ELECTROMAGNETIC INDUCTION AND ITS PROPAGATION

by Eric P. Dollard

http://ericpdollard.com

This paper is part of the notes that are part of Eric's upcoming presentation at the **2014 Energy Science & Technology Conference** is The ***Extraluminal Transmission Systems of Tesla & Alexanderson***. The conference has limited seating so learn more about this amazing event and register at http://energyscienceconference.com

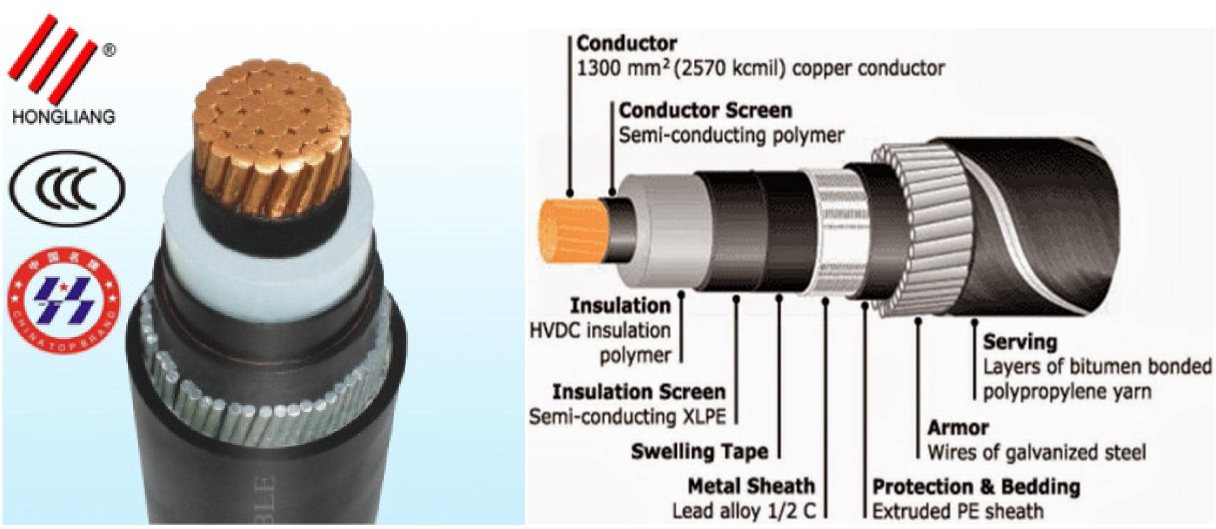
This document is posted at Energetic Forum in the Official Eric Dollard forum here: http://www.energeticforum.com/eric-dollard-official-forum

Electromagnetic Induction And Its Propagation

(1) To transmit electrical energy in an electromagnetic form from one location where it is produced to another location where it is consumed, an electric circuit is required. This circuit is a metallic-dielectric structure, the metallic commonly called the "conductor" and the dielectric commonly called the "insulator."

Electrical Conductor
http://image.made-in-china.com/2f0j00cBdQtRkCgbfW/Flexible-Electrical-Wire-with-PVC-Insulation-Copper-Conductor.jpg

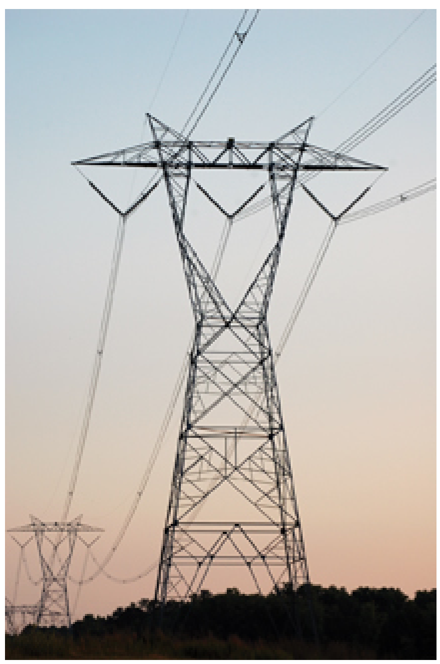
Electric Insulator
http://upload.wikimedia.org/wikipedia/commons/b/be/Medium_voltage_ceramic_standoff_electric_insulator_-_20060530.jpg



Coaxial Metallic Dielectric Geometry Consisting of Insulator & Conductor
http://image.made-in-china.com/43f34j00kvEtgwYhYFuV/11KV-Copper-Aluminum-Conductor-PVC-or-XLPE-Insulated-Electric-Cable.jpg

Electrical Insulator

http://4.bp.blogspot.com/-r3eL78siiWM/TeAQpM1dm_I/AAAAAAAAAFs/qlm6TsS2mms/s1600/9ee1_2.JPG



Electrical Transmission System

http://www.astm.org/SNEWS/MA_2010/images/enright_tower.jpg

Open Wire Metallic Dielectric Geometry Consisting of a String of Insulators & Paralled Metallic Conductors

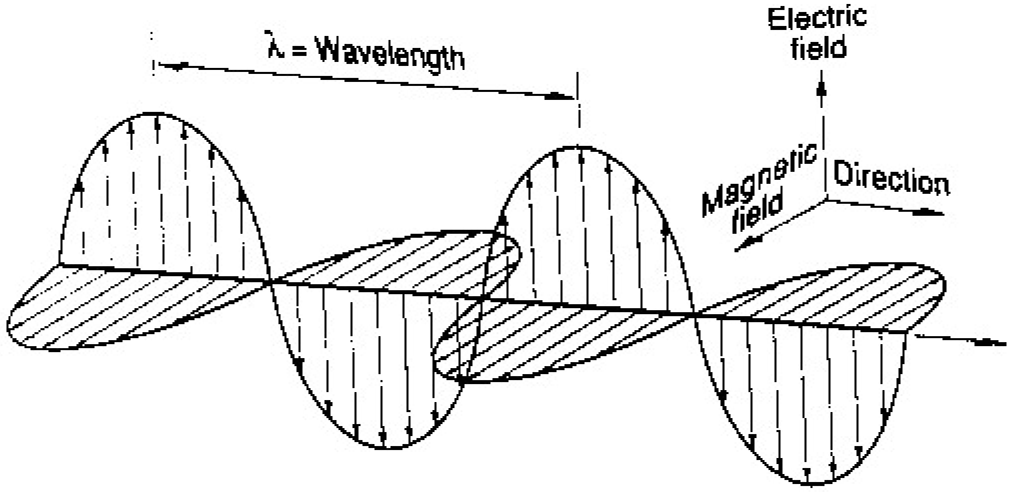
http://upload.wikimedia.org/wikipedia/commons/3/33/Pylon.detail.arp.750pix.jpg

Open Wire Metallic Dielectric Geometry

http://cdn2-b.examiner.com/sites/default/files/styles/image_content_width/hash/28/c7/28c7def6097c93943409252a73b0b177.jpg?itok=EMH8ai3N

These exist to create a boundary which confines the electric energy, in its electromagnetic form, to the enclosed space. This is known as the "Electromagnetic Boundary Condition" and it facilitates the existence of a guided electromagnetic wave. In general terms the electric circuit can be called a "waveguide." The guided electromagnetic wave is the subject presented in the writing to follow, that is, the theory and practice of the guided transverse electromagnetic wave. Here, electromagnetic energy exists in its most fundamental form.

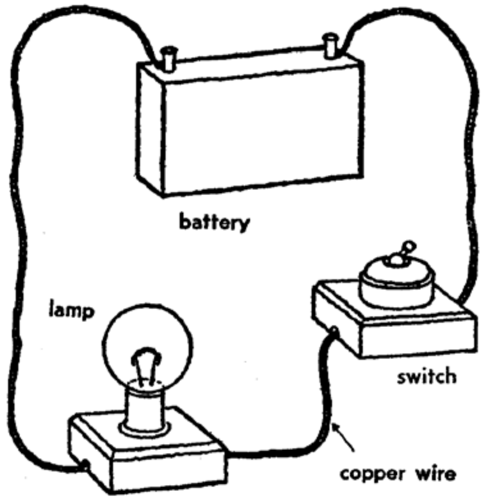
The structure of electromagnetism is a space quadrature union of magnetic induction with dielectric induction, both transverse to the direction with which the transmitted energy propagates. This quadrature relation engenders the electromagnetism and its propagation from the point of supply to the point of demand. This propagation is in space quadrature to the fields of induction that gave rise to it.



Space Quadrature Configuration
http://sunearthday.gsfc.nasa.gov/2010/images/ttt71-fig4.jpg

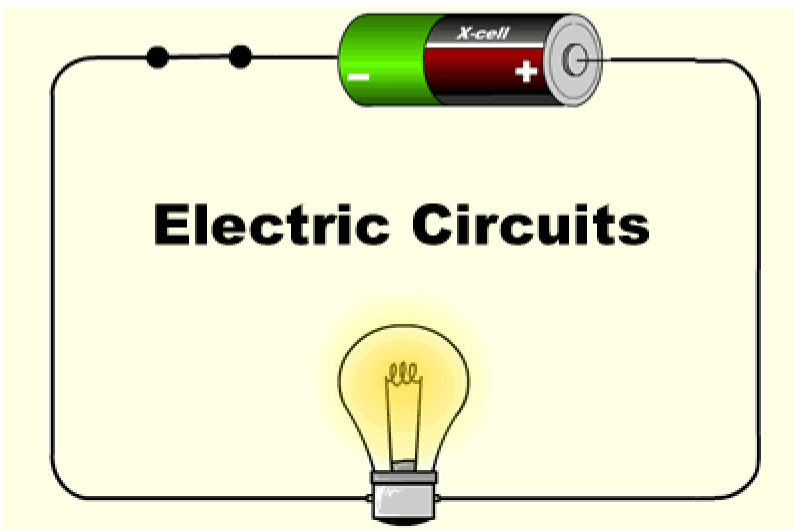
The propagation of energy in an electromagnetic form finds its existence within the space surrounding the metallic "conductors." This space is called the dielectric medium and is the seat of electromagnetism.

The metallic structure establishes the electric circuit, but it does not directly convey the electromagnetism. This metallic structure is wrongly called the "electric conductor," but its actual function is to define a closed loop. This loop serves to confine, or "bottle," the electromagnetic energy in the dielectric space enclosed by the system of conductors.



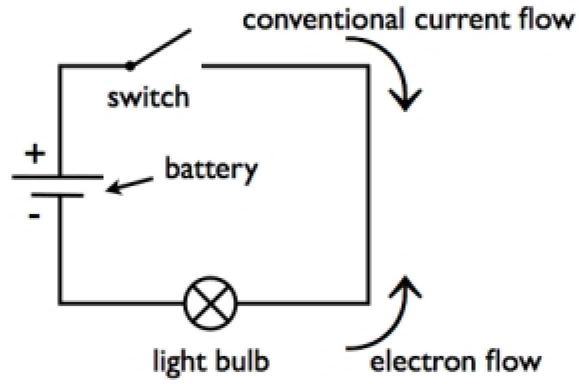
Electric Circuit

http://4.bp.blogspot.com/-VrV3p8Dp9AM/T1EUkB7FBWI/AAAAAAAAAFA/JoP3uk2lRNQ/s1600/electric%2520circuit.gif



Electric Circuits

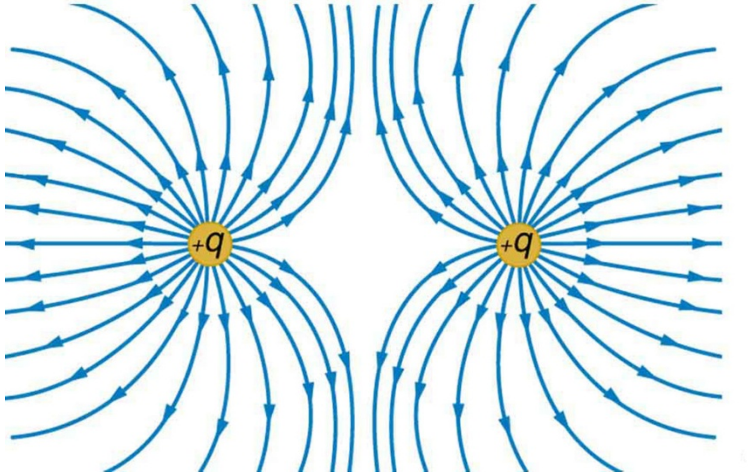
https://hwb.wales.gov.uk/cms/hwbcontent/Shared%20Documents/vtc/learnpremium/electric_circuits/eng/Introduction/circuits.gif



Schematic Diagram of Electric Circuit
http://www.rkm.com.au/ANIMATIONS/animation-graphics/circuit-diagram.jpg

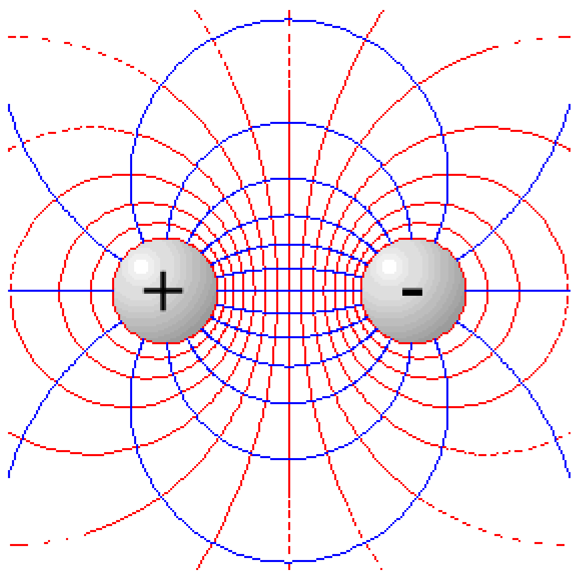
In general, the number of conductors which form the electric circuit is dependent upon the number of poles, or phases, of the electrical system. It is however that at least two conductors must be present in order to form a closed loop, that is, a closed circuit. This can be seen as a single conductor closed upon itself somewhat like a rubber bank. Breaks in this circuit can serve as entrance and exit points for the transmission of electromagnetic energy. For the condition of no breaks in the electric circuit, it is known as a "short circuit." An open break, unconnected, will interrupt the flow of electromagnetic energy completely and this is known as an "open circuit." Containment is not possible with an open loop, this is analogy with a hole in a tank.

(2) Various physical forces are exerted upon the metallic conductors which define the electric circuit. These forces arise from the actions of the magnetic and dielectric fields of induction existing in the dielectric space surrounding the metallic conductors. These fields constitute the bound electromagnetism, or what may be called the "Electromagnetic Induction." This is also known as an "electric field."

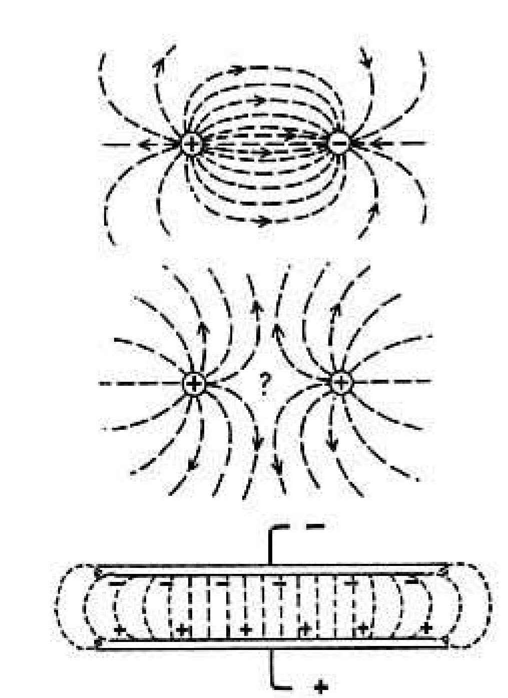


Electrostatic Field in a Non-Electromagnetic Form
http://i.stack.imgur.com/pNHut.jpg

The electric field is the composite of the magnetic field of induction and the dielectric field of induction, these being bound by the electric circuit. In general not all of this electric field takes part in the electromagnetic union, but part of one or the other is left over.

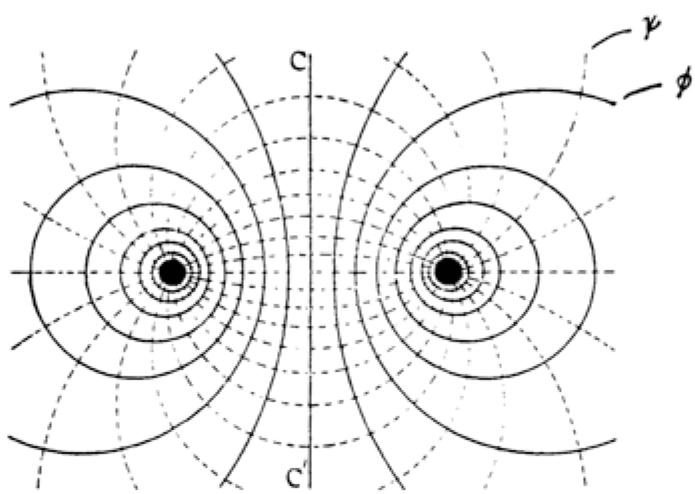


Electric Field & Electromagnetic Form
http://www.dannex.se/theory/pict/image122.gif



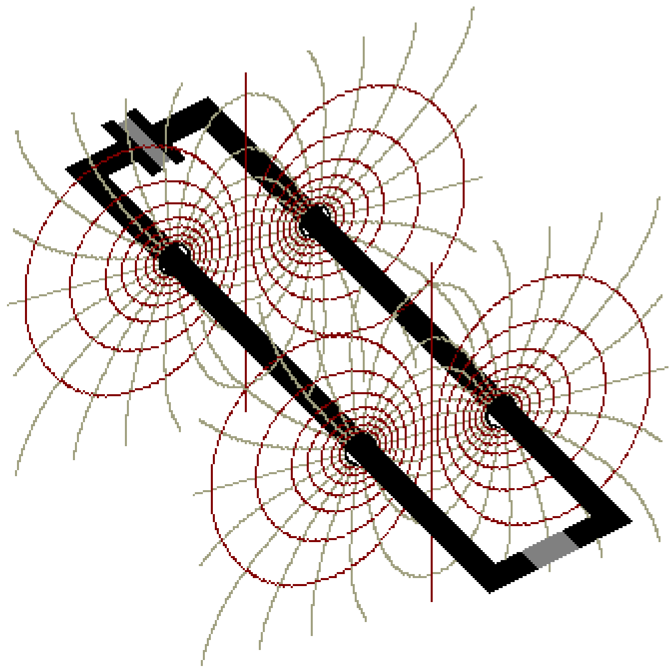
Longitudinal and Transverse Dielectric Fields

http://www.nuffieldfoundation.org/sites/default/files/images/Electric%20fields3_516.jpg

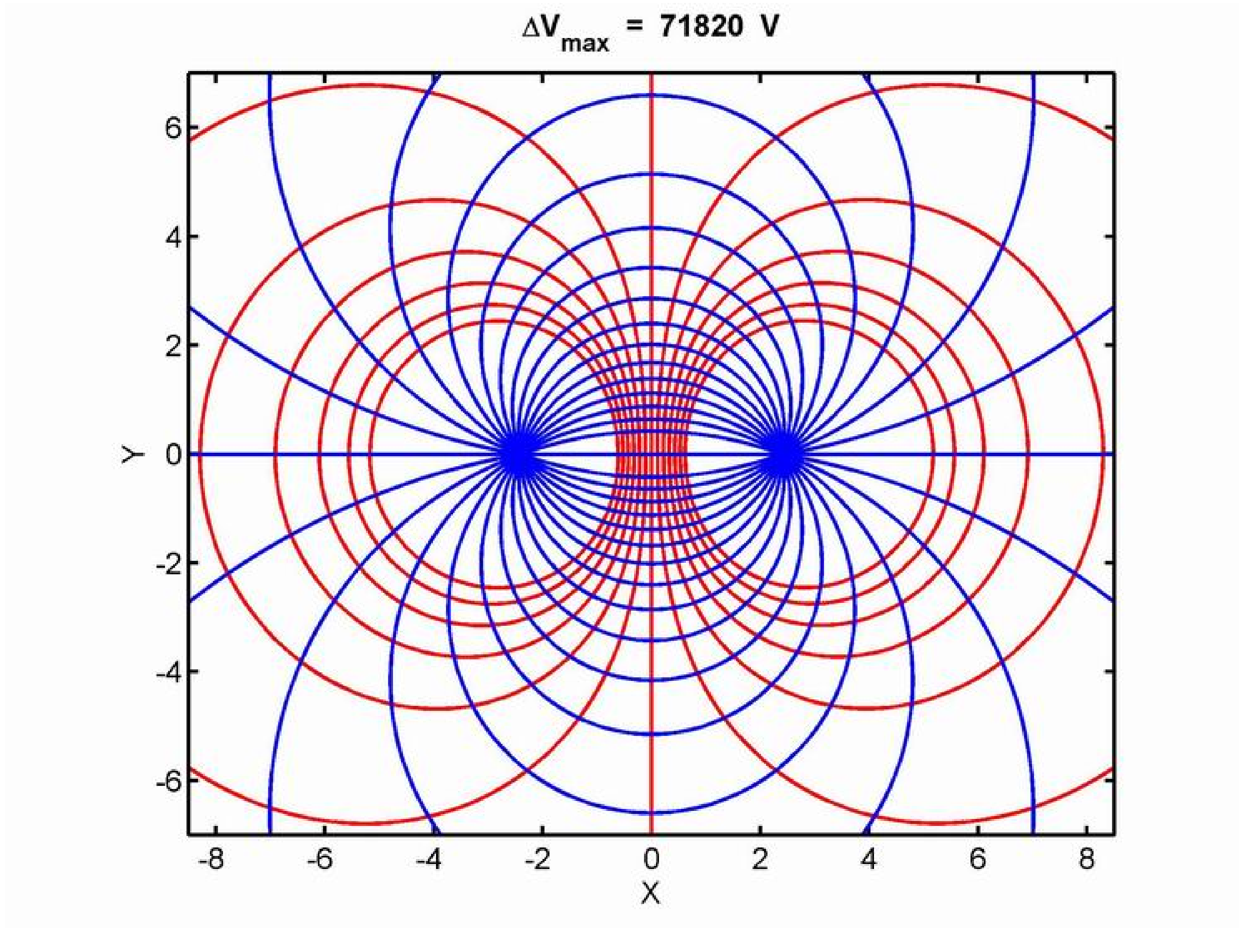


The Electrical Field Between Conductors Consisting of the Magnetic Field as Circles and the Dielectrical Field as Radial Lines – The Crossing Points Constitute Plancks – The Black Dots are the Wires

http://www.gestaltreality.com/wp-content/uploads/2011/11/Dielectric-and-Magnetic-Flux-Lines-2.png

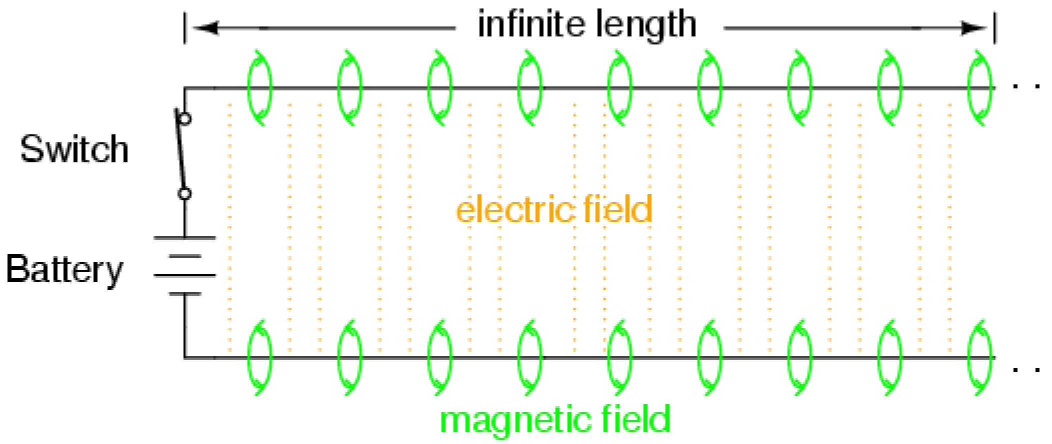


The Electric Field of the Electric Circuit
http://amasci.com/elect/poynt/voltagef.gif

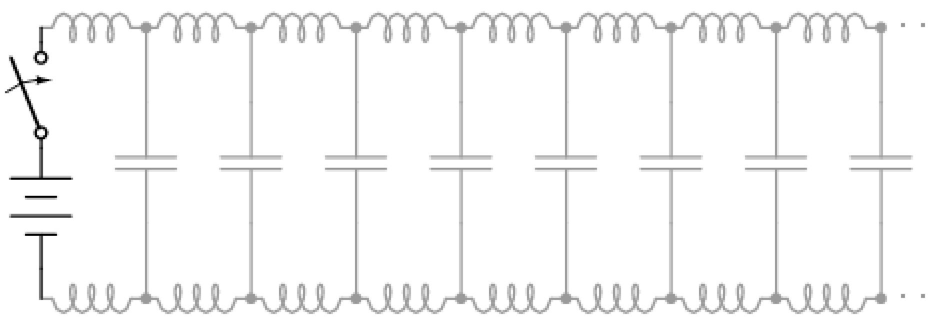


The Electric Field – Red is Magnetic, Blue is Dielectric
http://digilander.libero.it/web908/campogrande.jpg

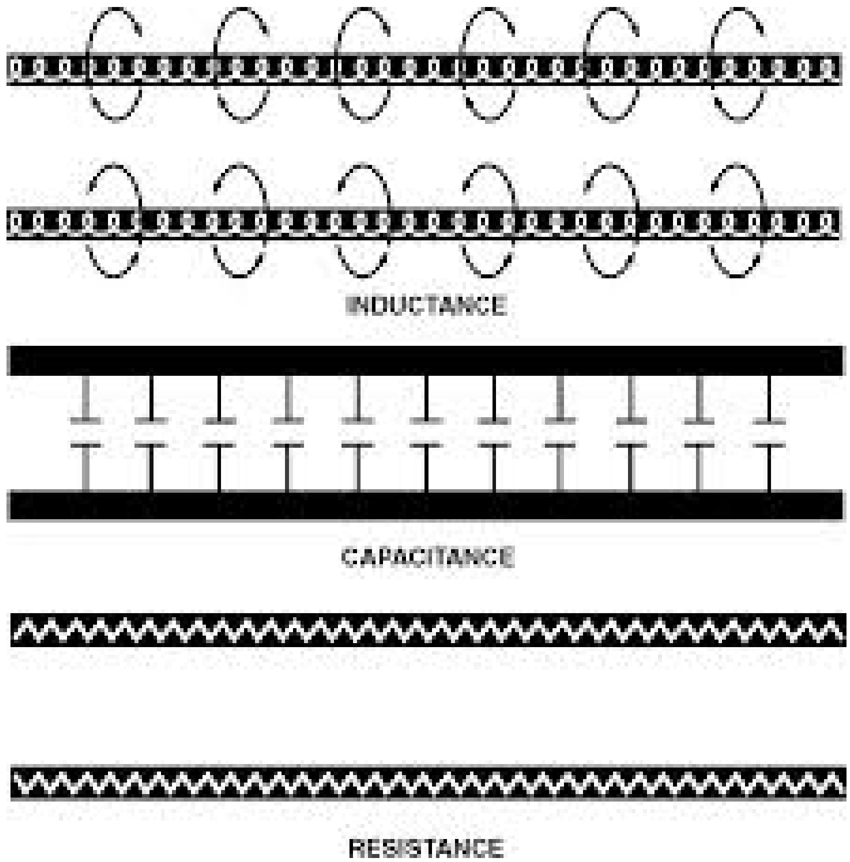
The magnetic field of induction forces against the metallic structure is an expansive manner. It pushes the conductors apart so as to increase the space which they bound. This in turn allows for an increase in the ability of the circuit to store magnetism, that is, potential energy in a magnetic form.



Electric Field Between Conductors – Orange is Dielectric, Green is Magnetic
The Dielectric Field is Incorrectly Called the Electric Field in this Diagram
http://sub.allaboutcircuits.com/images/02358.png



Schematic Representation of the Electric Field of the Electric Circuit, in terms of Capacitance and Inductance, The spirals are Inductance and the Parallels are Capacitance
http://sub.allaboutcircuits.com/images/02360.png



https://www.google.com/search?q=wardenclyffe&client=firefox-a&hs=n0Q&rls=org.mozilla:en-US:official&channel=sb&source=lnms&tbm=isch&sa=X&ei=TpsKU4fpC8P4oASNwIL4DA&ved=0CAcQ_AUoAQ&biw=1440&bih=686#channel=sb&q=capacitance+of+transmission+line&rls=org.mozilla:en-US:official&tbm=isch&tbs=isz:lt%2Cislt:xga&facrc=_&imgdii=_&imgrc=XlwiWeFz6sx2uM%253A%3BSSi4f1qC7edHMM%3Bhttps%253A%252F%252Frdl.train.army.mil%252Fcatalog%252Fview%252F100.ATSC%252F8594DF18-D94D-432C-823B-7D40C4B4BE4A-1274317197310%252F9-64%252FImage340.gif%3Bhttps%253A%252F%252Frdl.train.army.mil%252Fcatalog%252Fview%252F100.ATSC%252F8594DF18-D94D-432C-823B-7D40C4B4BE4A-1274317197310%252F9-64%252Fchap3.htm%3B1130%3B1146

Conversely, the dielectric field of induction forces itself upon the conductor in a contractive manner. It draws the conductors together so as to decrease the space which they bound. This in turn allows for an increase in the ability of the circuit to store dielectricity, that is, potential energy in a dielectric form. Here exists a condition of "counterspace" where a smaller space holds a greater quantity of induction. The concept of counterspace is important in understanding the relations of the electric field.

The forces exerted upon the bounding conductors are not directly related to the flow of the energy within the bounds of the electric circuit. These physical forces are brought about by an imbalance in the proportionality of magnetism and dielectricity in relation to the electromagnetic energy propagation. These forces arise from a preponderance of one field of induction over its complimentary field of induction. When the magnetism predominates the conductors are pushed apart, where the dielectricity predominates the conductors are pulled together. This excess of magnetism, or excess of dielectricity, is that induction not taking part in the electromagnetic union of the two field components.

Each electric circuit has its own unique proportion, or ratio, of magnetism to dielectricity which gives a balanced union, that is, where all the magnetic induction and all the dielectric induction take part in the process of electromagnetic propagation. This ratio is dependent upon the geometry of the electric circuit, such as conductor size or spacing. This is a natural proportionality and is commonly called the "Natural Impendence" when expressed in terms of the magnetism, or the "Natural Admittance" in terms of the dielectricity. These are natural characteristics of any electric circuit.

When the magnetic induction and the dielectric induction exist in this balanced, or natural, proportion all the magnetism is united with all the dielectricity. Neither exist in any excess, thus the expansive magnetic forces cancel the contractive dielectric forces. Here a condition balance exists with push and pull, so no net forces are exerted upon the bounding metallic conductors. In this condition it is said that the impedance of the electric circuit is matched to the impedance of the supply and demand of energy into and out of the electric circuit.

(3) The product of the magnetic field of induction and the dielectric field of induction is directly related to the flow of electromagnetic energy in the guiding electric circuit. Here defines the union of the two complimentary fields of induction, and this product as a quantity will be given the name "Planck" after Max Planck, the discoverer of this quantity. This is the most fundamental unit of electromagnetism and is that part of the electric field united into this electromagnetism.

frequency of radiation, sometimes written as f giving expression E = hf.

$$E = h\nu$$

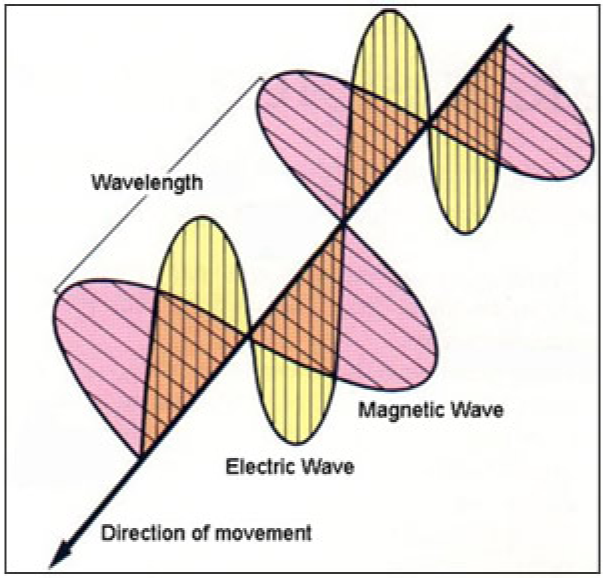
Quantum energy of a photon.

h = Planck's constant = 6.626×10^{-34} Joule·sec = 4.136×10^{-15} eV·s

Einstein's Definition of the Planck

http://hyperphysics.phy-astr.gsu.edu/hbase/imgmod/plnck.gif

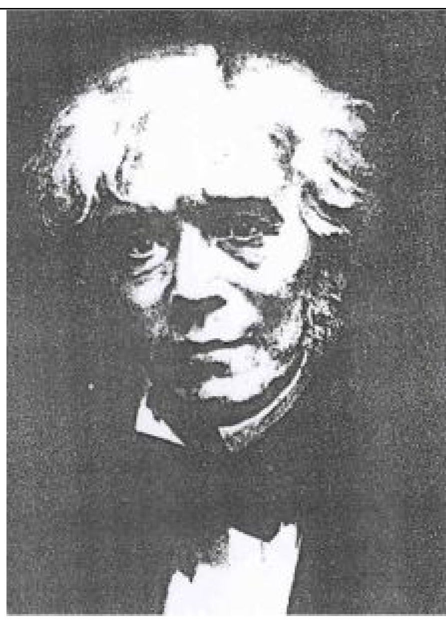
Each discrete, or unit value, Planck is the union of one distinct unit of magnetic induction with one distinct unit of dielectric induction.



The Unit Plancks

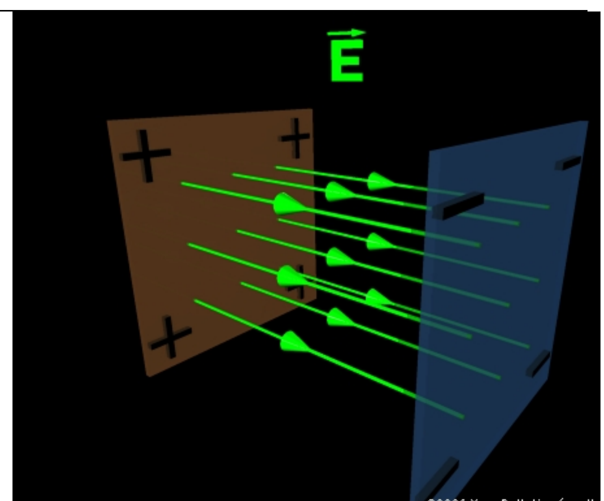
http://light.physics.auth.gr/images/enc/emwave.jpg

The unit of dielectric induction is defined in terms of what are known as "Faraday Tubes," these existing as formations in the Aether. All tubes individually are of the same size, and these also relate to equivalent units of magnetism.



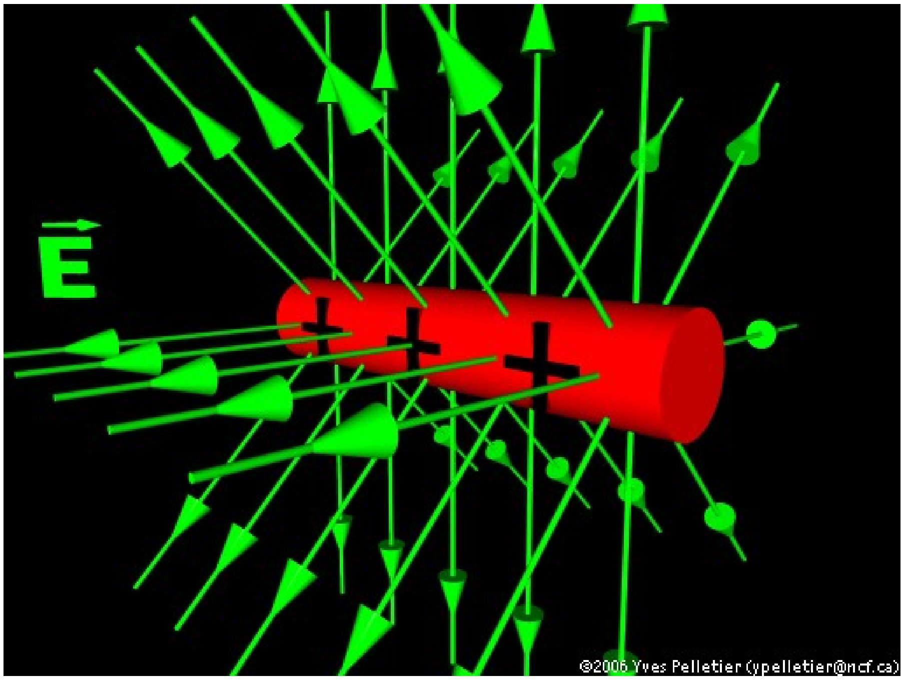
Michael Faraday

http://physics.tcd.ie/Magnetism/Guide/Magnetism/faradayb.jpg



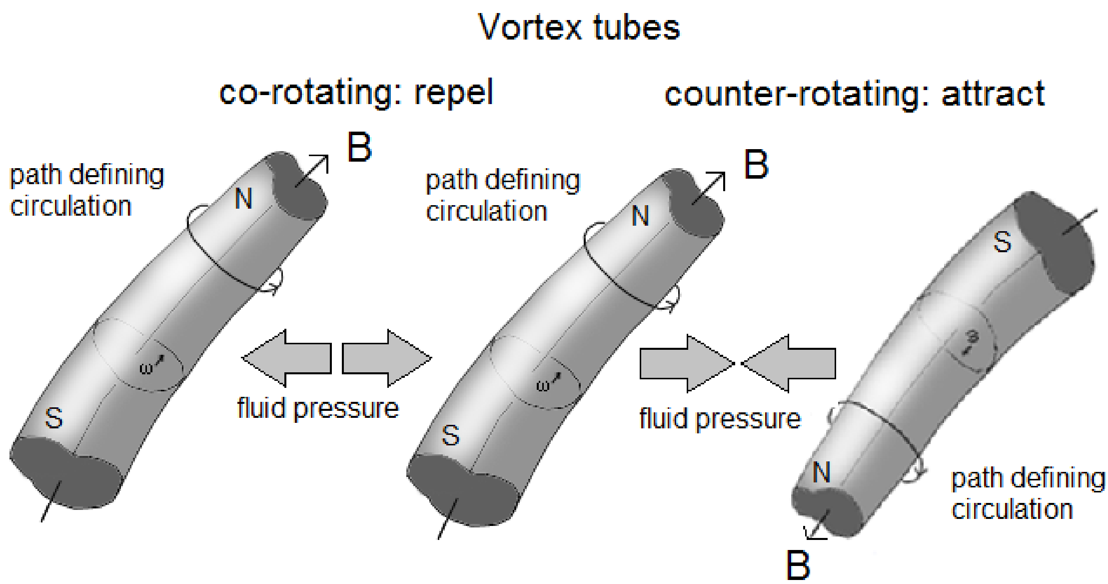
Faraday's Tubes of Force

http://web.ncf.ca/ch865/graphics/EFld2Plates.jpeg



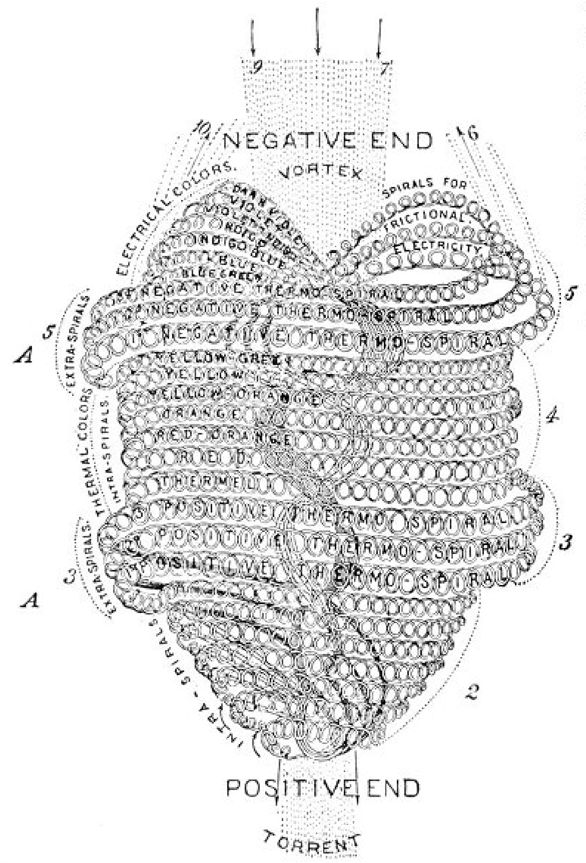
Faraday's Lines of Force on a Conductor
http://web.ncf.ca/ch865/graphics/EFldChargedCylinder.jpeg

Atom Composed of Faraday Tubes
http://1.bp.blogspot.com/_I6sqljFZpGw/Ssjn9h1UpvI/AAAAAAAAAKY/JGMu0pvkr24/s320/RiemannSphere.jpg



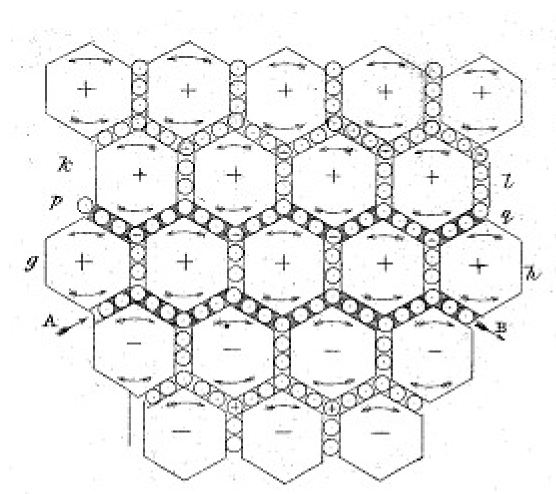
Faraday Tubes

https://www.google.com/search?q=electric+field&client=firefox-a&hs=Vik&rls=org.mozilla:en-US:official&channel=sb&source=lnms&tbm=isch&sa=X&ei=34wKU5qtK9HaoATiz4DYAQ&ved=0CAkQ_AUoAQ&biw=1440&bih=686#channel=sb&q=faraday+lines+of+force&rls=org.mozilla:en-US:official&tbm=isch&facrc=_&imgdii=_&imgrc=EK-cQ-dNhK3uDM%253A%3BjHeM4AeBwB_GCM%3Bhttp%253A%252F%252Fwww.conspiracyoflight.com%252FLorentz%252Fmag2.png%3Bhttp%253A%252F%252Fwww.conspiracyoflight.com%252FLorentz%252FLorentzforce.html%3B717%3B341



The Faraday Corpuscle of the Aether

http://www.sacred-texts.com/eso/sta/img/01300.jpg



Maxwell's Cellular Aether

http://www.guspepper.net/electro/Primer%20semestre/James%20Clerk%20Maxwell%20%281831-1879%29_files/vortices.jpg

The Planck, as a product of magnetic and dielectric induction, is a natural relationship, as is the ratio of the magnetic and dielectric inductions, the natural impedance. This product gives rise to a "Natural Velocity" of the electric circuit. Where it is such that the natural impedance (or admittance) is a function of circuit geometry, the natural velocity is a function of the material from which the electric circuit is constructed, both the metallic and dielectric. In general the natural velocity is <u>independent</u> of the circuit geometry, conductor ,size, spacing and etc.

This natural velocity is often wrongly considered to be the velocity of light, however, in that reality it can never reach that speed but can only be made to approach it asymptotically. The natural velocity is necessarily slower than luminal velocity. For conditions of extremely low frequency the departure from luminal velocity can be quite remarkably, it being but a small fraction of the speed of light. Conversely, for extremely high frequencies the natural velocity becomes very nearly equal to the luminal velocity which would exist in the dielectric medium that is enclosed by the conductors. In this high frequency condition the behavior of the dielectric to light becomes the dominant factor in determining the natural velocity.

Hereby described are the two principle relations of electromagnetic energy transmission, the natural impedance and the natural velocity. From these two relations the character of the electromagnetic propagation can be defined.

(4) In the conveyance of the electromagnetic energy from the point of its production to the point of its consumption, a certain amount of this energy does not arrive at the distance point of consumption. Some of this energy is stored in the electric field contained by the bounding electric circuit, and in this condition it exerts physical forces upon the bounding conductors. Some of the electromagnetic energy is lost into the material substances which constitute the metallic-dielectric geometry of the electric circuit. Here it is converted into the un-recoverable energy of heat. Finally, some of the electromagnetic energy escapes the electromagnetic boundary and it becomes lost to space, never to return.

Storage, heating and escape are considered as transmission impairments. Every attempt is made to minimize their actions in the electric circuit propagating energy in its electromagnetic form.

In common terms the storage is known as the "Reactance" in Ohms of the electric circuit. The heating is commonly known as the "Resistance" in Ohms of the electric circuit. The escape is commonly known as the "Radiation" in Ohms of the electric circuit.

Since a complimentary pair of fields of induction exist, the magnetic and the dielectric, each transmission impairment can exist as a pair of conjugate forms. Hence storage in magnetic form exists as a reactance in Ohms, but conversely storage in dielectric form exists as a "Succeptance" in Siemens.

Likewise heating in dielectric form exists as a "Conductance" in Siemens in distinction to heating in magnetic form as a resistance in Ohms.

Where it is understood that the escape of energy into external space is radiation, the conjugate escape of energy into internal, or counterspace, is not defined nor is it considered at all. In fact any relations regarding dielectric induction are completely ignored and relegated to denial. The escape of energy involves the concept of "Hysteresis," a time displacement between cause and effect, this distorting the relations of the electric field of inductions.

(5) In quantitative terms the calculation of the escape of energy into space via radiation is most difficult to express analytically. In general the rate of energy loss into space is in proportion to the square of the frequency of the electromagnetic energy, but for certain geometries this relation no longer holds true. For very high frequencies, the loss via radiation is considerable.

Lack of physical symmetry in the structure of the electric circuit greatly enhances the ability of energy to escape via radiation. The loss of energy is greatest for a single conductor which exists in isolation with respect to other related circuit conductors, at which point guided electromagnetic propagation ceases to exist. Such an isolated conductor is known as an "Antenna" and is said to radiate electromagnetic waves into free space. In this condition the loss of energy is in direct proportion to the frequency of the electromagnetic energy.

The calculation of the loss of energy by its conversion into heat also offers difficulties, this because of the distortion caused by the material substances engendering the loss to heating. Where it is that energy loss by escape is a function of the circuit geometry, the energy loss by heating is primarily a function of the material which constitutes the electric circuit.

The rate of energy loss due to heating is in proportion to the square root of the frequency of the electromagnetic energy. This represents a non-linear function and thus serves to distort the electromagnetic propagation. Most pronounced in this effect are magnetic materials such as iron. To calculate the rate of energy loss via heating published tables giving the specific resistive and conductive constants of the metallic and dielectric substances must be employed. In general the loss due to heating in minimum when the metallic material is completely reflective, and the dielectric material is completely transparent, these to the flow of electromagnetic energy. The propagation in this case is akin to that of light.

In this ideal condition the electromagnetism is entirely confined to the dielectric material and is excluded from the metallic material. The notion of a so-called "conductor" vanishes and the metallic serves only to confine the electromagnetic energy to the bounded space. This gives an ideal electromagnetic boundary condition, this existing in situations of very low metallic resistance, or very high frequency.

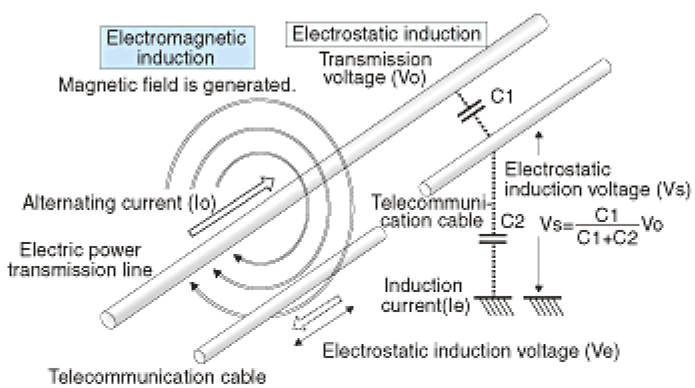
Energy loss via heating is much more difficult to minimize than the energy loss via escape. Heating losses are usually the dominant transmission impairment, and it constitutes the principle economic consideration.

In quantitative terms the calculation of the stored energy offers the least difficulty in its analytical expression. The functions involved are basic and offer no distortion to propagation. Here the energy is not lost but is stowed away in a potential form. It is returned to the points of production or consumption, but this return is displaced in time with the desired electromagnetic induction. This causes the electric field to be greater in magnitude than that required for the electromagnetic propagation, thus increasing the rate of energy loss via heating and escape. It interferes with the electromagnetic process.

Energy storage is a consequence of impedance mismatch between the natural impedance of the electric circuit and the impedance of the points of production or consumption. In this condition not all of the electric field takes part in the electromagnetic union. Part of the electric field is left over and becomes trapped in the electric circuit where it then exerts forces upon the bounding conductors. This energy is only considered "lost" in that it is not part of the flow of electromagnetic energy and thus manifests as a transmission impairment, that is, it is not delivered to the point of consumption at the time it is welcome, but arrives at some other time. Hence the stored energy is displaced energy.

Since energy storage is a function of impedance mismatch, the calculation of circuit impedance is a dominant consideration. While the natural impedance is primarily a function of circuit geometry, it is also in part a function of the materials from which the circuit is constructed. Thus the circuit impedance is in part related to circuit velocity and magnetic storage increases the natural impedance and dielectric storage decreases the natural impedances in general a change in natural velocity is accompanied by a change in the natural impedance, but in a complex manner.

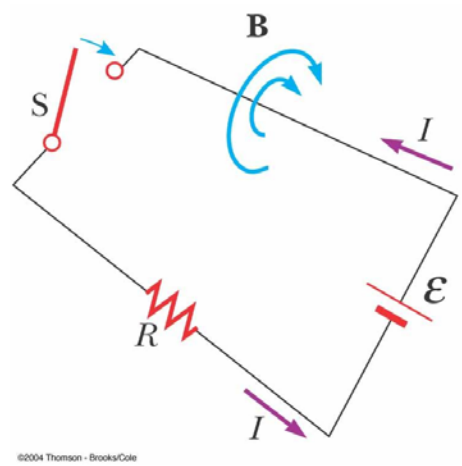
When considering stored energy in a quantitative manner circuit conditions are best expressed in terms of what are known as the energy storage coefficients. These directly relate to the circuits capacity for the storage of energy in a magnetic form or a dielectric form. The magnetic energy storage is then called the "Inductance" of the electric circuit, and the dielectric energy is then called the "Capacitance" of the electric circuit.



Inductance & Capacitance of a Transmission Line
https://www.ntt-review.jp/archive_html/200708/images/sf3_fig01.gif

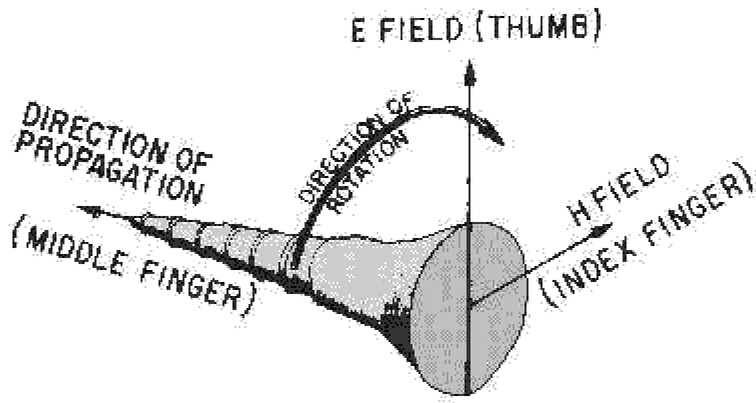
Self-Inductance

- When the switch is closed, the current does not immediately reach its maximum value
- Faraday's law can be used to describe the effect



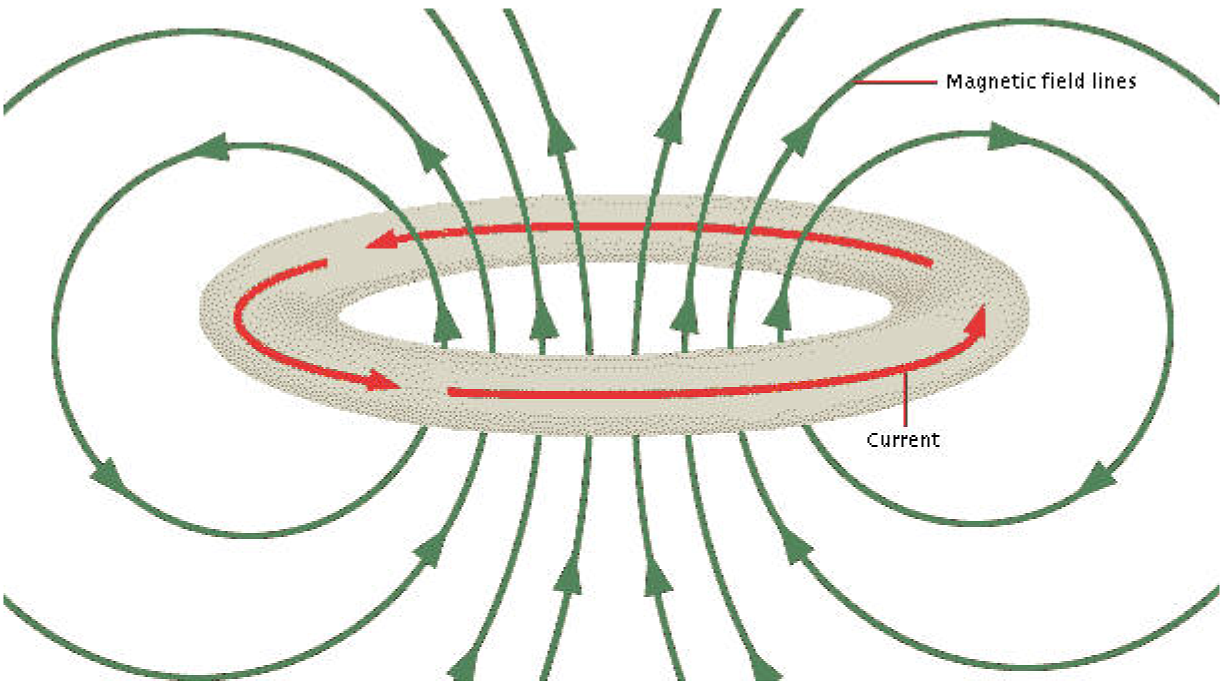
Self-Inductance

https://www.google.com/search?q=wardenclyffe&client=firefox-a&hs=n0Q&rls=org.mozilla:en-US:official&channel=sb&source=lnms&tbm=isch&sa=X&ei=TpsKU4fpC8P4oASNwIL4DA&ved=0CAcQ_AUoAQ&biw=1440&bih=686#channel=sb&q=inductance&rls=org.mozilla:en-US:official&tbm=isch&tbs=isz:lt%2Cislt:xga&facrc=_&imgdii=_&imgrc=hIDvg9mbV8_kVM%253A%3BGaGMcwSuhtkWpM%3Bhttp%253A%252F%252Fimg.docstoccdn.com%252Fthumb%252Forig%252F105391164.png%3Bhttp%253A%252F%252Fwww.docstoc.com%252Fdocs%252F105391164%252FSelf-Inductance%3B1500%3B1125



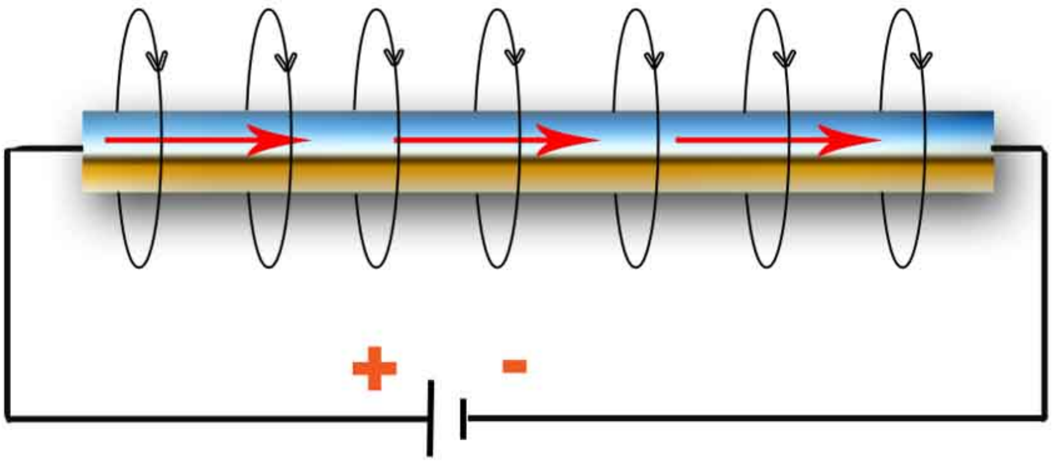
The Process of Electromagnetic Propagation

http://www.learn-about-electronics.com/images/The-Poynting-vector.GIF



Magnetic Field of a Short Circuit

http://www.askamathematician.com/wp-content/uploads/2011/02/t047412a.jpg



Magnetic Field Surrounding an Electric Conductor
http://kenolab.com/images/Magnetic%20Transmitter/Reduced%20size/current%20carrying%20conductor.jpg

In these terms the circuit natural impedance (or admittance) is defined as the square root of the ratio of the energy storage coefficients, impedance being the square root of the ratio of inductance and the capacitance, admittance being the square root of the ratio of capacitance to inductance.

In a similar manner the natural velocity is then defined as one over the square root of the product of the inductance, per unit length, and the capacitance, per unit length, of the electric circuit. This unit length can be per centimeter, per mile, per kilometer, and etc., and thus the velocity is c.m. per second, mile per second and etc.

The calculation of the energy storage coefficients of the electric circuit becomes then an important consideration in the quantitative expression of the propagation of electromagnetic induction. Inductance and capacitance for common circuit conditions can be derived from published charts and tables.

Break, more to follow.