Extracting Energy from Permanent Magnet Electron Spins

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1. Introduction

International patent WO 03/0011002 Magnetic Heater Apparatus and Method assigned to MagTec LLC has aroused some interest. This describes a form of heater where an electrically conductive disc is rotated close to an array of permanent magnets. Eddy currents induced into the disc create heat that is transported away by contact with a fluid flow. Data is given on the performance of a heater where the fluid is air at a flow rate of $3200ft^3$/min provided by a fan consuming 1.76KW, the air being raised in temperature by 80°F from contact with the heated disc driven by an electric motor consuming 20.9KW. This equates to a COP of 3.58. The preferred material for the disc is stated as Cu.

This paper studies the eddy current flows within a moving disc. At low speed the currents are in phase with the induced motional electric $\mathbf{E}=\mathbf{v}\times\mathbf{B}$ field, yielding magnetic forces on the disc that create a reaction torque as seen by the drive motor. That torque creates input power to the motor that accounts for the heating power delivered. It is then shown that at high speeds the electrical L/R time constant delay between the establishment of the induced electric field and the resultant eddy current creates an armature reaction where the forces occur at a different angular disposition, altering the torque and ultimately leading to over-unity behaviour. An explanation is offered for the excess energy where the closed loop eddy currents in the disc yield a closed loop reaction E field that, although being cyclic within the rotating reference frame of the disc, appears static in the reference frame of the magnets hence "loads" the atomic current circulations responsible for their magnetism.

There are also authentic accounts of excess energy being derived from magnets that have been conditioned in special ways. Two devices that share a common theme are those invented by Floyd Sweet and Arthur Manelas. These each use a large billet of ceramic ferrite material that has thee orthogonal windings on it. Unfortunately both inventors are now deceased and attempts to reconstruct or replicate working models of their devices have failed. Neither inventor left enough information for the inner workings of their device to be discovered. It is thought that both inventions use a bifilar coil connected in flux cancellation mode to create surface domains on an otherwise demagnetised ferrite, these domains being in spatial coherence with the bifilar coil. Other orthogonally wound coils are used to shift the domains in and out of register with the bifilar coil, thus inducing a voltage into that coil. Both schemes are therefore unusual forms of a PM generator.

The high speed aspect of the eddy current generator is extended to cover conventional PM generators that use magnets moving against coils. Using a phasor approach it is shown that at high rotation speeds, where the reactance of the coils are greater than the resistance of the loads, there is a phase shift that places the magnet in a position to come under the influence of a closed circular electric field that "loads" the atomic spins. This simple explanation has evaded conventional thinking but allows generators to behave in an overunity manner, the excess energy being taken from the quantum world that keeps the electrons in a perpetual spin state. Although they don't use rotation but use linear motion of the magnetic domains, the same arguments apply to the Sweet/Manelas devices.

2. Explanation for the Eddy Current Genrator

Consider an endless strip of conductive material moving at velocity **v** over an array of permanent magnets as shown in top and side views in figure 1.

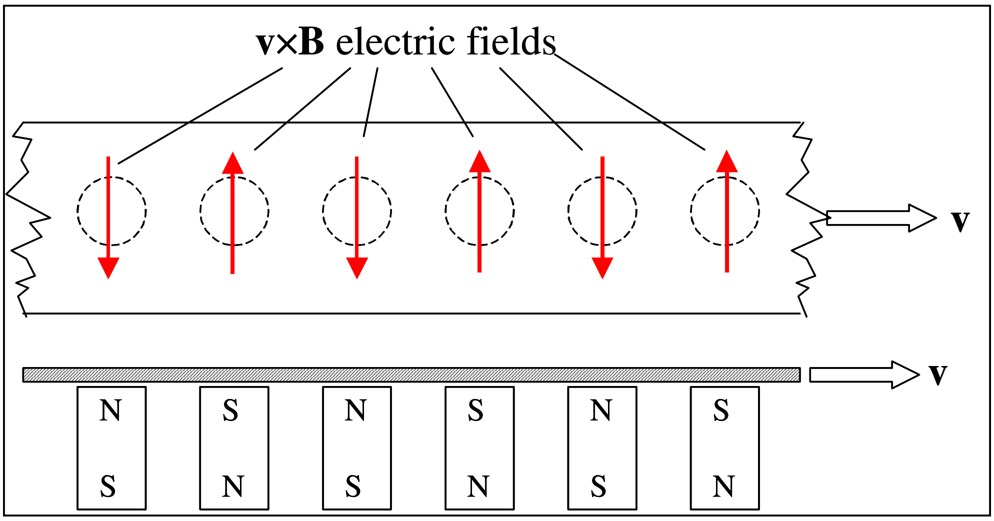

Figure 1. Conductive strip moving across magnet array.

The magnets are sequentially arranged with alternating polarity, hence the induced motional electric fields **E=v×B** have alternating directions above each magnet as shown by the red arrows. At low velocities these electric fields will drive eddy currents within the strip as illustrated in figure 2. Because the strip has finite conductivity energy will be dissipated in the form of heat. The source of that energy flow may be realized when each eddy current loop is viewed as an effective magnetic dipole, also illustrated in figure 2. It can be seen that these dipoles are positioned between the permanent magnets such that they experience a constant force upon them in a direction opposing the motion. Thus the mechanism driving the strip sees an opposing force and has to deliver mechanical power that exactly accounts for the electrical power dissipated in the strip.

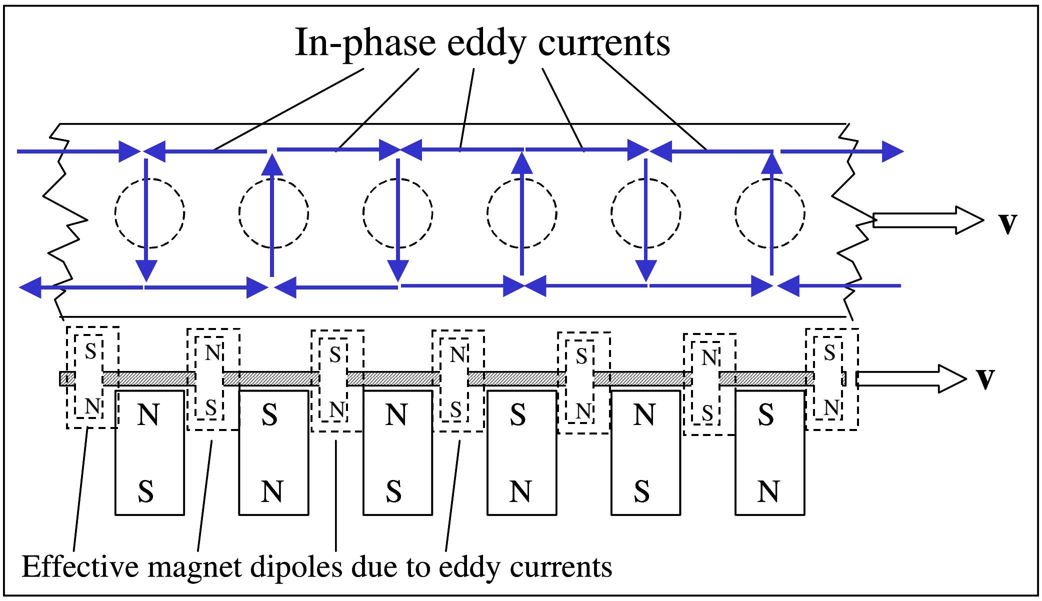

Figure 2. Eddy Currents and their effective magnetic dipoles.

Note that in the fixed reference frame of the magnets these eddy current loops appear fixed and constant, whereas in the moving reference frame of the strip they don't. Perhaps this is more clearly seen by considering an annulus of the strip material that contains one closed eddy current loop, see figure 3.

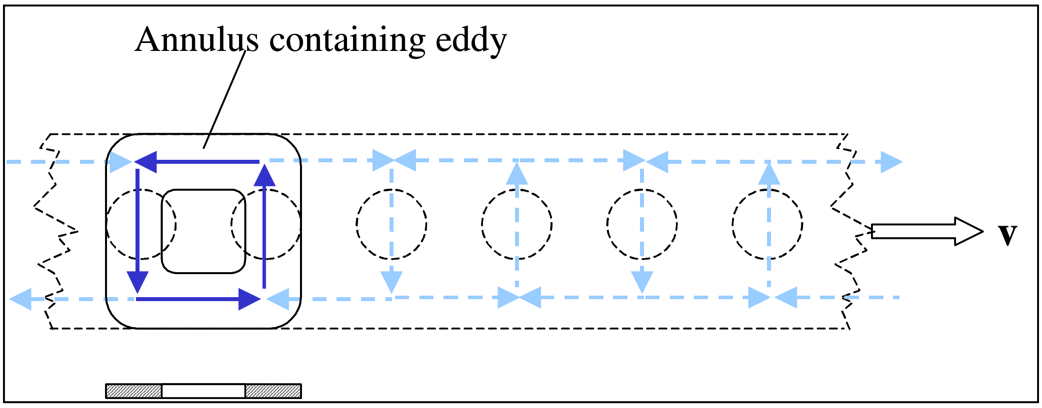

Figure 3. An eddy current annulus

If we examine this annulus a half cycle later we see that it has moved by one magnet separation distance and the eddy current has reversed direction, figure 4.

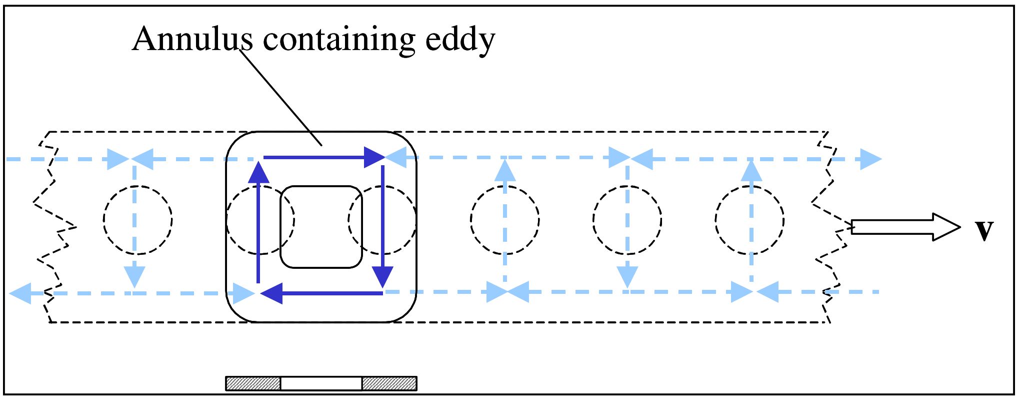

Figure 4. Annulus position after a half cycle.

Clearly within the strip the conditions are cyclic, and this leads to further considerations at greater speeds. It should be noted that the annulus is a single turn loop that has inductance determined by its dimensions, and also resistance due to the finite conductivity of the strip. Hence we have to consider the phase shift between the induced emf and the resulting current. To get a feel for this we can calculate the inductance of a typical and practical annulus of 50mm (2 inch) ID and 75mm (3 inch) OD of 5mm thick Cu. This is in the order of 4×10^{-8} H. The circular resistance is about 3×10^{-5} Ohms, yielding an L/R time constant of 1.33mS. Thus a cyclic frequency of just a few hundred Hz would introduce significant phase shift, and this is easily achievable in a rotating disc system using practical rotation speeds and a small number of magnets.

At a cyclic frequency where the inductive impedance is much greater than the resistance the phase shift between induced emf and current will approach 90°. Under this condition the eddy current loops will be shifted to a new position a half cycle later than that shown in figure 2. This is seen in figure 5 which also shows the new positions of their effective magnetic dipoles.

It is now seen that the eddy current dipoles are positioned directly above the permanent magnets and therefore do not endure any longitudinal force. The load on the mechanical drive has disappeared, yet there is still power dissipation within the strip. The next question is where does that anomalous power come from?

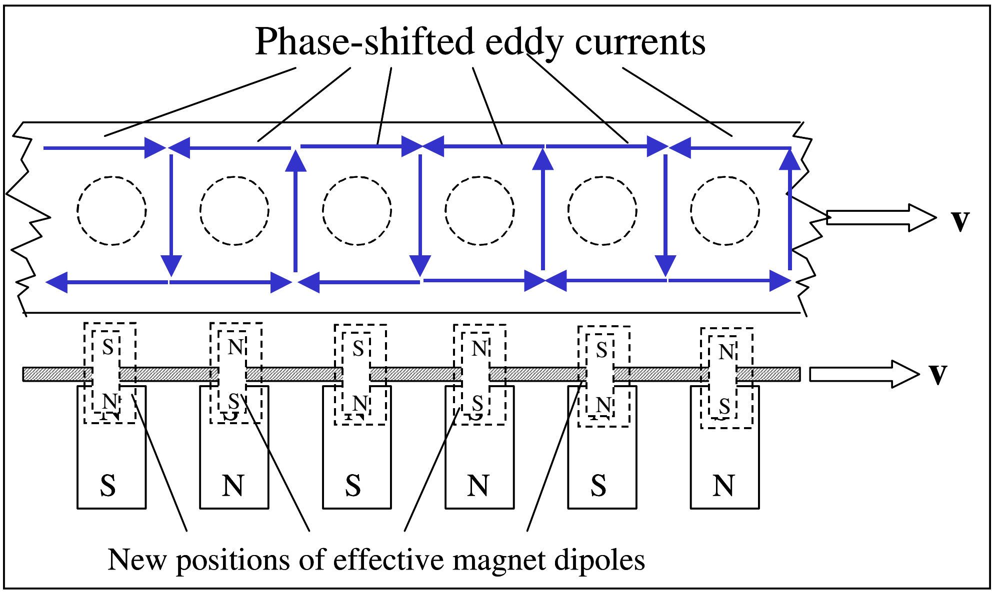

Figure 5. Phase shifted eddy currents

The eddy current loops occur at a phase when the emf drive is near zero, but because of the finite conductivity there must remain a small circular E field as a "voltage drop" around the loop. Put another way, within the strip there will be an E field obeying **E**=**J**σ where **J** is the eddy current density and σ is the conductivity. If that circular E field exists within the strip, it must also exist outside the surface of the disc where it can couple to the permanent magnets. Note that although this closed E field is cyclic within the moving frame of the strip, and is in phase with the eddy currents, in the fixed reference frame of the permanent magnets it is static. Each permanent magnet endures a DC closed E field. Such a closed static E field is unrecognised in contemporary physics, but holds the key for extracting power from the atomic dipoles responsible for magnetism. Its presence is easily seen from the phasor diagram relating current and voltage in a LR circuit, figure 6. Note this relates to the cyclic parameters in the moving frame.

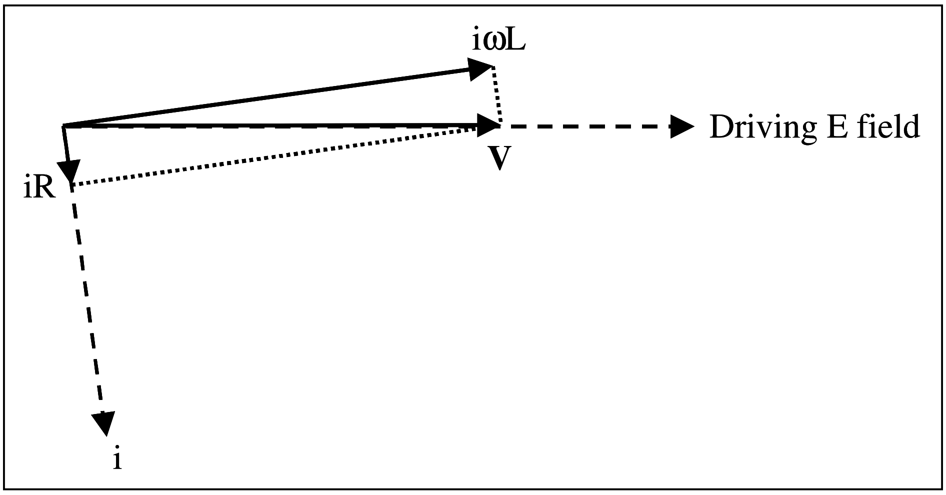

Figure 6. Phasor diagram

The driving **E=v×B** field supplies the voltage V and it is seen that the current and the iR voltage drop both lag by nearly 90°.

Extracting energy from atomic dipoles has been shown to occur within cyclic systems where that energy is clawed back in the next half cycle, the net energy gain over a full cycle being zero. There the closed E field around the magnet came from a changing (cyclic) magnetic field, and it was recognized that to gain net energy a static (DC) closed E field was required. It seems the eddy current disc can supply that condition. There the iR electric field is cyclic within the disc, but becomes static when seen from the fixed reference frame. It should be possible to use this rectification effect in other systems to achieve overunity.

3. Extracting energy from electron spin

One can get an idea on how a magnet can supply energy by considering an electron as a spinning sphere of negative charge. This is shown in figure 7 with a motor driving the spin. The presence of a circular closed static E field supplies force to the volume charge creating a retarding torque to the motor, hence the motor has to deliver mechanical power to the shaft, the retarding torque tries to slow down the spin. In the quantum world that can't happen, hence the quantum motor keeps the spin going and that quantum dynamo supplies the energy.

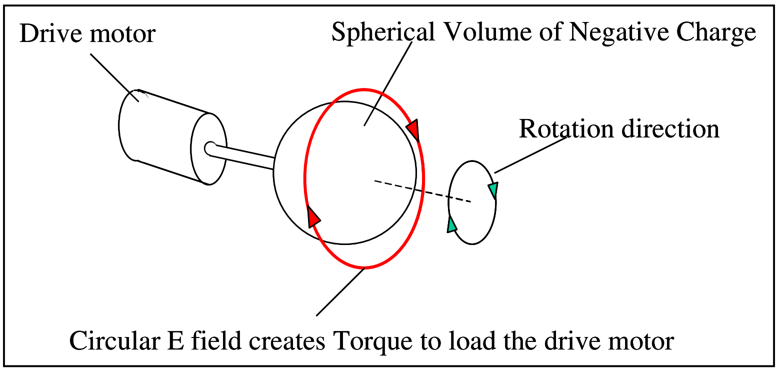

Figure 7. Spinning Charge Model of Electron

4. Application to Conventional PM Generators

Consider a conventional generator where a magnet rotates within a coil, figure 8. At low rotation speeds there is little phase shift between the voltage induced into the coil and the current through the load. The current peak occurs at the magnet shown in figure 8 where the flux through the coil is passing through zero.

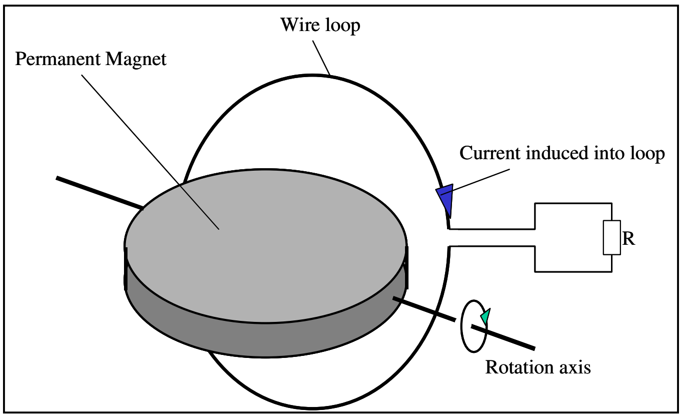

Figure 8. Conventional PM Generator

This is also the position of maximum back-torque supplied to the magnet by the flux from the coil current. Countless dynamic analyses of this condition have shown that the power delivered to the load is exactly accounted for by that back-torque loading the drive motor.

Now consider the situation at high rotation speeds where the reactance of the coil self-inductance L is much greater then the load resistance R. There now exists a phase shift that is best shown by the use of phasors. Figure 9 shows

- The flux phasors where the flux from the magnet and the flux from the coil current add vectorally to create the total flux in the coil.
- The induced voltage from that total flux (and at 90º to it), and the vector components as applied to the series LR circuit.
- The resultant current passing through L and R. Also shown as a broken line is the effective current creating the magnet's applied flux.

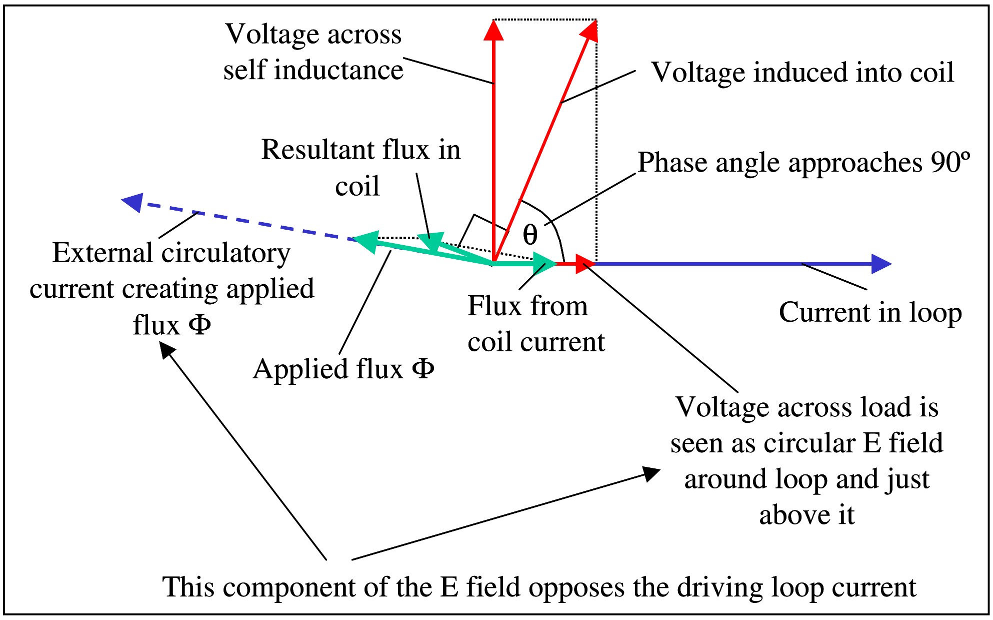

Figure 9. Flux, voltage and current phasors

It is seen that the current through the load is now almost in phase with the flux supplied by the magnet, and this means the magnet position at the peak current is no longer as shown in figure 8, but at 90º to it as shown in figure 10.

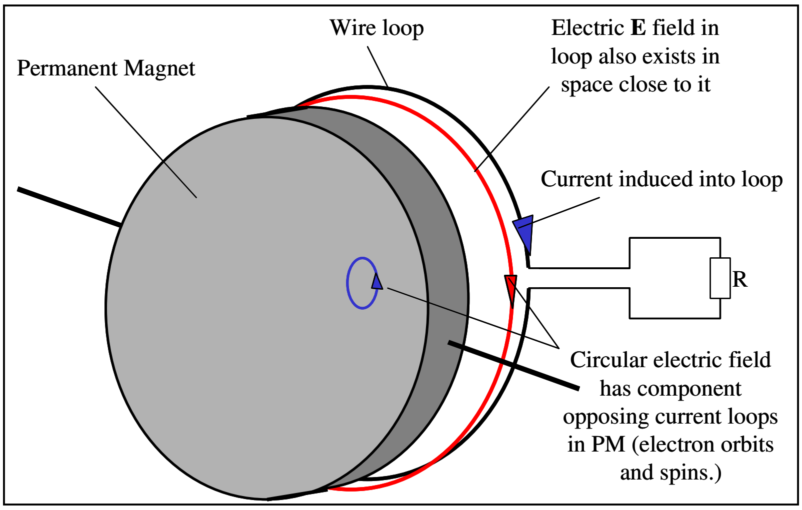

Figure 10. Magnet position at peak load current

This is a position where flux from current through the coil cannot apply much torque to the magnet. At that magnet position the coil is delivering voltage to the load, and what has escaped previous considerations is the fact that in doing so there is an E field within the conductor *which must also exist in the space just outside the conductor*, as shown in figure 10. This is a closed circular E field that is seen by the magnet, and it is in a direction to "load" the electron spins in the magnet. Some energy from those spins is transported to the load. If we had an energized coil there in place of the magnet we would see some energy being taken from that coil, there is a form of transformer coupling to the output coil. A half cycle later the current through the load is reversed, the closed E field is reversed, *but so is the position of the magnet.* Energy is still transported from the electron spins. Unlike transformers where the input coil and output coil are fixed, the rotation of the magnet (input coil) has caused a rectification effect whereby the magnet sees a series of unidirectional closed E fields.

5. Discussion

Such a closed E field having a DC component is the Holy Grail for extracting energy from a PM, and it exists in all classical PM generators. So why hasn't it been discovered before? The answer is that all conventional PM generators have practical limitations of strength of materials and coil resistance that prevent them from operating at high enough speeds to allow the L/R time constant or phase delay to reach the overunity regime. With efficiencies always below unity, and with scientific dogma that says overunity is impossible, there is little incentive to explore this anomalous corner of EM theory. The eddy current generator has shown overunity to be possible because it is a configuration where power is extracted as heat. It is likely that were calorimeter measurements to be taken on more conventional generators driving a low resistance or even a short circuit, where efficiency is low or zero because of "loss" of energy as heat in the coils, these too would be shown to be overunity. Figure 11 shows a shorted coil where its self inductance and its self resistance are distributed around the coil.

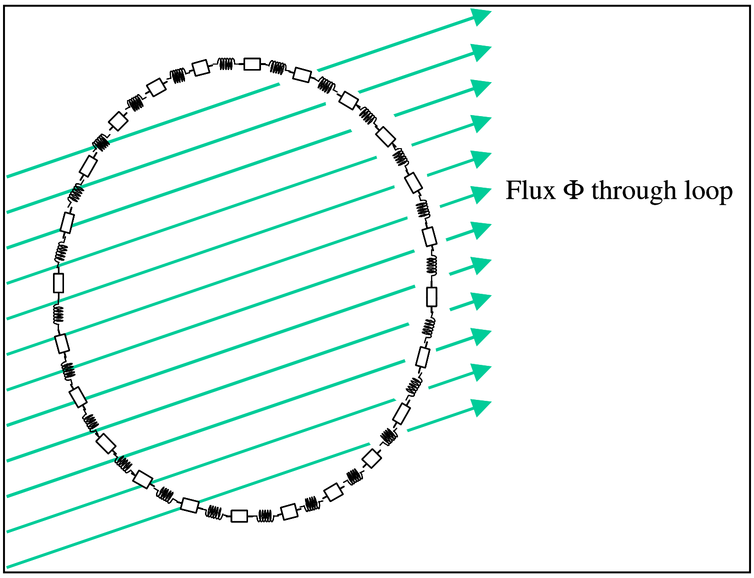

Figure 11. Shorted turn as series of L's and R's

It is easily appreciated that at the peak current position and at high phase delay the voltage across the indicuctors is passing through zero but there exists a voltage drop across the resistors. Thus there has to be an closed electric field around the loop and that also exists outside the loop. The eddy current generator utlizes that feature as depicted in figure 12.

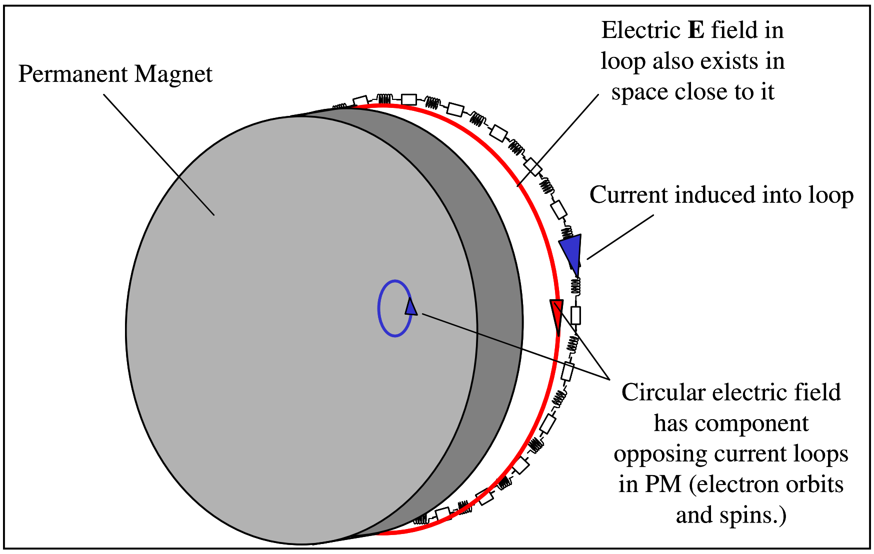

Figure 12. Magnet against eddy current loop

6. Conclusion.

The eddy current generator operates at an overunity regime because the L/R time constant for the eddy current loops introduces significant phase delay. The anomalous energy is extracted from the electron spins in the PM.

The Sweet/Manelas devices are overunity because they do not use mechanical drive and can operate at high flux switching speed such that the L/R delay becomes significant. There anomalous energy is extracted from the electron spins in the moving domains.