Terrestrial electrical energy transfer

Nikola Tesla, in patents US141333 (1914) and US943234, illustrated a method of transmission of electrical energy without wires using the Earth’s resonance frequency as a path of magnetic conductance. This paper will explore this topic by the introduction of a mathematical and experimental model which demonstrates the validity of the concept as well as showing which parts have required further investigation by the creation of the model at hand.

The model is first defined in terms of the circuital elements, a simple Lorentz force on a curved wire, as,



where,  is a quaternion in the form,  STOP

Hence, it must be declared that the current version of Lorentz force law is incomplete because of two historical reasons:

1. The Biot-Savart law was only two-dimensional and who Maxwell himself did not like, and,
2. Maxwell’s equations in quaternion form follow more closely his representations in *Treatise on Electricity and Magnetism,* which were detailed by Larmor (1897, 1900).

To review, consider the currently existing form of the Lorentz force law for a straight wire,  where ℓ is a vector whose magnitude is the length of wire, and whose direction is along the wire, aligned with the direction of conventional current flow *I*. The current is a complex number. In the more relevant case of a curved wire of the antenna,  The torque applied to the edges of the conductor are



where  is the torque,  is the magnetic dipole moment,  is the angular momentum vector,  is the external magnetic field, and  is the gyro-magnetic ratio which gives the proportionality constant between the magnetic moment and the angular momentum, a scalar value. Combined with the Larmor angular frequency,



The total power radiated by an antenna is given by Larmor,



NEED SUM MORE TO MAKE THE CONNECTION.

Unfolding the matrices and write the latter in terms of the matrix cross-product:



We see that for the Lorentz force law the magnetic field is a tensor with three independent components:



This is an anti-symmetric tensor whose diagonal elements are zero. This makes Lorentz force not to possess parallel component. The tensor magnetic field [𝑑𝑴] with nine degrees of freedom is more general than the vector magnetic field that has only three. This is why the corrected magnetic force law can describe complicated phenomena like parallel and perpendicular action and macroscopic Aharonov-Bohm effect while the Lorentz force law cannot.

My parallel and perpendicular actions and macroscopic Aharonov-Bohm effect experiments have shown new type of magnetic force that the Lorentz force law cannot explain. The corrected magnetic force law that I propose explains well the new phenomena. This law expresses the magnetic force that two (complex) current elements  and  (which, with dot product become a quaternion) act on one another, as,



shown in Fig.1.

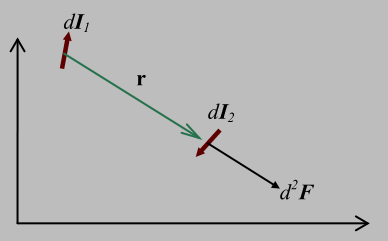


Fig.1.Some words to describe this figure.

This law states that the magnetic force between two (complex) current elements lies on the radial vector  but not perpendicular to the current. Its intensity is inversely proportional to the square of the distance. So, this law is an inverse square law like Coulomb’s law. At the place of charges’ product is the scalar product of the two (complex) current elements. This means that the intensity of the magnetic force varies as the cosine of the angle made by the two (complex) current elements. When the two currents are in the same direction, they attract; when they are opposed, repulse. When they are perpendicular no force arises. For closed loops, this law gives the same values as the Lorentz force law.

The Lorentz force law expresses Lorentz force as the cross product of a current element and the local magnetic field. The corrected magnetic force law must also be a product of current element and magnetic field. For finding this expression, we expand the three vectors,  of , as,



Then, we write the product of the three vectors in matrix form:



Where the dot product of the last two matrices are expanded into a 3x3 matrix:



Then, 1.1 is presented in full matrix form:



The quantity between the braces is a square matrix named 



Finally, the magnetic acceleration force  (velocity-vortex because it is tangential) is expressed into the product of the line matrix and square matrix 



where  is the differential current element that feels magnetic force and is the local magnetic field, which is now a tensor by its unfolding earlier in the paper.

Compute the sequence of equations and demonstrate they are well-fit to the antenna model.

**A set of equations to show utility in using the above notation to describe the system**

Based on Kirchhoff’s circuital laws, the relationship between these elements is



Representing the complex current,  as 



and the angular frequency,  as  (5) is transformed to

 (6)

which takes the form of the equation for a mass on a string

 (7)

In terms of a real circuit, the value of resistance, regardless of the size, is included as

 (8)

The implicit solution for the oscillations in the circuit, in terms of charge, 

 (9)

where  is the maximum charge on the capacitor, and  is the phase. Maximum current at any arbitrary point is

 (10)

and the first-order angular frequency, from (9), is

 (11)

The total energy oscillating in the circuit is therefore a component of the capacitance, inductance, and resonance frequency dependent upon the polarisation of the material comprising the loop. If the phase between the capacitor and inductor are offset by 90 degrees, the stored energy in each component is expressed as

 (12)

while the total energy stored by the oscillation is

 (13)

In consideration of velocity, the circuit is an oscillatory, second-order system

 (14)

where the force coefficient,  is the sum of the amplitudes,

 (15)

governed by polynomials expressed by the oscillator,

 (16)

where the  component is for the first cycle in  and  for the second cycle of  illustrated in Fig. 4. The force following from the sum of amplitudes of the under-damped system at the damping ratio of  sustains oscillations to a transient solution, 

 (17)

which converges to a steady-state solution of the form,

 (18)

where its derivatives are

 (19)

**Proof**

A computational model.

**Remarks**

Words.

**Errata**

As my experiments have confirmed, real magnetic field is a tensor field. Maxwell’s equations use only vector and must be amended. Maxwell has invented a quantity called displacement current in vacuum to keep his equations coherent. Then he used it to derive the wave equation. The tensor nature of magnetic field invalids Maxwell’s equations; my paradoxes invalidate displacement current in vacuum. So, electromagnetic wave equation will also be invalidated.

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