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ENERGY FROM THE ACTIVE VACUUM: THE MOTIONLESS ELECTROMAGNETIC GENERATOR

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CONTENTS

I. INTRODUCTION

This chapter explains the operational principles of a motionless electromagnetic generator (MEG)[1] experiment and invention where the generator is a system far from equilibrium in its energetic exchange with its active vacuum environment. The broken symmetry of a permanent magnet dipole is used as a transducer of vacuum energy, receiving longitudinal EM wave energy from the time domain (complex plane) and emitting it as real 3-space EM energy, by a process first shown by Whittaker [1][2] in 1903. As is well known, a system in energy exchange disequilibrium with its active environment is permitted to (1) self-order (2) self-oscillate, (3) output more energy than the operator inputs (the excess energy is received from the environment), (4) power itself and its load simultaneously (all the energy is received from the environment), and (5) exhibit negentropy. My colleagues and I achieved coefficient of performance (COP) of 5.0 in one experimental buildup and 10.0 in another. The MEG is in

[1] Covered by formal patent application by coinventors Thomas E. Bearden, James C. Hayes, James L. Kenny, Kenneth D. Moore, and Stephen L. Patrick. Intellectual property rights to the invention are assigned to Magnetic Energy Ltd., Huntsville, Alabama (USA), with Dr. James L. Kenny as Managing Partner. Several additional patent applications are in preparation.

[2] In this paper on the partial differential equations of mathematical physics, Whittaker decomposes any scalar potential into a harmonic set of bidirectional EM longitudinal EM wavepairs, where each wavepair is composed of a longitudinal EM wave and its phase conjugate replica wave. Dividing the overall waveset into two half-sets, we have one half-set consisting of incoming longitudinal EM waves in the complex plane (the time domain) and a second half-set composed of outgoing longitudinal EM waves in real 3-space. Hence the scalar potential represents a giant circulation of EM energy automatically established and maintained from the time domain (complex plane) into the source dipole establishing the potential, with the absorbed complex energy being transduced and reemitted by the dipole in all directions in 3-space as real longitudinal EM wave energy establishing the EM fields and potentials (and their energy) associated with the dipole.

patent-pending status. As of this writing, a variant of the MEG experiment has been independently replicated by Jean-Louis Naudin in France, and other independent replications are planned. Naudin's version produced a COP of 1.76. His results are posted on his Website: http://jnaudin.free.fr/html/megv2.htm. Arrangements were attempted for a team of skilled university scientists to independently test the MEG under U.S. Department of Defense auspices. Once COP > 1.0 was validated by the university team, a full proprietary disclosure was to be made to them under nondisclosure and noncompete agreement, and they would independently replicate the MEG themselves and test the buildup, again under DoD auspices the attempt failed.[3]

We especially wish to thank Jean-Louis Naudin for his prompt replication of the MEG experiment and for his kind permission to include his replication results and two of his illustrations.

II. BACKGROUND

A. Developmental History

For about 10 years the five researchers who invented the motionless magnetic generator (MEG) have been working together as a team, exploring many avenues whereby electromagnetic energy might be extracted from various sources of potential and eventually from the active vacuum itself. This has been arduous and difficult work, since there were no guidelines for such a process whereby the electrical power system becomes an open dissipative system in the manner of Prigogine's theoretical models [2–4] (see also the following paragraph) but using determinism and classical electromagnetics instead of chaos and statistics. There was also no apparent precedent in the patent database or in the scientific database.

Quoting, Prigogine, from p. 70 of his article on irreversibility as a symmetry-breaking process: "Entropy ... cannot in general be expressed in terms of observables such as temperature and density. This is only possible in the neighborhood of equilibrium.... It is only then that both entropy and entropy production acquire a macroscopic meaning." Prigogine received a Nobel Prize in 1977 for his contributions to the thermodynamics of open systems, particularly with respect to open dissipative systems. What he is pointing out here is that, where equilibrium (and hence symmetry) is broken, the usual presumption of entropy and entropic production have no macroscopic meaning. For such systems, the often encountered challenge on classical equilibrium thermodynamics grounds is a nonsequitur, and merely reveals the scientific ignorance of

[3]The team of university scientists observed the MEG in operation and were quite interested in performing full, independent replication and testing. However, the university's administration refused to sign a noncircumvention agreement. Consequently we stopped the process.

the challenger. In short, such a challenger would decry the windmill in the wind, denying that it can turn without the operator cranking it, because classical equilibrium thermodynamics forbids it. However, the windmill turns happily in the wind, without operator input at all, and in total violation of equilibrium thermodynamics because the windmill is not in equilibrium with its active environment, the active atmosphere. At the same time the windmill completely complies with the thermodynamics of open systems far from equilibrium, and energy conservation is rigorously obeyed. The windmill can ''power itself and its load'' since all the energy needed to power the windmill and power the load comes from the energy freely input by the wind.

It is generally realized that Maxwell's equations are purely hydrodynamic equations and fluid mechanics rigorously applies [5]. Anything a fluid system can do, a Maxwellian system is permitted to do, a priori. So ''electrical energy winds'' and ''electrical windmills'' are indeed permitted in the Maxwell–Heaviside model, prior to Lorentz' regauging of the equations to select only that subset of systems that can have no net ''electrical energy wind'' from the vacuum. Specifically, this arbitrary Lorentz symmetric regauging—while indeed simplifying the resulting equations and making them much easier to solve—also arbitrarily discards all Maxwellian systems not in equilibrium with their active environment (the active vacuum). In short, it chooses only those Maxwellian systems that never use any net ''electrical energy wind from the vacuum.'' Putting it simply, it discards that entire set of Maxwellian systems that interact with energy winds in their surrounding active vacuum environment.

Since the present ''standard'' U(1) electrodynamics model forbids electrical power systems with COP > 1.0, my colleagues and I also studied the derivation of that model, which is recognized to contain flaws due to its >136-year-old basis. We particularly examined how it developed, how it was changed, and how we came to have the Lorentz-regauged Maxwell–Heaviside equations model ubiquitously used today, particularly with respect to the design, manufacture, and use of electrical power systems.

The Maxwell theory is well known to be a material fluid flow theory [6],[4] since the equations are hydrodynamic equations. In principle, anything that can be done with fluid theory can be done with electrodynamics, since the fundamental equations are the same mathematics and must describe consistent analogous functional behavior and phenomena [5]. This means that EM systems with ''electromagnetic energy winds'' from their active external ''atmosphere''

[4] Quoting Sir Horace Lamb [6], p. 210: ''There is an exact correspondence between the analytical relations above developed and certain formulae in Electro-magnetism .... Hence, the vortex-filaments correspond to electric circuits, the strengths of the vortices to the strengths of the currents in these circuits, sources and sinks to positive and negative poles, and finally, fluid velocity to magnetic force.''

(the active vacuum) are in theory quite possible, analogous to a windmill in a wind. In such a case, symmetry is broken in the exchange of energy between the environment (the atmosphere) and the windmill. However, the present EM models used to design and build an electrical power system do not even include the vacuum interaction with the system, much less a broken symmetry in that interaction.

So the major problem was that the present classical EM model excluded such EM systems. We gradually worked out the exact reason for their *arbitrary* exclusion that resulted in the present restricted EM model, where and when it was done, and how it was done. It turned out that Ludvig Valentin Lorenz [7] symmetrically regauged Maxwell's equations in 1867, only two years after Maxwell's [8] seminal publication in 1865. So Lorenz first made arbitrary changes that limited the model to only those Maxwellian systems in equilibrium in their energy exchange with their external environment (specifically, in their exchange with the active vacuum). This arbitrary curtailment is not a law of nature and it is not the case for the Maxwell–Heaviside theory prior to Lorenz' (and later H. A. Lorentz') alteration of it. Thus, for electrical power systems capable of COP > 1.0, *removing* this symmetric regauging condition [9–14] is required—particularly during the discharge of the system's excess potential energy (i.e., during discharge of the excitation) in the load.

Later H. A. Lorentz [15],[5] apparently unaware of Lorenz' 1867 work, independently regauged the Maxwell–Heaviside equations so that they represented a system that was in equilibrium with its active environment. This indeed simplified the mathematics, thus minimizing numerical methods. However, it also discarded all ''electrical windmills in a free wind''—so to speak—and left only those electrical windmills ''in a large sealed room'' where there was never any net free wind.

B. Implications of the Arbitrarily Curtailed Electrodynamics Model

Initially an electrical power system is *asymmetrically* regauged by simply applying potential (voltage), so that the system's potential energy is nearly instantly changed. The well-known gauge freedom principle in gauge field theory assures us that any system's potential—and hence potential energy—can be freely changed in such fashion. In principle, this excess potential energy can then be freely discharged in loads to power them, without any further input from the operator. In short, there is absolutely no theoretical law or law of nature that prohibits COP > 1.0 electrical power systems—or else we have to abandon the highly successful modern gauge field theory and deny the gauge freedom principle.

[5]Such was H. A. Lorentz's prestige that, once he advanced symmetrical regauging of the Maxwell–Heaviside equations, it was rather universally adopted by electrodynamicists, who still use it today; see, for example, Jackson [15].

Although the present electrical power systems do not exhibit COP > 1.0, all of them do accomplish the initial *asymmetric* regauging by applying potential. So all of them do freely regauge their potential energy, and the only thing that the additional energy input to the shaft of a generator (or the chemical energy available to a battery) accomplishes is the physical creation of the potentializing entity: the source dipole [16]. [*Note*: The key is to apply Whittaker's 1903 decomposition of the scalar potential existing between the poles of a dipole. Whittaker showed that any EM scalar potential dipolarity continually receives longitudinal EM wave energy from the time domain (complex plane) and outputs real EM energy in 3-space. Thus the potential's dipolarity (voltage) placed on a circuit by a generator or battery actually represents free regauging energy coming from the time domain of the 4-vacuum, and therefore having nothing to do with the 3-space energy input to the shaft of the generator or with the 3-space chemical energy available in a battery.]

It follows that something the present systems or circuits perform in their discharge of their nearly free[6] regauging energy must prevent the subsequent simple discharge of the energy to power the loads unless further work is done on the input section. In short, some ubiquitous feature in present systems must self-enforce the Lorentz symmetry condition (or a version of it) whenever the system discharges its free or nearly free excitation energy.

Lorentz' [15] (see also footnote 5, above) curtailment of the Maxwell–Heaviside equations greatly simplified the mathematics and eased the solution of the resulting equations, of course. But applied to the design of circuits, particularly during their excitation discharge, it also discarded the most interesting and useful class of Maxwellian systems, those exhibiting COP > 1.0.

Consequently, Lorentz [15] (see also footnote 5, above) unwittingly discarded all Maxwellian systems with "net usable EM energy winds" during their discharge into their loads to power them. Thus present electrical power systems—which have all been designed in accord with the Lorentz condition—cannot freely use the EM energy winds that arise in them by simple regauging, as a result of some universal feature in the design of every power system that prevents such action.

We eventually identified the ubiquitous closed current loop circuit [17][7] as the culprit that enforces a special kind of Lorentz symmetry during discharge of

[6] In real systems, for regauging we have to pay for a little switching costs, for example, but this may be minimal compared to the potential energy actually directed or gated upon the system to potentialize it.

[7] More rigorously, this is any closed current loop circuit where the charge carriers in all portions of the loop have the same m/q ratio. For example, battery-powered circuits do not meet that condition, since the internal ionic currents between the battery plates may have m/q ratios several hundred times the m/q ratio of the electrons that pass between the outsides of the two plates and through the external circuit containing the load. With Bedini's process, a battery-powered system can be made to charge its batteries at the same time that it powers its load; see Bearden [17].

the system's excitation energy. With this circuit, the excitation-discharging system must destroy the source of its EM energy winds as fast as it powers its loads and losses, and thus faster than it actually powers its loads.

Also, as we stated earlier, and contrary to conventional notions, batteries and generators do not dissipate their available internal energy (shaft energy furnished to the generator, or chemical energy in the battery) to power their external circuits and loads, but only to restore the separation of their internal charges, thereby forming the source dipole connected to their terminals. Once formed, the *source dipole's giant negentropy* [16] then powers the circuit via its broken symmetry [18,19] [see the following subsection (Section II.B.1) also].

1. Particle Physics, Including Dipole Symmetry

A discussion by Nobelist Lee of particle physics and its findings, includes broken symmetry, which includes the broken symmetry of a dipole. Quoting from Lee [18], p. 184: "... the discoveries made in 1957 established not only right-left asymmetry, but also the asymmetry of the positive and negative signs of electric charge. In the standard nomenclature, right-left asymmetry is referred to as *P* violation, or parity nonconservation. The asymmetry between opposite signs of electric charge is called *C* violation, or charge conjugation violation, or sometimes particle-antiparticle asymmetry." "Since non-observables imply symmetry, these discoveries of asymmetry must imply observables."

Simply put, Lee has pointed out the rigorous basis for asserting that the arbitrarily assumed Lorentz 3-symmetry of the Maxwellian system is broken by the source dipole—and in fact by any dipole. Such broken 3-symmetry in the dipole's energetic exchange with the active vacuum is well known in particle physics, but still is not included at all in classical electrodynamics, particularly in the models used to design and build EM power systems. The proven dipole broken 3-symmetry rigorously means that part of the dipole's received virtual energy—continuously absorbed by the dipole charges from the active vacuum—is transduced into observable 3-space energy and reemitted in real (observable) energy form. That this has been well known in particle physics for nearly a half-century, but is still missing from the classical EM model, is scientifically inexplicable and a foundations error of monumental magnitude. Once made, it is the *source dipole* that powers the circuit.

C. Some Overlooked Principles in Electrodynamics

We recovered a major fundamental principle from Whittaker's [1] profound but much-ignored work in 1903. Any scalar potential is a priori a set of EM energy flows, hence a set of "electromagnetic energy winds," so to speak. As shown by Whittaker, these EM energy winds pour in from the complex plane (the time domain) to any *x*,*y*,*z* point in the potential, and pour out of that point in all directions in real 3-space [1,16,20].

Further, in conventional EM theory, electrodynamicists do not actually calculate or even use the *potential itself* as the unending set of EM energy winds or flows that it actually is. Instead, they calculate and use its *reaction cross section with a unit point static charge* only *at a specific point*. How much energy is diverged around a single standard unit point static coulomb is then said to be the ''magnitude of the potential'' at that point. This is a nonsequitur of first magnitude.[8]

For example, the small ''swirl'' of water flow diverged to stream around an intercepting rock in a river bottom is not the river's own flow magnitude. It certainly is not the ''magnitude of the river.'' Neither is the standard reaction cross section of the potential a measure of the potential's actual ''magnitude,'' but is representative only of the local intensity of the potential's composite energy flows. Indeed, the potential's ''magnitude'' with respect to any local interception and extraction of energy from it is limited only by one's ability to (1) intercept the flow and (2) diverge it into a circuit to power the circuit. The energy flows identically constituting the potential [1,16,20] replenish the withdrawn energy as fast as it can be diverged in practical processes, since the vacuum energy flows themselves move at the speed of light.

D. Work–Energy Theorem in a Replenishing Potential Environment

We also came to better understand the conservation of energy law itself. Particularly, the present work–energy theorem assumes only a ''single conversion'' of energy into a different form, where such ''conversion in form'' due to a converting agent is what is considered ''work'' on that agent. No ''replenishing of the dissipated or converted energy by a freely flowing energy river or process'' is considered. Instead of the ongoing divergence from a flowing stream of energy that it is, a collection of energy is erroneously treated as if it were a ''pile of bricks'' called *joules*.

On the other hand, in a system operating in a replenishing potential environment, a conversion in the form of the energy may increase the system energy (e.g., the kinetic energy of an electron gas) of the converting agent, since all the field energy and potential energy input to that converting agent may be replenished (from the time domain). If so, a *free regauging* occurs (Indeed, we would hesitantly nominate this process as the fundamental process underlying the gauge freedom principle itself, but will leave to more qualified theoreticians the affirmation or refutation of that speculation.). In that case,

[8] For example, simply replace the assumed unit point static charge assumed at each point with n unit point static charges, and the collected energy around the new point charge will be n times the former collection. If the former calculation had yielded the actual magnitude of the potential at that point, its magnitude could not be increased by increasing the interception. But since the potential is actually a flow process, increasing the reaction cross section of the interception increases the energy collection accordingly.

the original energy can change (e.g., into field energy form, which is not the kinetic energy of the electron gas), and yet a joule of work can have been done on the electron gas to alter its potential energy by as much work as was done on it. Thus the work performed by this change in energy form with simultaneous replenishment of the original form, may increase the energy of the medium while retaining as much field energy and potential energy as was input, just in different form.

This is a profound change to the implicit assumptions used in applying the work–energy theorem. In short, the present work–energy theorem (without replenishment) was found to be a special case of a much more general and extended ''replenished energy conversion of form with intermediate work freely performed upon the converter'' process. *Conversion of the form of energy* is rigorously what we call *work*. The energy is not consumed in the work process, and the replenished ''energy collection'' in its original form is also maintained so that it is not ''lost'' in doing work on the converter. So to speak, the well-established principle of gauge freedom as an energy replenishing mechanism has been arbitrarily excluded in the conventional view of the work–energy theorem. *The conventional form of the work–energy theorem applies only when there is no simultaneous regauging/replenishment from the vacuum* (*time domain*) *involved*. With replenishment, the more general work–energy theorem yields system energy amplification by free system regauging.

This extension of the work–energy theorem to a more general case, including the invocation of gauge freedom, has profound implications in physics. With the energy replenishing environment involved, the work–energy theorem becomes an *energy amplifying* process. Electrical energy can be freely amplified at will—anywhere, anytime—by invoking the extended energy–work process, if regauging accompanies the process simultaneously. Indeed, one joule of field energy or potential energy can do joule after joule of work on intermediary converters, increasing the kinetic energy and other forces. upon the converter medium, while the system retains replenished joule for joule of the input energy in differing field or potential forms. In this extended process, always after each joule of work on the converting agent there still remains a joule of field energy or potential energy of altered form, and the original joule of energy was freely replenished as well.

E. The Extended Principles Permit COP > 1.0 Electrical Power Systems

Gradually we realized that (1) electrodynamics without the arbitrary Lorentz regauging did permit asymmetrically self-regauging electrical power systems, freely receiving and converting electrical energy from their vacuum environment; (2) present systems are designed unwittingly to guarantee their reimposition of symmetry during their excitation discharge; (3) this excitation discharge symmetry is what can and must be broken by proper system design; and (4) a

magnetic system ''powered'' by a permanent magnet dipole's ongoing active negentropy processes [16,20] could readily be adapted since the source dipole of the permanent magnet was not destroyed by the circulating magnetic flux. We experimented on various buildups and prototypes, in this vein, for some years.

F. Patenting and Discovery Activity

After several years of experimental work, in 1997 we filed a provisional patent application on the first MEG prototype of real interest. We filed another formal patent application in 2000 after several years of experimentation in which we used multiple extraction of energy from a magnetic dipole. Fundamentally, we sought to extract electromagnetic energy from the magnetic vector potential that pours from a magnetic dipole due to the giant negentropy mechanism [1,16,20]. Originally we suspected that we would deplete the magnetic dipole, and our experiments sometimes seemed to indicate that a very slow depletion might indeed be happening. These indications were eventually found to be due to normal small measurement errors within the measurement tolerance of our instruments.

Since our last formal patent application filing in 2000, additional buildups and experiments have led us to the firm conclusion that one does not deplete the magnetic dipole. Instead, if one draws the energy *directly from the potentials* (primarily from the magnetic vector potential) furnished by the magnetic dipole of the permanent magnets, one can essentially draw as much energy as desired, without affecting the dipole itself.[9] We found that any amount of energy can be *freely withdrawn* from the vector potential without diminishing the vector potential itself, as long as the withdrawn energy is changed in form in the withdrawal. A giant negentropy mechanism—reinterpreted by Bearden [16] from Whittaker's work [1] and further investigated by Evans and Bearden [20]—is associated with the magnet dipole, and in fact with any dipole, since a scalar potential exists between its poles and the scalar potential decomposes via the Whittaker decomposition [1]. This negentropy mechanism [1,16,20] will replenish the magnetic vector potential energy as fast as energy is withdrawn from it and conducted aside in the circuit.

We hit on the stratagem of using a highly specialized magnetic core material, nanocrystalline in nature and in special tape-wound layered structure, to try to

[9]Indeed, from any nonzero potential, any amount of energy can be diverged and withdrawn. This is easily seen for the electrostatic scalar potential by the simple equation $W = \phi q$, where W is the energy diverged or collected in joules, ϕ is the reaction cross section of the potential in joules per interacting coulomb, and q is the number of interacting static point coulombs. As can be seen from the equation, from a potential of given nonzero reaction cross section, the energy that can be collected is limited only by the number of coulombs of interacting charges—or considering repetition, from how many additional times a given amount of collecting charge is ''dipped'' into the potential to diverge and collect additional energy flow.

extract the energy from the magnetic vector potential (**A** potential) as a magnetic **B** field (curl of the **A** potential) that is locally restricted to the special nanocrystalline material that forms a closed magnetic flux path closed on both poles of the permanent magnet dipole. Because of its nature and also its tape-wound layered construction, the nanocrystalline material (obtained off the shelf as a commerical product from Honeywell) will perform this separation of **B**-field and **A**-potential energy that is heretofore unheard of in such a simple magnetic core mechanism and flux path material.

We point out that a tightly wound, very long coil does a similar thing, as does a good toroid, and the separation of **A** potential from **B** field is known. This forms the basis for the Aharonov–Bohm [21] effect, for example.[10] In such cases, it is not so well known that the curl-free **A** potential remains fully replenished, even though ''all'' the magnetic field (curled **A** potential) has been diverted. To our knowledge, such effects have not previously been utilized in magnetic core materials themselves, where the **B**-field energy is extracted and moved into a separate flux path through space. Our experimental measurements showed the magnetic field was indeed missing in the space surrounding the closed flux path material, but the **A** potential was still present outside the core and its changes interacted with coils in a dA/dt manner. The **B**-field and associated magnetic flux were rigorously confined internally to the nanocrystalline material flux path.

Now we had two streams of EM energy, each in different form, and *each equal in energy* (determined by the Poynting-type calculation approach, which only accounts for diversion *from* and not *for* the river) *to the original stream!* In short, we had exercised gauge freedom and asymmetric self-regauging to freely achieve energy amplification in the system.

[10]Quoting Aharonov and Bohm in their paper on the significance of electromagnetic potentials in the quantum theory, on p. 485: ''contrary to the conclusions of classical mechanics, there exist effects of potentials on charged particles, even in the region where all the fields (and therefore the forces on the particles) vanish.'' Our comment is this: Indeed, since the field is usually defined as the force per unit charge in classical electrodynamics, then the field as defined does not exist until after the causative ''field as a separate entity'' interacts with a charged mass. Hence the field as defined is an *effect* of the interaction, not the *cause* of it. Further, being an effect and an observable as defined, it does not exist in spacetime as such, since no observable does. A priori, any observable is the output (effect) of a $\partial/\partial t$ operation upon LLLT, yielding an LLL ''frozen snapshot'' at an instant in time, which snapshot itself does not exist in time but was only a 3-space fragment of what was existing in the ongoing 4-space interaction at that point in time. The field-free 4-potential, together with its structure and its dynamics, provides the *causes* existing in spacetime before they interact with intermediaries to produce effects. One major problem with the present classical electrodynamics is that much of it still hopelessly confuses cause and effect. This is a residue of the original assumption (including that by Maxwell in his equations) of the material ether. When the material ether was destroyed by the Michelson–Morley experiments in the 1880s, not a single Maxwell–Heaviside equation was changed. Hence the field concept as defined still assumes a material ether, and still is an effect confused as a cause.

This then led to very novel ramifications and phenomenology, which we have been intensely exploring since filing the previous patent when—to be conservative—we assumed possible slow depletion of the magnetic dipole of the permanent magnet. Now we clearly have no depletion of the magnetic dipole, and also we can now explain where the continuous ''magnetic energy wind'' comes from, what triggers and establishes it, and how to apply the resulting principles.

Consequently, rapid progress in nondepleting versions of our previous invention, as a full extension to both the previous invention and also to the previous process utilized (possible depletion of stored potential energy), has been accomplished. A second patent application has been filed.

Because of the importance of this furiously progressing work and the urgency of the escalating electrical energy crisis worldwide, a paper [22] describing our results was placed on a Department of Energy Website, (see Ref. 22). The paper was later moved to a restricted DOE site reserved for scientists, until such time as independent testing verification and independent replication is obtained, to assure a fully valid scientific experiment.

Happily, independent replication by Naudin has just been accomplished at the time of this writing (Nov. 2000).

G. Results of the Research

It is now clear—by fluid flow analogy and actual experiment—that we have found the perfect magnetic mechanism for (1) producing ''magnetic energy winds'' at will, furnished freely by nature in natural dipole processes only recently recognized [16] and clarified [20] in the literature; (2) producing a magnetic ''windmill'' that freely extracts energy from these free winds provided by nature from these newly understood processes; and (3) creating positive energy feedforward and feedback iterative interactions in a coil around a core, resulting from dual energy inputs to the coil from actions (1) in the core inside the coil and (2) in the surrounding altered vacuum containing a continuously replenished field-free magnetic potential **A**, and hence representing a separate source of energy that will react with a coil.

Iterative mutual interactions, occurring between the two interactions in the coil itself, add a third small increase of energy from the resulting convergent energy gain (asymmetric self-regauging) series. The additional amplification of the energy is given by the limit of the resulting convergent series for energy collection in the coil. In this novel new usage, the net result is that the coil is an *energy amplifying* coil, or negative resistor, freely and continuously fed by excess input energy from an external active source. As can be seen, this is a startling extension to conventional generator and transformer theory.

A multiplicity of such positive energy feedforward and feedback loops occur and exist between all components of the new process. The system becomes a

true open system receiving excess energy from the free flow of energy established in its vacuum environment by the subprocesses of this invention's system process.

Consequently, we have experimentally established this totally new process and field of technology, and also have experimentally established that it is not necessary to deplete the permanent-magnet dipole after all. With the new techniques, direct replenishment energy from the active vacuum is readily furnished to the permanent magnet and utilized by the system.

Extraction of usable EM energy from the vacuum is not some tremendously difficult technical feat that can only come a century or so from now. Instead, it is a readily obtainable capability right now, once the fundamental principles are understood and applied.

III. THREE IMPORTANT PRINCIPLES AND MECHANISMS

We explain three very important principles and mechanisms necessary to comprehend the new energy amplifying (regauging) process in a replenishing potential environment:

A. Conservation of Energy

The conservation of energy law states that *energy cannot be created or destroyed*. What is seldom realized is that energy can be and is reused (changed in form) to do work, over and over, while being replenished (regauged) each time. If one has one joule of energy collected in one form, then in a replenishing potential environment, one can change all that joule into a different form of energy, thereby performing one joule of work. However, one still has a replenished joule of energy remaining, by the conservation of energy law in such an environment, even though the first joule was removed in different form. Note that present engineering practice has not considered that the input joule in its original form is replenished. If one extracts and holds that converted joule in its new form, and then changes the form of it yet again in the replenishing environment, one does yet another joule of work—and still has a joule of energy left, just in a yet different form. The process is infinitely repeatable, limited only by the ability to hold the changed form of the energy each time it is changed. In a replenishing potential environment, not only will we do joule after joule of work, but we will still have a joule of "input" energy to use, as well as accomplishing the joule of work, as well as having a new joule of energy leaving the work site in different form. This follows without violation of energy conservation, as a result of the continual free regauging and energy amplification.

Further, only two energy forms are needed for endless iterative shifting of form—say, form **A** and form **B**, since **A** changed totally into **B** performs

work on the transforming medium equal to **A** energy dissipation, but yields **A**-equivalent amount of energy still remaining because of replenishment. The **B**-form energy can then be changed back from **B** to **A** yet again, wherein the same amount of work is done on the transforming medium for the second time, and one *still* has a joule of **B** energy remaining because of replenishment. This process can be iterated. We call this the *pingpong principle* and use the iterative work done by each replenished change of energy form to continually increase the excitation energy of a receiving entity, the Drude electron gas in the coil and its attached circuit. We emphasize that this is also a novel way to directly generate and utilize free regauging energy.

To do work, one does it at a certain rate (power level), and so the rate of change of the energy form becomes the important factor that must be manipulated quite precisely.

Cyclic transform of the energy by ''pingpong'' between two different forms of energy or energy states with replenishment—and where meticulous care is observed with rates of change of the energy form in each case—is all that is required to produce as much work as one wishes in the intermediary, from a single joule of operator-input energy. This regauging energy amplifying process is limited only by one's ability to hold the new form of energy after each transformation and not lose it (or not lose all of it). By letting this iterative pingpong work be done on the Drude electron gas, the energy of that gas is excited much more than by the energy we originally input, if the input energy had been *used only once* [meaning that it was dissipated (escaped from system control) in the conversion (work) process] to perform work (if its form were only changed once) and there was no replenishment.

We stress that present electrical power systems deliberately use their collected energy only once, and do not take advantage of energy regauging by free replenishment from the potential environment. So engineers are totally unfamiliar with the pingpong mechanism and do not apply it, and they are totally unfamiliar with the energy amplifying process and do not apply it. In short, they simply do not use the extended (replenishing) energy–work theorem and the pingpong effect to dramatically increase the energy in the Drude electron gas in the external circuits connected to the generator or battery.

B. "Pingpong" Iterative Change of Energy Form

The **A** potential and the **B** field are extraordinarily useful for just such ''pingpong'' iterative change of energy form, from **B**-field energy to **A**-potential energy and vice versa, back and forth, repeatedly. That is precisely what happens in each coil of the process of the invention, and this results in dual inputs of energy—one in curl-free **A** form and one in **B** form—simultaneously to the coil. Quite simply, one can extract the energy from a volume of **A** potential, in **B**-field form where the **B**-field energy is removed from the volume,

and the **A** potential beyond will instantly (at least at the speed of light) simply refill the volume, but with curl-free **A** potential.

The time rate of change $d\mathbf{A}/dt$ of the resulting curl-free **A** potential is an **E** field that will react—in electric field fashion—directly with the charge of the electrons in the Drude electron gas in the output coil, entering from the surrounding space outside the core. The entering $d\mathbf{A}/dt$ electric field energy interacts in the ideal case with the ''full'' energy of the original vector potential **A**. The magnetic field **B** in the core in the center of the coil simultaneously interacts with the spin of the same Drude electrons in the same coil, and with the ''full'' energy of the original vector potential **A**. Consequently, the electrons receive an interaction energy gain of 2.0, and the pingpong between the two processes adds about another 0.5 gain, for an overall gain per output coil of 2.5. With two output coils, the energy amplification is about 2.5, and hence the generator exhibits COP = 5.0.

A similar effect is also demonstrated by the well-known Aharonov–Bohm effect [21,23],[11] but usually in only very small effects, without the pingpong effect, and not used in power systems. By analogy, we may compare this iterative process to ''dipping several buckets of water in succession'' from a mighty rushing river; the river refills the ''hole'' immediately after each dipping. We can continue to extract bucket after bucket of water from the same spatial volume in the river, because of the continual replenishment of the extracted water by the river's flow.

Any change of **B**-field energy in the center of the coil, interacts with the coil magnetically since the coil's magnetic field is at its greatest strength in its precise center, and the center of the coil is in the center of the core flux path material. This magnetic interaction between core and coil produces voltage and current in the coil (and therefore in a closed loop containing the coil and the external load). The interaction also simultaneously produces an additional equal energy outside the coil in the form of field-free **A** potential. This latter interaction is absolutely permitted since the magnetic energy in **B** form was ''dissipated'' (transformed) into **A**-potential energy, thereby causing the electrons in the wires to flow by doing work that built voltage and current, which then was a change of form of the **B**-field energy. Simultaneously, the electron current produces the **A**-potential energy around the coil and outside it, which is absolutely permissible since a change in form of the energy is again involved.

[11] Full discussion of the Aharonov–Bohm effect and hundreds of references can be found in Ref. 23. According to Nobelist Feynman, it required 25 years for quantum physicists to clearly face the Aharonov–Bohm issue of the primacy and separate action of the force-field-free potential. Another long period passed before physicists finally accepted it, even though it was experimentally demonstrated as early as 1960.

Since these changes in energy form occur nearly at the speed of light, in a local coil they appear ''instantaneous,'' although in reality they are not quite instant, just very rapid. However, the work produced by each change of form of the energy in that rapid ''pingpong'' between the several energy states, continually produces *work on the Drude electrons*, producing momentum and motion in the Drude gas, thus resulting in voltage and current. In this way, the increased momentum and motion—involved in the currents flowing in the voltage drop of the coil and external loop—result in increased stored kinetic energy in the moving Drude gas, which is electromagnetic energy of a different form.

As can be seen, the speed of the pingpong energy-state transformations results in each transformation doing cumulating work in the Drude electron gas of the output coil, to increase that gas's excitation and energy. A continuous ''collection'' of excess energy—caused purely by the change of form of the energy and not by ''loss'' or ''disordering'' of the energy—occurs in the Drude electron gas, resulting in increased voltage and current in the circuit containing the coil. This is simply a mechanism for a ''regauging'' or increase of potential energy of the Drude electron gas system. The Drude electron gas system's increased excitation energy can then be dissipated ''all at once'' in conventional fashion in the external load, providing more energy dissipated as work in the load than was input to the coil originally by the operator.

Hence an *energy amplifying* action of the coil and its multiplicity of processes is generated. There is no violation of the energy conservation laws, of the laws of physics, or of the laws of thermodynamics since this is an open system far from equilibrium with its source of potential energy (the magnetic dipole of the permanent magnet), which, in turn, continuously receives replenishment energy from the vacuum by a giant negentropy process reinterpreted by Bearden [16] from Whittaker's work [1] and clarified by Evans and Bearden [20].

C. Dissipation of Energy

The dissipation of the final collected regauging energy within the load can permissibly be greater than what we ourselves initially input,[12] because of the iterative change of form of the energy with replenishment. Therefore the iterative interactive work done on the Drude electron gas provides more than one joule of work done on the gas—thereby increasing its potential energy by more than one joule—for each joule of energy input by the operator to the

[12] See Refs. 9–14,16,17,73–75. We comment that the standard calculation of the Poynting energy flow is not the calculation of the total EM energy flow at all, but only a calculation of how much of the total energy flow is intercepted by the surface charges of the circuit and thereby diverged into the conductors to power the Drude electrons. The energy input to the system by the operator has nothing to do with the energy dissipated by the system in the load—only with the energy expended in continually re-forming the source dipole that the conventional system is designed to destroy faster than it powers the load.

system process. The cumulated potential energy in the Drude electron gas is then discharged in loads in normal fashion. Note that, even here, the energy is not lost when dissipated from the load and outside the system, but just flows out of the load in a different form (e.g., as heat radiated from a resistor load). Again, this process involves an open system not in equilibrium with its active vacuum environment; it is comparable to a windmill in a wind, where we input a little wind and find a way to cause the environment to freely add some additional wind to our own input.

The various asymmetric regaugings violate Lorentz' arbitrary symmetric condition, specifically in the discharge or change of form of the energy. Hence, this process restores to electrodynamics one group of those missing Maxwellian systems arbitrarily discarded by first Lorenz and later Lorentz, more than a century ago. A rigorous rebuttal of objections to COP > 1.0 EM systems has been given [75].

IV. THE PROCESS IS THEORETICALLY SUPPORTED

Several rigorous scientific papers [24–37] by the Alpha Foundation's Institute for Advanced Study (AIAS) have been published or are in the publication process, fully justifying the fact that energy currents (energy winds) can readily be established in the vacuum, and that such energy winds do allow the extraction of EM energy from the vacuum. Two rigorous theoretical papers explaining the motionless electromagnetic generator have been published [73,74].

Also, Cole and Puthoff [38] have shown that there is no prohibition in thermodynamics that prevents EM energy being extracted from the vacuum and utilized to power practical systems.

In electrochemistry it has long been known [39][13] that there can be no current or movement in electrodes without the appearance of excess potential (regauging) called the *overpotential*.

Further, in the most advanced model in physics—gauge field theory—the freedom to change gauge (in electrodynamics, to change the potential) at will, is an axiom of the theory. If we freely change the potential of a physical electrical power system, we freely change its potential energy (in a real system, we may have to pay for a little switching energy losses).

[13] Essentially, *the overpotential is a shift in the Fermi level necessary to allow the electron in the electrode metal to have energies overlapping with vacant acceptor levels in molecules adjacent to the electrode in the solution*. It enables the transfer of electrons via quantum transfer (tunneling). Quoting from Ref. 39, p. 356: "*Unless a system exhibits an overpotential, there can be no net reaction* [emphasis in original]." We point out that an overpotential is an advantageous regauging (free change) of the potential energy of the local region where the overpotential appears.

It follows that we can also freely change (regauge) the excess potential of that system yet again, by any means we choose, including discharging that excess potential energy in a load to do work. Thus gauge field theory has for decades already axiomized the rigorous basis for COP > 1.0 electrical power systems—but such systems have remained neglected because of their arbitrary discard by the ubiquitous use of Lorentz symmetrical regauging.

That such COP > 1.0 electrical power systems have not been previously designed or built is therefore not due to a prohibition of nature or a prohibition of the laws physics at all, but to a characteristic used to design and build the systems themselves. Because of their ubiquitous closed current loop circuits, conventional power systems use half their collected energy to destroy their own source dipoles, which destroys any further use of energy from ''the potential between the ends of the dipole'' since both dipole and potential vanish, as do the negentropy process and the broken 3-symmetry. The potential of the source dipole, after all, is what potentializes the external circuit with additional excitation energy, to be utilized to power the system. In present systems, half that excitation energy is dissipated to destroy the dipole along with the source potential, and less than the remaining half is used to power the load. This rigorously limits such systems to COP < 1.0.

In the MEG, we do not destroy the potentializing source dipole, which is the magnetic dipole of the permanent magnet. We include the vacuum interaction with the system, and we also include the broken symmetry of the source dipole in that vacuum exchange—a broken symmetry proved and used in particle physics for nearly a half century, but still inexplicably neglected in the conventional Lorentz-regauged subset of the Maxwell–Heaviside model. We also use the extended work–energy theorem, as discussed.

Consequently, our work and this novel process are rigorously justified in both theory and experiment, but the principles and phenomenology are still not incorporated in the classical electrodynamics theory utilized to design and produce electrical power systems. These principles are indeed included in the new O(3) electrodynamics being developed by AIAS (Alpha Institute for Advanced Study)[14] that extends the present U(1) electrodynamics model, as shown by some 100 scientific papers carried by the U.S. Department of Energy on one of its private scientific Websites in Advanced Electrodynamics, and by an increasing number of publications in leading journals such as *Foundations of Physics*, *Physica Scripta*, and *Optik*.

[14] A private communication from Dr. Myron Evans, Sept. 30, 2000, rigorously confirms that the magnitudes of the vector potential and the 4-current do in fact provide EM energy from the vacuum, and determine its magnitude as well.

We thus have invented a process that indeed is well-founded and justified, but the basis for it is not yet explained in the texts and university courses. It is our belief that this absence will be rapidly rectified in the universities, in both the physics and electrical engineering departments, on the advent of practical self-powering electrical power systems freely regauging themselves and extracting energy from the magnetic dipole of a permanent magnet, and that the energy will be continuously replenished to the dipole from the active vacuum via the new giant negentropy process [1,16,20].

V. CONSIDERING THE PROCESS

A. A Potential and Field-Free A Potential

This invention relates generally to the field of electromagnetic power generation. Specifically it relates to a totally new field of extracting additional electromagnetic energy in usable form from a permanent-magnet dipole's magnetic vector potential energy, in addition to the electromagnetic energy extracted from its magnetic field energy, wherein the excess magnetic vector potential energy taken from the magnet dipole is continuously replenished to the permanent-magnet dipole from the active vacuum that is a curved spacetime with an ongoing giant negentropy flow process [1,16,20].

With respect to the electrostatic scalar potential, electrodynamicists are familiar with the fact that unlimited energy can be extracted from a potential. The very simple equation

$$W = \phi q \tag{1}$$

gives the amount of energy W in joules, which is collected at any given point x,y,z from the electrostatic scalar potential—whose reaction cross section is given by ϕ, in joules collected per point coulomb—by charges q in coulombs and located at point x,y,z. Note that as much intercepting charge q as desired can be used at any point to increase the energy collection at the point, and collection can be accomplished at as many points x,y,z as is desired.

So any amount of energy can be collected from any nonzero scalar potential, no matter how small the potential's reaction cross section, if sufficient intercepting charge q and collecting points x,y,z are utilized. In short, one can intercept and collect energy from a potential indefinitely and *in any amount*, and *in any form taken by the collecting interaction*, because the potential is actually a set of EM energy flows in the form of longitudinal EM waves, as shown by Whittaker [1] in 1903 and further expounded by Bearden [16,40]. Subsequently, Evans and Bearden [20] have more rigorously interpreted Whittaker's [1] work

and extended the principle into power systems. Thus any energy diverged and ''withdrawn'' from the potential in a given local region of it is immediately replenished to the potential and to that region from the complex plane (the time domain) by the potential's flowing EM energy streams [1,16,20], as rapidly as the energy is deviated and withdrawn.

For the magnetic vector potential, some preliminary comments are necessary. First, for over a hundred years it has been erroneously advanced that the magnetic vector potential **A** is ''defined'' by the equation

$$\mathbf{B} = \nabla \times \mathbf{A} \tag{2}$$

This is easily seen not to be a definition at all, since an equation says nothing about the nature of anything on its right or on its left, but merely states that the entire right side has the same magnitude as does the entire left side. For an expression to be a *definition*, it must contain an identity ($\equiv$) sign rather than an equal ($=$) sign. Hence in seeing what is attempted to be defined, we rewrite equation (2) as

$$\mathbf{B} \equiv \nabla \times \mathbf{A} \tag{3}$$

Now it is seen that it is the magnetic field **B** that is being defined as the curl of a swirling **A**-potential, which swirling component we will call $\mathbf{A}_C$ for the ''**A** circulating'' component of **A**. Rigorously, this is correct because all fields *as defined in classical electrodynamics* are effects and the observable results of interactions. The potentials and their structural dynamics are the primary causes [21]. The curl of the circulating **A** is a magnetic field **B**, by identity (3). There may, of course, be present additional **A** potential that has zero curl, but that additional longitudinal $\mathbf{A}_L$ potential or $\mathbf{A}_L$ current does not produce a magnetic field **B** per se. However, its change dA/dt does interact with charges as an **E**-field.

In 3-space, the field-free $\mathbf{A}_L$ potential may be moving longitudinally, in which case it is identically an electrical potential ϕ that is moving longitudinally and hence no longer really a *scalar* potential ϕ but a vector potential $\boldsymbol{\phi}$. If $\boldsymbol{\phi}$ translates without changing magnitude, there is no **E**-field and hence $\boldsymbol{\phi}$ is a field-free vector potential. Identity (3) still does not define **A**, but defines **B** in terms of **A** and the curl operator. Note particularly that, in identity (3), we may have additional $\boldsymbol{\phi}$ present as a curl-free, longitudinal magnetic vector potential $\mathbf{A}_L$, and we shall refer to this additional curl-free magnetic vector potential as $\mathbf{A}_L$ (for longitudinally translating **A** component without swirl).

B. General Relativistic Considerations

We are rigorously using the Sachs [41][15] unified field theory view that energy of whatever form represents a curvature in spacetime (ST). We argue that how we then observe or "see" the energy effects and label them, depends on the factors of physical interaction with that ST curvature. Thus interaction with magnetic charge produces magnetic energy aspects, while interaction with electrical charge produces electrical energy aspects, and so on. Motion of either of the interactions lets us also "see" some of the magnetic energy as electrical energy, and some of the electrical energy as magnetic energy, and so on. Quoting from Evans [42]:

> With respect to O(3): In 1992 it was shown that there exists a longitudinal component of free space electromagnetism, a component which is phaseless and propagates with the transverse components. Later this was developed into a Yang-Mills theory of electromagnetism with O(3) Lagrangian symmetry. This theory is homomorphic with Barrett's SU(2) electrodynamics and has far reaching implications in field theory in general. Recently it has been recognized to be a sub theory of the Sachs theory of electromagnetism, based on the irreducible representations of the Einstein group of general relativity. The Sachs theory produces a non-Abelian structure for the electromagnetic field tensor. The O(3) electromagnetism also has implications for the potential ability of extracting energy from the vacuum, and its topological implications are currently being investigated by Ranada. The O(3) electromagnetism has been tested extensively against empirical data, and succeeds in describing interferometric effects and physical optical effects where the conventional Maxwell Heaviside theory fails. Implicit in both the O(3) and Sachs theories of electromagnetism is the ability to extract electromagnetic energy from curved space-time.

However, when $\mathbf{A}_L$ interacts with electrical charge, the charge may swirl, in which case the swirling component of the ϕ moving with the charge is an $\mathbf{A}_C$ component, and this $\mathbf{A}_C$ swirling component will produce a magnetic field $\mathbf{B}$ by identity (3).

In the unified field theory approach being used [41–45] in spacetime all energy is simply a special curvature of that spacetime, regardless of the form of the energy. (This is believed to resolve the foundations issue pointed out by Feynman [46]: "It is important to realize that in physics today, we have no

[15] Sach provides a great generalization of general relativity and electrodynamics reaching from the quarks and gluons to the entire universe. O(3) electrodynamics forms a very important subset of Sachs' theory, which means that general relativistic effects such as curved spacetime and EM energy from the curved spacetime vacuum can be engineered electromagnetically. The present invention does engineer curved spacetime to obtain excess energy from the active vacuum.

knowledge of what energy *is*." In Feynman's view, energy is a curvature of spacetime, and the "form" of the energy observed is determined by the type of material interaction that occurs with ST curvature.) Hence one can readily visualize the energy being changed from a vector potential to a scalar potential and vice versa, depending simply on whether the potential is moving or stationary with respect to the frame of the observer (the laboratory frame).

It is also a well-known facet of general relativity that any change of energy density in spacetime a priori is associated with a curvature of spacetime (i.e., in Einstein's theory with the single exception or gravitational field energy, and even that exclusion has been challenged [47]; more recent experiments tend to support Yilmaz' predictions over those of the unaltered Einstein Theory). What has been neglected in general relativity (and arbitrarily discarded in electromagnetic theory long before general relativity was born) is the enormous *unaccounted* nondiverged EM energy flow filling the space around every EM circuit [40] — and in fact around every field and charge interaction[16] — with almost all of it missing the circuit entirely, and not being intercepted and diverged into the circuit to power it.

This nonintercepted huge energy flow was recognized by Heaviside [48–50],[17] not even considered by Poynting [51],[18] and arbitrarily discarded by Lorentz [52][19] as having "no physical significance" because it did not strike the

[16] Consider carefully the implication that the so-called "magnitude of the field" at a point has been defined as the magnitude of the result of the interaction of the field with a unit static point charge. In other words, the *effect* of the field has been erroneously defined as the causative *field itself*, a nonsequitur. The effect cannot be the cause.

[17] Heaviside's paper on the forces, stresses, and fluxes of energy in the EM field [48] followed previous publications several years earlier by Heaviside, including papers in *The Electrician*, beginning in 1885. Here Heaviside also credits Poynting with first discovering EM energy flow in space. On the other hand, Poynting credited Heaviside with being first; for instance, see editorial on energy transfer [49] in *The Electrician*.

[18] Poynting, in his paper on energy transfer in the EM field, got the direction of the flow wrong, which was later corrected by Heaviside. Further, Poynting considered only that very minor component of energy flow surrounding the circuit that actually strikes the circuit and enters it to power it. The enormous additional energy flow which is present but misses the circuit entirely and is usually wasted, was not considered by Poynting at all.

[19] Figure 25 on p. 185 of Ref. 52 (on EM field energy) shows the Lorentz concept of integrating the energy flow vector around a closed cylindrical surface surrounding a volumetric element. This is the procedure that arbitrarily selects only a small component of the energy flow associated with a circuit—specifically, the small Poynting component striking the surface charges and being diverged into the circuit to power it—and then treats that tiny component as the "entire" energy flow. Thereby Lorentz arbitrarily discarded all the vast Heaviside energy transport component, which does not strike the circuit at all, and is merely wasted.

circuit and power any part of it.[20] It is still arbitrarily discarded today, using Lorentz's discard method. We quote from Heaviside [50, p. 94]:

> It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire .... Prof. Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. The departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire.

Also, it is still largely unrecognized in Western science that pure general relativity contains no energy conservation equations [53,54][21] of the kind encountered in electrodynamics and mechanics. This is easily seen by considering the impact of gauge freedom, which allows the potential energy of any region of spacetime to be *freely* changed at will. But this is also a form of freedom of spacetime curvature, hence the notion of *fixed* accountability of energy replenishment and dissipation is completely voided by gauge freedom.

Hilbert [54] first pointed out this remarkable absence of energy conservation laws from general relativity, not long after Einstein published his theory.

It also appears that the ultimate energy interaction is the transduction of energy form between the time domain (complex plane) and 3-space. In fact, *all 3-spatial EM energy actually comes from time-like EM energy currents after 3-symmetry breaking* [1,16,20].

C. Indefiniteness Is Associated with the A Potential

A magnetic vector potential **A** produced by a current-carrying coil not tightly wound or closed (or very long), must possess both a swirl component $\mathbf{A}_C$ (from

[20] This is rather like discarding all the wind on the ocean except for that tiny component of it that strikes the sails of one's own sailboat. It is true that the wind missing one's own boat has no further significance for that one boat, but it may, of course, be captured in the sails of an entire fleet of additional sailing vessels to power them quite nicely. Hence the statement of "no physical significance" is a nonsequitur; "no physical significance to that one specific circuit" is better—but even then is incorrect if additional "sails" (interceptors) are added to catch more of the available energy wind and diverge more of it into the circuit.

[21] Quoting from Hilbert [54]: "I assert ... that for the general theory of relativity, i.e., in the case of general invariance of the Hamiltonian function, energy equations ... corresponding to the energy equations in orthogonally invariant theories do not exist at all. I could even take this circumstance as the characteristic feature of the general theory of relativity." As Logunov and Loskutov [53] pointed out, unfortunately this remark of Hilbert was evidently not understood by his contemporaries, since neither Einstein himself nor other physicists recognized the fact that in general relativity conservation laws for energy, momentum, and angular momentum are, in principle, impossible.

the circling of the coil in each turn of the coil) and a longitudinal component $\mathbf{A}_L$ from the longitudinal advance of the current between coils, since a coil is actually a helix and not a set of circles. It will also possess a magnetic field, both inside the coil and outside it.

Hence, considering both curled and curl-free types, the actual magnitude of **A** is always indefinite—and, in fact, the indefinite nature of the potential together with the freedom to change it at will is universally recognized by electrodynamicists [55] (see also Section V.C.1).[22] However, the prevailing argument that change of potential does not affect the system is a nonsequitur.

Further, in 1904 Whittaker [56] (see also Section V.C.2) showed that any electromagnetic field, wave, etc. can be replaced by two scalar potential functions, thus initiating that branch of electrodynamics called *superpotential theory* [58]. Whittaker's two scalar potentials were then extended by electrodynamicists such as Bromwich [59], Debye [60], Nisbet [61], and McCrea [62] and shown to be part of vector superpotentials [58], and hence connected with **A**.

1. Jackson's Studies on EM Potential

In symmetrically regauging the Heaviside–Maxwell equations, electrodynamicists and gauge field theorists assume that the potential energy of any EM system can be freely changed at will (i.e., that the system can first be asymmetrically regauged, due to the principle of gauge freedom). The symmetric regauging actually consists in two asymmetric regaugings carefully chosen so that the net forcefield [electromotive force (EMF)]—available for excitation discharge of the excited system—is zero. In circuits, this means that the back EMF (across the source dipole) is precisely equal and antiphased to the forward emf (across the external circuit with its loads and losses). Jackson's book does not even address circuits.

For operating EM systems, their initial potentialization (application of potential to the system to increase its potential energy available for further discharge) is asymmetric a priori and universally used. Gauge field theory and its assumption of gauge freedom assures us of the validity of this theoretically work-free process of increasing the energy of the system. In real systems, a little switching cost or other expenditure may be required, but is minuscule in relation to the amount of extra potential energy that can be generated in the system at will.

[22] On p. 67 of their paper on Lorentz-invariant potentials and the nonrelativistic limit, Bloch and Crater [57] state: "[It is usually] ... assumed that the magnitude of potential energy is irrelevant, being arbitrary to the extent of an additive constant." We comment: by noting that this "standard" assumption in classical electrodynamics is totally wrong, particularly when one considers (1) conservation of energy and (2) gravitational effects. We have previously nominated this arbitrarily discarded extra potential energy as a solution to the "dark matter" problem in astrophysics, and as being responsible for the extra gravity holding together the arms of the distant spiral galaxies; see Ref. 40.

As shown by Jackson [55], for the conventional EM model electrodynamicists actually select only a subset of the Maxwellian systems and deliberately discard the remaining Maxwellian subset. Following Lorentz, the electrodynamicists arbitrarily select *two* asymmetric regaugings but precisely such that none of the initial excess regauging energy—freely received in the system by its potentialization—can subsequently be dissipated to power loads without equally destroying the system potentialization represented by the source dipole. This inanity occurs because the *net force* is deliberately brought to zero, thus consisting of equal forward and backward EMFs—or MMFs in a magnetic circuit. This custom produces much simpler equations for that remaining *simpler* subset of Maxwellian systems that are in equilibrium in their exchange with the active vacuum during their dissipation of the free regauging energy.

Hence, for more than a century it has been "customary" to *arbitrarily* discard all Maxwellian systems and subsystems that would *asymmetrically* regauge themselves during the discharge of their initial free excitation energy. This arbitrary, self-imposed condition is neither a law of nature nor a law of electrodynamics or thermodynamics. It is purely arbitrary and imposed by system design. It assumes that half the gauge freedom's excess potential energy be dissipated internally (against the source dipole's back EMF) to destroy any further energetic activity of the system by destroying the source dipolarity (any excess potential on the system, and hence any excess potential energy).

The remaining half of the initial free gauge excitation energy is dissipated *usefully* in the system's external loads and losses. This means that this remaining half of the excitation energy is dissipated *detrimentally* by the system to destroy its own energetic operation. Since any real system has losses, the net result is that *half* the gauge freedom potential energy of the excited system is used to destroy the source dipole itself and all potentialization of the system, and *less than half* is used to power the loads. Since it requires as much additional energy to restore the source dipole as it required to destroy it, the operator then must furnish more energy to provide for continually restoring the dipole than the system *permits* to be dissipated in the external loads.

The set of Maxwellian systems arbitrarily discarded by the ubiquitous Lorentz regauging are precisely those open dissipative Maxwellian systems not in thermodynamic equilibrium in their vacuum exchange. Those are precisely the Maxwellian systems that *do not* forcibly and symmetrically regauge themselves in accord with the Lorentz condition during their excitation discharge. Those *arbitrarily discarded* Maxwellian systems are thereby free to dissipate their gauge freedom initial "free excitation" energy primarily in the external loads and losses, with much less being dissipated in the source dipole to destroy it.

The performance of the *arbitrarily discarded* asymmetrically regauging Maxwellian systems is described by the thermodynamics of an open dissipative

system not in equilibrium with its active environment, rather than by classical equilibrium thermodynamics. As is well known in the thermodynamics of such systems (for which Prigogine received a Nobel Prize in 1977), such an open dissipative system is permitted to (1) self-order, (2) self-oscillate or self-rotate, (3) output more energy (e.g., to do useful work) than the operator must input (the excess energy is freely received from the external environment, in this case the active vacuum), (4) power itself and its load(s) simultaneously (all the energy is freely received from the external environment, in this case the active vacuum), and (5) exhibit negentropy.

That our normal EM power systems do not exhibit COP > 1.0 is purely a matter of the arbitrary design of the systems. They are all designed with closed current loop circuits, which can readily be shown to apply the Lorentz symmetric regauging condition during their excitation discharge in the load. Hence all such systems — so long as the current in the loop is unitary (its charge carriers have the same m/q ratio) — can exhibit only COP < 1.0 for a system with internal losses, or COP $= 1.0$ for a superconductive system with no internal losses.

2. *Whittaker's Studies on EM Potential*

Whittaker's groundbreaking paper [56] was published in 1904 and orally delivered in 1903. Whittaker shows that all EM fields, potentials, and waves consist of two scalar EM potential functions. Whittaker's method is well known in the treatment of transverse electric and transverse magnetic modes of a cylindrical cavity or a waveguide. The Debye potentials and the Bromwich potentials are essentially radial components of the vector potentials of which Whittaker potentials are the real parts. Our further comment is that, since each of the scalar potentials used for the Whittaker functions has an internal Whittaker 1903 giant negentropic substructure and dynamics, then all present EM waves, fields, and potentials have — and are composed of — vast internal longitudinal EM wave structures and dynamics, and these have been almost entirely neglected in Western electrodynamics. The ''internal'' or ''infolded'' structures and dynamics inside normal EM fields, waves, and potentials can be engineered, and this area has startling implications to all of science, particularly to medical science. Discussion of this ''infolded'' electrodynamics is beyond the scope of this chapter.

D. Applying the Giant Negentropy Mechanism

So let us consider the **A**-potential most simply as being replaced with such a Whittaker [1,56] decomposition. Then each of these scalar potentials — from which the **A** potential function is made — is decomposable into a set of harmonic phase conjugate wavepairs (of longitudinal EM waves). If one takes all the phase conjugate half-set, those phase conjugate waves are converging on

each point in the magnetic vector potential **A** from the imaginary plane (from the time domain). At that same point in **A**, the other waveset—composed of the harmonic set of longitudinal EM waves in 3-space—is outgoing. The 4-conservation of EM energy requires that the incoming energy to the point from the complex plane is being transformed at the point (by the assumed unit point charge at that point) into real EM 3-space energy, and radiating outward from that point as real EM energy, in this case in the form of the magnetic vector potential **A** without curl since the curl operator is absent.

We have previously pointed out [16,20] that this energy flow input from the complex plane to every point in the potential, with its output in real 3-space, is a more fundamental symmetry than is the usually assumed 3-symmetry in EM energy flow in 3-space. Further, it is a giant negentropy and a continuous, sustained reordering of a fraction of the vacuum energy, and the reordering continues to expand in space at light speed so long as the source dipole for the potential exists.

So the **A** potential—in either of its components $\mathbf{A}_L$ or $\mathbf{A}_C$—is not to be thought of as having "fixed energy" since it consists of and identically is a myriad energy flow processes ongoing between the time–energy domain (the complex plane) and the real energy domain (real 3-space).

As is any potential including the electrostatic scalar potential ϕ between the poles of an electric dipole and the magnetostatic scalar potential Φ between the poles of a permanent magnet, the **A** potential is an ongoing set of longitudinal EM energy flows between the time domain (imaginary plane) and real 3-space [1,16,20].

We stress that the EM energy flows constituting the so-called scalar potential and all vector potentials violate 3-flow symmetry in energy conservation, but rigorously obey 4-flow symmetry. There is no law of nature that requires that energy be conserved in 3-space! If we work in 4-space as is normal, then the laws of nature require that energy be conserved in 4-space, as is done by the potential. Imposing the arbitrary additional requirement of 3-flow energy conservation imposes a 3-symmetry restoring operation that destroys or nullifies the giant negentropy 4-process[23] of the dipole [16] and results in system 3-equilibrium with the active vacuum. It results in design and production of electrical power systems exhibiting only COP < 1.0. The ubiquitous closed current loop circuit design produces a circuit that deliberately (albeit unwittingly) reimposes the 3-flow symmetry, kills the dipole and the giant

[23] Which, in turn, destroys the ability of any observable to exist (in time). An observable is a priori a 3-space fragment of an ongoing 4-space interaction, torn out at one frozen moment of time. The fact that observables do not persist in time has a profound impact on the foundations of physics, but its implications remain to be explored. A major impact is that physicists have missed the mechanism that generates the "flow of a mass through time." Discussion of that mechanism is beyond the scope of this chapter.

negentropy process, requires at least as much continuous input energy by the operator as was utilized to kill the dipole, and has generated the gigantic burning of hydrocarbons and the pollution of the biosphere.

E. A Negative-Resistance Process

Because of its giant negentropy process [1,16,20], any potential—and even any vanishingly small but finite region of it—is an open EM energy flow system, freely receiving energy from the complex plane in its active vacuum environment, transducing that received reactive power (in electrical engineering terms) into real power, and outputting real EM energy flow in space in all directions at the speed of light [16,20]. An ordering of the local vacuum results from that action.

The vacuum–dipole energy exchange process is negentropic, since there exists total 1 : 1 correlation between the inflowing longitudinal EM waves in the complex plane and the outflowing EM waves in real 3-space [1,16,20]. The potential then may rigorously be regarded as a novel kind of *negative resistor*,[24] constituting an automatic ongoing negative-resistance process. By *negative resistance process* we mean that each spatial point (and its mathematical neighborhood of immediately surrounding points) occupied by the potential continuously

1. Receives EM energy in unusable form (in the form of longitudinal EM waves input from the complex plane, which is the continuous receipt of reactive power)
2. Transduces the absorbed or received energy into usable form (real energy in 3-space)
3. Outputs the received and transduced EM energy as usable EM energy flow in 3-space

Thus, associated with and contained in any potential and any dipolarity—including the dipolarity of a permanent magnet—we have a novel, free source of EM energy from the vacuum's complex plane (reactive power input, in electrical engineering terms, with real power output). That is true whenever we have a potential of any kind, either $\mathbf{A}$ or ϕ, or a dipole of any kind, either electrical or magnetic, or a polarization. Further, any energy that we divert (collect)

[24] We define a *negative resistor* as any component or function or process that receives energy in unusable or disordered form and outputs that energy in usable, ordered form, where that is the *net* function performed. We specifically do not include "differential" negative resistors such as the tunnel diode, thyristor, and magnetron, which dissipate and disorder more energy overall than they reorder in their "negative resistance" regimes. Also, we extend the definition to 4-space, to include input of energy from the time domain to the negative resistor entity, and output of the energy in 3-space.

from this potential by and on intercepting charges, and hold in the localized vicinity of the charge, is an energetic excitation of the perturbing charges.

F. Modeling the Transduction Mechanism

Charges can be thought of as rotating 720° in one "full rotation," that is, 360° rotation in the complex plane followed by 360° rotation in real 3-space. The charges in the source dipole thus absorb the incoming reactive power while rotating in complex space and are excited therein, then reradiate this absorbed EM excitation energy in real 3-space during their subsequent 360° rotation in that 3-space. Further, all the energy diverted from the energy flows representing the potential, is immediately replenished by the vacuum to the source dipole, by the stated giant negentropy mechanism [16,20].

G. Replenishment via Giant Negentropy

It follows that we may collect energy from an **A** potential of a permanent magnet by applying the curl operator to **A**, then withdrawing and holding the resulting $\mathbf{B} = \nabla \times \mathbf{A}$ magnetic field energy in a localized material flux path. That is the withdrawal of $\mathbf{A}_C$ energy from the overall **A** potential in space, which is the withdrawal of $\mathbf{A}_C$ energy from the magnetostatic potential outflow dynamics between the poles of the magnetic dipole of the permanent magnet. This withdrawal and sharp path localization of the $\mathbf{A}_C$ energy from the permanent-magnet dipole's outpouring **A**-potential energy will be continuously replaced at light speed by the giant negentropy process [1,16,20] engendered in 4-space by the magnetic dipole of the permanent magnet. Hence an unlimited amount of energy may be withdrawn from the **A** potential in space around the magnet in this fashion, and the withdrawn energy will be continuously replaced at light speed from the active vacuum via the giant negentropy process. In real systems, the materials and components will impose physical limits so that only a finite amount of excess energy flow can be accomplished, but in real materials these limits still permit system $\mathrm{COP} \gg 1.0$ [40].

The foregoing discussion shows that, in a magnetic apparatus or process functioning as part of an overall electromagnetic power system, we may have one subprocess that continuously withdraws energy from the curled portion of **A** (i.e., holds and localizes the magnetic field **B** and confines it to a given path), and in that case the source (in this case the permanent magnet) of the **A** potential will simply replenish—at light speed—all the **A** energy that was withdrawn and localized. The replenished **A** energy will not be localized, since under a given set of conditions only so much energy is withdrawn and held in the localized condition.

The principle is that, as energy is drawn from the vector potential and then contained and circulated in field form in a localized material region or path, the withdrawn **A**-potential energy in space outside that localized path is continually

replenished from the permanent magnet dipolarity to the space surrounding the localized **B**-field energy path as the real EM energy flow output of the giant negentropy process [16,20] engendered by the magnet dipole. Further, the energy drawn from the permanent-magnet dipolarity is continually replenished from the surrounding vacuum by the input EM energy flow to the magnet dipolarity from the vacuum's complex plane in the ongoing giant negentropy process [1,16,20].

H. Regauging Can Be Negentropic or Entropic

Any increase or decrease of energy in the apparatus and process in the local spacetime constitutes (1) self-regauging by the process, whereby the process freely increases the potential energy of the system utilizing the process; and (2) concomitant curvature of spacetime and increase in that spacetime curvature because of the increase of local energy in the system process.

From the standpoint of gauge field theory, free asymmetric regauging is permitted by gauge freedom and is rigorously allowed, in effect allowing the violation of classical equilibrium thermodynamics because the regauged system freely receives EM energy from an external active source, the active vacuum's complex plane in the evoked giant negentropy process.[25] From the standpoint of general relativity, the excess energy from spacetime is freely allowed, since all EM energy moves in curved spacetime [33,36,37,41–43,45,63] a priori, and simple conservation of EM energy as usually stated in classical equilibrium electrodynamics need not apply in a general relativistic situation [53,54].

I. Use of a Nanocrystalline "Energy-Converting" Material

A nanocrystalline material recently available on the commercial market was found and utilized in this process. When utilized as a closed flux path external to and closed on the two poles of a permanent magnet, the special nanocrystalline

[25] It may be that we are *defining* the causative mechanism for gauge freedom itself as being pure entropy (energy dissipation by disordering) or pure negentropy (energy increase by reordering), but we defer to the advanced theoreticians to determine the truth or falsity of such a question. If one considers Whittaker's process [1] in either direction (i.e., energy freely entering 3-space by exiting from the time domain, and energy freely entering the time domain by exiting from 3-space), the conjecture may have merit. At any rate, it appears that all 3-spatial EM energy comes from the time domain (from *ict*) in the first place. It would appear that a more rigorous reexamination of the fundamental concept of energy propagation "in 3-space" should be accomplished. To first order, it appears that what propagates from the source charge (or source dipole) is the process whereby time energy converted into EM energy in 3-space. Apparently both the time energy cause and the 3-space EM energy effect are propagating in iterative quantum form. If so, this perfectly corresponds to F. Mandl and G. Shaw, *Quantum Field Thory*, Wiley, 1984, "Convariant Quantization of the Photon Propagator" in Chapter 5. Mandl and Shaw argue that the longitudinal and scalar polarizations of the photon are not directly observable, but only in combination, where they manifest as the "instantaneous" Coulomb (i.e., electrostatic) potential. Their argument, translated from particle terminology to wave terminology, directly fits my re-interpretation of Whittaker's 1903 decomposition of the scalar potential.

material will contain all the $\mathbf{B} = \nabla \times \mathbf{A}$ field energy (curled potential energy) in the closed flux path containing the magnet itself, while the magnetic dipole of the permanent magnet continuously replenishes and maintains the external circulation of field-free **A**-potential energy filling the space around the nanocrystalline closed flux path containing the withdrawn magnetic field energy.

This performance can, in fact, be measured, since magnetic field detectors detect little or no magnetic field surrounding the flux path (or even around the magnet in the flux path at an inch or two away from it), and yet coils placed in the spatial flux path outside the core interact with the field-free **A** potential that is still there. A coil placed around the flux path so that the flux path constitutes its core, interacts with both the field-free **A** potential outside the material flux path core, and simultaneously—via the magnetic field inside the coil—with the magnetic field flux energy inside the core.

J. Dual Interactions with Pingponging between Them

Further, the two simultaneous interactions also *iteratively* interact with each other, in a kind of iterative retroreflection and interception of additional energy, so that a net amplification of the electrical energy output by the dually interacting coil results. The fact that iterative retroreflection processes can increase the energy collection from a given potential and enable COP > 1.0 has been previously pointed out [28]. In addition, multiple coils placed around the closed material flux path, forming a common core of each and all of them, all exhibit such gains and also mutual interaction with each other, leading to further gain in the energy output by the coils and their interaction processes.

In short, the novel process of this invention takes advantage of the previously unrecognized giant negentropy process [1,16,20] ongoing to and from the permanent magnet's dipole and between the complex plane of the vacuum energy and real 3-space energy flows constituting the magnetic vector potential and the magnetostatic scalar potential, to provide a gain in the total amount of electromagnetic energy being diverted from (drawn from) the permanent magnet by the attached circuit, components, and their processes.

The total collectable energy now drawn from the magnet is the sum of (1) the magnetic field energy (curled **A**-potential energy) flowing in the flux path, (2) the magnetic energy in the uncurled **A**-potential energy flowing in the surrounding space, (3) a further iterative ''pingpong'' gain component of energy caused by mutual and iterative interactions [28] of the multiple coils and their multiply interacting processes, and (4) additional energy that can be intercepted and diverged (collected) from the flowing uncurled **A**-potential energy flowing in the surrounding space, and converted into output electrical energy as the outputs of coils, by simply adding additional interceptors (separate receiving circuits with loads.).

We have thus discovered a process for amplifying the circuit's *available* output energy extracted from a permanent magnet dipole's energy outflow,

where the dipolarity is an open system and a negative resistor, freely receiving excess energy from the surrounding active vacuum, transducing the received energy into usable form, and outputting the energy as a continuous flow of usable excess electromagnetic energy. Thereby, additional energy may be intercepted in a system employing this process, and the process can be used in practical EM power systems and EM power system processes having COP > 1.0 when used in open-loop mode, and self-powering when used in closed-loop mode.

Further, we may utilize a collector or interceptor (such as a common coil wound around the flux path through it so that said flux path constitutes a core) that interacts with both available components of energy flow and with iterative interactions mutually between the two basic interactions. Each turn of the coil constitutes a $\nabla\times$ operator, bathed by the flowing uncurled **A** potential outside the line material. Hence the charges in the coil intercept the uncurled **A** flow, and curl the energy intercepted to produce a curled **A** flow, thus producing additional magnetic field $\mathbf{B} = \nabla \times \mathbf{A}$. This magnetic field is at its maximum in the exact center of the coil, which is in the exact center of the nanocrystalline core material with its retained $\mathbf{B} = \nabla \times \mathbf{A}$ field energy. Hence the coil interacts with two components of energy flow, because (1) the internal $\mathbf{B} = \nabla \times \mathbf{A}$ field energy is retained in the nanocrystalline material in the coil's core, (2) the external uncurled **A**-potential energy flow striking its outside surface charges and changed into additional magnetic field energy and into additional electrical current flowing in the coil and out of it, and (3) in addition, iterative mutual interaction between the two basic interactions also occurs, increasing the energy gain and the coefficient of performance.

Any additional EM energy input into the core material and flux path increases the $\mathbf{B} = \nabla \times \mathbf{A}$ field energy flowing in the flux path, hence withdrawn from the vector potential **A** around the flux path, hence replenished from the permanent magnet dipole, and hence replenished to the magnet dipole from the complex plane, via the giant negentropy process [16,20]. This increased energy collection in the magnetic flux in the core material passes back through the permanent magnet (which is in the path loop and completes it), momentarily altering the effective pole strength of the magnet and thereby increasing the magnitude of the giant negentropy process associated with said dipole of the permanent magnet. In turn, this increases the outflow of **A** energy from the magnetic dipole, increasing both its output $\mathbf{B} = \nabla \times \mathbf{A}$ field energy in the flux path and its output uncurled **A**-flow energy in space outside the flux path. This further increases the spacetime curvature of the local space surrounding the flux path material, since the energy density of said local spacetime has increased.

K. Varying the Pole Strength of a Permanent Magnet

Hence the process is the first known process that deliberately and interactively alters the pole strengths of the poles of a permanent magnet, utilizing

the momentary alteration to vary and increase the pole strength and hence the magnitude of the energy density flowing in the giant negentropy mechanism [16,20]. From the general relativity view, it is the first known process that deliberately increases and structures the local curvature of spacetime, by electromagnetic means, so as to momentarily alter and increase the pole strength of a permanent magnet, using the pole strength alteration to increase the flow of energy into and out of the local spacetime, thereby increasing the curvature of the local spacetime and the resulting EM energy extracted therefrom.

Any extra uncurled **A**-flow energy increase outside the nanocrystalline flux path material increases the interaction with this field-free **A**-flow energy of any coil around the flux path, thereby increasing the magnetic **B**-field flux inside the flux path, and so on.

L. Regenerative Energy Gain

In short, the mutual iterative interaction of each coil wound on the flux path of the special nanocrystalline material, with and between the two energy flows, results in special kinds of regenerative energy feedback and energy feedforward, and regauging of the energy of the system and the energy of the system process. This excess energy in the system and in the system process is thus a form of free and asymmetric self-regauging, permitted by the well-known gauge freedom of quantum field theory. Further, the excess energy drawn from the permanent-magnet dipole is continually replenished from the active vacuum by the stated giant negentropy process [1,16,20] associated with the permanent magnet's magnetic dipole due to its broken 3-symmetry [18] in its energetic exchange with the vacuum.

As a result, each coil utilized is an amplifying coil containing an amplifying regenerative process, compared to a normal coil in a normal flux path that does not hold localized the $\mathbf{B} = \nabla \times \mathbf{A}$ field energy within its core material, and does not simultaneously interact with both internal **B**-field flux energy and external excess field-free **A**-potential.

M. Open System far from Equilibrium, Multiple Subprocesses, and Curved Spacetime

The entire system process is thus a self-regauging regenerative system process and an energy-amplifying system process, where the excess energy is freely furnished from the local curved spacetime as energy flows from the magnetic dipole of the permanent magnet and, in turn, is freely replenished to the permanent-magnet dipole by the giant negentropy process established in the active vacuum environment by the broken 3-symmetry of said magnetic dipole [18] and the concomitant locally curved spacetime.

The system process is thus an open electromagnetic process far from thermodynamic equilibrium [2–4] in its active environment (the active

vacuum), freely receiving excess energy from said active environment via the broken 3-equilibrium of the permanent-magnet dipole. Each coil is an open system freely receiving excess energy from its active environment (the active field-free **A** potential flowing through the space occupied by the coil and surrounding it), and creating a local curved spacetime by its extra energy density, while also receiving energy from its internal environment, the **B**-field magnetic flux in the material flux path through the center of the coil and making up its core, and also curving the local spacetime by means of the extra energy density of the local spacetime.

The system process is also a general relativistic process [33,36,37,41,45,63] whereby electromagnetic energy is utilized to curve local spacetime, and then the locally curved spacetime continuously acts back on the system and process by furnishing excess energy to the system and process directly from the curved spacetime; the excess energy is continually input to the system from the imaginary plane (time domain) [1,16,20].

VI. SUMMARY OF THE PROCESS FROM VARIOUS ASPECTS

We summarize the many aspects of the overall process as follows, taking advantage of the following facts:

1. The magnetic flux and magnetic vector potential **A** are freely and continuously furnished by a permanent magnet to a material flux path, where the material flux path holds all curled vector potential **A** and thus all magnetic field inside the flux path, and where the permanent magnet freely furnishes additional field-free magnetic vector potential **A** to replenish the **B**-field (curled magnetic vector potential **A**) energy that was confined to the interior of the material flux path, and where multiple intercepting coils and processes are utilized with mutual iterative positive feedforward and positive feedback between the collectors and subprocesses to increase the energy collected and hence increase the COP of the system and system process.

2. A previously unrecognized giant negentropy mechanism is used as shown unwittingly by Whittaker [1] in 1903, recognized by Bearden [16] and further clarified by Evans and Bearden [20], and the active vacuum continuously replenishes all magnetic vector potential **A** (both curled and field-free) that is continuously output by the permanent magnet into the material flux path and into space surrounding the material flux path. Further, the replenishment energy flow from the active vacuum is from the time domain [1,16,20] and thus from the complex plane, constituting the continuous input of reactive power by the active vacuum environment via time-like energy flows. These time-like potentials and energy flows are known in extended electrodynamics [26,27,29,32,33, 36,37,63–65] but were not previously deliberately utilized in electromagnetic

systems, particularly in EM power systems, even though shown by Whittaker [1] as early as 1903.

3. The field-free magnetic vector potential **A** is continually replenished and remains (with replenishment by the vacuum to the permanent-magnet dipole and thence replenishment from the magnet dipole to the space surrounding the material flux path) when a material flux path is utilized wherein the magnetic field associated with a permanent magnet's flux, through the flux path, is held internally and entirely in the material flux path, with the field-free magnetic vector potential **A** remaining in space surrounding the flux path.

4. A coil will interact with either a magnetic field (i.e., the curl of the **A** potential) or a changing **A** potential where no magnetic field (no curl) is present, or simultaneously with a combination of both a curled **A** potential (with magnetic field **B**) and a field-free **A** potential (without magnetic field **B**) if the two are separated. Indeed, there is a ''pingpong'' reiterative interaction between the two processes in the coil, constituting positive feedforward from each to the others, and positive feedback from each to the others.

5. A simultaneous interaction of a coil with both a magnetic field (curl of **A**) and a field-free **A** potential produces electromagnetic energy in the form of voltage and current in an external circuit connected to the coil, and the net voltage and amperage (power) produced by the coil is a result of the summation of both simultaneous but separated interactions with the coil and its Drude electrons and of the iterative ''pingpong'' interactions between the two simultaneous interactions, and therefore the summation provides a greater coil output energy than is produced by the coil from either the magnetic field (curled **A**) separately, or the field-free **A** potential separately, or from both when unseparated. Further, the ''pingpong'' iterative interaction adds additional energy collection and gain to the electrical power output of the coil.

6. Multiple coils are wound on the material flux path, where magnetic flux is input to the material flux path from a permanent magnet, and where the material flux path holds internally all curl of **A** (magnetic field) from the permanent magnet's flux, so that (a) magnetic field and magnetic flux from the permanent magnet are inside the closed material flux path, (b) no magnetic field is outside the closed material flux path, and (c) a field-free magnetic vector potential **A** replenishes the curled **A** potential held in the material flux path, and where the replenished field-free magnetic vector potential **A** occupies the space outside the material flux path and flows through the surrounding space.

7. A broken 3-space symmetry exists of a magnetic dipole [18] of a permanent magnet, well known in particle physics since 1957 but inexplicably not yet added into classical electrodynamics theory, wherein the broken symmetry of the magnetic dipole rigorously requires that the dipole continually absorb magnetic energy from the active vacuum in unusable form, and that the

broken symmetry output (reemit) the magnetic energy in usable form as real magnetic field energy in 3-space and real magnetic vector potential in 3-space. The receipt of unusable EM energy, transduction into usable form, and output of the usable EM energy, constitutes a true negative resistance process [16,20] resulting from the ongoing giant negentropy process engendered by the broken 3-symmetry of the magnetic dipole of the permanent magnet.

8. Whittaker's 1903 mathematical decomposition [1] of any scalar potential applies Whittaker decomposition to the magnetostatic scalar potential existing between the poles of the permanent magnet, revealing that the magnetostatic scalar potential of the permanent magnet is composed of a set of harmonic longitudinal EM wavepairs, where each wavepair consists of a longitudinal EM wave and its phase conjugate replica wave.

9. The incoming half-set of Whittaker decomposition waves consists of the phase conjugate waves, which are all in the imaginary plane [16,20] prior to interaction and continuously converging upon the magnetic charges of the permanent-magnet dipole at the speed of light. The incoming, converging longitudinal EM waves are continuously absorbed from the imaginary plane by the magnetic charges (magnetic poles), so that the permanent magnet dipole is continuously replenished with time-like energy flow from the active vacuum environment, while continuously transducing the received time-like energy into 3-spatial energy, and outpouring real EM energy flow in the form of the longitudinal EM Whittaker waves [1] emitted in 3-space in all directions.

10. The other half-set of the Whittaker decomposition waves, consisting of outgoing real EM Whittaker longitudinal waves [1] in 3-space, is continuously and freely emitted from the permanent-magnet dipole charges (poles) and continuously diverges outward in space in all directions from the permanent-magnet dipole at the speed of light. Thus there is revealed and used a process for a natural, continuous source of magnetic energy from the vacuum: a continuous EM wave energy flow convergence of electromagnetic energy from the vacuum to the magnetic dipole, but in the imaginary plane and hence constituting a continuous energy input in the form of imaginary power [16,20], In this process the absorbed magnetic energy is transduced into real power and reemitted in real 3-space in all directions, whereby the absorption of energy from the vacuum from the imaginary plane (time domain) is in 4-flow equilibrium with the re-emission of the absorbed energy in 3-space, but not in 3-flow equilibrium, and where the outgoing real magnetic energy provides the surrounding magnetic field and the surrounding magnetic vector potential of the permanent magnetic dipole.

11. In this manner the broken 3-symmetry of the magnetic dipole (permanent magnet) allows the dipole to continuously receive reactive power from the vacuum's time domain, transduce the reactive power into real EM power in 3-space, and reemit the absorbed energy as real magnetic energy pouring into

space and consisting of both a magnetic field and a magnetic vector potential. Thus the permanent magnet, together with its Whittaker-decomposed [1] magnetostatic scalar potential between its poles, represents a dynamo and an energy transducer, continuously and freely receiving energy from an external source (the active vacuum) in the complex plane and transducing the received complex plane EM energy into real EM energy [16,20], and radiating the real EM energy into real space as real EM power. EM energy flow conservation in 3-space is permissibly violated because of the broken 3-symmetry of the magnetic dipole, but EM energy flow in 4-space is not violated and is rigorously conserved. There is no law of nature requiring energy conservation in three dimensions and 3-space; instead, energy conservation is required by the laws of nature and physics in 4-space. The additional condition usually assumed—that energy conservation is also always conserved in 3-space—is not required by nature, physics, or thermodynamics, and the additional 3-conservation requirement is removed by this process in any dipole, by the broken 3-symmetry of the dipole. It is this newly recognized giant negentropy process advanced by Bearden [16] and extended by Evans and Bearden [20] that is directly utilized by this new power system process, in conjunction with directing and interacting material flux paths, intercepting coils, separation of curl of the **A** potential (i.e., the **B** field), and the field-free **A**-potential (replenished from the vacuum), and interaction of a coil with a magnetic field and magnetic flux running through a material core through the coil, and with an external field-free magnetic potential reacting with the coil. The foregoing actions provide a magnetic system that receives—via the permanent-magnet dipole—replenishment EM energy from the active vacuum to the dipole, and from the dipole to the circuit and the space surrounding it, to enable the permanent magnet to continuously furnish magnetic field and flux to a flux path in the process, and continuously furnish both the curl energy of the **A** potential and the field-free energy of the **A**—potential replenished from the vacuum. This system should also have multiple coils interacting simultaneously with both curled **A** potential and magnetic flux inside the coils, while also interacting simultaneously with field-free magnetic **A**-potential from the space in which the coil is embedded, such that excess energy is added to the interacting coils by dA/dt from the changing field-free **A**-potential in space, and where the field-free **A**-potential in space is continuously furnished by the permanent magnet dipole and the extra energy for the furnished field-free **A**-potential is continuously received by the permanent magnet dipole from the active vacuum exchange, via the process shown by Whittaker's decomposition [1] and elaborated by Bearden [16].

12. The difficulty heretofore experienced by designers, engineers, and scientists with using the magnetic energy continuously emitted to form the static field and magnetic scalar potential of a permanent magnet dipole is that all schemes for using the magnetic energy have relied on physical motion, energy input to

overcome the field of the permanent magnet, or other brute-force methods. This invention provides a new process for a coil to extract excess EM energy from the magnetic vector potential energy in space from the permanent magnet, while simultaneously interacting with the magnetic field energy of the permanent magnet flowing through a flux path through the center of the coil but not in space surrounding the flux path. The Whittaker decomposition shows that when the system extracts EM energy from the magnetic vector potential **A** and magnetostatic scalar potential Φ, the energy to continuously form and maintain the magnetic vector potential's vector current is continuously replenished from the vacuum by the convergent reactive EM power being input from the imaginary plane (time domain). Evans and Bearden [20] have also shown that, in the most general form of the vector potential deduced from the Sachs unified field theory [41], EM energy from the vacuum is given by the quaternion-valued canonical energy–momentum. Further, the most general form of the vector potential (i.e., flowing EM energy in vector potential form) has been shown by Evans and Bearden [20] to contain *longitudinal and time-like components* (*energy currents*), in agreement with the simpler Whittaker decomposition [1] as a special case, but much richer in available structure than Whittaker's decomposition. Evans and Bearden [20] have also shown that the scalar potential is in general a part of the quaternion-valued vector potential, and can be defined only through suitable choice of metric for a given experimental setup. They have shown the energy current in vacuum in this more advanced treatment in O(3) electrodynamics, and it is this demonstrated vacuum EM energy current that continuously replenishes any excess energy drawn from the permanent magnet dipole's magnetostatic scalar potential to replenish the curl of the **A** potential (the magnetic **B**-field energy) held inside the material flux path powered by the magnet and also to replenish the field-free **A**-potential filling space around the material flux path.

13. A special nanocrystalline material is contained in the closed flux path powered by the permanent magnet, where the nanocrystalline material performs the highly special function of separating and retaining the curl energy of the **A** potential (i.e., retaining the magnetic field energy) inside the material flux path along with the magnetic flux. The nanocrystalline material consists of coiled flat ''tape'' layers of material, with the layers acting in the fashion of a perfect toroid to retain all magnetic field (curled **A** potential) inside the material, while having the curl-free **A**-potential filling all space outside the nanocrystalline material.

14. This special nanocrystalline material may be further considered in the manner of a ''layered'' magnetic flux path material, wherein (a) the ''layers'' are a molecule in thickness; (b) essentially all eddy currents are eliminated or reduced to completely negligible magnitude; (c) as a result, the nanocrystalline material does not dissipate magnetic energy from the flux path; (d) as a result,

the nanocrystalline material does not produce eddy currents; (e) as a result, the nanocrystalline material does not exhibit heating since heat consists of scattered and dissipated energy; and (f) no such scattering or dissipating of the magnetic flux energy occurs in the nanocrystalline material. Thus the system process is able to process significant power and energy without heating of the core flux path material at all, and without requiring cooling of the core material, as these characteristics have a remarkable advantage over other core materials subject to eddy currents, substantial heating, and the need for cooling.

15. The magnetic flux from a permanent magnet provides a source of magnetic flux energy to and within the nanocrystalline material in a flux path, such that the nanocrystalline material holds the magnetic field component (curl energy of the vector potential **A**) in the flux path while the flux path material itself is not further interacting with the field-free magnetic vector potential and its energy that fill the space around the closed material flux path, and where the field-free magnetic vector potential—in space external to the material flux path—geometrically follows the directions and turns of the material flux path but outside it.

16. Any coil immersed in the nanocrystalline material's magnetic vector potential in space, but not wound around a portion of said nanocrystalline flux path, will react to the magnetic vector potential and its energy. Each turn of a coil acts as a curl operator, producing a magnetic field due to the received energy current from the magnetic vector potential. If an electrical current is passed through the coil, and if the magnetic flux produced by the electrical current in the coil is aligned with the magnetic flux that is produced by the coil's interaction with the magnetic vector potential from the nanocrystalline flux path material, then the two magnetic vector potentials will vectorially add, so that the magnetic field produced by the current through the coil will be augmented by the curl operation of the coil now acting on an increased magnetic vector potential summation consisting of the vector sum of the curled magnetic vector potential and the field-free magnetic vector potential.

17. Any time rate of change of a magnetic vector potential, either curled or curl-free, constitutes an electric field, which, in an interacting pulsed coil, produces pulsed voltage across the coil and pulsed current through the coil and produces current and power in a closed circuit loop consisting of the interacting coil and a connected external circuit. The excess magnetic energy is received by the circuit from the magnetic dipole of the permanent magnet (and replenished to the dipole from the time-like Whittaker energy currents from the active vacuum). The process transduces the excess magnetic energy into excess electrical energy, and outputs the excess electrical energy into electrical loads to power them, whereby the excess energy received and replenished from the active vacuum environment via the giant negentropy process of the permanent magnet dipole [16,20] allows system $\mathrm{COP} > 1.0$.

18. Further, with COP > 1.0, a fraction of the output electrical energy from the process and system can be extracted and positively fed back to the operator input of the system and process (such as the electrical energy fed to a driver coil), with governing and clamping control of the positive-feedback energy magnitude, so that the system process becomes self-powering, freely powering itself and its loads, receiving all the energy from an external energy source due to its broken symmetry in its vacuum exchange and the resulting giant negentropy process [16,20] thereof, and thus constituting an open system far from thermodynamic equilibrium with its active environment, easily self-regauging and powering itself and its load simultaneously by dissipation of energy freely received from its active environment.

19. The dual-action effect is increased in an interacting coil if the coil is wound around a portion of the nanocrystalline flux path, due to the permeability of the flux path as a magnetic core and the input of flux from the permanent magnet. In this case, the increased magnetic field produced inside the coil also interacts with the magnetic flux path core in its center, producing an increased change in the magnetic flux in the nanocrystalline material itself. The coil interacting in such dual fashion thus has *iterative* ''energy feedforward and feedback'' between the two simultaneous processes, one process proceeding outward from inside, and the other proceeding inward from outside. A convergent series of summing energy additions (regaugings) thereby occurs in the coil, thus producing *energy amplification* in the coil.

20. As a result of the combined actions listed above, the coil's energy output increases on receiving and transducing extra energy from the magnetic flux of the permanent magnet, the magnetic field of the permanent magnet, and an extra field-free magnetic potential $\mathbf{A}$ surrounding the flux path and continuously furnished by the permanent magnet. The production of one or more potentials is also the production of one or more regaugings. As is well known from electrodynamics and gauge field theory, gauge freedom is permitted freely and at will. In electrodynamics, regauging to change the potential of a system simultaneously changes (freely) the potential energy of the system. In the present process, this regauging is physically applied by (a) holding the curl of the $\mathbf{A}$ potential inside the special nanocrystalline flux path material, (b) furnishing additional field-free magnetic vector potential $\mathbf{A}$ from the permanent magnet dipole, and (c) continuously replenishing the potential and energy from the vacuum.

21. This process provides for a permissible gain in the magnetic energy output of the interacting coil(s) for a given amount of energy input by the (a) operator to the active coil (used similar to a ''primary'' coil in a transmitter) or (b) a clamped, governed positive energy feedback of a fraction of the energy output from one output coil back to the input coil. This additional magnetic field

energy output is retained in the nanocrystalline flux path, and the additional magnetic vector potential energy output moves through space surrounding the coil. The system process of the invention thus is a new process for energy amplification, with the excess output energy freely received from the vacuum and thence to the permanent-magnet dipole, and thence from the permanent magnet dipole to the other parts of the system, via the giant negentropy process associated with the magnet dipole as shown by Evans and Bearden [20] and Whittaker [1].

22. Every multiple coil wound around the special nanocrystalline material flux path will exhibit regauging energy gain by the processes described above, with the energy continuously replenished from the vacuum to the source dipole and from the source dipole to process, via the process illustrated by Whittaker decomposition.

23. Any scalar potential such as the magnetostatic scalar potential between the poles of a permanent magnet, and the magnetic vector potential considered as two scalar potential functions in the manner shown by Whittaker [56], are continually replenished energy flow processes [1,16], so that any system utilizing the output flow from the permanent-magnet dipole and containing such dipole, is an open system far from equilibrium in the replenishing vacuum flux, as shown by the Whittaker decomposition [1] and more precisely expanded by Evans and Bearden [20].

24. The entropy of any open system in disequilibrium with its vacuum environment is a priori less than the entropy of the same system in equilibrium, and, in fact, the entropy of such an open system cannot even be computed, as pointed out by Lindsay and Margenau [66][26] and as well known in physics.

25. This process, producing an open system in disequilibrium with a recognized continuous source of energy [2–4,16,20], is permitted to perform any of five functions: (a) self-order, (b) self-oscillate, (c) output more energy than the operator inputs (the excess energy is freely received from the active environment), (d) power itself and its loads and losses (all the energy is freely received from the active environment), and (e) exhibit negentropy. The process specified by this invention permits all five functions. For example, by extracting some of the output energy from an output section (coil) used in a system employing the process, and feeding the extracted energy back to the input section (coil), the energy gain of the system permits it to become self-oscillating

[26] When a system departs from equilibrium conditions, its entropy must *decrease*. Thus the energy of an open system not in equilibrium must always be greater than the energy of the same system when it is closed or in equilibrium, since the equilibrium state is the state of maximum entropy. Thus, broken 3-equilibrium is a broken 3-symmetry between the active vacuum and material systems, and it is a *negentropic* operation.

and hence self-powering, while obeying energy conservation, the laws of physics, and the laws of thermodynamics.

26. Multiple feedforward and feedback subloops exist between the various parts of a complete flux path loop and **A**-potential flow loop, so that regenerative energy collection gains are developed in the various subprocesses of the overall process. The result is an overall feedback summation and overall feedforward summation, whereby the system process regauges itself with **A**-potential flow energy from the magnetic dipole, and the regauged energy is continuously replenished and received from the active vacuum via the stated giant negentropy process. Increasing the number of interacting coils and/or increasing the magnetic flux results in an increase in the COP, limited only by the saturation limit of the core material.

27. The system process consists of a magnetic negative-resistor process, where energy is received freely in unusable form (pure reactive power from the time domain of the spacetime vacuum), transduced into usable form, and output in usable form as real EM energy flow in 3-space [1,16,20].

28. The system process is a permissible local energy gain process and a self-regauging process, freely increasing the process's and system's potential energy and receiving the regauging energy from the active vacuum via the giant negentropy process [16,20], and freely collecting and dissipating the excess regauging potential energy in loads.

29. The system process may be open-loop where the operator inputs some electrical energy and the system outputs more electrical energy than input by the operator; the excess energy is freely received from the permanent-magnet dipole and from the vacuum to it via the giant negentropy process [16,20], with process transductions of the various energy forms between magnetic form and electrical form.

30. The system process may be closed-loop and ''self-powering,'' where a portion of the amplified energy output is extracted, rigidly clamped in magnitude, and positively fed back to the input. This replaces the operator input entirely, and all energy input to the system process is received from the vacuum through the permanent magnet dipolarity's Whittaker decomposition and constituting direct system application of the stated giant negentropy process [16,20].

31. The system process is a magnetic regenerative gain process, outputting more energy than the operator personally inputs, with the excess energy received from the active vacuum via the broken 3-symmetry of the dipole which initiates and sustains the giant negentropy process [16,20], whereby EM energy continuously flows into the system from the complex plane (time domain), is transduced into usable magnetic energy in real 3-space, and is then transduced into ordinary electrical energy by the system process, thereby powering both the system and the loads.

32. In an embodiment using the process, all coils exhibit energy gain and increased performance, as does the overall system. All coils are energy amplifying coils, each with gain in energy output greater than 1.0 compared to the same coil without simultaneous but separate exposure to and interaction with separate inputs of field-free magnetic potential and magnetic field, and without iterative positive feedback between the two simultaneous interactions.

33. For power system processes, the combined process requires using at least one primary (active) coil in dual interaction with iterative feedback between the duals, and one secondary (passive) coil in dual interaction with iterative feedback between the duals, both on a common nanocrystalline flux path. The resulting ''minimum configuration'' embodiment produces a power system that is an open thermodynamic system, not in equilibrium with its external environmental energy source: to wit, the continuous inflow of EM energy from the complex plane of the active vacuum into the permanent magnet dipole, and the continuous outflow of real magnetic energy from the permanent magnet dipole, with the holding of the magnetic field energy and magnetic flux energy inside the nanocrystalline material in the closed magnetic flux path, and with excess field-free magnetic vector potential filling the surrounding space, as continuously furnished by the permanent-magnet dipole and continuously replenished to the dipole by the active vacuum as a result of the dipole's broken 3-symmetry in its vacuum energy exchange and the giant negentropy 4-space energy flow operation [16,20] initiated thereby.

34. This process permissibly violates 3-symmetry energy conservation, but rigorously obeys 4-symmetry energy conservation and thus it has not been applied in electrical power systems. The basic excess energy input is received from an unusual source: the complex plane (time domain) of the locally curved and active spacetime (vacuum), as shown by the Whittaker decomposition [1] of the permanent magnet's magnetostatic scalar potential between its poles, and as further demonstrated in several AIAS papers [20,36,37,64,65], and as recognized by Bearden [16] and investigated more deeply by Evans and Bearden [20]. The energy into the nanocrystalline flux path material is input directly from the permanent magnet as magnet flux energy. From its dual interaction with two magnetic energy components, the active (driving) coil produces increased magnetic field flux in its center and thus in its interaction with the magnetic flux path and the magnetic flux in the flux path, and also produces increased magnetic flux back through the permanent magnet dipole, thereby momentarily altering the pole strength of the permanent magnet, and also produces increased field-free **A** potential in space surrounding both the permanent magnet and the nanocrystalline flux path, and flowing geometrically in the direction taken by the nanocrystalline flux path. From its dual interaction with two magnetic vector potentials as well as two magnetic field components

superimposed, the passive (driven) coil produces increased EM field energy in the form of current and voltage out of the coil and into any conveniently attached external load for dissipation in the load by conventional means.

35. The process in this invention uses and applies an open system process for receiving excess energy from an external source (the permanent-magnet flux and **A** potentials), and since the permanent-magnet flux and **A** potentials are continuously replenished from the vacuum via the broken 3-symmetry of the magnet dipolarity via its Whittaker decomposition [1], the process is allowed to (a) be adapted in systems to produce COP > 1.0 and (b) be close-looped with clamped positive feedback from load output to input, so that the system powers itself and its load simultaneously.

36. The open system far from equilibrium process of this invention thus allows electromagnetic power systems to be developed that permissibly exhibit a coefficient of performance (COP) of COP > 1.0. It allows electromagnetic power systems to be developed that permissibly (a) power themselves and their loads and losses, (b) self-oscillate, and (c) exhibit negentropy.

37. No laws of physics or thermodynamics are violated in such open dissipative systems exhibiting increased COP and energy conservation laws are rigorously obeyed. Classical equilibrium thermodynamics does not apply and is permissibly violated. Instead, the thermodynamics of open systems far from thermodynamic equilibrium with their active environment—in this case the active environment-rigorously applies [2–4].

38. This appears to be the first magnetic process deliberately utilizing and separating special energy flow processes—associated in a curved spacetime with the permanent-magnet's dipolarity—to provide true magnetic energy amplification, receiving the excess energy freely from the permanent-magnet dipole, with said energy continually replenished to the dipole from the imaginary plane in spacetime by the giant negentropy process [16,20].

39. This appears to be the first power system process that in open-loop mode receives electrical energy input by the operator or outside normal source, wherein (a) the electrical energy input is transduced into magnetic energy flows, (b) curled **A**-potential flow (magnetic field energy flow) is separated from field-free **A**-potential flow, (c) dual and iterative ''pingpong'' interactions of energy feedforward and feedback occur in each active component, (d) the feedforward and feedback pingpong interactions create local energy gain in each active component, (e) the magnetic potential energy of the system is self-regauged and increased (receiving the excess by giant negentropy replenishment from the active vacuum), (f) the increased magnetic energy flow is then re-transduced into electrical energy and output to power loads, (g) the output energy powering the loads is greater than the input energy provided by the operator.

40. The foregoing system functions as described, where the system process positively feeds back a clamped fraction of its electrical output to its electrical input, result in a regenerative, energy amplifying, self-regauging open system process that powers itself and its loads, where the powering energy is freely received from the active vacuum curved spacetime via the giant negentropy process [1,16,20].

41. The process therefore appears to be the first process for an electrical power system that permissibly violates EM energy conservation in 3-space, due to the use of the recognized and proven broken 3-symmetry of the dipole [18], but while rigorously conserving electromagnetic energy in 4-space [16,20]. It therefore appears to be the first electrical power system process that enables the use of a clamped positive feedback from output to input in an electrical power system having $\mathrm{COP} > 1.0$ so that the system continuously receives all the energy—to power its loads and losses—from the magnetic energy flow of a permanent magnet, where the energy flow is continually replenished to the permanent magnet by the energy circulation from the imaginary plane (as absorbed reactive power) and transduced into real power output by the magnet's dipole, and where the freely received magnetic flux energy from the dipole is separated into field energy and magnetic vector potential energy.

42. This appears to be the first $\mathrm{COP} > 1.0$ electrical power system process that deliberately takes useful advantage of the fact that any amount of energy can be intercepted and collected from a potential, regardless of its magnitude, if sufficient intercepting charges (in this case, magnetic charges, or pole strengths) are utilized. In this case, coils utilized around the special nanocrystalline core material interact with the field-free magnetic vector potential filling the space occupied by the electron spins in the Drude electron gas in the coils, while simultaneously the produced magnetic field in the coil due to its curl operation interacts with the localized magnetic field flux in the nanocrystalline flux path and core, and vice versa. In this way, the energy interception and collection is effectively multiplied beyond what is obtained by a coil with a core operating in normal magnetic field coupled to its magnetic vector potential in space.

43. This appears to be the first magnetic process that is a proven true negative resistance process, where ''negative resistance process'' is defined as a process whereby electromagnetic energy is continuously and freely received in unusable form, converted into usable form, and continuously output in usable form.

44. This appears to be the first power system process that deliberately uses energy to perform more than one joule of work per joule of original input energy, by transforming a given amount of replenished energy into a different form, thereby performing work in the same amount on a receiving medium while retaining the energy in its new form, then transforming that energy back

into the first form again, thereby again performing work in the same amount on the receiving medium again while retaining the energy back in its original form, and so on in ''pingpong'' iterative fashion. The fraction of the energy that is retained from one transformation to the other determines the increase in energy of the medium receiving the work and thus being excited with kinetic energy, and thereby determines the energy gain of the power system in the multiplicity of such regenerative processes used in the system.

45. This appears to be the first magnetic process for EM power systems that deliberately creates and uses curved local spacetime to provide continuous energy and action on the process's active components and subprocesses. Sachs' unified field model [41–45] as implemented by one of its important subsets—O(3) electrodynamics per Evans [63] and Vigier—is implemented in the system to provide several specific local curvatures of spacetime, and excess energy is thereby regauged into the system and used to power loads, including a self-powering system that powers itself and its loads simultaneously, and also including an open-loop system wherein the operator inputs a little EM energy and obtains more EM energy being dissipated as work in the load.

VII. RELATED ART

There is believed to be no prior art in such true magnetic negative resistor processes for

1. Utilizing curvatures of local spacetime to provide excess energy from spacetime input into the various active components of the system process
2. Receiving EM energy from the spacetime vacuum in unusable reactive power form
3. Having the permanent-magnet dipole convert the received unusable EM energy into usable magnetic energy form
4. Splitting the magnetic energy output of the permanent magnet into separate magnetic field flux and both curled and uncurled magnetic vector potential current, each traveling in a different spatial pathway
5. Producing energy amplification by dual interaction of multiple simultaneous processes in a coil, with iterative feedforward and feedback between the simultaneous interactions
6. Producing driving and driven coils both in curved spacetime and with their magnetic flux inside a nanocrystalline core inside said coils and with a field-free magnetic vector potential in the space in which the coil is embedded
7. Transducing the excess magnetic energy available for output, into electrical energy

8. Outputting the excess energy as ordinary electrical energy—consisting of voltage and current—to power circuits and loads
9. Permissibly exhibiting COP > 1.0 while rigorously obeying energy conservation, the laws of physics, and the laws of thermodynamics
10. Being operated in either open-loop or closed-loop fashion. In open loop the operator inputs a lesser EM energy than is dissipated in the load; in closed loop a fraction of the output energy is positively fed back into the input to power the system and system process, while the remainder of the energy is dissipated in the load to power it
11. Using and applying the extended work-energy theorem for a replenishing potential environment

This appears to be the first process to take advantage of the above listings of operations, functions, and processes, in which no heating or eddy-current dissipation is produced in the cores of coils utilized in embodiments of the process, and where said process and embodiments output electrical power in loads without the need to cool the process components.

The closest *somewhat* related work would appear to be several patents of Raymond C. Gelinas [67][27] in that these patents use the curl-free magnetic vector potential. All the Gelinas patents deal with communications and receivers and transmitters, have no application to electrical power systems, do not use additional EM energy extracted from a permanent magnet and replenished by the vacuum, do not use curved local spacetime, do not use the giant negentropy process, do not function as open systems far from equilibrium in their vacuum exchange, do not use iterative pingpong feedforward and feedback in their various components to achieve gain, do symmetrically regauge themselves so that their excitation discharge is symmetric and not asymmetric, do not function as negative resistors, are not self-powering, cannot produce COP > 1.0, cannot self-operate in closed-loop form, and can and do produce only COP < 1.0. They therefore have no application to the field of the present invention.

A. Description of the Figures and System Operation

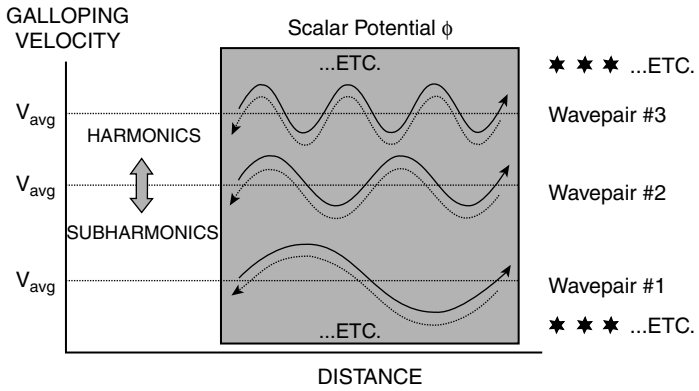
The process in this invention is described below and in the process gain block diagrams cited below, which are intended to be read in conjunction with the following set of drawings, which include (1) the background Lenz reactions, Poynting and Heaviside energy flow operations, Heaviside energy flow

[27] All these Gelinas patents are assigned to Honeywell. All deal with communications, have no application to electrical power systems, do not use additional EM energy extracted from a permanent magnet and replenished by the vacuum, do not use curved local spacetime, do not use the giant negentropy process, do not function as open systems far from equilibrium in their vacuum exchange, symmetrically regauge themselves so that their excitation discharge is symmetric and not asymmetric, and produce only COP < 1.0.

component, giant negentropy operation, Whittaker's decomposition of the scalar potential, and creation and use of curved local spacetime utilized in the invention; (2) the principles, the functional block diagram, a physical laboratory test and phenomenology device; and the process operation of the invention as well as typical measurements of a laboratory proof-of-principle device; and (3) the replication of the MEG by Jean-Louis Naudin (see footnote 10, above).

Figure 1 graphically shows Whittaker's decomposition [1] of the scalar potential into a harmonic set of phase conjugate longitudinal EM wavepairs. The 3-symmetry of EM energy flow is broken [16,20] by the dipolarity of the potential, and 4-symmetry in energy flow without 3-flow symmetry is implemented [1,16].

Figure 2 expresses this previously unexpected functioning of the scalar potential—or any dipolarity, including the magnetic dipole of a permanent magnet—as a true negative resistor [see footnote 24, above), receiving energy in unusable form, transducing it into usable form, and outputting it in usable form. Any EM potential is itself a true negative resistor process.



The Structure Is:

- A harmonic set of longitudinal wavepairs.
- In each wavepair the two waves superpose spatially, but travel in opposite directions. The two are phase conjugates and time-reversed replicas of each other.
- The convergent wave set in the imaginary plane, and hence is not observable.
- The charge's spin is 720 degrees, 320 in the real plane and 320 in the imaginary plane.
- Hence the charge receives the complex convergent EM energy, transduces it into real EM energy, and emits enormous energy at the speed of light in all directions.
- This produces the fields and potentials from the "source charge."

Figure 1. The scalar potential is a harmonic set of phase conjugate longitudinal EM waves.

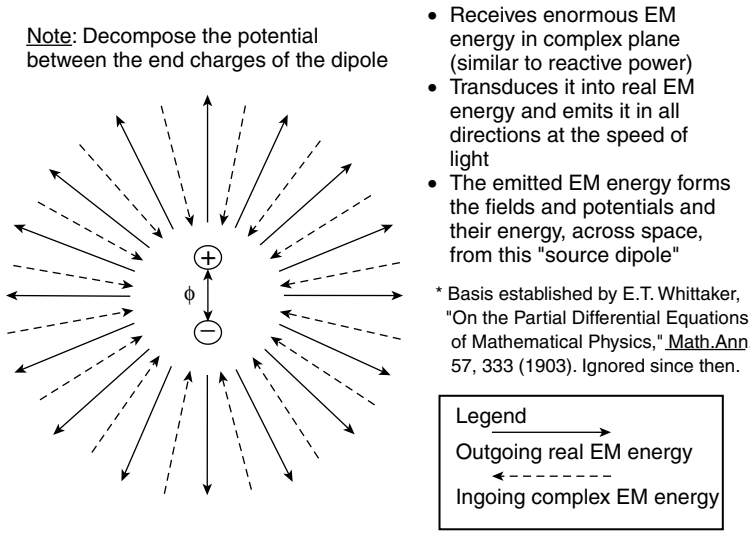


Figure 2. The dipole is a true negative resistor.

Figure 3 shows the startling ramifications of this previously unsuspected process. An ongoing, free, negentropic reordering of a fraction of the local vacuum energy [16] is initiated, spreads at the speed of light in all directions from the moment of formation of the dipole, and continues as long as the dipole and its broken 3-symmetry exists. We have previously stated [19,68,69] that the energy input to the shaft of a generator, and the chemical energy of the battery, have nothing to do with powering the external circuit connected to the battery or the generator. The available internal energy dissipated by the generator or battery does not add a single joule per second of energy flow to the external circuit. Instead, the available internal energy is dissipated internally and only to power its own losses and to force the internal charges apart, forming the internal source dipole connected to the terminals. The energy input to a generator and expended by it, and the chemical energy available by a battery and expended by it, thus are expended only to *continuously re-form the source dipole that the closed current loop circuit continuously destroys*.

Once established, the source dipole applies the giant negentropy process [16,20] shown in Figs. 1–3. Energy is continuously received by the dipole charges from the surrounding active and negentropically reordered vacuum (curved spacetime), transduced into usable form, and output as real EM energy flow in 3-space. The dipole's receipt of this energy as reactive power freely absorbed from the vacuum, does not yet appear in present classical electrodynamics texts. The texts do not include the vacuum interaction, much less the

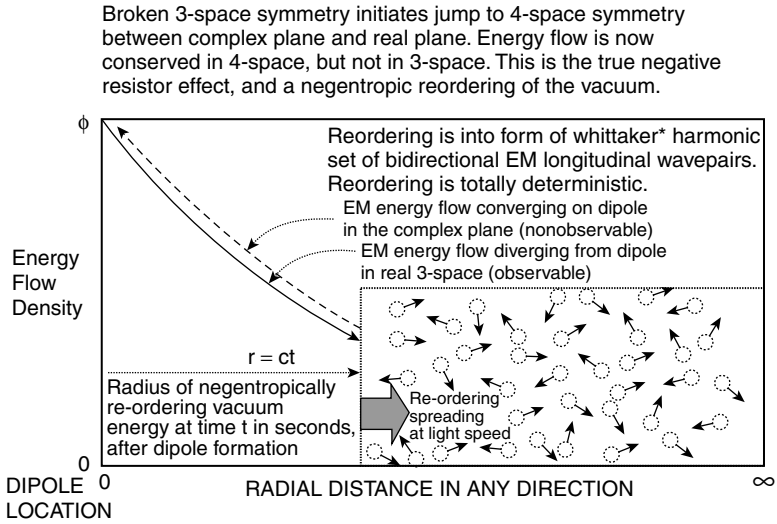


Figure 3. The dipole's broken 3-symmetry initiates a spreading giant negentropic reordering of a fraction of the vacuum's energy.

broken symmetry of the source dipole in that vacuum exchange, even though such has been proved in particle physics since the 1950s. The present invention is believed to be the first applied process using this previously omitted procedure of easily extracting energy from the vacuum and outputting it in usable transduced form as real EM energy flow, via the giant negentropy process [16,20].

The transduced EM energy received from the vacuum by the source dipole, pours out of the terminals of the battery or generator and out through space surrounding the transmission lines and circuits connected to the terminals (Fig. 4) as shown by Kraus [70][28] As is well known, the energy flow (Fig. 4) fills all space surrounding the external circuit conductors out to an infinite lateral radius away [70]. This is an *enormous* EM energy flow—when one includes the space-filling nondiverged component discovered by Heaviside [48–50]. This neglected vast nonintercepted, nondiverged energy flow component was never even considered by Poynting [51], and was arbitrarily discarded by Lorentz [52] as ''of no physical significance.''

Figure 5 shows that almost all that great EM energy flow—pouring out of the terminals of the generator or battery and out through the surrounding space

[28] Figure 12-59 on p. 576 shows a good drawing of the Poynting flow component that is withdrawn from that huge energy flow filling all space around the conductors, with almost all of it not intercepted, not diverged into the circuit, but just wasted. The amount of Poynting energy being withdrawn into the conductors is given by the numbers Kraus assigns to his contours. As can be seen, the Poynting effect is relatively localized.

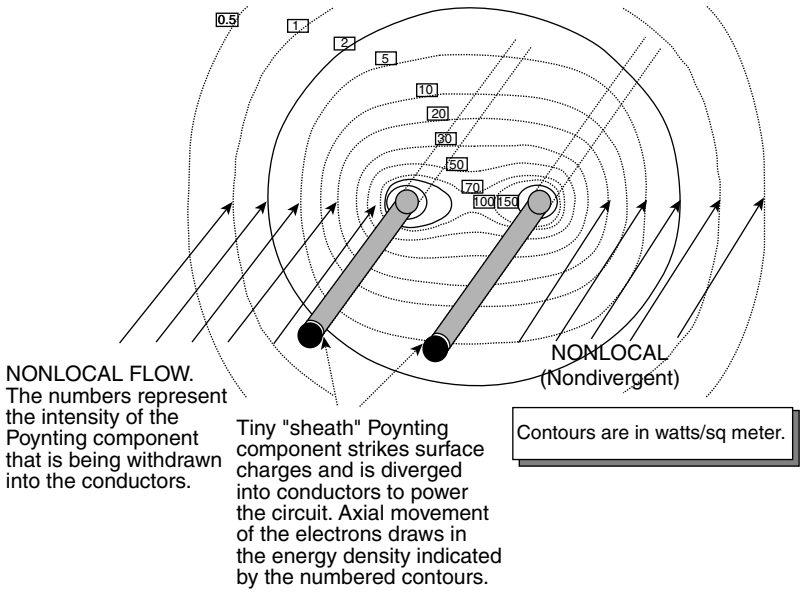


Figure 4. Poynting (caught) energy flow contours surrounding a transmission line.

surrounding the transmission line conductors—misses the circuit entirely and is simply wasted in conventional circuits having no iterative feedback and feed-forward additional collection components and processes. In a simple circuit, for example, the arbitrarily discarded Heaviside nondiverged energy flow

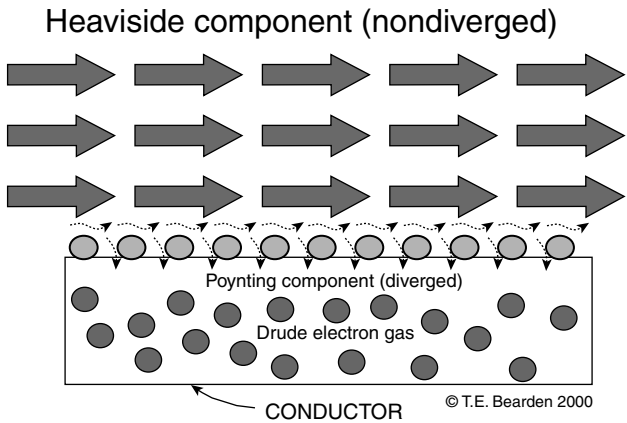


Figure 5. Heaviside and Poynting energy flow components. The Heaviside component is often 10 trillion times the Poynting component, but is simply wasted in ordinary single-pass energy flow circuits.

component may be some 10 trillion times [71][29] in total rate of energy flow as the feeble Poynting component that is intercepted by the surface charges in the circuit conductors and components, and diverged into the wires to power the Drude electrons and the loads and losses.

Figure 6 illustrates the negative-resistor process diagrammatically. The source dipole and the associated scalar potential between its poles act as a true negative resistor, receiving enormous EM energy from the surrounding vacuum in unusable form (via the giant negentropy process shown in Fig. 3). The charges of the dipole absorb this unusable energy and transduce it into usable EM energy form, then reradiate it as usable EM energy. This, of course, is precisely a negative resistor process.

Figure 7 shows the integration trick that Lorentz [52] originated to discard the perplexing and enormous Heaviside nondiverged energy flow component, while retaining the diverged (Poynting) energy flow component. In short, Lorentz' procedure—still utilized by electrodynamicists [72] to discard the embarrassing richness of EM energy poured out of every dipole and not intercepted and used by the attached external circuit—for over a century has specifically and ubiquitously diverted electrodynamicists' attention away from the process described in this invention.

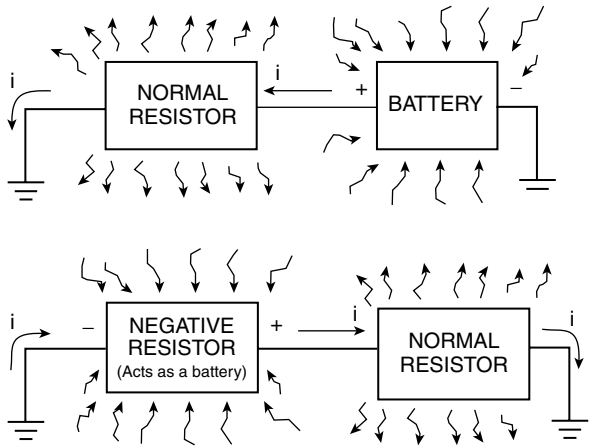
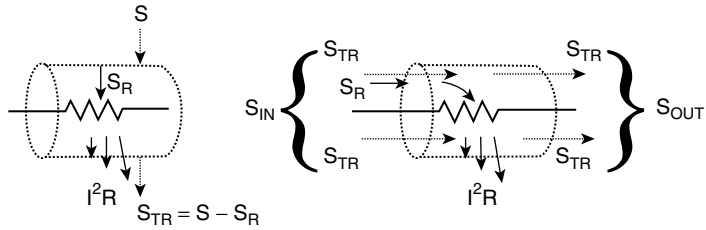


Figure 6. Negative resistance process versus positive resistance process. A negative resistor receives energy in unusable form, transduces it, and outputs it in usable form. A positive resistor receives energy in usable form and scatters it into unusable form.

[29] In Fig. 5 on p. 16 of Ref. 71, the fraction of the energy flow that is intercepted and collected by a nominal circuit (i.e., the Poynting component) is roughly shown to be on the order of 10^{-13} of the entire energy flow available. Thus the Heaviside component that misses the circuit and is nondiverged and wasted is about 10^{13} times as great in magnitude as is the Poynting component that is intercepted and diverged into the circuit to power it.



1a. Lorentz surface integration. 1b. Actual S in and S out.

See Panofsky & Phillips, Classical Electricity and Magnetism, 2nd. edn., Addison Wesley,1962, p. 178–181.

Note: If the S vector is integrated over the closed surface, then all nondiverged energy flow is zeroed, leaving only the very small component of the input S-flow that is powering the joule heating of the resistor. In short, only the small component of the S-flow that is equal in magnitude to the Poynting vector remains. This measures only the tiny portion of the S-flow that is intercepted and diverged into the conductors by their surface charges, powering the electrons and then dissipated out of the resistor as joule heating.

The Lorentz procedure arbitrarily discards the enormous Heaviside component that misses the circuit entirely and is wasted. This results in a non sequitur of first magnitude in energy flow theory.

Figure 7. Lorentz' integration trick to discard the enormous Heaviside nondiverged energy flow component: (a) Lorentz surface integration; (b) actual S_{in} and S_{out}.

We strongly iterate the following point. We have designed the process of this invention and its embodiments by and in accord with Sachs' unified field theory [41–43,45] and the Evans–Vigier O(3) electrodynamics subset thereof [63]. Consequently, all energy in mass-free spacetime is general relativistic in nature, modeling, and interpretation. The general relativity interpretation applies at all times, including that for the electrodynamics. Hence any local change of energy in spacetime is precisely of one and only one nature: a curvature of that local spacetime. A traveling EM wave thus becomes identically a traveling *oscillating curving* of spacetime. Further, wherever the wave exists, its energy a priori curves that part of the spacetime. So EM waves, fields, potentials, and energy flows always involve and identically are spacetime curvatures, structures, and dynamics. We also accent that time is always part of it, since what exists prior to observation is spacetime, not space.[30] Hence ''energy currents in time'' [16,20] and ''electromagnetic longitudinal waves in the time domain'' [29,33,36] are

[30] The present notion in EM theory that EM energy travels through a flat spacetime is in fact an oxymoron, since to have had an energy density change in spacetime at all is a priori to curve spacetime.

perfectly rational expressions and facts, albeit strange to the >136-year old classical electrodynamics stripped of its integration with general relativity.

Figure 8 shows the relationship between a linearly moving magnetic vector potential $\mathbf{A}_L$, a swirling or circulating $\mathbf{A}_C$, the implementation of the $\nabla\times$ operator by the interacting coil and its moving charges, and the resulting magnetic field **B**. $\mathbf{A}_L$ can also be defined as the vector potential ϕ_L if desired, where ϕ_L is a vector potential and no longer the familiar scalar potential ϕ since ϕ is in motion. If the coil is wound very tight and is very long (or closed such as in a very tight toroid), then the magnetic field **B** will be retained entirely inside the coil, while the field-free (curl-free) $\mathbf{A}_C$ will remain outside the coil. This illustrates one of the major unrecognized principles of the potential (such as **A**) as a flow process; specifically, what is usually considered to be the energy in the potential in a given volume of space is actually the ''reaction cross section'' of the potential in that volume. Conventional electrodynamicists and electrical engineers do not calculate magnitudes of either fields or potentials per se, but only their *reaction cross sections*, usually for a unit point static charge assumed fixed at each point. We point out that this procedure calculates the divergence of energy from the potential, and hence the reaction cross section of the potential, but not the potential itself.

The energy so calculated—in this case, the curl of the **A** flow, which is the magnetic field **B**—can in fact be diverted from the **A** potential flow through a volume of space into another different volume of space. The magnitude of the **A** potential flow will continue undiminished through the original volume of space, as long as the source dipole performing the giant negentropy process and thus providing the continuous EM energy flow represented by **A** remain unchanged.

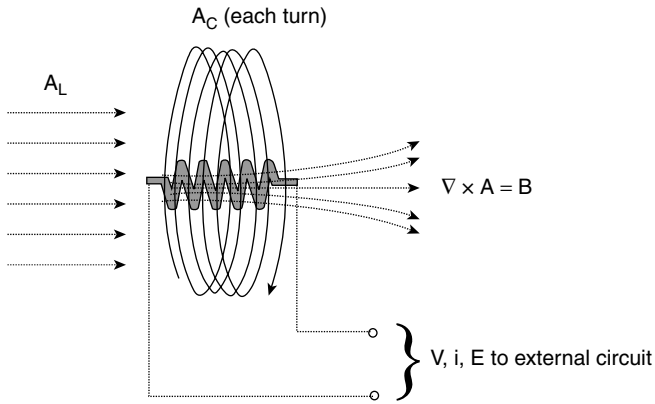


Figure 8. The $\mathbf{A}_L$ and $\mathbf{A}_C$ vector potentials, **B** field, and $\nabla\times$ operator. The $\nabla\times$ operator operates on the $\mathbf{A}_C$ potential energy current, to produce normal **B** field.

In the case used in the process of this invention, we diverge the magnetic field energy from the **A** flow, while simultaneously retaining all the **A**-potential energy flowing through the space outside the tightly wound coil. This is in fact an ''energy collecting amplification'' subprocess, and is no more mysterious than diverting a tiny flow of water from a nearly infinite river of flowing water, and having the river flow on apparently undiminished. In short, we may deliberately use the *energy flow nature* of the potential **A** in order to simultaneously separate it into two flows of different energy form: curled and uncurled.

If we place a square pulse in the current of the coil in Fig. 8, we also invoke the Lenz law reaction (Fig. 9) to momentarily increase the current and hence the $\mathbf{A}_C$ and the action of $\nabla \times \mathbf{A} = \mathbf{B}$, so that additional $\mathbf{A}_C$ energy and additional **B** energy are obtained. In this way, the energy gain is increased by the Lenz law effect—which is a regauging effect deliberately induced in the invention process by utilizing square pulse inputs. Then when the trailing edge of the pulse appears and sharply cuts off the pulse, a second Lenz law gain effect (Fig. 9) is also produced, further increasing the energy gain in both $\mathbf{A}_C$ and in **B**. We use these two serial Lenz law effects to increase the potential energy of the system twice and also the collected field energy, thus allowing COP > 1.0 since during the regauging process the potential and the potential energy of the system are both increased freely, and so is the diversion of the increased potential energy into **B**-field energy inside the coil. Both the changes increase

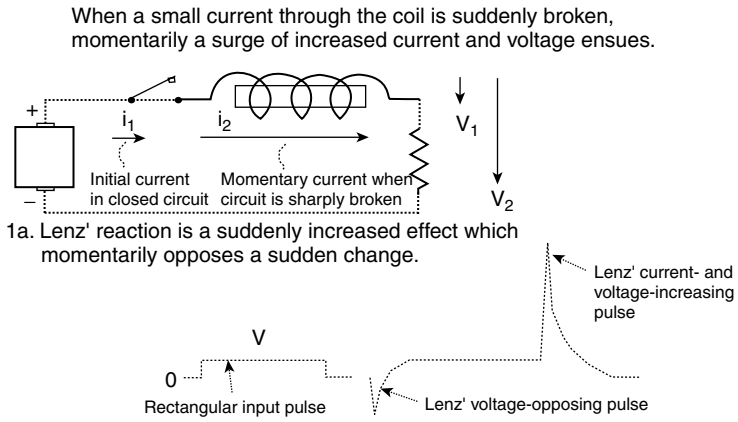


Figure 9. Lenz' law reaction momentarily opposes a sudden change and increases the ongoing action which is to be changed: (a) Lenz' reaction is a sudden effect that momentarily opposes a sudden change; (b) two successive Lenz reactions to two interruptions by leading and trailing edges of a rectangular pulse.

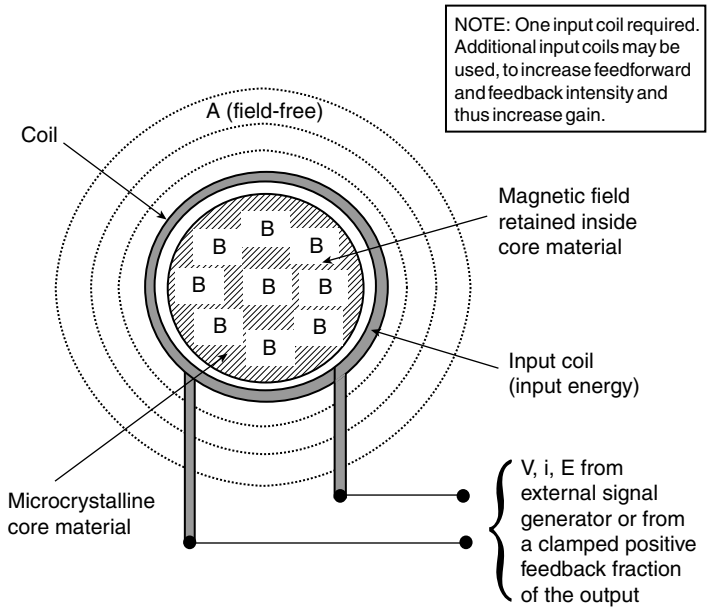


Figure 10. Input coil for either open-loop or closed-loop operation.

the voltage drop across the coil and the current through it, translating the increased magnetic energy into usable electrical energy to power loads and losses.

Figure 10 shows the cross section of an input coil, one form of input device. The input can be from a separate signal generator, in which case the system runs ''open loop'' and requires continuous input power, but still provides COP > 1.0. Or, a portion of the output power can be extracted, clamped in magnitude, and positively fed back to the input, in which case the system runs ''closed loop'' and the operator need furnish no external power input once the unit is in operation. In either case, the system is an open system far from thermodynamic equilibrium with its active vacuum environment, freely receiving energy from the active environment to the dipole in the permanent magnet, and from the dipole out into the nanocrystalline material core in the form of magnetic field energy **B**, and in the space outside the core in the form of field-free **A** potential. As can be seen, the **B**-field energy is confined to the core material inside the coil, and the **A** potential outside the core is field-free **A**. Any change in the **B**-field inside the *core* is also a change in the **B** field inside the *coil* and the coil interacts with it to produce current and voltage. Any change in the **A** potential outside the core, also interacts with the coil as $d\mathbf{A}/dt$, which is an **E**-field interaction. The movement of the Drude electrons also applies the $\nabla\times$ operator,

thereby producing voltage and current in the coil and also producing additional **B**-field in the core material. In turn, this changes the **B** field in the core, which produces more voltage and current in the coil and additional **A** potential outside the coil, and so on. Hence there are dual iterative retroreflective interactions between the two simultaneous interactions with the coil. The dual interaction increases the performance of the coil, rendering it an *energy amplifying* coil, and also increases the COP of the system process. The output of the input coil is thus due to the alteration and increase of the **B**-field flux and energy in the core material, and an increase and alteration in the field-free **A** potential surrounding the coil and moving around the circuit in the space surrounding the nanocrystalline core material flux path, and interacting simultaneously with the coil in $d\mathbf{A}/dt$ fashion (**E**-field fashion).

Figure 11 shows a cross section of a typical output coil for either open-loop or closed-loop operation. The operation is identical to the operation of the input coil, except this coil outputs energy in the form of voltage and current to an external circuit, external load, and so on, and also outputs energy from its reaction with the **A** potential (i.e., with $d\mathbf{A}/dt$) coming in from outside the flux path. It outputs both an **E**-field energy reaction with the Drude electrons, and also a change in **B**-field energy to the nanocrystalline flux path material in its

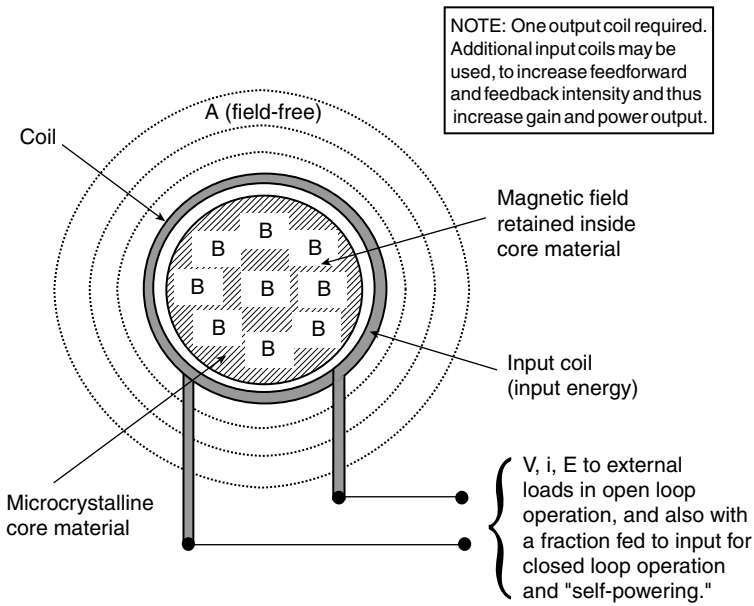


Figure 11. Output coil for either open-loop or closed-loop operation. Multiple output coils may be used in a variety of configurations.

core due to the movement of the electron currents in the coil. The output coil receives its energy input from the field-free **A**-potential outside the nanocrystalline material flux path as well as from the **B**-field energy and magnetic flux inside the nanocrystalline flux path through its core. In short, we ''dip'' the full Poynting energy flow component from the **A** potential as **B**-field energy, separate this **B**-field energy, and pipe it to the center of the output coil to interact magnetically with the Drude electrons in the coil. The **A** potential is instantly and fully replenished as a curl-free **A**-potential. The time rate of change of this **A** potential thus can be adapted so that a full Poynting energy flow component also interacts with the Drude electrons from outside as a large **E**-field energy reaction. We thus *multiply* the EM energy flow available for interacting with the output coil, compared to conventional ''single dipping'' and ''single Poynting component interacting'' systems in a transformer–generator. This ''double dipping'' provides an energy gain, since it constitutes a free regauging of the potential energy of the system, and an application of the gauge freedom principle of gauge field theory. The lesser additional *mutual interaction* between those primary interactions adds the extra 0.5 gain, so that each output coil now gives a gain of 2.5. With two output coils, the COP of the system is $\mathrm{COP} = 5.0$.

Further, all coils on the core material serve somewhat as both output and input coils, and also have mutual iterative interactions with each other around the loop, coupled by the field-free external **A** potential and the **B**-field and magnetic flux in the nanocrystalline material flux path acting as the cores of the coils. These interactions also provide gain in the kinetic energy produced in the Drude electron gas, due to the iterative summation work performed on the electrons to increase their energy. When more coils are utilized, the gain is affected correspondingly.

Further, these mutual iterative feedback and feedforward energy gains also change the flux back through the permanent magnet, alternating it, so that the pole strength of the magnet alternates and increases. This, in turn, increases the dipolarity of the permanent magnet, which, in turn, increases the magnitude of the associated giant negentropy process [16,20]. This results in more energy received from the active vacuum by the permanent magnet, and also more energy output by said permanent magnet dipole to the core material and to the coils.

Thus we have described a system and process having a multiplicity of iterative feedbacks and feedforwards from each component and subprocess, to every other component and subprocess, all increasing the energy collected in the system and furnished to the load. In open-loop operation, this results in $\mathrm{COP} > 1.0$ permissibly, since the excess energy is freely received from an external source. In closed-loop operation, the COP concept does not apply except with respect to operational efficiency. In that case, the operational

efficiency is increased because more energy is obtained from the broken symmetry of the permanent dipole, and therefore additional energy is provided to the loads, compared to what the same permanent magnet can deliver when such iterative feedback and feedforward actions in such multiplicity are not utilized. In closed-loop operation, the system powers itself and its loads and losses simultaneously, and all the energy is freely supplied from the active vacuum by the giant negentropy process of the permanent magnet dipole and the iterative asymmetric self-regauging processes performed in the system processes.

Figure 12 is another view showing the major energy flows in an output coil section and subprocess, and the iterative dual inputs and interactions, of the basic scheme of operation of the process and its active component subprocesses.

Figure 13 is another view showing the dual energy flows in an input coil section and subprocess.

Figure 14 is a block diagram illustration of the components and processes in the system and system process, with the dual feedforward and feedbacks shown. It accents the overall system process gain due to the multiplicity of interactions and iterative interactions between the various system components and subprocesses, and further interactions with the dual local interactions and iterative feedforwards and feedbacks, thus providing a multiplicity of individual energy gain processes and an overall energy gain process.

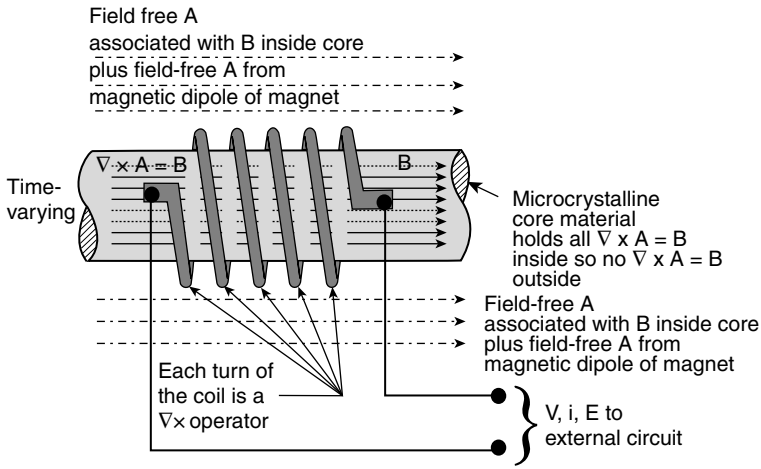


Figure 12. Basic scheme showing dual energy inputs and interactions with the coil. The output of each of these two interactions also ''feeds forward'' to the other interaction as an additional input to it, resulting in interative ''pingpong'' of additional energy collection in the circuit, providing energy gain.

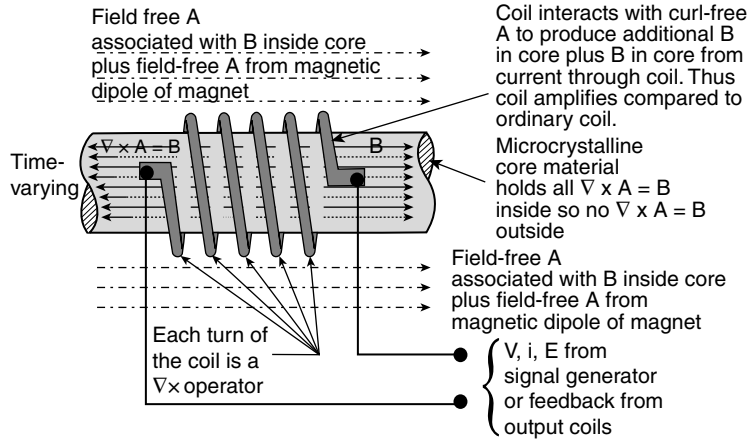


Figure 13. Dual energy inputs to the coil result in amplifying coil–core interaction. Not shown are the other feed loops providing extra curl-free *A* input from the surrounding space and extra *B* input in the core.

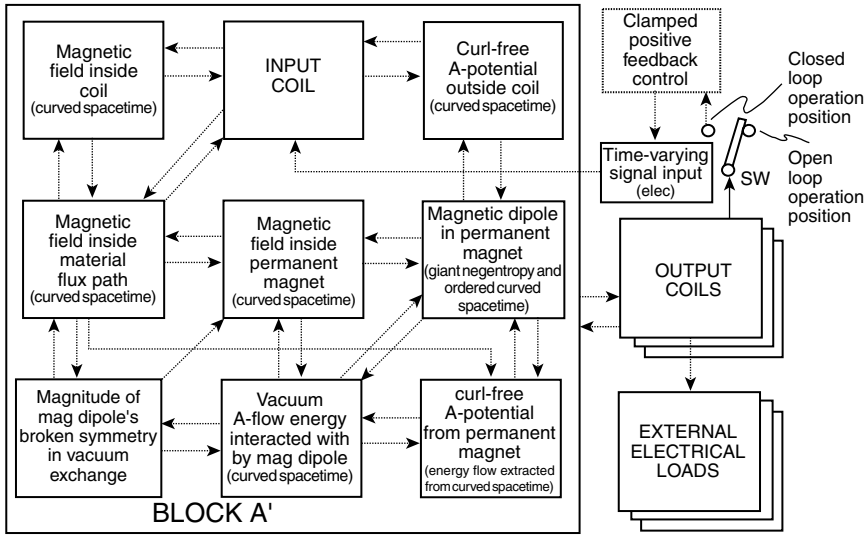


Figure 14. Energy gain process using feedforward and feedback subprocesses providing individual energy gain operations.

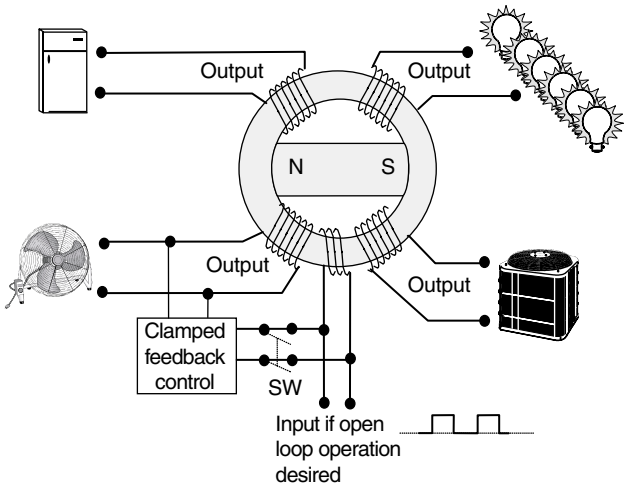


Figure 15. Typical embodiment system and application.

Figure 15 shows a type embodiment of the system and system process, perhaps at a home and powering a variety of home appliances and loads. The system as shown is ''jump-started'' initially in open-loop mode, and once in stable operation is disconnected from the jump starter (such as a battery) to run in closed-loop operational mode.

Figure 16 shows one of the former laboratory test buildups embodying the process of the invention. This test prototype was used for proof-of-principle and

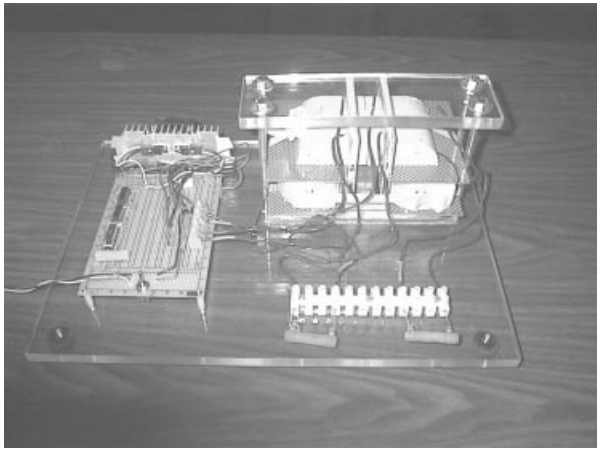


Figure 16. Motionless electromagnetic generator (laboratory experiment).

phenomenology testing. This experimental buildup has been substantially replicated by French researcher Naudin, who achieved COP = 1.76 with a less optimized core material (see footnote 10, above). Naudin is the first experimenter to replicate our MEG experimental apparatus. His key illustrations are used in our Figs. 26 and 28 (below) with his permission.

Figure 17 shows a simplified block diagram of a basic embodiment demonstrating the process. Many of these buildups were undertaken to test various core materials, observe phenomenology, and perform other tasks. The ''square C's'' of the flux path halves right and left, as shown in this Fig. 17, were actually made as ''half-circle C-shaped flux path halves'' right and left in Fig. 16 above.

Figure 18 shows the measurement of the input to the actuator coil of the test unit of Fig. 16 operated in open-loop mode.

Figure 19 shows the measurement of the output of one of the output coils of the test unit of Fig. 16 operated in open-loop mode.

Figure 20 shows the output power in watts as a function of the input potential in volts, thus indicating the output versus potentialization sensitivity. The circles indicate actual measurements, and the curve has been curve-fitted to them.

Figure 21 shows the COP of a single output coil's power divided by the input power, as a function of input potentialization. The circles indicate actual measurements, and the curve has been fitted to them. The second coil had the same power output and COP simultaneously, so the net unit COP of the unit is double what is shown in the figure.

Figure 22 shows the projected unit output power sensitivity versus voltage input, expected for the next prototype buildup now in progress.

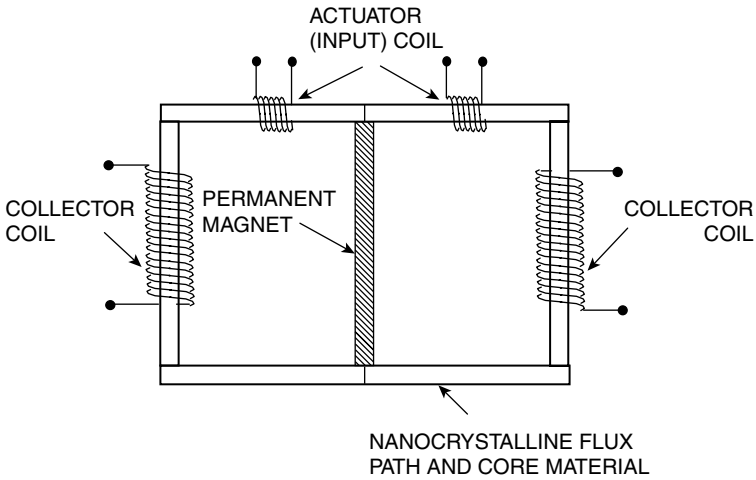


Figure 17. Diagram of laboratory test prototype.

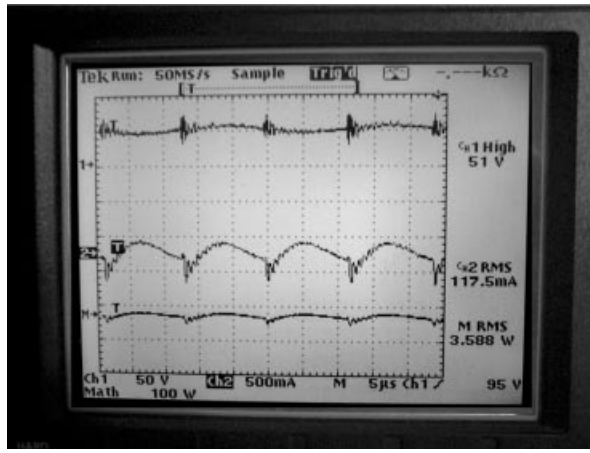


Figure 18. MEG input measurements.

Figure 23 shows the projected unit COP versus input potentialization expected for the next prototype buildup now in progress. We eventually expect this type of unit to easily operate at the COP = 30 or COP = 40 level, with multiple kilowatt output power.

Figure 24 shows the true operation of a typical coal-fired power plant and generator, and the associated power line. As can be seen, all that burning the coal accomplishes is to force the internal charges in the generator apart and form the source dipole. None of that adds a single watt to the power line. Instead, once

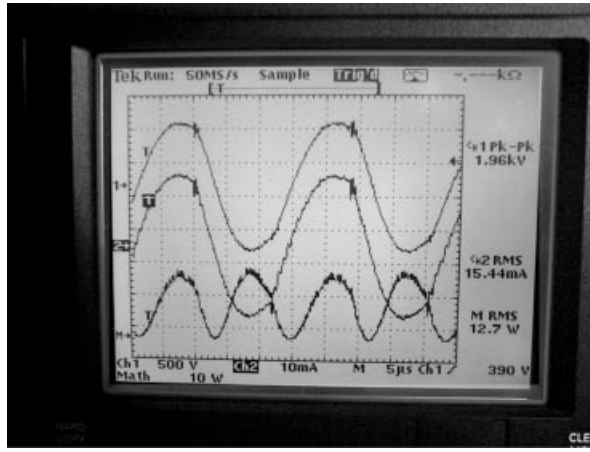


Figure 19. MEG output measurements.

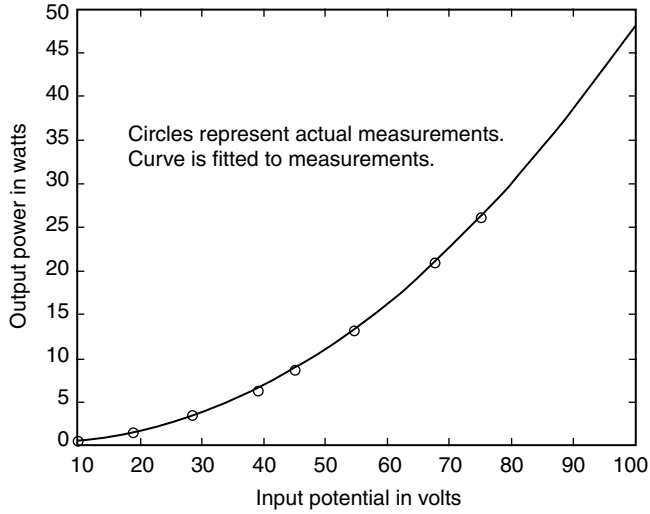


Figure 20. MEG prototype potentialization sensitivity.

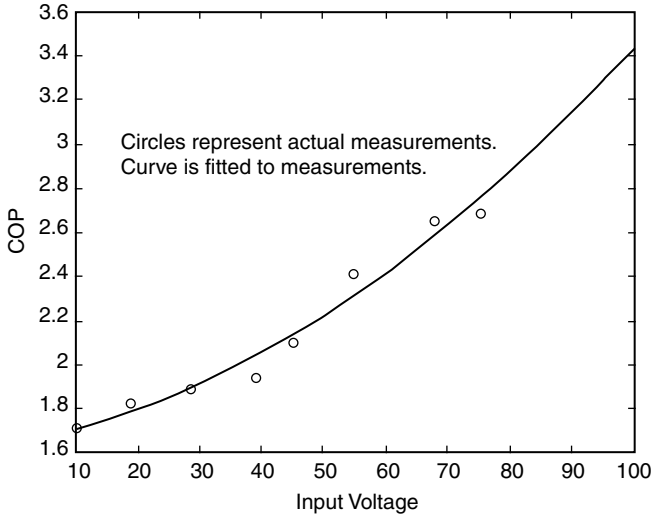


Figure 21. COP (power out versus power in), as a function of sensitivity (open-loop prototype).

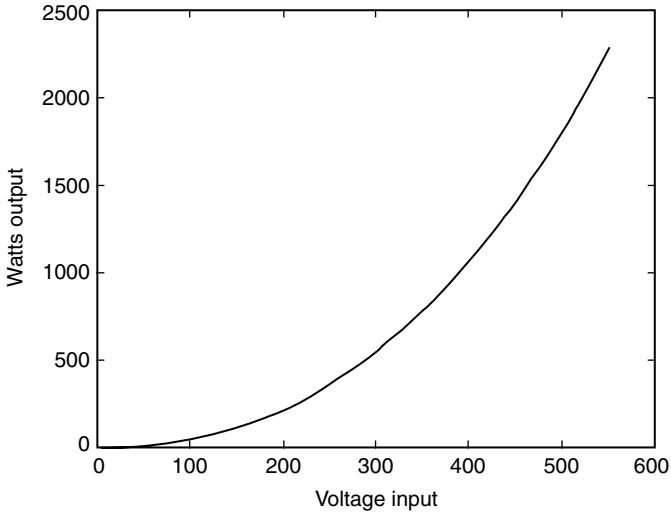


Figure 22. MEG projected sensitivity (test buildup in progress).

the dipole is formed, its broken 3-symmetry produces an inflow of energy from the complex plane (time domain) from the active vacuum. The dipole transduces the absorbed *reactive* power (in electrical engineering terms) and outputs it as real, observable EM energy flow. Note particularly the enormous amount of the

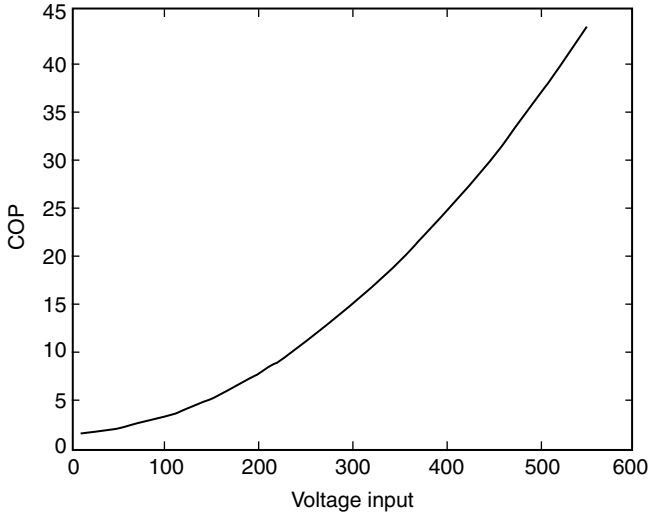


Figure 23. MEG projected COP versus input voltage (test buildup in process).

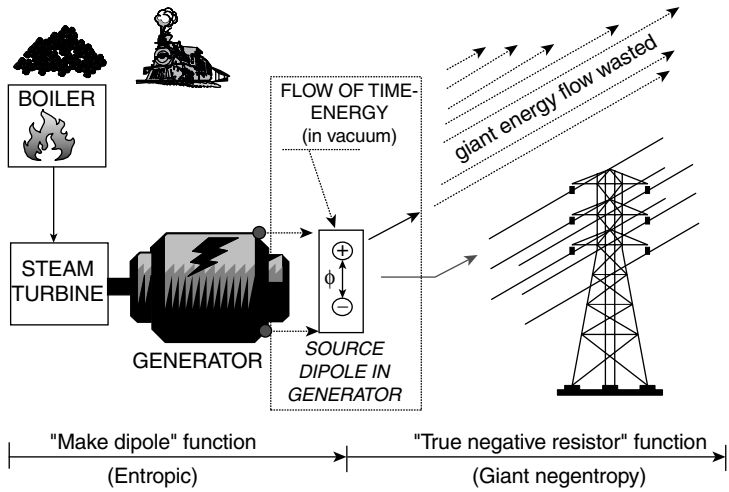


Figure 24. Generators do not power circuits and power lines; they make the source dipole.

energy flow pouring out of the terminals, most of which misses the power line entirely and is just wasted. Only a very tiny component of that giant Heaviside flow is intercepted by the power line and circuits, and diverged into the conductors to power the Drude electrons. In addition, half the Poynting energy collected in the circuit is dissipated in the dipole's back emf, scattering the charges and continually destroying the dipole—which is restored continually by additional shaft input energy that is continually input. This inane way of building power systems is what has required all the burning of hydrocarbons, use of nuclear fuel rods and dams, and so on. None of that powers the power grid, and we have been damaging and polluting our environment for no good reason at all. Every electrical power system is now and always has been powered by EM energy extracted directly from the active vacuum by the broken 3-symmetry of the source dipole in the generator or battery.

Figure 25 shows a waterwheel ''material fluid flow analogy'' of the ''double-dipping'' principle used by the MEG. In a fast-flowing stream with appreciable drop in elevation along the flow, we insert a waterwheel in the river past the bottom of a small waterfall. The ''reaction cross section'' of the bottom of the waterwheel immersed in the rushing stream is a certain amount, which determines the amount of energy diversion and hence the work done on the wheel if used in normal waterwheel fashion. However, we have inserted a pipe at the top of the waterfall, and ''piped'' a large flow of water down to the top of the waterwheel, turning its direction so that, when it flows out on the left side of the waterwheel, it strikes the same reaction cross section of the left side of the

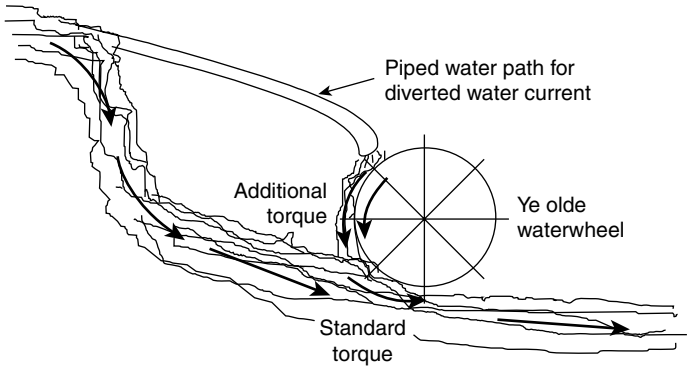


Figure 25. Double-dipping waterwheel analogy of MEG operation.

wheel. Hence a "couple" exists so that twice the energetic interaction occurs with the double-dipping waterwheel, as is normal for single-dipping waterwheels. In short, we get twice the energetic interaction on the waterwheel to power it, because the wheel interacts twice rather than once. If we do not press this simple analogy very far, it suffices to demonstrate that, in flowing stream of energy, we can divert part of the stream and then interact twice with the energy flow rather than just once. The difference is that, in the case of diversion of the energy flow in the magnetic vector potential as a magnetic field flux, the magnetic vector potential is replenished instantly and freely, so that the two streams are equal in flow, and hence equal in interaction. In the water analogy, of course, the two streams are not necessarily equal in flow magnitude.[31]

Figure 26 shows Naudin's second MEG variant buildup, in November 2000. His core material is less optimal than is the core material utilized by Magnetic Energy Ltd. Hence he achieved COP = 1.76 with this unit, instead of the full COP = 2.5 or 5.0. We are pleased that Naudin is the first researcher to have successfully replicated our MEG unit, including achieving COP > 1.0.

Figure 27 shows a simplified diagram of the double-dipping principle, applied by the MEG. From the permanent magnet's magnetic dipole, there pours forth an "energy stream" called the *magnetic vector potential*. We intercept this stream right at the poles of the magnetic dipole, with the special nanocrystalline core material. This material extracts and curls magnetic energy

[31] In the MEG, the *interception* of energy from the uncurled A-potential in space outside the core may be made much larger than energy intercepted from magnetic flux switched in the core. This is accomplished by adjusting the rise and decay times of the edges of rectangular pulses in the primary coil. The E-fields produced by dA/dt may be made very large, increasing the energy collected in a given set of external receiving circuits with loads.

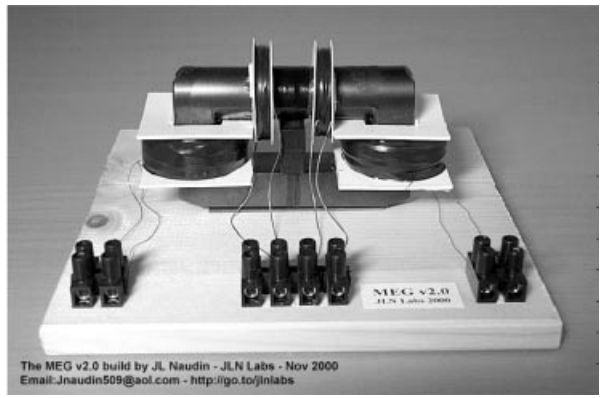


Figure 26. Naudin's replication of a MEG variant in Nov. 2000.

from the magnetic vector potential, and magnetic field energy is then separated from the curl-free magnetic vector potential river, which is instantly replenished. Thus the material acts as a ''diverger'' so that we conduct the extracted magnetic field energy through the core path and through the center of the input and output coils, in a closed path with the permanent magnet. Magnetic field measurements will show little or no magnetic field outside the core path, but of course the replenished **A** potential is there, but without curl. We use the input coil to perturb the magnetic flux and simultaneously perturb the **A** potential. So two equal energy perturbations—one a perturbation of the magnetic field flux in the core and the other a perturbation of the **A** potential in space outside the core material—are propagated. The **A**-potential perturbation propagates outside the core, and the **B**-field perturbation propagates inside the core. Both equal-energy perturbations strike the output coil simultaneously, where the rate of change of the **A** potential interacts with the coil's Drude electrons in **E**-field fashion,

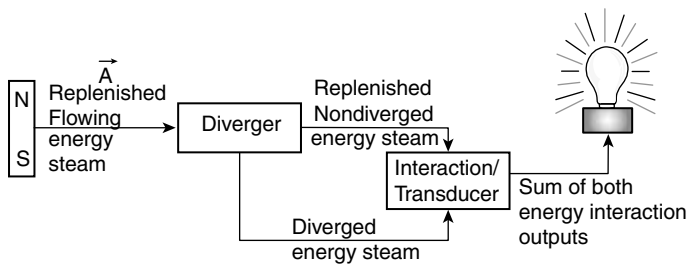


Figure 27. MEG ''double dipping'' from a replenished manetic vector potential energy stream.

while the magnetic field perturbation in the core in the center of the coil interacts with the Drude electrons in magnetic field fashion. A slight interaction within the coil occurs there between the two interactions, resulting in slight increase of the energy of the coil's interaction. Hence this double-acting coil is actually interacted with some 2.5 times the energy that normal magnetic field interaction would provide; that is, the output coil interacts and outputs 2.5 times as much EM energy as we input into the input coil (with two output coils, the COP = 5.0). No laws of physics or thermodynamics are violated, because the magnetic vector potential from the permanent magnet is freely and continuously replenished, regardless of how much energy we draw from it by "double-dipping," "triple-dipping," and so on. In theory, the COP is unlimited. In practice, a COP = 10 or even 20 can be achieved with some difficulty.

Figure 28 shows Naudin's actual measurements as he varied his input conditions to his MEG 2 variant. As can be seen, the COP varies as the efficiency of the separation process varies, and that varies as the conditions of the input vary

MEG v2.0 Tests	by JL Naudin on 11-07-00			Email: JNaudin509@aol.com			
Rload (ohms) = 100000							
Time (sec)	VTG OUT (V)	PWR OUT (W)	VTG INP (V)	CUR INP (A)	PWR INP (W)	Efficiency (%)	COP
0	790	6.24	23.7	0.35	8.30	75%	0.76
30	909	8.26	23.7	0.35	8.30	100%	1.00
50	995	9.90	23.7	0.35	8.30	119%	1.19
60	1045	10.92	23.7	0.35	8.30	132%	1.32
90	1120	12.54	23.7	0.36	8.53	147%	1.47
120	1140	13.00	23.7	0.36	8.53	152%	1.52
150	1167	13.62	23.7	0.36	8.53	160%	1.60
180	1190	14.16	23.7	0.36	8.53	165%	1.66
210	1244	15.48	23.7	0.37	8.77	176%	1.76

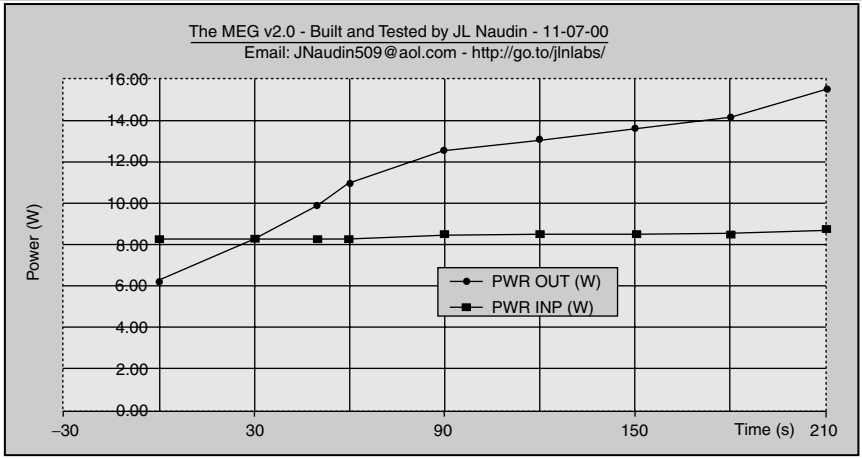


Figure 28. Naudin's Nov. 2000 results, reaching COP = 1.76.

for a given design. These results were obtained by Naudin shortly before the cutoff deadline of this paper, increasing his previous results of COP = 1.5. The point is that rigorous, independent replication has indeed been achieved.

VIII. RAMIFICATIONS

A. Importance of the Process and Its Subprocesses

A process has been provided whereby useful electromagnetic energy may be extracted from the dipole of a permanent magnet, via the giant negentropy process [16,20] associated with the magnetic dipole. In that process, an outflow of EM energy is continuously furnished by the magnet dipole in all directions in 3-space, and the energy to the dipole is freely furnished from the time domain of the active vacuum [1,16,20]. Whittaker [1] demonstrated this giant negentropy mechanism in 1903, but apparently failed to recognize its implications for electrical power systems. Recent recognition of the mechanism and its implications for electrical power systems was accomplished by one of the inventors, Bearden [16], and then more deeply examined by Evans and Bearden [20].

By using the principle that essentially unlimited energy can be withdrawn from (collected from) a potential, and the withdrawn energy will be replaced by the potential's negative-resistor action using the giant negentropy mechanism [1,16,20], a practical approach to free-energy sources for self-powering and COP > 1.0 electrical power systems anywhere in the universe is provided.

By using the principle that iterative transformation of its form energy in a replenishing potential environment can be repeatedly reused to do work, so long as the form of the energy resulting at the completion of each work phase is retained and reprocessed, one joule of energy can be utilized to do many joules of work, as precisely permitted by the energy conservation law with regauging. This is a major change to the work–energy theorem of electrodynamics, which implicitly has assumed only a single change of form of the energy, followed by loss (escape from the system) of all the energy in the new form. In short, *the present work–energy theorem is only a special case valid under those assumed special conditions*. The invented process takes advantage of the extended work–energy theorem where one joule of energy—accompanied by retention of the new form of energy resulting from work—can evoke multiple joules of work in a replenishing potential environment.

By using the principle that one joule in "iterative form changing mode with retention" can do many joules of work on a component of a system—to wit, on the Drude electron gas in an electrical circuit, where the potential energy is increased by the increased kinetic energy of the electrons having the work done on them—the extended work–energy theorem can be utilized to overpotentialize the receiving Drude electron gas, thereby regauging the system to add

excess energy by gauge freedom and outputting more electrical energy to the load than is input to the system by the operator.

By then dissipating in loads this excess energy collected in the Drude electron gas in the output circuit, the invented process provides greater energy to be dissipated in the load than is input by the operator. The combination of processes thus allows an EM system freely functioning as an open system not in equilibrium with its active vacuum (due to the giant negentropy mechanism [1,16,20]), hence permitted to exhibit COP > 1.0. In this way, more work output can be accomplished by the system process than the work that the operator must perform on the system to operate it.

By using the principle of governed, clamped positive feedback[32] of a portion of the increased output back to the input, the system can be close-looped and can power itself and its load, with all the energy furnished by self-regauging from the active vacuum as an external energy source, furnishing excess energy to the magnetic dipole's magnetostatic potential and associated magnetic vector potential, thereby replenishing energy withdrawn from the magnetic vector potential by the subprocesses in the overall system process.

One system operating in closed-loop mode can also have one fraction of its output devoted to jump-starting another such system in tandem, then switching the second system into self-powering closed-loop mode, then jump-starting another such system, which is then switched to self-powering, and so on. In that way, multiple systems can be ''piggybacked'' so that an exceptionally large power system consisting of a group of such ''piggy-backing'' systems can be produced. In case of system failure, all can be started again in the same series, by furnishing only the initial small input required to jump-start the first system of the group. In this way, very large power systems such as necessary to power automobiles, trucks, ships, trains, and other vehicles can be produced, and yet the backup jump-starting source—such as a storage battery—can be very small, such as a simple flashlight battery.

B. Implications for the Crisis in Oil Supplies versus Energy Demands

The emerging overunity electrical power systems—including ''self-powered'' systems freely taking all their energy from the local vacuum—will produce a total revolution in transportation, electrical power systems, backup power systems, and so on [68,69]. In the process, the electrical power is obtained freely and cleanly from the vacuum, from permanent-magnet dipoles continuously replenished from the active vacuum via the giant negentropy process.

[32]We state, however, that at about COP ≈ 2.0 Special Dirac sea hole current phenomena are encountered in close-looping, as a new kind of decay mechanism from the disequilibrium state back to the Lorentz equilibrium. Bedini and Bearden have filed a patent application for energy transduction processes to overcome this effect and allow close-looping.

A more significant fraction of the electrical power system can thus be decentralized, and degradation in case of system failure will be graceful and local. Yet full use can still be made of the existing power grids and power systems. As an example, arrays of self-powering electrical heater systems can be developed and used to heat the boilers in many standard power systems, thereby stopping the burning of hydrocarbons in those plants, and drastically reducing the pollution of the biosphere and the lungs of living creature including humans. This would allow a graceful phase-in of new, clean, self-powering electrical power systems; reduction of hydrocarbon combustion for commercial electricity production; and ready increase in electrical power to meet increasing world demands, even in poor nations and developing countries, while capitalizing and using much of the very large ''sunk costs'' investment in present large power systems. The core material fabrication is labor-intensive, so it is made in developing nations where such jobs are sorely needed and greatly benefit both the individual people and the nation. The dramatically increased use of and demand for these materials would thus stimulate substantial economic growth in those nations by providing many more jobs.

The conversion of power systems and replacement of a fraction of them, can proceed vigorously, since production and scaleup of systems utilizing this process can be very rapid. Except for the cores, all fabrication, parts, techniques, tooling, and other procedures are simple and standard and very economical—and are already on hand and used by a great many manufacturing companies worldwide.

At this time of an escalating world oil crisis and particularly a shortage of refining facilities, a very rapid and permanent solution to the oil crisis and the rapidly increasing demand for electricity—and also much of the problem of the present pollution of the biosphere by combustion byproducts, and of the present global warming enhancement by the emitted CO_2 from the hydrocarbon combustion—can be provided cheaply, widely, and expeditiously.

The steady reduction and eventual near-elimination of hydrocarbon combustion in commercial power systems and transport, the dramatic reduction in nuclear fuel rod consumption, and other improvements will result in cleaner, cheaper, more easily maintained power systems and a reduction in the acreage required for these power systems.

The gradual decentralization and localization of a substantial fraction of the presently centralized power grid will eliminate a significant fraction of power transmission costs, thereby lowering the price of electrical energy to the consumers.

The scaleup weight-per-kilowatt of systems using this system process will be sufficiently low to enable rapid development of electrically powered transport media such as automobiles. These will have weight about the same as now, carry a small battery as a backup jump-starter, and have very agile performance

suitable for modern driving in heavy traffic. With fuel costs zeroed, the cost to the citizens of owning and operating vehicles will be reduced. Costs to the trucking industry, for instance, will be dramatically reduced, since fuel is a major cost item. In turn, since most goods are moved via the trucking industry, the lower transport costs will mean more economical sales prices of the goods. These are very powerful and beneficial economic advantages of the new process.

C. Some Specific Advantages

The process ensures the following advantages for electrical power systems:

- The systems can have a high output power : weight ratio. Second- and third-generation equipment will have a very high output power : weight ratio.
- The systems can be highly portable for mobile applications.
- The size and output of the systems are easily scalable, and piggybacking is simple.
- The logistics burden for remote operation of MEG power systems such as on manned space capsules and satellites in orbit will be dramatically reduced.
- The systems will be rugged and reliable for use in hostile environments where conventional generators would fail or be extremely difficult to sustain. The systems can easily be environmentally shielded.
- The systems can function effectively in very wide operating temperature ranges and can be used where conventional batteries and fuel cells cannot function. As an example, a system can power a resistance heater to keep its own immediate environment continuously warm. It can also power electrostatic or magnetic cooling devices to keep the unit and its immediate environment cool in higher-temperature environments.
- The system will have an extremely long life cycle and high reliability, allowing it to be placed where frequent maintenance is not possible.
- The system uses no fuel or fuel transport, packaging, storage, and disposal systems and needs no intermediate refining facilities and operations. The resulting overhead and financial savings are vast and significant.
- Use of the systems in a combined centralized and decentralized electrical power system provides survival of electric power and graceful degradation, rather than catastrophic collapse, of electrical power in the presence of damage and destruction. This is particularly important since the greatest threat to the United States and many other nations is terrorist attacks against our cities, or against our fuel supplies, electrical power grids, and other structures and systems.

- The systems produce no harmful emission, harmful or radioactive byproducts, hazardous wastes, or biospheric pollutants. As usage is phased in worldwide, a significant reduction of environmental pollutants and hazardous wastes will result, as will a cleaner biosphere.
- The systems can produce AC or DC power directly by simple electrical additions, and provide shaft power simultaneously. Frequency can be changed by frequency conversion.
- Coupled with normal electric motors, the systems can provide attractive power system alternatives for automobiles, tractors, trucks, aircraft, boats, ships, submarines, trains, and other vehicles, again without exhaust emissions, pollutants, or harmful waste products and without fuel costs.
- The systems can be developed in small-system sizes, rugged and efficient, to replace the motors of hosts of small engine devices such as garden tractors, lawnmowers, power saws, and leaf blowers, which are presently recognized to be very significant biospheric polluters.

These descriptions provide illustrations of some of the presently envisioned preferred embodiments and applications of this invention.

D. Extension and Adaptation of the Process

For example, we have mentioned piggybacking arrays of such systems for easily assembled large power plants.

As another example, conversion to furnish either DC or AC, or combinations of either, at whatever frequencies are required, is easily accomplished by standard conversion techniques and add-on systems.

As another, less obvious, example, the process uses a multiplicity of positive energy feedforwards and feedbacks, and iterative change of the form of the energy between multiple states in a replenishing environment, to provide iterative gain by ''pingpong.'' As the number of feedback and feedforward operations is increased, it is possible to advance the system process into a region where the regenerative feeds produce an exponentially *increasing* curve of regauging energy and potential energy increase, with concomitant exponentially increasing curve of output energy. Material characteristics, saturation levels of cores, and other variables provide ''plateaus'' where the exponentially rising output curve is damped, leveled off, and stabilized. By using spoiling and damping, such exponential increase in energy density of the system can be leveled off at specifically desired plateau regions, which can be easily adjusted at will, either manually or automatically in response to sensor inputs. By this means, these systems enable automatically self-regulating, self-adapting power grids and power systems, which automatically adjust their state and operation according to the exact needs and conditions, changes of these needs and conditions, and other requirements without impact on supporting fuel, transport, refining,

storage, and other activities. These ''exponential but plateau-curtailed'' systems are capable of producing very large power-per-pound levels, and sustaining them without overheating, limited only by the saturation level of the core materials. Such new adaptations of the fundamental system process of this invention can be developed in a straightforward manner in the third generation.

The adaptations and alterations of the process are limited only by the ingenuity of the scientists and engineers and by the particular needs of a given application. The process uses the laws of nature in a novel and extended manner, such as using one joule of input energy together with automatic replenishing to cause many joules of output work to be done in the load. Many alternative subprocesses, embodiments, modifications, and variations will be apparent to those skilled in the art of conventional electrical power systems and magneto-electric generators.

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