout.

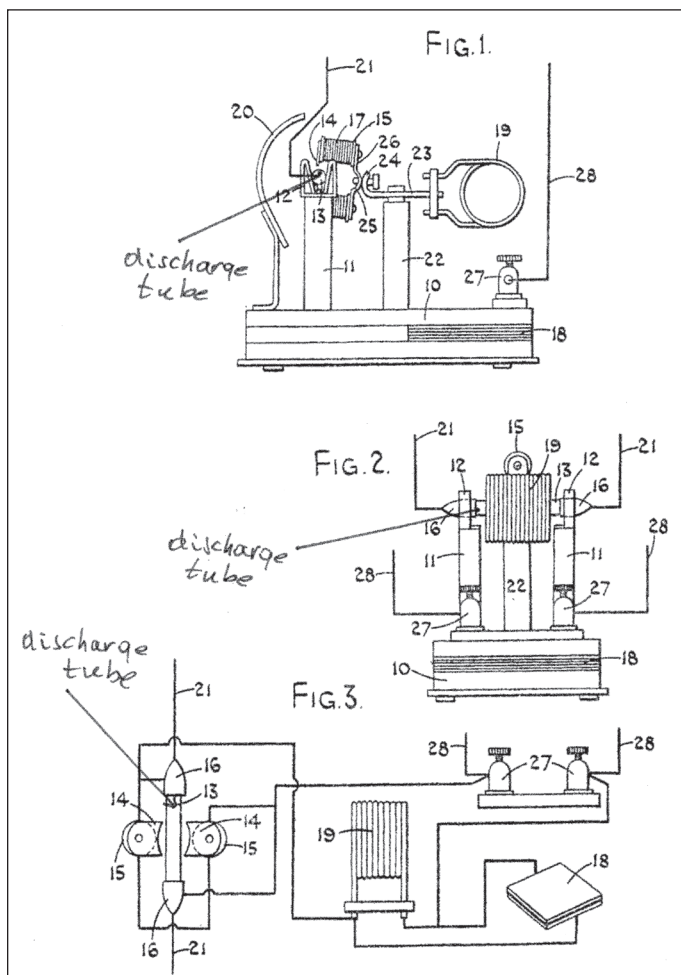


Figure 8. Layout of the Colman device from sides and front. The small discharge tube is penetrated with a transient magnetic field.

ing chemical composition: cobalt nitrate and crystal water, one part of $\text{CoNO}_3 + 6 \text{H}_2\text{O}$, two parts of cadmium chloride, CdCl_2 , and three parts of calcium phosphate, Ca PO_3 and 10 carbon, unspecified whether amorphous or graphite.

Fourteen sets of layers are crammed into the tube, always in the same order: copper dust, the above-mentioned mixture, then zinc dust, all of them repeated 14 times.

The quartz field tube is part of a resonant electric circuit. Moreover, there is a radial transient magnetic field across the tube, probably to generate vortex-like electric fields along the length of the tube, since weak magnetic fields have little effect upon ions, and electrons in atmospheric discharge tubes. (Note the parallel with the Jekkel tube, and the third Papp patent.)

The energy-producing process is ignited by a short (max. 1 min) irradiation of the tube by RF radiation (300 MHz), then, according to the patent, electrical energy is produced for one hour and then the cycle is repeated by starting radio frequency irradiation of the tube.

Apart from a dozen open technical questions, there is a big puzzle: what makes electrons diffuse to an electrode, and positive ions to the other electrode? Because this makes a pulsed electric generator, otherwise the tube is just a highly dissipative member of a high frequency oscillating circuit. If the external magnetic field is not exactly of mirror symmetry, the vortex-shaped electric field acting along the tube may separate positive and negative charges as required above, and it is a logical technical solution. The source of energy is the fusion of hydrogen, provided by the crystalline water in cobalt nitrate.

The role of carbon dust is not discussed at all in the description but personally I have found it a useful material for many transmutation reactions.

The grain size distribution is important, but not disclosed by the inventors. Certainly the quartz tube cannot be fully packed; it must be penetrable, sponge-like with open pores. Thus an electric discharge may take place in the inter-granular space, where the grain particles act like individual, charged dust particles. The semiconducting dust layer is the site where dielectric barrier discharge takes place, along with a constrictive glow.

The Colman-Gillespie tube is a bad joke at first glance but it fits into the broad pattern of transient dusty plasma/sharp electrode inventions, which are characteristic of the forgotten LENR inventions. Here the discharge is volumetric, as for example in the Moray tube, or Jekkel tube, not like in the Correa and Chernetzky tubes.

This small tabletop device can be an interesting and inexpensive research area for open source research. It is a high risk, low investment project. It is strange this finger-sized controlled fusion reactor is layered, just like the Soviet H-bomb designed by Andrei Sakharov, called "slojka" (layered cake), which was exploded in 1953. This was the very same year when Colman and Seddon-Gillespie filed their application to the British Patent Office. Of course, the U.S. H-bomb, invented by Edward Teller (a distant relative of mine) and S. Ulam, is a layered one, too.

Hundreds of millions of dollars were spent on the uncontrolled fusion bomb, and the basic concept of controlled thermonuclear fusion was established then. Yet the unknown Colman and Seddon-Gillespie intellectually far surpassed the bomb designers.

Based on the knowledge of oscillating dusty plasma and LENR, this layered dusty plasma device has the potential of producing electricity via controlled fusion of hydrogen, hidden in the crystal water of CoNO_3 .

The carbon dust added to the mixture of the above listed three salts makes the layer structure conductive. Thus it can be heated by RF to red hot in a minute, creating dusty plasma. Chlorine, as a negative ion, makes the oscillations more powerful (since resonance is not possible in the sponge-like layered grain tube). The thin layers are necessary because charge separation (modified Debye length) is short.

The most important feature is proper dust size in the tube, which makes the surface quality steady and reliable, as opposed to the Correa or Chernetzky solutions.

Though the disclosure of Colman and Seddon-Gillespie is short and sketchy, it is the most detailed LENR-based electricity device. Sadly, nothing else remained for us, so we had to start nearly from scratch.

It is quite possible that even more forgotten, similar inventions are buried on the shelves of various patent offices. The underwater resonant discharge effects of Stanley Meyer, Stephen Horvath, Peter and Neal Graneau, and Ruggero Santilli come to my mind. These devices were notoriously uncontrollable. Most probably because surface quality, and (thus bubble formation), or current density were not monitored, and could not be reliably maintained. The Graneaus believed the source of excess energy came from the release of unknown bonding energy of water molecules. The excess energy did not come from the water but from the plasma of the underwater discharges.

Of course plasma is not necessary for all LENR effects, but a high yield economic process is hard to imagine without plasma, (though full ionization is not necessary.)

Lessons of Failures

In my opinion, the cause of serial failures of all the ingenious technical breakthroughs was just pride and prejudice. This is true in technical and human terms as well. Scientists, in general, considered LENR as impossible on theoretical grounds. This is sheer prejudice.

Even in the small LENR community, the notion of direct electric energy production is met with skepticism, and the same kind of disbelief concludes that LENR can yield nothing other than heat energy. This is an overabundance of pride.

In order to reduce this "excess pride," I am shortlisting lessons from past, forgotten LENR solutions producing electrical, mechanical and chemical energy:

1. The process must take place in pulsed plasma, but not in a fully ionized "hot" one, but preferably in a hydrogen dominated dusty plasma.
2. Such a plasma can be maintained without electrodes, preferably by microwaves.
3. The electric energy can be extracted in principle by resonant, capacitively driven external circuits. There are only hints that Tesla drove his electric car by a capacitively driven discharge tube. Devices just accelerate what takes place in nature at a slower rate.

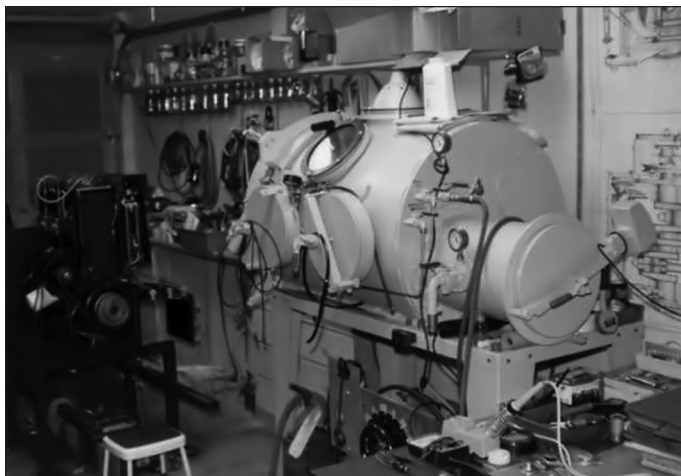


Photo 5. Glove box for handling mildly radioactive materials. Those were placed into sacks beside the electrodes (see Photo 4). The radioactive materials help ionization.

4. Cathode shape. There are a number of cases where dusty plasma was combined with edge effects to facilitate neutron formation and transmutation of heavier isotopes at efficient rates but a single, sharp point (Shoulders' effect) or a thin wire (Claytor-Fowler effect) is not yet economic. The careful design of the cathode shape (cavity cathode) is a must for economic applications. The Moray tubes, the cascade Gray tube, the zigzag silver blobs of the Jekkel tube but especially the British Colman "sandy" discharge tube are good examples. Even the compression head of the Papp engine is a sort of cavity cathode, but it is a rather poorly designed acoustic resonator.

5. Cathode material. Spongy material, even at micron and/or nanoscale, are preferable. Partly for their enhanced ability for cathode sputtering, dust production, and for cavity cathode effects, which yield economic electric cloud production.

6. Field, as a function of time. The electric field pulses must be one sided, because an alternating current is harmful. The reason is that the cathode material must be "doped" with hydrogen isotopes under the surface. This feature is found in all inventions, when this problem is mentioned. Palladium

is beneficial, but it is not the only material which is able to absorb hydrogen isotopes under the surface. It is not necessary that hydrogen isotopes diffuse evenly through the whole cathode volume; it is counterproductive. Current density should be restricted to small values, and arcing is disastrous. Glow or corona discharge is suitable. The latter is even better due to the self-organized Trichel pulses. In my opinion, commercial success can be achieved only in this regime, with one-sided pulses. The "single wire" technology of Tesla is suitable for these pulses, but the system is sensitive to capacitive objects nearby, and requires grounding, which is a severe restriction.

7. There is much room for further research and thus discoveries. The Shoulders and Claytor effects cover weird and yet uncharted areas of charge clusters, which have their own physics, ignored by mainstream and LENR researchers.

8. The work of Felix Ehrenhaft must be completed. Quasiparticles, including magnetic monopoles, may take an active role in catalytic nucleosynthesis.

9. The structure of nucleons must be revised. Recent mainstream models are just untenable. The crystal symmetric models of N. Cook or L. Sindely do have physical merit.

Reference

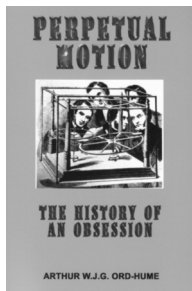
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Part 4 is scheduled to appear in Issue 137, and will focus on transmutation and briefly on the Mitkevich experiment. Part 4 will include an Appendix on the physics of dusty plasma.

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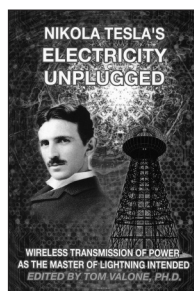
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