

Electrodynamics without electrons

We exist in the universe. Everything around, our birth, our existence, is Energy.

Free interpretation of what it is - ENERGY is a verb that describes the activity of the ether that becomes disordered or dispersed. If there is resistance that Ether suffers, since it goes from an organized and polarized state to a disorganized and chaotic state, we can say that it is energy. And keep in mind, if the potential of the etheric source moves without any resistance, then there is really no work and literally no energy.

Interpretation in physics:

Energy (Ancient Greek: *ἐνέργεια* = [*ἐν-* (en-, "in") + *ἔργον* (érgon, "work") = to act] + *-ος* (os, "is") + *-ία* (-ia, "m") — **activity**) is a scalar physical quantity, a general quantitative measure of the movement and interaction of all types of matter. Energy does not arise from nothing and does not disappear anywhere, it can only pass from one state to another (the law of conservation of energy). The concept of energy combines all natural phenomena into one whole, is a general definition of the state of physical bodies and physical fields. Due to the existence of the law of conservation of energy, the concept of "energy" combines all natural phenomena. The concept of energy is related to the ability of a physical body or system to do work. During this, the body or system partially loses energy, spending it on changes in the surrounding bodies.

There is also an interesting phenomenon of the Universe that everyone is looking for, cognizing, but the disputes between scientists and other seekers are still ongoing. This phenomenon is called **Ether**. At the link you can briefly familiarize yourself with the stages and views of Ether and the basis of the Universe.

Ether or Ether (ancient Greek. *αιθήρ*) is a hypothetical medium, a material through which scientists explained the propagation [of electromagnetic waves](#) and [gravitational interaction](#) during the XIX century.

Of all this, two positions are interesting (we quote).

Electromagnetic ether

With the discovery [by James Clerk Maxwell of equations](#) ([the history of Maxwell's equations](#)) describing the dynamics of [the electromagnetic field](#), the electromagnetic theory of light was developed and received experimental confirmation: it was established that light is electromagnetic, not mechanical waves. Consequently, there was no need for the hypothesis of a mechanical ether.

According to [Maxwell's equations](#), an electromagnetic wave propagates at a constant speed of $c = 299,792,458$ m/s (in [a vacuum](#)). From the point of view of Newtonian mechanics, this condition cannot be fulfilled simultaneously in all [inertial frames](#): if in one of the inertial frames the speed of light is equal to c , then in another system that moves relative to the first, this speed, according to [To](#) solve this problem, a hypothesis was proposed about the existence of an electromagnetic ether — a medium through which electromagnetic interaction propagates. It was assumed that only in a frame of reference that is at rest relative to this medium, Maxwell's equations are valid and the speed of light is equal to a fixed value c . In other frames of reference that move relative to the ether, the speed of light would have to be different from c .

Aether and relativity

[Albert Einstein's special theory of relativity](#) rejected the hypothesis of the existence of the ether. Einstein's theory is based on the postulate of the same speed of light in all inertial frames of reference and the complete

equality of these frames. The hypothesis of the propagation of light in the medium — the ether — contradicts this postulate, since a special frame of reference that is unequal with others could be associated with this medium. However, in a speech at the University of Leiden on May 5, 1920 Albert Einstein said: "In summary, we can say that according to the general theory of relativity, space is endowed with physical properties; Therefore, in this sense, there is ether. According to general relativity, space without the ether is unthinkable; since in such a space not only would there be no propagation of light, but there would also be no possibility of the existence of space and time standards (measuring rods and clocks), and therefore of any space-time intervals in the physical sense. But such an ether cannot be imagined as endowed with the properties of ordinary matter, it does not consist of separate parts, the change in position of which can be monitored in time. The very idea of movement cannot be applied to it."

From the point of view of modern physics, electromagnetic waves, in particular, light, can propagate in a vacuum without the need for any medium for their propagation. The hypothesis of the ether, in the form in which it existed in the late nineteenth and early twentieth centuries, does not correspond to the realities of modern science. attract more and more interest from physicists and philosophers of science. The problems of the ether were investigated by the American physicist [Dayton Clarence Miller](#)

Another interpretation: [Ether](#) (*luminiferous ether*, from Ancient Greek *αἰθήρ*, upper layer of air; Latin *aether*) is a hypothetical all penetrating medium, the vibrations of which manifest themselves as electromagnetic waves (including visible light). The concept of the luminiferous ether was put forward in the XVII century by René Descartes and received a detailed justification in the XIX century within the framework of wave optics and Maxwell's electromagnetic theory material analogue of absolute Newtonian space.

Usually, most are interested in the issue of obtaining energy for existence, performing tasks, etc. Our civilization is electric. Electricity in our lives is everything from communications, training, manufacturing, accounting, finance, entertainment, etc. Let's not dive into how we became electrically dependent, we need to figure out how to become electrically independent, and use all the benefits of electric civilization at a low cost of obtaining electricity, I mean - to have our own source of electricity. So what kind of energy do we call electricity? In physics, the types of energy have been graduated quite well, but what we will consider is called electromagnetic energy.

But once again, what is Energy:

[Energy](#) is a scalar physical quantity that is the only measure of the various forms of motion and interaction of matter, as well as a measure of the transition of the movement of matter from one form to another. In mechanics, there are two types of energy: kinetic and potential. Energy characterizes the ability of bodies and fields to do work and is widely used in all branches of physics to describe the processes of energy transfer and transformation.

At the same time, Matter (*from the Latin *māteria* "substance"*) is one of the basic concepts of physics, a general term defined by the set of all the contents of space-time and affects its properties. Matter is the object of study of physics, where it is considered, which does not depend on the mind of objective reality.

But movement is not necessarily the movement of something at a distance from A to B. I would call the action of "transition" a transformation from one form to another. Yes, modern science knows perfectly, it cannot answer how rain and hail are formed. What is absolute cold, source of the earth's electric or magnetic field. Gravitational field? ... Therefore, I will study what is not related to power electricity, we will not. Power electricity is what you have in your electrical outlet and what is generated in the battery and electromagnetic generator (alternator) in your car.

A wire under current has a finite state of radiation as magnetic. So, a magnetic field and exhaust radiation are formed around the wire on this phenomenon: infrared, which you see every night, and some at night in an

incandescent light bulb, carbon wire, which is installed in ceramic heaters, etc.; The magnetic field, which magnetizes steel or interacts in permanent magnets, has made it possible to create electric motors (the main development of progress was carried out precisely for the development of electric motors, which are an integral part of electrical civilization), technical electromagnets, various relays and locks on the doors that you open. But the magnetic field does not exist on its own as a source. Magnetic induction is a consequence of a transformation (remember my edits to the definition). You will probably object to me that permanent magnets are also a phenomenon of our civilization, we have learned to create quite strong magnets. Yes, I will agree that a permanent magnet is in some sense a source of magnetic induction, but its analogue is an electromagnet with a core (metal core), which needs the external current of the coil of an electrical circuit (circuit) to generate a magnetic field in the core. If the circuit is opened, the magnetic field of the electromagnet core disappears. The permanent magnet after the electromagnetic pulse of start-up, generates all the time after start-up. Under proper operation, this generation can exceed the life span of a person.

If the magnetic field (induction) of an electromagnet can be expressed by the formula $\nabla \times \mathbf{B}_m = \mu \mu_0 \mathbf{H} (T)$; where the magnetic strength of the wire with a current of $\mathbf{H} = \mathbf{I} / 2\pi \mathbf{r} (A/m)$ according to [the Biot-Savart-Laplace law \(1820\)](#), then it is impossible to establish any connections after the independent existence of a permanent magnet with the electromagnetic circuit of the starting pulse. Residual magnetization is a term from the spent power of starting the generation of magnetic induction in a permanent magnet, according to the principle "More generates Less". A kind of uncertain process of how and where rain comes from.

I have taken the liberty of expressing the process of magnetic field generation in a permanent magnet - the formula for magnetic induction of a permanent magnet takes the form:

$$\nabla \times \mathbf{B}_m = \mathbf{QE} / (\partial t \rightarrow \infty)$$

Where $\mathbf{QE}$ is the ether that is the cause of the generation of magnetic induction in the material of a permanent magnet, $\partial t \rightarrow \infty$ is the period of time of this generation that tends to infinity.

Why did I write this way, it is absolutely known that the cause of the magnetic field (induction) in magnetically conductive materials can be another field (for example, the earth's magnetic field). Example: magnetizing the steel with another permanent magnet or electromagnet. But for this operation, the orientation of the poles of the induced induction in steel and magnet is important - the source must be the corresponding distance of the poles, etc. Ether is an isoteric designation as an all-encompassing energy field (charge), thus until it is known exactly what is the cause of magnetic induction in the material of the magnet, it is advisable to assume that the source is the Ether. But this does not answer the question of how it is done.

The concept of fields was introduced, in particular, by Faraday. Albert Einstein wrote:

The exact formulation of spacetime laws was the work of Maxwell. Imagine his feeling when the differential equations he formulated proved to him that electromagnetic fields propagate in the form of polarized waves and at the speed of light! Few people in the world were entrusted with such an experience ... It took physicists several decades to comprehend the full significance of Maxwell's discovery, so bold was the leap that his genius imposed the ideas of his colleagues.

— [Einstein](#) (Science, May 24, 1940)

Heaviside worked on the elimination of potentials ([electric potential](#) and [magnetic potential](#)), which Maxwell used as central concepts in his equations; This attempt was somewhat controversial, although by 1884 it was clear that potentials should propagate at the speed of light, like fields, as opposed to the concept of instantaneous action at a distance, like the concept of gravitational potential at the time.

A Brief History of EM (for Dummies)

Maxwell's "Treatise on Electricity and Magnetism" was published in 1873. His 1000-page book contained 20 equations. To visualize and understand EM's own mathematical ideas, he used mechanical analogies: balls, bearings, hooks. Heinrich Hertz (1888) freed the EM theory from the mechanical model. Oliver Heaviside (1893) modernized the EM theory by reducing the equations to four, giving them the form commonly used today. ... In 1905, Maxwell's theory became the main element of Einstein's special theory of relativity (STS).

Overview from AI

Electromagnetic energy is a form of energy that is associated with an electromagnetic field, consisting of electric and magnetic fields. Its propagation in space occurs with the help of electromagnetic waves, such as light, radio waves, X-rays, etc.

Description of electromagnetic energy:

Electromagnetic field: Electromagnetic energy is related to electric and magnetic fields, which can exist in different volumes of space.

Electromagnetic waves: The propagation of electromagnetic energy occurs in the form of electromagnetic waves, which are made up of oscillations of electric and magnetic fields.

Sources: Electromagnetic waves can be generated by various sources, such as oscillating charged particles, alternating electric currents, or the uneven movement of electric charges.

But about **the Sources**, everything is confusing and veiled. Therefore, you need to put everything on the shelves and find out what kind of beast it is - Electromagnetic Energy. **We will not consider electromagnetic waves in a power electrical circuit (electric circuit).**

Electric (electromagnetic) energy of an electric circuit and Electrodynamics without electrons.

Physics studies electricity as: [https://uk.wikipedia.org/wiki/ Classical_electrodynamics](https://uk.wikipedia.org/wiki/Classical_electrodynamics) is a branch [of physics](#) that studies the electromagnetic field. It includes the connection of electrical and magnetic phenomena, [electromagnetic radiation](#) (in various conditions, both free and in various cases of interaction with matter), [electric current](#) (generally speaking, alternating) and its interaction with the electromagnetic field (electric current can be considered as a set of moving charged particles). Any electrical and magnetic interaction between charged bodies is considered in modern physics as mediated by an electromagnetic field, and, therefore, is also the subject of electrodynamics.

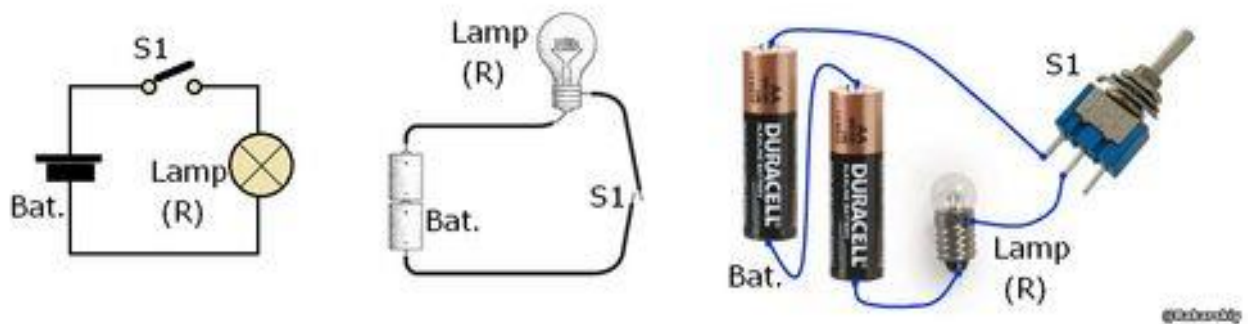
Most often, the term "electrodynamics" by default is understood as classical (does not affect quantum effects) electrodynamics; to refer to the modern quantum theory of the electromagnetic field and its interaction with charged particles, the stable term [quantum electrodynamics is usually used](#).

The basic concepts of classical electrodynamics are the idea of [the electric](#) and [magnetic field](#) around [charged](#) bodies and [conductors](#) with current.

Special sections of electrodynamics:

- [Electrostatics](#) describes the properties of a static (not variable in time or one that changes slowly enough that "electrodynamic" effects can be neglected, i.e., when in Maxwell's equations it is possible to discard, due to their smallness, terms with time derivatives) of the electric field and its interaction with electrically charged bodies (electric charges) that are also stationary or moving at sufficiently low speeds (or, Maybe, if there are and are fast-moving charges, but they are small enough in magnitude) that the fields they create can be roughly considered static. Usually, this also means the absence (or neglect of the effect due to a slight strength) of magnetic fields.
- [Magnetostatics](#) examines direct currents (and permanent magnets) and permanent magnetic fields (fields do not change in time or change so slowly that the rate of these changes in the calculation can be neglected), as well as their interaction.
- Continuous media electrodynamics considers the behavior of electromagnetic fields in continuous media.
- [Relativistic electrodynamics](#) considers electromagnetic fields in moving media.

We all know about a simpler electrical circuit from school: an electric battery, connecting wires, a switch and an incandescent lamp.



The diagram shows an electric battery, which is [galvanic source](#)Electricity. The first such source of electricity is considered to be the artifact "[Baghdad battery](#)". A galvanic cell is basically a device that converts chemical energy into electrical energy. It works by redox reactions between two different [Metals](#) and [electrolyte](#). But the galvanic cell is [chemical source](#)electricity, which generates a difference [Electric potentials](#), between the terminals of the galvanic cell (*The electric potential in a power supply circuit is a characteristic of the electric field that determines the potential energy of the charge at a certain point. The potential difference between the two points of the circuit causes an electric current.*) In electrostatics, the electrostatic potential ϕ is determined according to $\mathbf{E} = -\nabla\phi$ where $\mathbf{E}$ — electric field strength. Often, to determine the electrostatic potential, it is convenient to solve the differential equation, which it satisfies — [Poisson's equation](#): $\Delta\phi = -4\pi\rho$ where ρ is the density of the charge. But for a clear consideration of a simpler electrical circuit, the battery is not a very good example. There is such a device - [Electric condenser](#) ([English. capacitor](#); [Ge. Kondensator](#) m) is a system of two or more [Electrodes](#) ([covers](#)), which are separated by [dielectric](#), the thickness of which is smaller compared to the size of the covers. Such a system has a mutual [electrical capacity](#) and is able to accumulate and store [Electric charge](#). The capacitor just corresponds to the example of interpreting an electric field in a state of voltage / voltage. Electrical voltage and electrical intensity are two different physical quantities that describe an electric field.

Electrical voltage characterizes the work that must be done to move a unit of charge Q between two points.

The voltage can be determined from the ratio: $U=W/Q$, where W is the work of extraneous and [Coulomb](#) forces to move the charge, Q is the magnitude of the electric charge. For the potential field, the voltage corresponds [to the potential](#) difference between two points [of the electric field](#): $U = \phi_1 - \phi_2$. From [Ohm's law](#) for an incomplete circle: $U=I \cdot R$, where I is the strength of the current* passing through the conductor, R is the electrical resistance of the conductor. Devices [called](#) voltmeters, [millivoltmeters, etc.](#), can be used [to](#) measure voltage.

This interpretation is accepted as a constant, but not everything is as complicated as it seems.

The strength of an electric current (current strength or simply current) is a quantitative characteristic [of the electric current](#) in [a conductor](#), a scalar value $I=\Delta q/\Delta t$, which corresponds to the amount [of charge](#) (Δq) passing through the [cross-section](#) of the conductor in time Δt divided by that time period. The unit of current strength is taken as such a current strength at which segments of parallel conductors 1 m long, located at a distance of 1 m from each other, interact with a force of $2 \cdot 10^{-7}$ N. [Current strength is also called a value that determines the rate of charge transfer by particles that create current through the cross-section of a conductor.](#) Current is the orderly movement of charged particles. In the [SI system](#), the current is measured in [Amperes](#) (designation A). Accordingly, [the current density](#) is measured in A/m^2 .

From now on, we will figure it out. How is the current measured practically in a circle. There is a device for this [Ammeter](#) which is based on an early device [Galvanometer](#) (galvano — from the name of the scientist [Luigi Galvani](#) and [Dav.-Gr. metreo](#) — measure) is a highly sensitive device for measuring small, constant and variable [electric currents](#). Unlike conventional micro ammeters, [Scale galvanometer](#) can be graduated not only in units [Amperage](#), but also in units [Voltage](#) Other [physical quantities](#), or have a conditional, dimensionless graduation, for example, when used as null indicators.

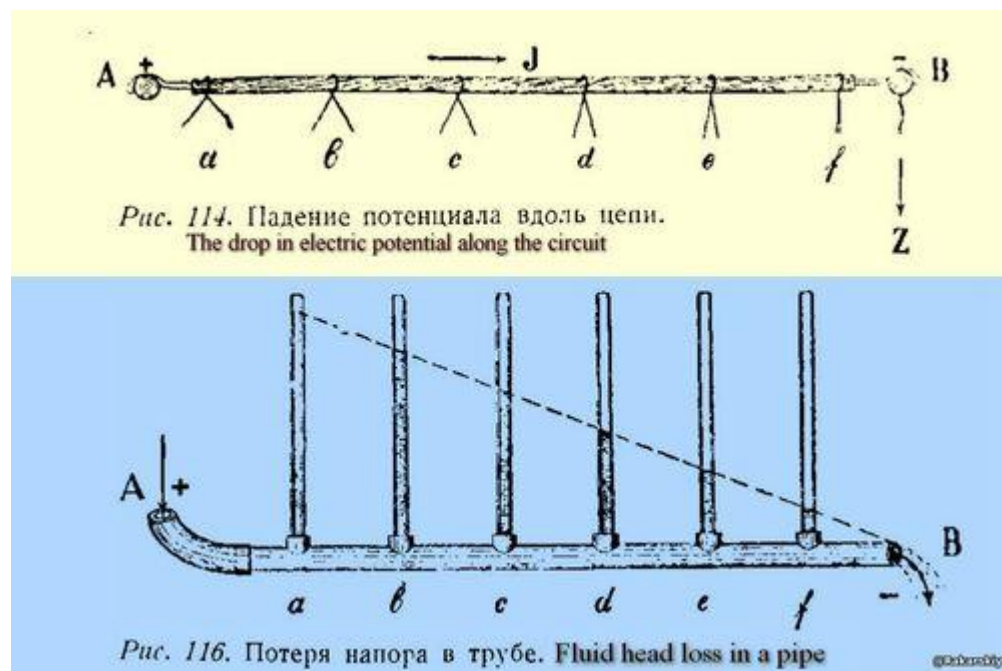
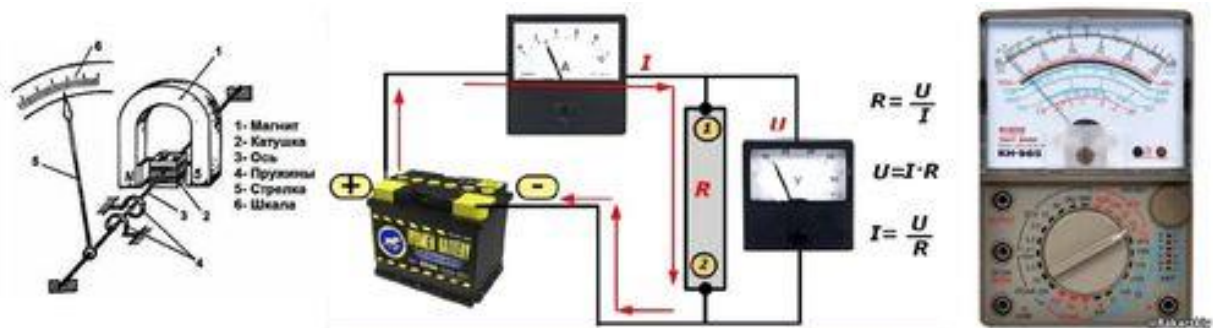


Ammeters are magnetoelectric, **electromagnetic, electrodynamic**, thermal, induction, detector, thermoelectric and photoelectric. The action of a **magnetoelectric device** is based on the creation of a torque due to the interaction between the field of a permanent magnet and the current passing through the winding of the frame. An arrow is connected to the frame, which moves along the scale. The angle of rotation of the arrow is proportional to the strength of the current. **Electrodynamic ammeters** consist of stationary and movable coils connected in parallel or in series. The interaction between the currents passing through the coils causes the deviation of the moving coil and the arrow connected to it.

(Why am I so picky about this question? Because there's a contradiction here, and it's been there from the beginning.)

The description does not specify what exactly is the force that deflects the hands of the ammeter. What does physics explain in this regard: A conductor with a current always creates a magnetic field around itself. This occurs due to the movement of electric charges (electrons) along the conductor, which, according to the laws of electromagnetism, causes the occurrence of a magnetic field. Magnetic lines of force concentrically surround

the electric current. That is, the movement of current in a conductor and the magnetic field are different phenomena that are interdependent. Even respected scientists compare the work of electric current with the pressure of water in a pipe, but this is an erroneous interpretation.



Electromagnetic measuring devices are based on the principle of operation The galvanometer is a device used to measure small electric currents. The principle of operation of a galvanometer is based on the interaction between the magnetic field created by the current coil and the magnetic field of a permanent magnet. When an electric current passes through the coil, it creates its own magnetic field, which interacts with the field of the permanent magnet and causes it to rotate. This rotation deflects the needle of the galvanometer, and the angle of deflection is proportional to the amperage. According to the method of connecting an electrical circuit to the circuit, voltage or current strength is measured.

The logic is that the final phenomenon of the electric current around the wire is the magnetic field, which is measured with a galvanometer, that is, it is consumed from the source. The question arises as to which phenomenon is the source.

Electric field, Electric source

The electric field is the physical field that surrounds the electric charge, through which it acts on other electric charges. It is the region of space where the electric charge experiences a force, and the electric field is a vector quantity that can be visualized as arrows that show the direction and strength of the electric field. (Electrostatic field, Electricity of air)

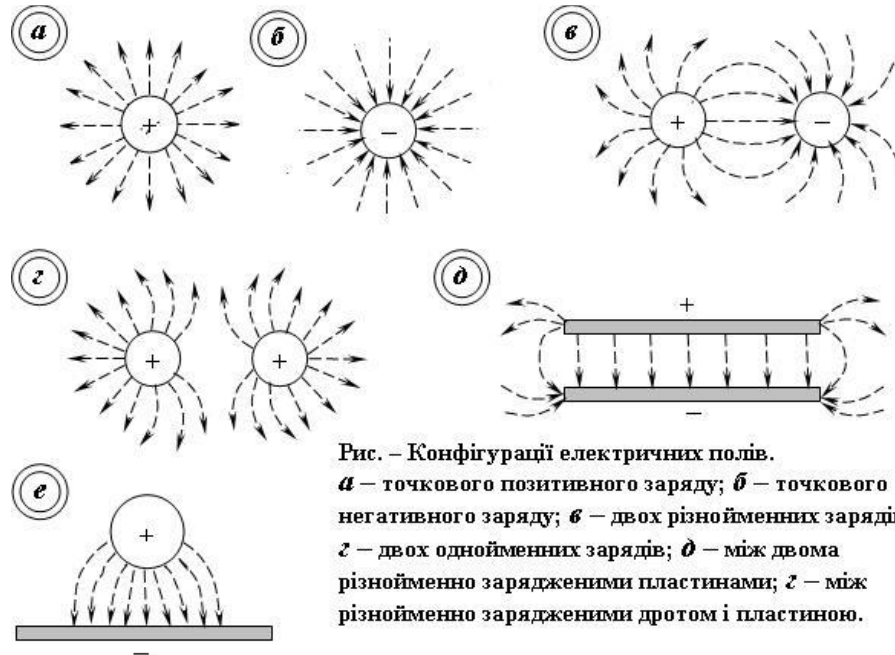
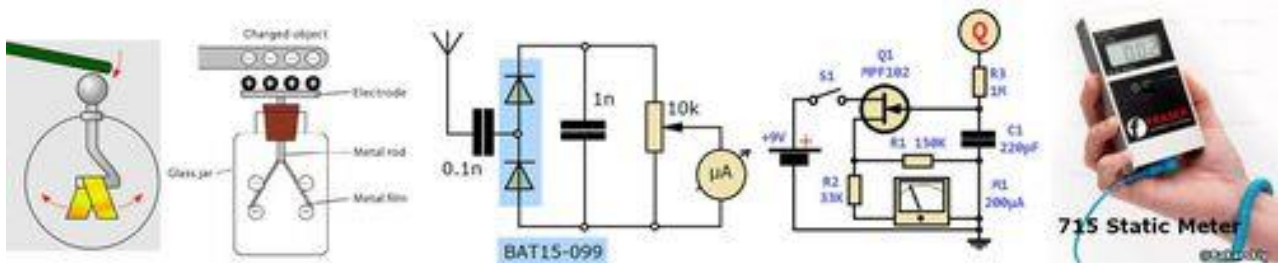


Рис. – Конфігурації електричних полів.
a – точкового позитивного заряду; **б** – точкового негативного заряду; **в** – двох різноіменних зарядів;
г – двох однойменних зарядів; **д** – між двома різноіменно зарядженими пластинами; **е** – між різноіменно зарядженими дротом і пластиною.

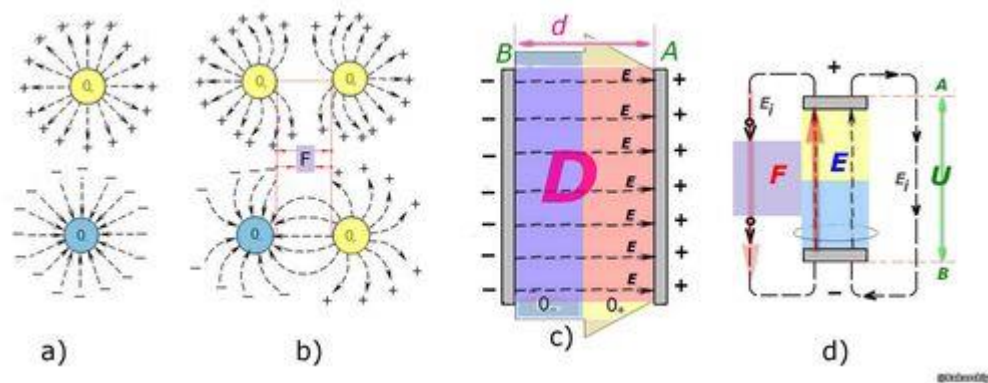
There is also a device that induces the presence of a static electric field. An electroscope is an instrument used to detect and identify electrical charge. In addition to the simpler, there are electronic ones in the glass jar.



What do we measure with these instruments? Electric field strength is one of the main fundamental quantities of classical electrodynamics. In this branch of physics, only the magnetic induction vector is comparable in importance. In static electricity, there are two types of electrical charges: positive and negative. I also once believed that there are also two types of electric charges in an electric circuit. But later I came to the logical conclusion that there is only an electric voltage vector (induction). Now I will explain a little. We will draw a few conclusions, we will not refute static electricity, but there is something that needs to be paid attention to. In the figure above (configurations of electric fields) we have an idea of the point electric charge and its lines of force. Let's try to theoretically transfer this point charge between the plates of a simpler nonpolar capacitor.

I have drawn how an electric charge is converted into an electric polarization element of an electric capacitor. I have not found an explanation for how a dipole (+/-) can be formed from a monopole electric charge. This position coincides with the magnetic induction vector. The difference is that the lines of force of electric polarization **E** are not closed, as in the lines of force of magnetic induction **B**. The zero zone is the zone in

which the phenomenon [of Implosion](#) [0-] and [https://uk.wikipedia.org/wiki/ Explosion](https://uk.wikipedia.org/wiki/Explosion) [0+] occurs. I have made a drawing in accordance with the new interpretation of electric charges.



a) a drawing of a point static electric charge, positive or negative (Explosion [+], Implosion [-]);

b) a drawing of the interaction of static point electric charges, taking into account the zones of Explosion [+], Implosion [-];

c) conversion of electric charge into polarization of the dielectric medium between metal plates. In this case, we see that the electric dipole is the neutral zone of the medium in the middle of the dielectric medium with the phenomena of Explosion [0+] Implosions [0-], which form a vector of electrical intensity E between the poles of an electric dipole +/- by analogy with a permanent magnet N-S. To describe electric fields in dielectrics, it is convenient to introduce the concept of electrical displacement. Electrical displacement is sometimes also called electrical induction. [Electric displacement vector \$D\$](#) in the simplest case, it is associated with the electric field strength vector E Ratio $D = \epsilon \epsilon_0 E$. This is the direct action of the electric polarization of the dielectric medium. At the same time, this polarization has the ability to maintain (accumulate) electrical intensity $E(D)$, without the action of an external source after charging. *A researcher from Ukraine (Kherson region) conducted an interesting experiment: [Where is the charge stored in the capacitor?](#)*

d) an illustration of the forces and phenomena of the source (capacitor) in an electrical conditional circuit. Where the Force F is the force between the poles of the electric dipole containing the electrical induction vector inside the source E . Physics states that a dielectric does not conduct electric current. The question arises, what is the current of which the dielectric medium does not conduct (*so we investigate further*). The line of force of electrical induction $E(D)$ of the source tends to close on itself +/- through the line of force of electrical induction Ei . outside the source. If there is no conductor closing the electrodes of the capacitor, the lines of electrical induction and electrical displacement are not closed.

Once again about [Electric field intensity](#) is the force characteristic of the electrostatic field, which is determined by the force ratio F acting on a positive point charge q , placed at a given point in the field to the magnitude of this charge: $E = F/q$ where F —force, q —[Electric charge](#), E — electric field strength. At each point at a given time, there is its own vector value E (generally speaking, different at different points in space), thus, E — this [Vector field](#).

Thus, we can state that [Maxwell's equation - according to Gauss's theorem](#): $\nabla \cdot D = \rho$ or $D = \epsilon E$ where $\nabla \cdot E = \rho / \epsilon_0$, is an expression of the field of an electric source where ρ - [Electric charge density \[pV\]](#) is the bulk density of electric charge: bulk electric charge density Greek symbol (ρ) usually denotes the electric charge, and the subscript V indicates the volumetric charge density. Since charge is measured in coulombs [C] and volume is measured in meters³ [m³], the units of electric charge density in the equation are [C/m³]. Physics states that since the electric charge can be negative or positive, the charge density can be negative, positive, or zero; ϵ -

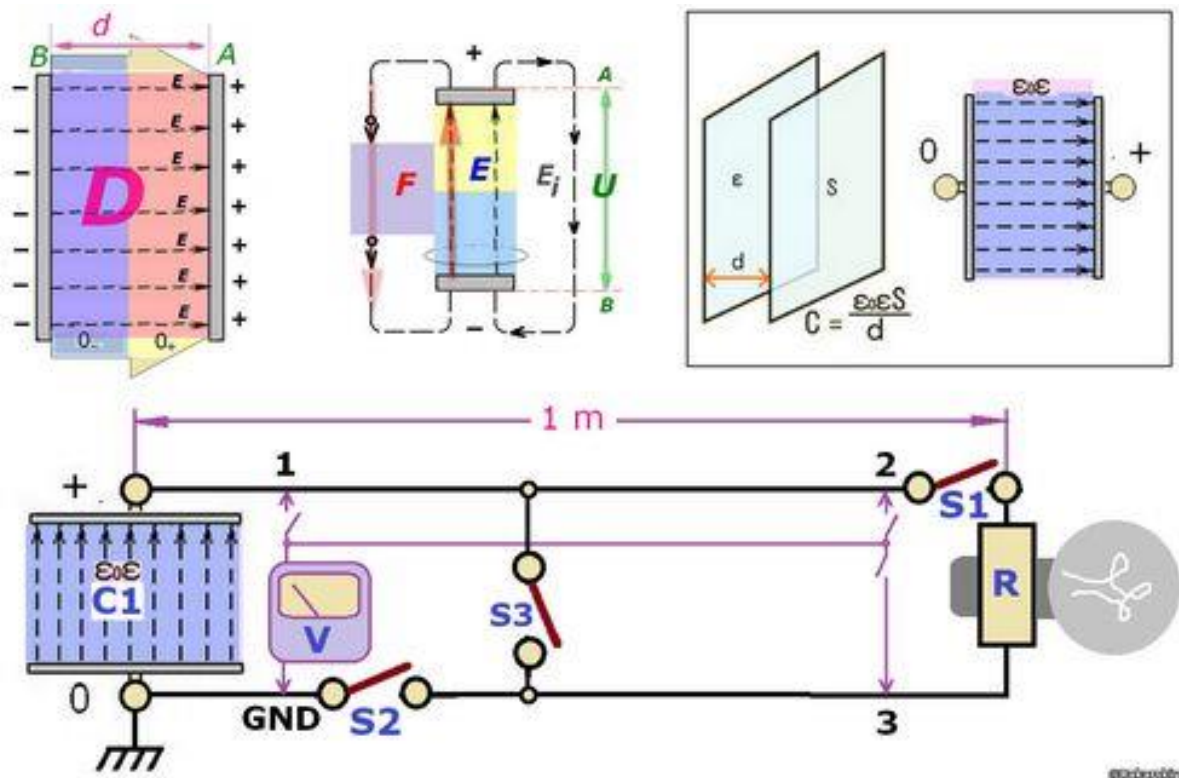
[Dielectric constant](#) is a physical characteristic of a medium that determines how many times the force of interaction between charges in a given medium is less than in a vacuum. It characterizes the insulating properties of a dielectric, that is, a substance that does not conduct electric current.

[Muswell's equation](#) - [on Gauss's law for an electric field](#)

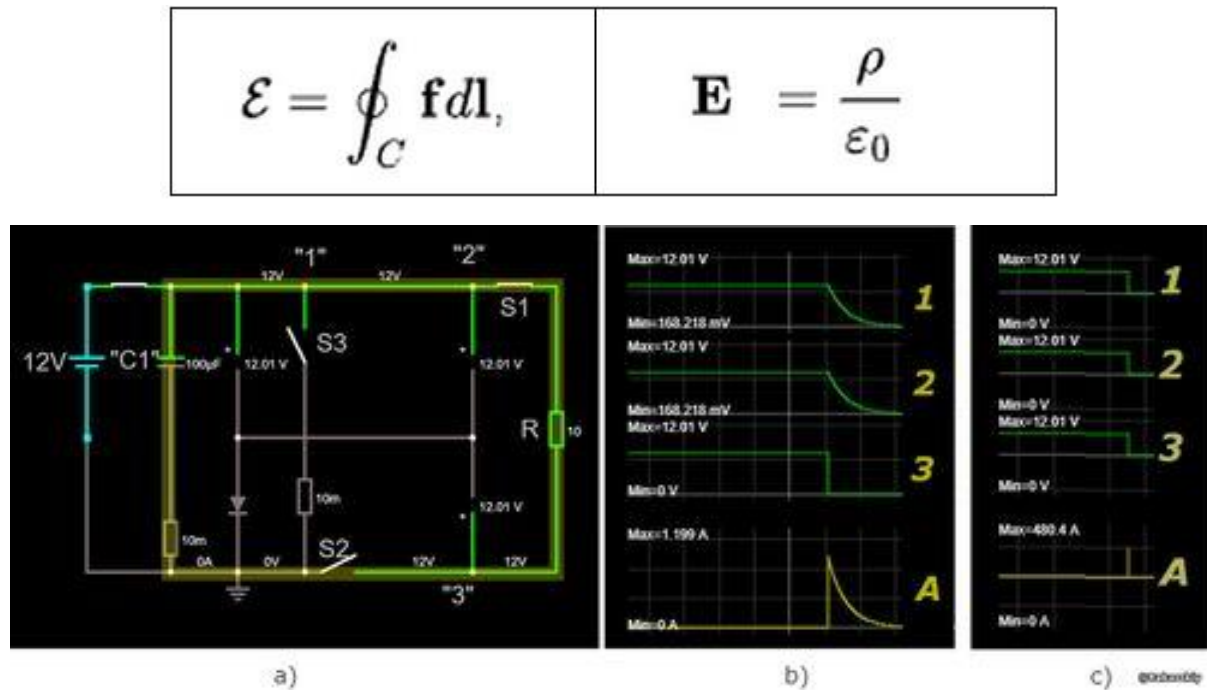
1	$D = \rho$	Gauss's law for electricity	The source of the electric field is charges
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But $D = \rho_v = \epsilon E$ is also an expression of the corresponding dipole electrical intensity of a dielectric drive, where $ED = \epsilon E = \rho_v / \epsilon \epsilon_0$, that is, an expression in fact. But we do not know what is the cause of such a phenomenon as the retention of the accumulation of an electric field in the state of a conditional dipole in a dielectric. In addition, the negative side of the induction (-) of such a drive is not registered. Lines of force like a static negative negative charge are not detected. Therefore, the expression $E_D = \rho / \epsilon \epsilon_0$ charge in a dielectric can only have the corresponding value: zero [0] or [\[GND\]](#) and positive [+E] with the corresponding spin of the electric induction line of force E_i around the conductor. In addition to the nonpolar, simplest capacitor, there are electrolytic polar capacitors, capacitors are passive sources, they only accumulate an electric field with subsequent discharge into an electrical circuit. There are also [Galvanic cells](#) (have a reverse and irreversible electrochemical reaction). The principle of operation of the galvanic cell is used in [electrochemical batteries](#). There is still [Fuel cell](#), [Electric battery](#), [Electrochemical cell](#), [Concentration element](#). These are all voltage generators, since during the discharge process they produce voltage (constantly maintain electrical tension at the terminals of the device).

Consider a simpler circuit with source **C1** [*charged capacitor*], connection wires **1 meter long**, active load **R**. There are three circuit breakers **S1**, **S2**, **S3** and a measuring device voltmeter that connects to measure the voltage [U] between points **1**, **2**, **3**, **negative terminal** (-) [\[GND\]](#).



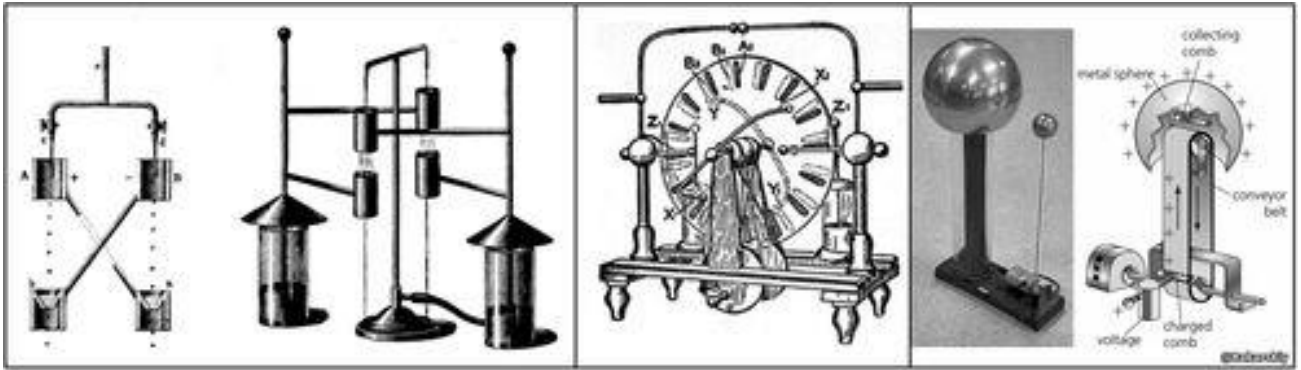
Suppose that the capacitance of the capacitor is **100 μ F**, which is charged to **12V**. Suppose that the load **R** has a resistance of **10 ohms**. The question is how the voltage **E [D]** is the voltage of **12V** of the dielectric layer of the capacitor **C1**, reaches these measurement points for a conductor with a length of 10 cm (**1**), 1 m (**2**) and 1.9 m (**3**), when **S2, S3** are open? Why the load **R (10 ohms)** is not how, therefore does not interfere [Fig. a)]. How does the electrical intensity **E [D]** get from the positive plate of the capacitor **C1** to the tip of the wire having an open circuit at the terminals of the switches **S1, S2**? We can only explain this by the conductivity of the lines of force focused in the dielectric of the source **C1** along the surface of the wire. This is the same phenomenon as [the electromotive force](#). But the physical interpretation refers only to the phenomenon of the occurrence of **E** from an external force, which is the cause of the occurrence of an electromotive force in a closed circuit. In fact, **EMF [E_D]** is a directional electrical tension around a conductor that occurs even when the circuit is not closed, and is a phenomenon for a section of wire on which an external force acts. The records are identical



If we further turn on **S2** [Fig. b)], we get a linear volt-ampere characteristic of the capacitor discharge with the formation of a current in Amperes along the entire length of the connecting wires of **2 meters**. But the falling voltage is recorded only at measurement points **1, 2**. At the third point of measurement, the voltage drop is instantaneous. After a resistance of **10 ohms**, no voltage **E** we do not observe the corresponding value of points **1, 2**. That is, 1 m of wire with intensity **E**, and the second 1 m of wire without the corresponding intensity **E** of the source.

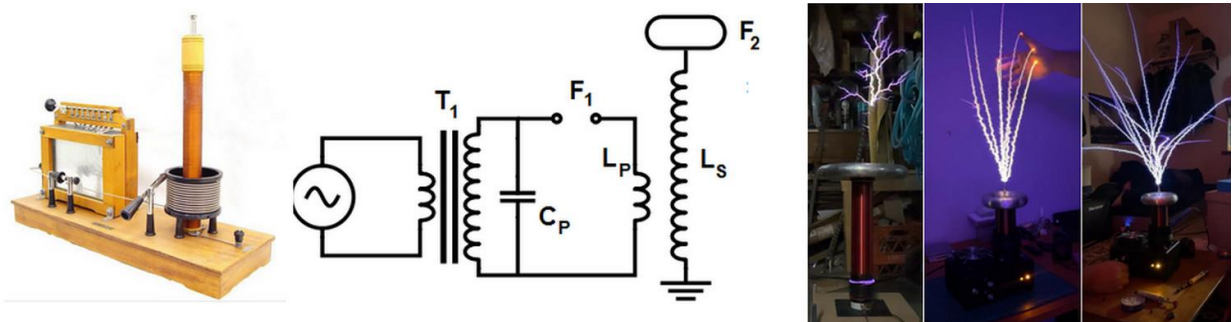
[Electrostatic \(induction\) machines](#) are a type of electrical machine that uses electrostatic induction to convert mechanical energy into electrical energy. Unlike conventional generators, which use electromagnetic induction, they do not use magnetic fields, but rather separate charges in the ether using [electrostatic induction](#). The mechanical work carried out in this case against the action of electric forces regarding the separation of charges in space is converted into the energy of the electric field (potential difference).

By design, electrostatic machines are: with rigid rotors (cylinders, discs) - machines from Töpler, Goltz, Wommelsdorf, [Wimshurst](#); with flexible belts and chains – [Van de Graaff generator](#), [Pelletron](#); with drip and dust removal – [Kelvin dropper](#); Other.

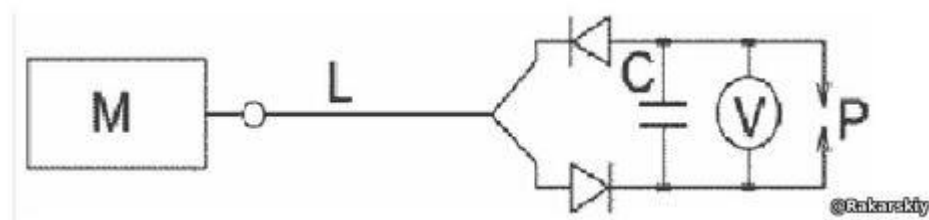


Conventional machines with low operating voltage operate in the air. To reduce the size of the insulators, high-voltage circuit breakers can be placed in a dry gas environment under increased pressure. There are also vacuum-packed designs. To reduce corona losses in the design of machines, all angles and points are avoided (for example, a Van de Graaf generator with a ball electrode with a diameter of 80 cm allows you to accumulate potential up to 750 kV, after which the corona discharge begins). Usage: [electrostatic deposition](#); [electric gas purification](#); [powder coating](#); electrical separation; [breakdown test](#) of insulation of electrical installations; [lightning protection test](#); demonstration lectures on physics course; power supply [of charged particle accelerators](#).

In addition to the above machines, there is a high-voltage [Tesla Transformer](#), also **Tesla coil** ([English. Tesla coil](#)) is a device invented [Nikola Tesla](#), bearing his name and made in the form of [Transformer](#), enabled [Windings](#) in oscillating circuits, which operate in a resonant mode and serve to form a high [electrical voltage](#) (tens of kilovolts) of high frequency (usually 20...100 kHz). The device was patented on September 22, 1896 as an "Apparatus for the production of electric currents of high frequency and potential". Unfortunately, in addition to demonstration measures, TT is not used. But Tesla himself sought to use technology in the energy sector to generate and wirelessly transmit currents.



To introduce the electrostatic potential generated by electrostatic machines into an electrical circuit, a technology is required to convert from a state of surface charge to a charge of polarization of a dielectric, followed by use in a power electric circuit with loads. There is such a device - the Avramenko plug is a simple electronic device used to equalize asymmetry in high-frequency power transmission systems. It consists of two diodes and a capacitor, and is named after the Ukrainian engineer Avramenko.



[Fork Avramenko](#) ([Avramenko diode plug](#)) is a circuit on diodes consisting of two diodes connected to a capacitor, the diodes are connected by the cathode and anode, and the free ends of the diodes are connected to the capacitor. The devices are used to reduce asymmetry in high-frequency power transmission lines.

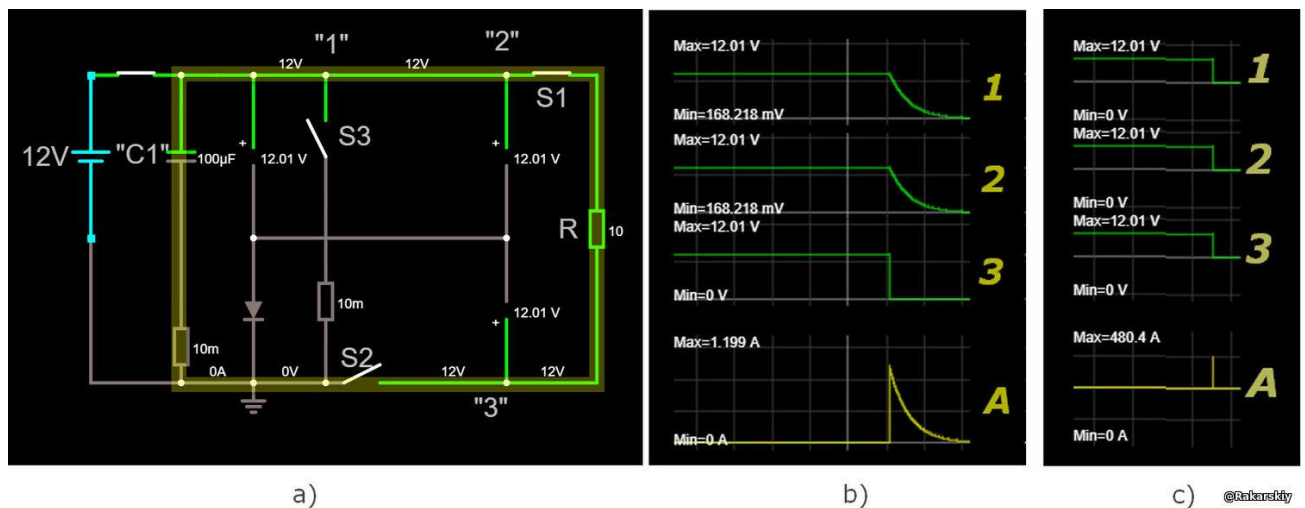
For more details, if you wish, check out my post "[Electric field is a source of energy!](#)"

The most famous generation device, which, according to the author Taniel Kapanadze, used BB TT, is a device known as KAPAGEN, you can find it at the link: "[The Secret of Kapanadze's Generator](#)"

Little by little we move on to a closed electrical circuit. We have already seen that the action in an electrical circuit is the appearance of current **strength I**, this is another Maxwell equation for Ampère's law, which we will review in the next part.

Electric circuit, Current strength, Ampère's law, Biot-Savard law, Magnetic field.

Let's recall our online modulation of a simpler electrical circuit (circuit):



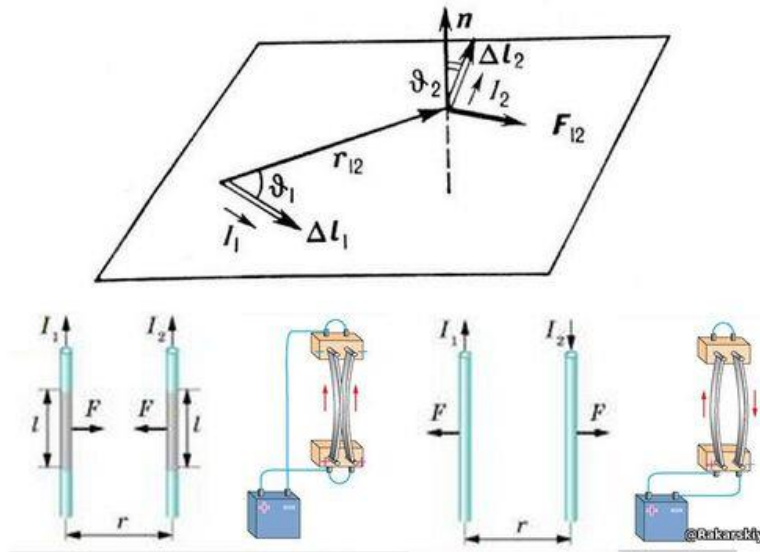
In the position when the switches **S1**, **S2** have the effect of closing the circuit, we have the corresponding I-V indicators: the primary value of the current: $I = U / R + r = 12B / 10 \text{ Ohm} + 0.01 \text{ Ohm} = 1.19A$, when the capacitor charge drops to 1V: $I = U / R + r = 1B / 10 \Omega + 0.01 \Omega = 0.09A$. on the second, 1 m of length **E** is practically absent.

In the graphs [Fig. c)], the I-V data of the short circuit of the charged capacitor through the switch **S3** (**S1**, **S2** are disconnected): $I = U / R + r = 12B / 0.024 \text{ ohms} + 0.01 \text{ ohms} = 480A$. The voltage drop is instantaneous and the formation of a large-dimensional stump force.

Little by little we move on to a closed electrical circuit. We have already seen that the action in an electrical circuit is the appearance of current **strength I**, this is another Maxwell equation on Ampère's law, which we will review next.

Ampere's law — in 1820, **A.M. Ampère** established a law describing the interaction of two elementary currents $I_1 d\lambda_1$ and $I_2 d\lambda_2$. The magnitude and direction of the force of interaction are determined by the double **vector product**: $dF_{12} = k I_1 I_2 (d\lambda_1 (d\lambda_2 \times r_{12})) / r_{12}^3$, where r_{12} is [the distance](#) between conductors of elementary currents, $k = \mu_0 / 4\pi$ (in [the International System of Units](#), SI), $k = 1/c^2$ (in the Gaussian system of units), c is [the speed of light](#). This force is not a central force, since the direction of its action does not lie on a [line](#) linking

elementary currents. The force acting on the current element $I_2 dl_2$ is perpendicular to this element and lies in the [plane](#) containing the current element $I_1 dl_1$ and the radius vector r_{12}



Two wires with current are attracted or repelled depending on the direction of the current. If currents flow in one direction, the wires are attracted; if in the opposite, they repel each other. This phenomenon is used to determine the unit of current, the ampere.

Ampère's Law:

1. **Pulling:** If two parallel wires carry currents in the same direction, then they are attracted to each other.
2. **Repulsion:** If two parallel wires carry currents in opposite directions, then they repel each other.

Magnetic field and Ampere force:

1. **The current in the conductor creates a magnetic field.**
2. The action of the magnetic field of one wire on another wire with current, causes a force known as the Ampere force.
3. **The Ampere force is proportional to the amperage, the length of the conductor, and the magnetic induction of the field.**
4. The direction of the Ampère force is determined by the left hand rule: if the left hand is placed so that the magnetic field lines enter the palm of the hand, and the four outstretched fingers show the direction of the current, then the bent thumb shows the direction of the Ampère force.

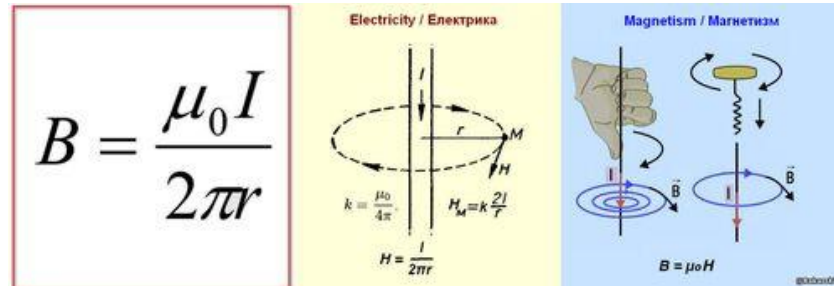
Ampère's law is similar to Gauss's law in that it allows us (analytically) to determine the magnetic field produced by an electric current in configurations that have a high degree of symmetry. Ampère's law says:

$$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0 I_{enc}$$

where the integral on the left is the "path integral", similar to how we calculate the work done by a force over a particular path. The sign of the circle on the integral means that it is an integral over a "closed" loop; a path where the start and end points are the same. I_{enc} is a pure current that crosses a surface that is defined by a closed path, often referred to as a "current stacked" path. This is different from Gauss's Law, where the integral is over a closed surface (rather than a closed path as it is here). In the context of Gauss's Law, we mean

"calculating **the flow of** an electric field **through** a closed surface"; in the context of Ampère's Law, we mean " calculating **the circulation** of a magnetic field **along** a closed path". We apply [Ampère's Law](#) in much the same way that we apply [Gauss's Law](#).

All actions that are associated with force or attraction - repulsion of wires are based on the phenomenon of a magnetic field (magnetic induction) around a conductor with a current.



[The Biot-Savart-Laplace law](#) is a law that defines magnetic induction around a conductor in which an electric current flows. The Biot-Savart-Laplace law was formulated in 1820. Jean-Baptiste Biot and Félix Savard experimentally proved its existence, and Pierre-Simon Laplace formulated a general formula based on their research.

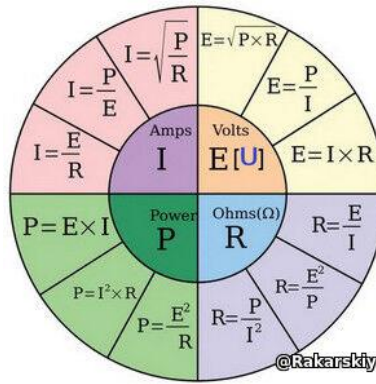
Both the laws of **Ampère** and **Biot-Savart-Laplace** appeared in 1820 and it was proved that the CURRENT STRENGTH [**I**] is directly related to the formation of a magnetic field (induction) **B** around the conductor. [Later in 1826, Ohm's Law was discovered](#) (by the German physicist **Georg Simon Ohm**). He established the relationship between current, voltage and resistance in an electrical circuit, which became the foundation for electrical engineering.

Ohm's law is a fundamental principle in electricity that describes the relationship between amperage, voltage, and resistance in an electrical circuit. It states that the amperage [**I**] in a section of the circuit is directly proportional to the applied voltage [**U**] and inversely proportional to the resistance [**R**]. Ohm's law formula is as follows: **I = U/R**, For a closed circuit: **I = ε / R + r**. There is also the phenomenon of voltage drop **ΔU = IR**.

Later, the measure of watt power (W) was adopted by the British Scientific Association in 1882. At the 11th General Conference of Weights and Measures in 1960, it was included in the International System of Units (SI). [Power](#) is an important physical quantity that characterizes the speed at which work is done or energy is converted per unit of time. It is used in various fields of physics and engineering, including mechanics, electricity, and thermal engineering.

Power (N, P, W) is [the work](#) done per unit of time, or [the energy](#) transferred per unit of time: $N = A / t$, where **N** is the power, **A** is the work performed, **t** is the period of time for which this work is performed. In [the SI system](#), power is measured in [Watts](#). Another unit of measurement that is still widely used today is [horsepower](#) (1 hp = 735,5 [watts](#)). **In mechanics**: If a force acts on a moving body, then this force performs work. The power in this case is equal [to the scalar product of the](#) force vector by the velocity vector at which the body moves: $N = \mathbf{F} \cdot \mathbf{v} = F \cdot v \cdot \cos \alpha$, where **F** is the force, **v** is the velocity, **α** is the angle between the velocity vector and the force. **In electricity**: Electric power (electric current power) is a physical quantity that characterizes the rate of transmission or transformation [of electrical energy](#). The instantaneous value of electric power **P(t)** for a section of an electric circuit: **P(t) = I(t)·U(t)**, where **I(t)** is the instantaneous value of electric current in a section of the circuit; **U(t)** is the instantaneous value of the voltage in the same section.

With the addition of the Power parameter (**P, W**) to the calculation matrix of Ohm's Law, the formulas of Ohm's Law took on the modern form:



How modern physics explains the phenomenon of electric current:

Electric current is an orderly, directed movement of electrically charged particles in a substance or in a vacuum. As stated in Ampère's law, **this becomes noticeable due to the magnetic field and usually causes the conductor to heat up** (does not occur in superconductors). Current occurs in an electrical circuit as soon as a conductive connection occurs between the terminals of the power supply. In addition, the displacement current is part of the electric current. This is not caused by the movement of charges, but by a change in the flow of the electric field. For example, it appears between the plates of a capacitor when it is being charged or discharged and creates a magnetic field, just like a normal current. The electric current flows in the direction from the positive pole of the DC power supply to the negative one. Moving charges that form electric current are called current carriers: in metals these are electrons, in semiconductors - electrons and holes, in electrolytes - positively and negatively charged ions, in ionized gases - ions and electrons. The orderly movement of current carriers in an electrically conductive medium under the action of an electric field is called conduction current. If the movement of charges occurs together with the body on which they are located, then such a current is called convection. An example of convection currents are the currents that occur when charged water droplets fall in the atmosphere, due to gravity. Short-term electric currents also arise in dielectrics due to the displacement of bound electric charges under the action of an external electric field. Such currents are called polarization currents.

The electric field is a surface effect for a conductor (static electricity): The electric field cannot penetrate the conductor's medium. In physics, there are parameters such as **Dielectric Constant** (ϵ) and **Magnetic Constant** (μ). In electrical engineering, with Ohm representation, there is such a parameter as: **Resistance to electric current**. In a conductor, it is a physical quantity that characterizes the ability of a material to resist the passage of electric current. It is measured in ohms (Ω) and depends on the properties of the material, its length and cross-sectional area. The formula for calculating the electrical resistance of a conductor is: $R = \rho \cdot (L / S)$ where: **R** is the electrical resistance, **ρ** is the resistivity of the material (depends on its physical properties), **L** is the length of the conductor, **S** is the cross-sectional area of the conductor. The greater the resistivity of the material, the more it resists the current. For example, silver and copper have low resistivity, making them excellent conductors, while rubber or glass are good high-resistance insulators. But - *electrical resistivity* - **ρ** , for many substances was established during research. There are tables in which data measured at a temperature of 20 degrees Celsius are entered. They are often used to solve various problems related to electricity.

Therefore, there is no evidence that the phenomenon of direction is associated with the movement of charged particles through the conductor medium. But the conductor can create the same zero zone [0+/-] **on the floor** for coupling or focusing the direction of the lines of force of the electrical induction of the source. I will not draw conclusions only from the facts now. The first fact is that the electrical tension (induction) reaches instantaneously the end of the wire, which is not yet closed to the negative terminal of the source. No electrons from the negative terminal can yet be in the circuit, and the tension at the free end of the wire already exists.

Current strength is just a phenomenon only for a closed electrical circuit, which, like a twin brother, is connected to the magnetic field around the conductor. In one of the Soviet textbooks, the author very beautifully described the action in an electrical circuit:

§ 41. Закон Ома 1. Одним из главных способов возбуждения электрического тока в телах является создание и поддержание в них электрического поля. Как показывает опыт, для многих тел (например, металлов) в широких пределах плотность электрического тока J пропорциональна напряженности электрического поля E. Это — один из важнейших, хотя и не фундаментальных, законов электродинамики. Он называется <i>законом Ома</i> (1787—1854). Математически закон Ома выражается формулой $J = \lambda E, \quad (41.1)$ где λ — постоянная для данного материала величина, называемая его <i>удельной проводимостью</i> или <i>электропроводностью</i>. Она зависит от физического состояния тела (температуры, давления и пр.). Строго говоря, закон Ома справедлив лишь для <i>физически однородных</i> тел. Величина, обратная удельной электропроводности, называется <i>удельным сопротивлением</i> материала: $\rho = \frac{1}{\lambda}. \quad (41.2)$	§ 43. Сторонние силы. Концентрационный элемент 1. Допустим, что единственными источниками электрического поля E в проводниках, по которым текут токи, являются электрические заряды, возбуждающие поля по закону Кулона. При <u>прохождении тока непрерывно происходит убыль зарядов, точнее, нейтрализация положительного и отрицательного электричества</u>. Для того чтобы напряженность поля E, а с ней и плотность электрического тока J оставались неизменными, необходимы какие-то дополнительные силы или процессы, непрерывно пополняющие электрические заряды. Плотность электрического тока, как видно из формулы (42.7), определяется полной силой F, действующей на электрон или другой носитель зарядов. Силу F можно разложить на две части: силу электрическую и силу незлектрическую, включающую в себя все прочие силы. Эти прочие силы принято называть <i>сторонними</i>. В соответствии с этим полагаем $F/e = E + E^{стор}$, где $E^{стор}$ — <i>напряженность поля сторонних сил</i>, т. е. сторонняя сила, отнесенная к единице заряда. С учетом сторонних сил закон Ома записывается в виде $J = \lambda (E + E^{стор}). \quad @Rakarskiy$
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I quote: During the passage of current, there is a continuous decrease in charges, or, more precisely, neutralization of positive and negative electricity.

I can only see one logical conclusion: something disappears, positive and negative electricity (charges, electrical induction, voltage) and something appears, current (magnetic field, magnetic induction). Where did the electrical components go? Dissipated due to the formation of a magnetic field (magnetic induction). Well, there is Maxwell's equation for Ampère's law:

4	$\nabla \times \mathbf{H} = \mathbf{J} + d\mathbf{D} / dt$	Ampere's Law Advanced Maxwell	Electric current Moving electric field create a magnetic field.
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All the ins and outs of this Maxwell equation are very well explained on this page: [Maxwell's 4th equation](https://www.maxwells-equations.com) (https://www.maxwells-equations.com) I took the formulas a bit and formulated what exactly the formula written by Maxwell on Ampère's Law states. Maxwell made an entry in the electric metric system, where the symbol $\mathbf{H}$ indicates the formation of magnetic tension in Amperes per meter.

In fact, to maintain the magnetic intensity $\mathbf{H}$, one must have two elements current $\mathbf{J}$ and displacement current $\mathbf{J}_D = d\mathbf{D} / dt$. [$\nabla \times \mathbf{H} = \mathbf{J} + d\mathbf{D} / dt$]

$$\nabla \times \mathbf{H} = \frac{\partial \mathbf{D}}{\partial t} + \mathbf{J} \quad \oint \mathbf{H} \cdot d\mathbf{L} = I_{enc}$$

$$\oint \mathbf{H} \cdot d\mathbf{L} = 2\pi r H = I_{enc} \Rightarrow H = \frac{I_{enc}}{2\pi r}$$

$$\nabla \times \mathbf{H} = \mathbf{J} \quad \nabla \cdot (\nabla \times \mathbf{H}) = \nabla \cdot \mathbf{J} \quad 0 = \nabla \cdot \mathbf{J}$$

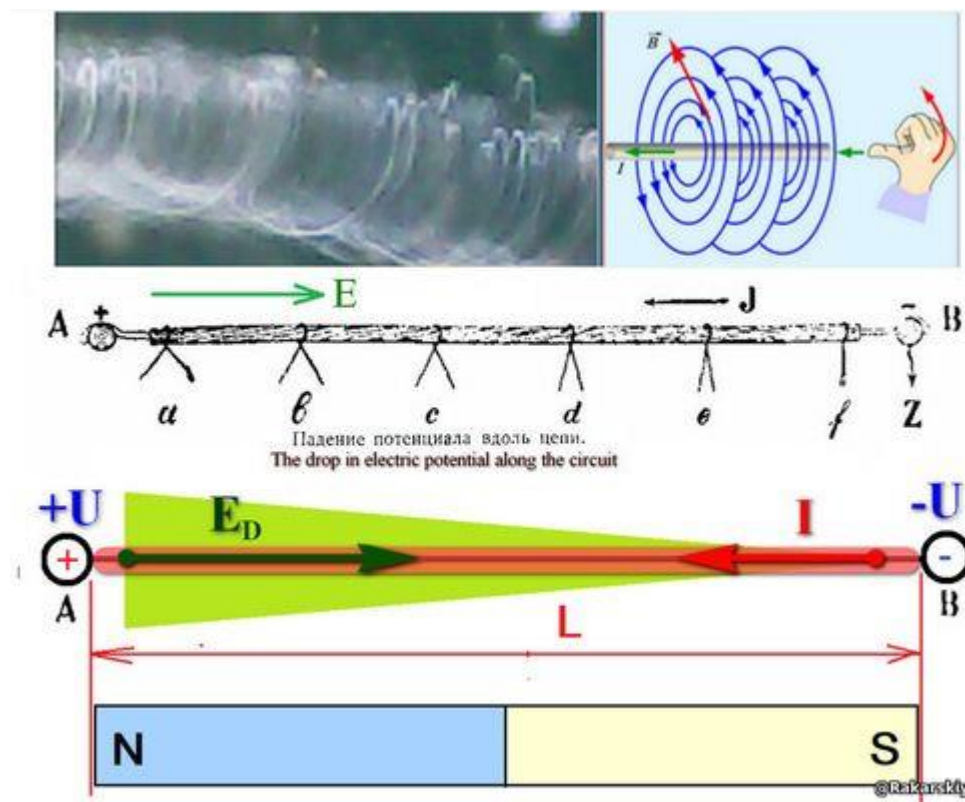
$$\frac{\partial \mathbf{D}}{\partial t} = \mathbf{J}_d \quad \nabla \times \mathbf{H} = \mathbf{J} + \mathbf{J}_d \quad \nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$$

[Displacement Current Density *щільність струму зміщення* @Rakarskiy]

Let's compare two formulas: Maxwell's equation for Ampère's law: $\nabla \times \mathbf{H} = \mathbf{J} + \mathbf{J}_D$, and the conditions for maintaining current in Ohm's law from the textbook (see slide above) $\mathbf{J} = \lambda (\mathbf{E} + \mathbf{E}_{ext})$. The conclusion from the publication is that $\nabla \times \mathbf{H} = \mathbf{J}$ speaks for itself: the current $\mathbf{J}$ and is the magnetic field (induction) $\mathbf{H}(\mathbf{B}_i)$, around the wire in a closed circuit. How to express the electrical intensity around a wire, it already has the appropriate EMF designation, or it can be expressed as a displacement of the electric charge density line (Maxwell's displacement current) at the speed of light along the surface of the conductor.

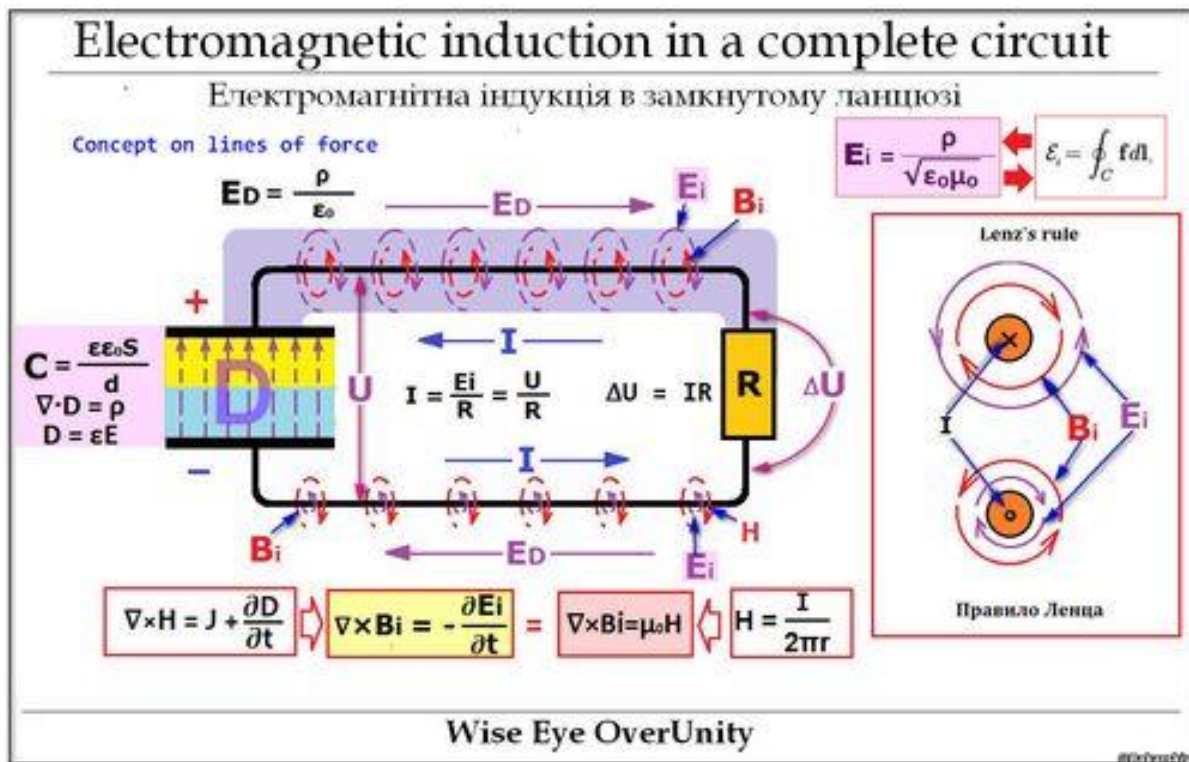
$\mathcal{E}_i = \oint_C \mathbf{f} d\mathbf{l},$	$\mathbf{E}_i = \frac{\rho}{\sqrt{\epsilon_0 \mu_0}}$
---	---

Another proof that current is a magnetic component of force. A magnetic dipole has an equal component of poles. If the electrical voltage along the conductor shows signs of decay, then the current and magnetic intensity have a uniform distribution along the conductor. Even in the part where the electrical voltage is almost zero. Visualization of magnetic lines of force around the wire indicates a spiral structure of electrical induction around the wire. This indicates that the magnetic line of force begins and ends at the electrical poles of the source. We can doubt it as much as we want, but the fact is the fact. The electrical bias intensity disappears $\mathbf{E}_i$, the current strength (magnetic induction) $\mathbf{J}=[\mathbf{B}_i]$ appears.



We conclude that the notations: Maxwell $\nabla \times \mathbf{H} = \mathbf{J} + d\mathbf{D}/dt$, or Ohm's law $\mathbf{J} = \lambda (\mathbf{E} + \mathbf{E}_{ext})$, are the actual expression of the electromagnetic induction of the conversion of an electric field into a magnetic field, and we can express it as:

$$\nabla \times \mathbf{B}_i = - d\mathbf{E}_i / dt$$



In addition, we owe the minus sign in the formula of electromagnetic induction

$$\nabla \times \mathbf{B}_i = - \mathbf{dE}_i / \mathbf{dt}$$

to the physicist of German origin from tsarist Russia Lenz. Lenz's rule determines the direction of the induction current and says: "***The induction current always has such a direction that it weakens the effect of the cause that excites this current!***" The rule was formulated in 1833 by E. H. Lenz. On the slide, I noted exactly how this happens.

Magnetic field (two types of magnetic field)

Another [Maxwell equation for Gauss's law \(theorem\)](#):

2.	$\nabla \cdot \mathbf{B} = 0$	Gauss's law for a magnetic field	There is no magnetic field charge , the lines of force of the magnetic field are closed.
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Before you read further, you should have read her about Gauss's law for electric fields. If this makes sense, then the second of Maxwell's equations will be quite simple. First, consider both Gaussian laws written in the "Equation":

$$\nabla \cdot \mathbf{D} = \rho \text{ [1]; } \nabla \cdot \mathbf{B} = 0 \text{ [2]}$$

As you can see, both of these equations specify the divergence of the field in question. For the [1] equation, we know that Gauss's law for electric fields states that the divergence of the electric flux density $\mathbf{D}$ is equal to the density of the bulk electric charge (ρ). Why? Why is the divergence $\mathbf{B}$ not equal to the density of the magnetic charge? But it just so happened that no one ever found a magnetic charge - not in the laboratory or

on the street, not in the subway. And so, Until this hypothetical magnetic charge is found, we set the right-hand side of Gauss's law for magnetic fields to zero:

$$\begin{aligned}\nabla \cdot \mathbf{B} &= 0 \quad (\text{Magnetic Charge Does Not Exist}) \\ \nabla \cdot \mathbf{H} &= 0 \quad (\text{also true since } \mathbf{B} = \mu \mathbf{H})\end{aligned}$$

Since $\mathbf{B}$ and the magnetic field $\mathbf{H}$ are related by the permeability of μ , then in equation [2] we note that the magnetic field divergence is also zero.

This conclusion is fully confirmed by our previous consideration. The magnetic field $\mathbf{V}_i$ around the conductor is a phenomenon of electromagnetic conversion induction, and it does not have an independent source. In addition, I would like to note that this field must be identified as "hot". This field also exists in the form of a hot plasma. But, there is also a magnetic field in ferromagnetic materials. Let us denote it as $\mathbf{B}_m$ (cold). In the ferromagnetic core of an electromagnet, the field $\mathbf{B}_m$ excites the field that is formed from electromagnetic induction in an electrical circuit: $\nabla \times \mathbf{B}_i = -d\mathbf{E}_i / dt$.

$$\nabla \times \mathbf{B}_m = \mu \mu_0 \mathbf{H} \text{ or } \nabla \times \mathbf{B}_m = \mu \mathbf{B}_i$$

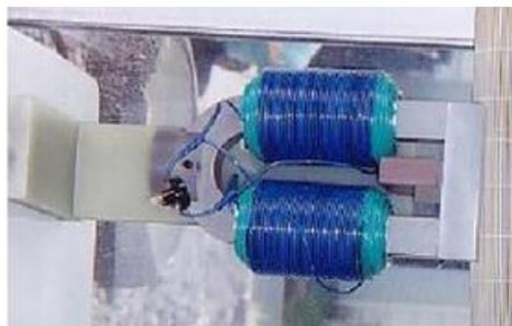
But there is a contradiction, the first is the existence [of permanent magnets](#), which are formed by a pulse of a magnetic field from an excitation coil $\nabla \times \mathbf{B}_m = \mu \mathbf{B}_i$. What is the source of magnetic induction after firing by an electromagnetic pulse is unknown, and the explanation of the phenomenon is rather an act of failure to establish the truth of the cause of the phenomenon. Therefore, I wrote down the formula for the magnetic induction of a permanent magnet in the form:

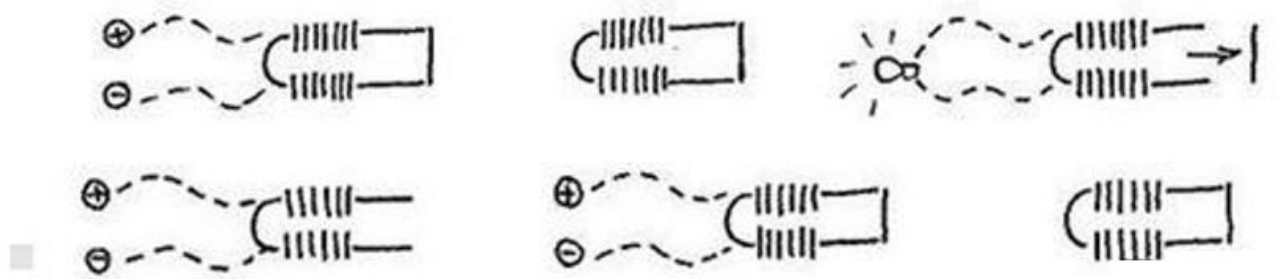
$$\nabla \times \mathbf{B}_m = \mathbf{Q}\mathbf{E} / (\partial t \rightarrow \infty)$$

Where $\mathbf{Q}\mathbf{E}$ is the ether that is the cause of the generation of magnetic induction in the material of a permanent magnet, $\partial t \rightarrow \infty$ is the period of time of this generation that tends to infinity.

Why did I write this way, it is absolutely known that the cause of the magnetic field (induction) in magnetically conductive materials can be another field (for example, the earth's magnetic field). thus until it is known exactly what is the cause of magnetic induction in the material of the magnet? It is reasonable to assume that the source is Ether. But this does not answer the question of how it is done.

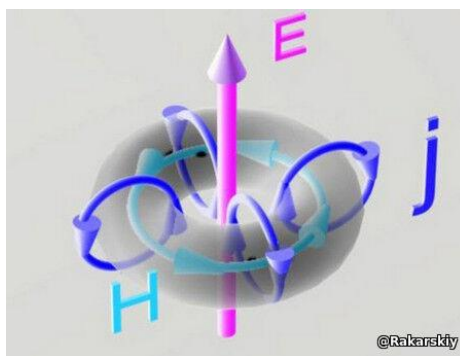
There is also such a phenomenon known as [Edward Leedskalnin's magnetic keeper](#). ([Edward Leedskalnin](#)) This device is described in his book "[Magnetic current. 1945](#)". The operation of this device is very simple, the collapsible iron core has a coil to create a magnetic flux $\mathbf{B}_i$, which induces a field in the core $\mathbf{B}_m$, but it is not clear how the magnetic field is retained in the core without supplying the excitation coils with current from an electrical source. After the forced separation of the core elements in the coil, an EMF roller pulse is generated.





Ukrainian YouTube blogger and researcher [Igor Biletsky](#) conducted interesting experiments that indicate that the magnetic field in the closed state of the iron core is very strong: [VIDEO1](#) and [VIDEO2](#). A possible explanation for the retention of the magnetic field in the closed state of the iron core is the [phenomenon of the ANAPOLE MOMENT](#), which is formed after excitation in a closed magnetically conductive medium and is recorded, but the cause of this phenomenon is unknown.

[ANAPOL](#) (from the Greek *an* - negative particle and *polos* - pole), **toroidal dipole** - a system of currents, the electromagnetic field of which is characterized by the vector of the anapole moment. A change in the anapole moment over time causes the system to emit electromagnetic waves.



In short, ANAPOL is a circular circular magnetic flux $\Phi = \mathbf{B}_m \mathbf{S}$, in a homogeneous medium of a magnetically conductive circuit. For example, they have been trying to obtain a looped flux $\Phi = \mathbf{B}_i \mathbf{S}$ for a long time, the [TOKAMAK project](#).

American version of the anapole moment: [Toroidal moment](#)

In the next part, we will consider the phenomena of electromagnetic induction, the appearance of an electric field with a change in the magnetic field.

Electromagnetic induction and generation of an electric field from a magnetic field.

This part will be very interesting, because the question that we will consider further has a lot of white spots in electrodynamics. Since the question of what is electromagnetic induction was answered by AI: **Electromagnetic induction is a phenomenon when an alternating magnetic field creates an electric field in space, or, as a result, an electric current in a closed conductive circuit. In other words, if the magnetic flux that permeates the circuit changes, then an induction current occurs in this circuit.** that there are two elements in an electric circuit: the displacement of the flow of electrical induction $[\mathbf{ED}]$ by lines of force of electrical intensity $[\mathbf{Ei}]$ and the formation of magnetic induction around the conductor $[\mathbf{Bi}]$. The question arises: what is **induction current**? In what capacity **does the electric field arise** and how **should the magnetic field change**?

[[Physics lesson 9-11 grades: Faraday's experiments. Electromagnetic induction](#)] read and remember what you learned about this phenomenon at school.



Electromagnetic induction was discovered independently of each other [by Michael Faraday](#) and [Joseph Henry](#) in 1831, however, Faraday was the first to publish the results of his experiments. How the phenomenon is interpreted by various sources:

Electromagnetic induction (RU) is the phenomenon of the occurrence [of an electric current](#), [electric field](#), or [electric polarization](#) when a [magnetic field changes](#) in time or when a material medium moves in a magnetic field. Electromagnetic induction was discovered [by Michael Faraday](#) on August 29, 1831. (EMF) occurring in a closed conductive circuit is proportional to the rate [of change of magnetic flux](#) through the surface bounded by this circuit. The magnitude of the electromotive force does not depend on whether the change in flow is a change in the magnetic field itself or the movement of the circuit (or part of it) in a magnetic field. [The electric current](#) caused by this EMF is called [induction current](#).

Electromagnetic induction (UA) is the phenomenon of creating [a vortex electric field in space](#) by an alternating [magnetic flux](#). One of the consequences of electromagnetic induction is the coupling between alternating electric and [magnetic fields](#) in [an electromagnetic wave](#), another consequence that is practically important for the generation of electric current is the occurrence [of an electromotive force](#) in the conductive circuit, through which the magnetic flux changes. The units of measurement of electromagnetic induction are [tesla](#) (in the [SI system](#)), [gauss](#) (in the [CGS system](#)); $1 \text{ T} = 10^4 \text{ Gs}$.

Electromagnetic or magnetic induction (EN) is the generation [of an electromotive force \(EMF\)](#) on [an electrical conductor](#) in an alternating [magnetic field](#). [Michael Faraday is](#) usually credited with the discovery of induction in 1831, and [James Clerk Maxwell](#) mathematically described it as [Faraday's law of induction](#). [Lenz's law](#) describes the direction of an induced field. Later, Faraday's law was generalized and turned into the Maxwell–Faraday equation, one of [Maxwell's four equations](#) in his theory of [electromagnetism](#). Electromagnetic induction has found many applications, including electrical components such as [inductors](#) and [transformers](#), as well as devices such as [electric motors](#) and [generators](#).

Faraday's law of induction (or simply [Faraday's law](#)) is [a law of electromagnetism](#) that predicts how [a magnetic field](#) will interact with [an electrical circuit](#) to form [an electromotive force](#) (EMF). This phenomenon, known as [electromagnetic induction](#), is the basic principle of operation of [transformers](#), [inductors](#) and many types of [electric motors](#), [generators](#) and [solenoids](#).

According to Faraday's law of electromagnetic induction (in SI):

$$\mathcal{E} = - \frac{d\Phi_B}{dt},$$

Where: $\mathcal{E}$ is [the electromotive force](#) acting along an arbitrarily selected circuit ([volts, V](#)), Φ is [a magnetic flux](#) through the surface bounded by this circuit ([Weber, Wb](#)).

The minus sign in the formula reflects [Lenz's rule](#), named after the physicist [E. H. Lenz](#): *The induction current arising in a closed conductive circuit has such a direction that the magnetic field created by it counteracts the change in the magnetic flux that caused this current* * (**the rule is not exact, not author's*).

For a coil in an alternating magnetic field, Faraday's law can be written as follows:

$$\mathcal{E} = -N \frac{d\Phi_B}{dt} = -\frac{d\Psi}{dt},$$

Where: $\mathcal{E}$ is the electromotive force, N is the number of turns, Φ is the magnetic flux through one revolution, Ψ is [the coil flow coupling](#).

As you can see, the explanations on different pages of Wikipedia have differences, but the result is the Electromotive Force EMF ($\mathcal{E}$), which is measured in *volts* (V). The modern explanation of the operation of *Lenz's rule* * does not suit me, because we put the minus sign into the form in which the electric field counteracts the magnetic field, and the explanation for this opposition is put into the action of the current, the magnetic field, which occurs already when the EMF is discharged when it is closed in an electric circuit. What does it look like the primary formulation of the rule: "*The induction current always has such a direction that it weakens the effect of the cause that excites this current!*" The rule was formulated in 1833 by E. H. Lenz. It will be true that **the EMF** vector ($\mathcal{E}$) will counteract the magnetic field vector (induction) $\mathbf{B}$. More precisely, this is written by Maxwell. [The 3rd Maxwell's Equation](#). Faraday's first formula, Maxwell's second:

$$EMF = -\frac{d\Phi}{dt} \quad [1] \quad \nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \quad [2]$$

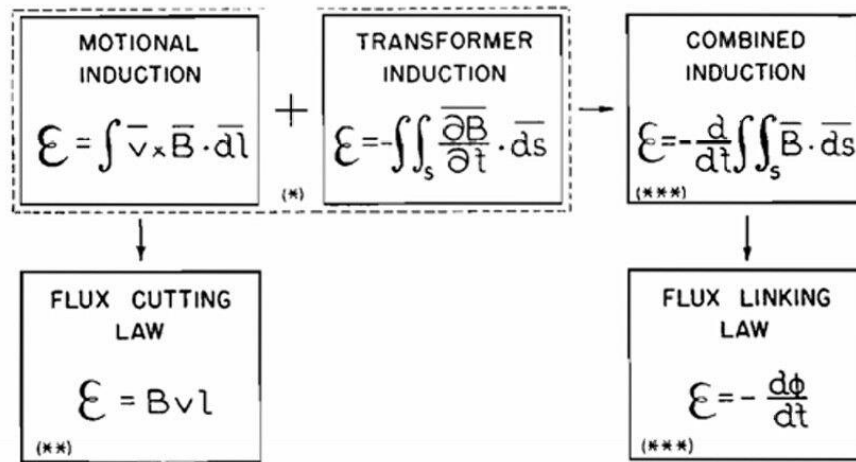
[Some physicists note](#) that Faraday's law describes two different phenomena in one equation: '*moving EMF*', generated by the action of a magnetic force on a moving wire, and '*transformer EMF*', generated by the action of an electric force due to a change in the magnetic field. [James Clerk Maxwell](#) drew attention to this fact in his work [On Physical Lines of Force](#) in 1861. In the second half of Part II of this work, Maxwell gives a separate physical explanation for each of these two phenomena.

References to these two aspects of electromagnetic induction are found in some modern textbooks. As Richard Feynman writes:

Thus, the "flow rule" that the EMF in a circuit is equal to the rate of change of magnetic flux through the circuit applies regardless of the reason for the change in flux: either because the field changes, or because the circuit moves (or both)... In our explanation of the rule, we used two completely different laws for two cases - $\mathbf{v} \times \mathbf{B}$ for a "moving chain" and $\nabla \times \mathbf{E} = -\partial_t \mathbf{B}$ for a "changing field". ... We do not know of any analogous position in physics when such simple and precise general principles would require for their real understanding of analysis in terms of two different phenomena.

— 'Richard Feynman', [Feynman Lectures on Physics](#)

A publication that investigates the presence of two distinct phenomena of electromagnetic induction: [George R. Cohn - Electromagnetic induction 1949. \(PDF\)](#)



- * Completely general when combined
- ** Flux must be uniform, and B , v , and l must be mutually orthogonal
- *** Motion of material and path of integration must be identical

@Rakarskiy

Transformer induction: In the case of purely transformer induction, there is no movement of material bodies as such.

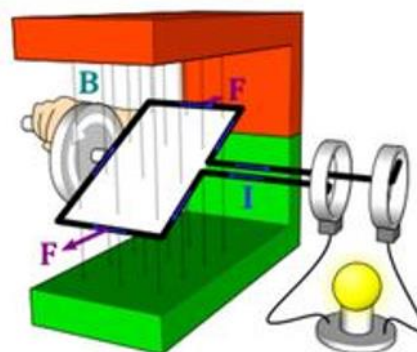
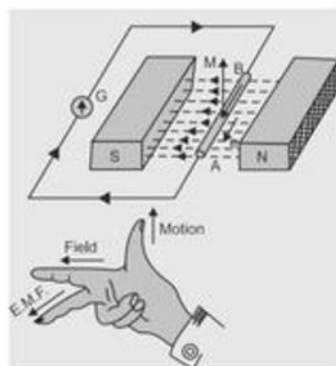
Motor (Mobile) Induction: In the case of purely motor induction, there is no change in the magnetic field over time as such.

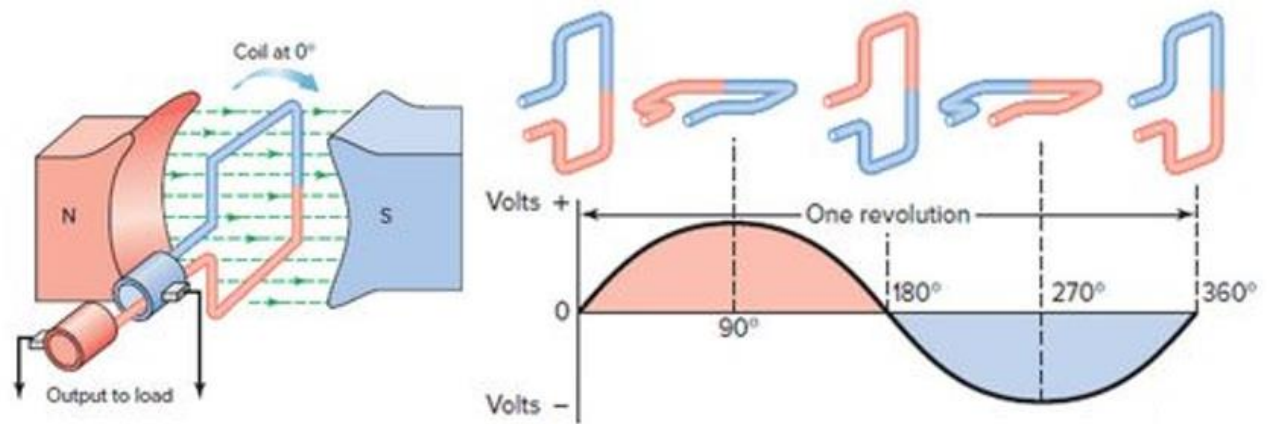
There are two practical engineering formulas by which the measurement of EMF for the corresponding conditions is calculated: the first is 'motion EMF', the second is 'transformer EMF':

$\mathcal{E} = \frac{\Delta\Phi}{\Delta t} = Blv \sin \alpha$	$\mathcal{E} = \frac{\Delta\Phi}{\Delta t} = \frac{2\pi\Phi f}{\sqrt{2}} = 4.44\Phi f$
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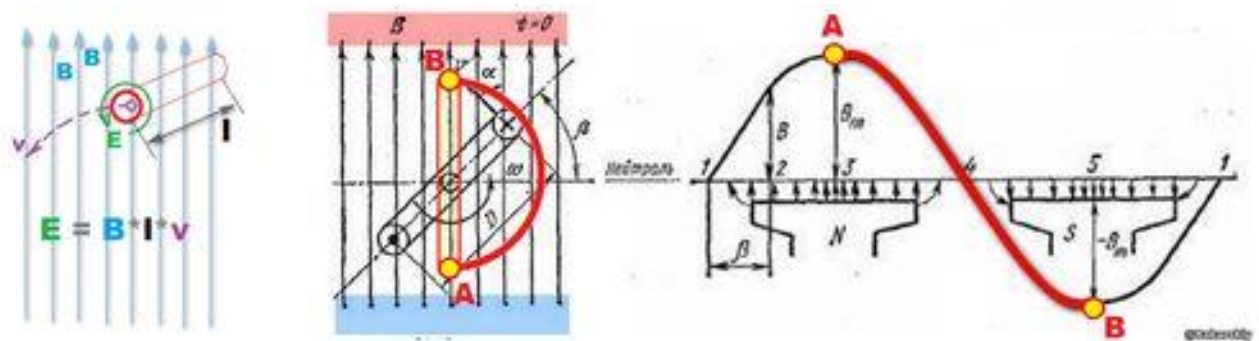
In general educational resources and textbooks, there are enough explanations of the action of EMF during the movement of a wire in a magnetic field. Very simply, the moment of occurrence of EMF - E (volts), at the ends of the conductor, the length of the conductor l (meters), which intersects the magnetic lines of force of magnetic induction B (Tesla) with a speed v (m/s) [$v \times B$] at an angle $\sin \alpha$ corresponds to the multiplication in the equation of these parameters:

$$F = B * l * v * \sin \alpha$$

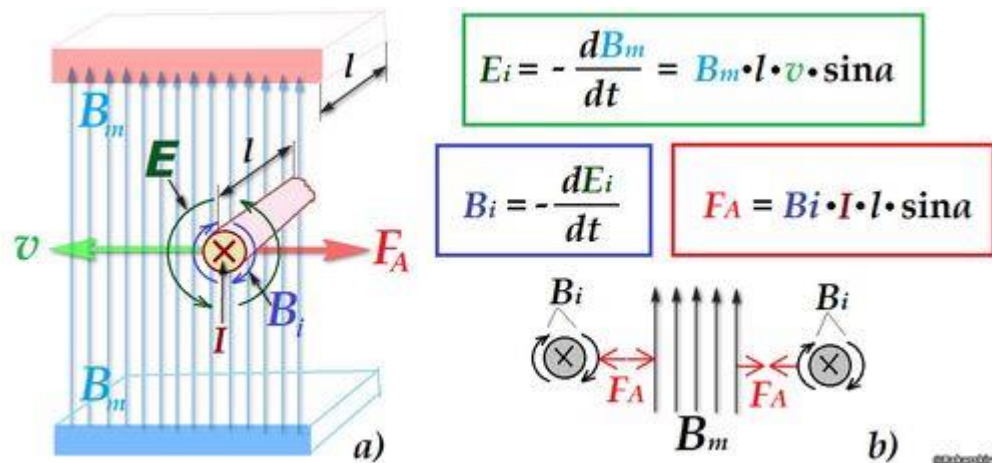




Such a mechanism for calculating the EMF is not objectionable. But there is something that raises questions. Is it the intersection of the magnetic induction lines, or is it the movement in and against the direction of the magnetic induction line vector of the external magnetic field? I have a question that needs to be clarified. You can also try the corresponding test.



To understand how the simultaneous induction of EMF $[E]$ and magnetic field $[Bi]$ (current $[I]$) occurs, I made a slide. On it, I depicted the movement of a wire of length $[l]$ through a homogeneous magnetic flux with a magnetic induction vector $[Bm]$, at a speed $[v]$, at an angle of 90° (Fig. a). $[I]$ works in a magnetic flux (Fig. b). On the wire side, when the magnetic induction lines are in the same direction as the magnetic flux lines, they attract, and on the opposite side, they are repelled. But, when a wire with electromagnetic induction is closed in an electrical circuit with a load, two electromagnetic inductions are carried out simultaneously and symmetrically.



Why, when the wire moves everywhere the magnetic field on the surface, the lines of force of electrical induction $[E_i]$ are formed to *this* day has not been clarified. Unfortunately, the interpretation of the Lorentz force has a very large discrepancy, which we will consider later.

The interpretation of the Lorentz Force implies that there are electric charges in the conductor that are excited when the magnetic induction vector is exposed to them.

The Lorentz force is the force that acts on a charged particle moving in an electromagnetic field. It consists of two parts: the force acting on the electric field and the force acting on the magnetic field. The electric field acts on the charge along the field lines, and the magnetic field acts only on moving charges, perpendicular to the direction of charge movement and the direction of magnetic induction. The formula for the Lorentz force is: $F_L = q (E + [v \times B])$, where q is the charge of the particle, E is the electric field strength, v is the velocity of the particle, B is the magnetic induction, and $[v \times B]$ is the vector product of velocity and magnetic induction.

Most likely, the Lorentz formula combines all the actions in a closed circuit: electromagnetic induction in the modulus of rapid change of magnetic flux (induction), current strength and Ampère force from the presence of current - magnetic induction around a wire with current:

$$E = -dB_m/dt; I = \Delta q/\Delta t$$

Then $B_i = -\Delta E_i/\Delta t$ because $[I]$ is $[B_i]$; $F_A = B / (IL)$ or $F_A = I [\Delta L \times B]$.

$$F_A = B_m / (B_{il}) \text{ or } F_A = B_m [\Delta L \times B_i]$$

Therefore, the expression of the Lorentz Force $F_L = q (E + [v \times B])$ is more suitable for the expression of the Ampère force $F_A = I [\Delta L \times B]$. We found out that the Ampere Force has nothing to do with Faraday's electromagnetic induction. Unfortunately, the Lorentz force rather the desire to explain the phenomenon of electromagnetic induction from the action of the force of magnetic induction on the presence of charges in the conductor was unsuccessful. Electrical induction on a conductor is a superficial effect. The presence of "drowsy" electric charges in a conductor that is "excited" in an alternating magnetic field, or in a conductor moving in a magnetic field - by the action of the magnetic field force - is unsuccessful? What is the true mechanism for the formation of electrical induction around a wire in an alternating magnetic field is unknown.

What is the EMF line of force on a conductor? It is identical to the same line of electrical induction E_i which has an extension from the source of the accumulator with a dielectric dipole E_D , in an electric circuit, with one exception - the source is the magnetic induction B_m of an external magnetic field, which has a variable character to the conductor:

$\mathcal{E}_i = \oint_C \mathbf{f} d\mathbf{l},$	$\mathbf{E}_i = \frac{\rho}{\sqrt{\epsilon_0 \mu_0}}$
---	---

But if we remember how the friction of an ebonite stick on the wool works and how an electrical voltage is generated on the stick, we can try to draw an analogy. The conductor moves in a magnetic field, and the conductor material has magnetic permeability. The effect of rubbing the wire against the magnetic induction line can work. But the Lorentz force tensor does not have the opposite of the Ampère force. EMF is generated in the phase winding even during idle rotation in the absence of a resistance force to the magnetic friction of the wire against the magnetic lines of force. I believe that the term Lorentz force does not refer to the force manifestation of the armature reaction, which is the phenomenon of the interaction of the magnetic field created by the current in the armature winding of an electric machine with the main magnetic field of the

machine. Simply put, it is the effect of the current in the armature winding on the magnetic flux generated by the excitation winding, which can cause the main magnetic field to be distorted and affect the operation of the machine.

It is very contradictory to consider the Lorentz force to be a constant "for a constant" in relation to the generation of EMF in an alternating magnetic field or when a conductor crosses a magnetic field. What we get on a wire in the form of EMF is not an independent component of electrical induction, the source of which is the effect of a magnetic field on the magnetic permeability of a conductor. or against that vector.

Self-induction is the phenomenon of the occurrence [of an electromotive force](#) current in [a conductor](#) when [the electric current in it changes](#).

The magnitude of the electromotive force of self-induction is determined by the formula:

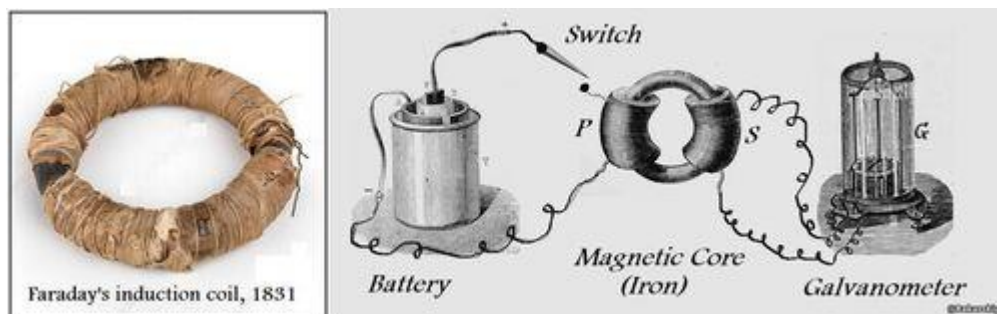
$$E = -L (dI/dt),$$

Where E is the electromotive force, I is the current strength, L is [the inductance](#) (or *self-induction coefficient*) is the coefficient of proportionality between the electric current I flowing in any closed circuit and the total magnetic flux Φ , also called the flux coupling created by this current through the surface whose edge is this circuit.

To put it simply, we have a section of wire on which electromagnetic induction takes place (Ampère's Law) $\nabla \times \mathbf{B}_i = -d\mathbf{E}_i/dt$. When the circuit is broken from the source, the magnetic induction around the wire instantly begins to decrease, this action is also a magnetic friction for the conductor material with magnetic permeability. The speed at which V_i decreases is high, so we have the inverse effect of EMF on Ampère's Law $\nabla \times \mathbf{E}_i = -d\mathbf{B}_i/dt$. If the wire has a coil structure, then the magnetic circuit still has a toroidal structure, which enhances the value of magnetic induction $\mathbf{B}_i$, which interacts with the conductor. If the coil has an iron core, then a still cold magnetic field $\nabla \times \mathbf{B}_m = \mu \mathbf{B}_i$. The expression of self-induction, when excited by cold magnetic induction in the core and hot magnetic induction in the wires of the coil, will be as follows:

$$\nabla \times \mathbf{E}_i = -d[\mathbf{B}_i + \mathbf{B}_m]/dt$$

[Recall the experiment of Michael Faraday](#), who experimented with circuits and magnetic coils back in the distant times of the 1830s. His experimental setup, which led to Faraday's law, is shown in the figure:



The experiment itself is somewhat simple. When the battery is disconnected, we do not have electric current flowing through the wire. Therefore, there is no magnetic flux induced in iron (magnetic core). Iron is like a highway for Magnetic fields - they flow through magnetic material very easily. Therefore, the purpose of the core is to create a path for magnetic flux to flow. When the switch is closed, electrical current will flow inside the wire attached to the battery. When this current flows, it has an associated magnetic field (or magnetic flux) with it. When the wire is wrapped around the left side of the magnetic core (as shown in the figure), a magnetic

field (magnetic flux) is induced within the core. This flow moves around the core. So the magnetic flux produced by the wire coil on the left exists in the wire coil on the right, which connects to the ammeter. Now a funny thing is happening that Faraday noticed. When he closed the switch, then the current would start to flow and the ammeter would jump to one side (say measuring +10 Amps on the other side). But it was very short, and the current on the right coil would go to zero. When the switch has been opened, the measured current will jump to the other side (say -10 Amps will be measured) and then the measured current on the right side will be zero again. Faraday understood what was happening. When the switch was changed initially From open to closed magnetic flux inside the magnetic core increased from zero to some maximum number (which was a constant value, compared to time). As the flow increased, there was an induced current on the opposite side.

Similarly, when the switch was opened, the magnetic flux in the core would decrease from its constant value back to zero. It follows that the decreasing flow within the core induced the opposite current on the right side. Faraday found that the changing magnetic flux in the circuit (or closed circuit of the wire) produced induced EMF, or voltage in the circuit. He wrote it like this:

$$EMF = - \frac{d\Phi}{dt} \quad [2]$$

In equation [2], the magnetic flux Φ , covers the circuit (or part of it), and the EMF is the electromotive force, which is basically the source of the voltage. Then equation [2] says that the induced voltage in the circuit is the opposite of the time rate of change of the magnetic flux.

I assure you that in this experiment Michael Faraday had a dish with four phenomena of electromagnetic induction.

A. When a switch with a primary winding is closed to a galvanic battery, electromagnetic induction is performed in a twisted circuit:

$$\nabla \times \mathbf{B}_i = - \mathbf{dE}_i / \mathbf{dt} \text{ (Maxwell's level according to Ampère's law: } \nabla \times \mathbf{H} = \mathbf{J} + \mathbf{dD}/\mathbf{dt})$$

Into. Magnetic flux induction in an annular iron core:

$$\nabla \times \mathbf{B}_m = \mu \mathbf{B}_i$$

S. When the switch with the primary winding is turned off, the phenomenon of self-induction is performed in the primary and secondary windings

$$\nabla \times \mathbf{E}_i = - \mathbf{d}[\mathbf{B}_i + \mathbf{B}_m] / \mathbf{dt}$$

D. Performance of the phenomenon of reciprocal wire induction (mutual induction).

We will consider this issue separately, because the causal interpretation of physics is incorrect:

Mutual induction (mutual induction) is the phenomenon of the occurrence of EMF induction in one circuit with a change in the current strength in the second circuit and vice versa.

$$E_2 = -d\Psi_1/dt = -L (dI_1/dt)$$

where E_2 is the electromotive force in the second circuit; Ψ is the flow coupling of the primary circuit; I is the current strength in the primary circuit; L is the mutual inductance of the circuits.

Consider this electromagnetic induction - mutual induction separately further in the plane of the Faraday experiment. I have already investigated mutual induction and self-induction in the plane of operation of a transformer: [Transformer](#).

Okay, we have to find out what happens in an electromagnetic device, which in electrical engineering is called an electrical transformer. What do we know .

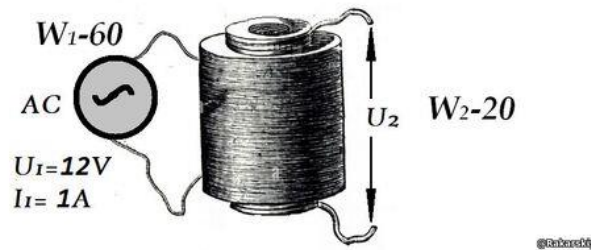
In electrical engineering, a transformer (EN) is a passive component that transfers electrical energy from one electrical circuit to another circuit or multiple circuits. The alternating current in any transformer coil creates an alternating magnetic flux in the transformer core, which induces a variable electromotive force (EMF) on any other coils wound around the same core. Faraday's induction, discovered in 1831, describes the effect of induced voltage in any coil due to a change in the magnetic flux surrounded by a coil.

or

Transformer (UA) (from Latin transformo — to convert) is a device for converting parameters (amplitudes and phases) of voltage and currents. A transformer is a static electromagnetic device that has two or more inductively coupled windings and is designed to convert one or more AC systems (voltage) into one or more other AC systems (voltage) using electromagnetic induction without changing the frequency of the AC system (voltage).

Education and scientists claim that this device performs the Faraday electromagnetic induction algorithm. That is, the cause of the EMF of the secondary winding is the magnetic field created by the primary winding. Moreover, the operation of the device is better with an iron core than without a core. I do not agree with the statement that transformers with two windings work according to this principle of operation. Firstly, all transformers are devices that change the output voltage, and are calculated according to the principle of volt-turns. From this moment on, how to calculate two devices with and without a core, based on the Faraday EMF phenomenon, then in a device without a core, we will not have enough magnetic induction to obtain the appropriate EMF value in the secondary winding of the device.

Example: we have two solenoid-type coils. Suppose we have coils wound around each other. Winding length 3 cm (0.03 m). Suppose our device operates at a switching frequency of $f=1000$ Hz. The primary external winding is 60 turns, the internal secondary winding is 20 turns. The voltage of the primary winding is 12V, and we expect the voltage to decrease to 4V [$60/20=3$; $12/4=3$].



We make calculations: The internal cavity of the primary winding, where the secondary winding is located, is a cylinder with a diameter of 2 cm (0.02 m) and a height of 3 cm (0.03 m), with a cross section:

$$S = \pi r^2 = \pi * 0.02^2 = 0.0004 \pi \approx 0.001256 \text{ m}^2$$

Magnetic induction is calculated using the appropriate formula:

$B = \mu_0 (N/l)I = \mu_0 nI$; where N is the number of turns in the solenoid, l is the winding length of the solenoid, n is the number of turns per unit length, I is the current strength in the solenoid, μ_0 is the magnetic constant ($4\pi \cdot 10^{-7}$ Gn/m). Let's calculate: $n = 60/0.03 = 2000$

$$B = \mu_0 nI = (4\pi \cdot 10^{-7} \text{ Gn/m}) * 2000 * 1A = 0.002512 \text{ Tesla}$$

The formula by which we will calculate the EMF of the secondary winding is called transformer EMF:

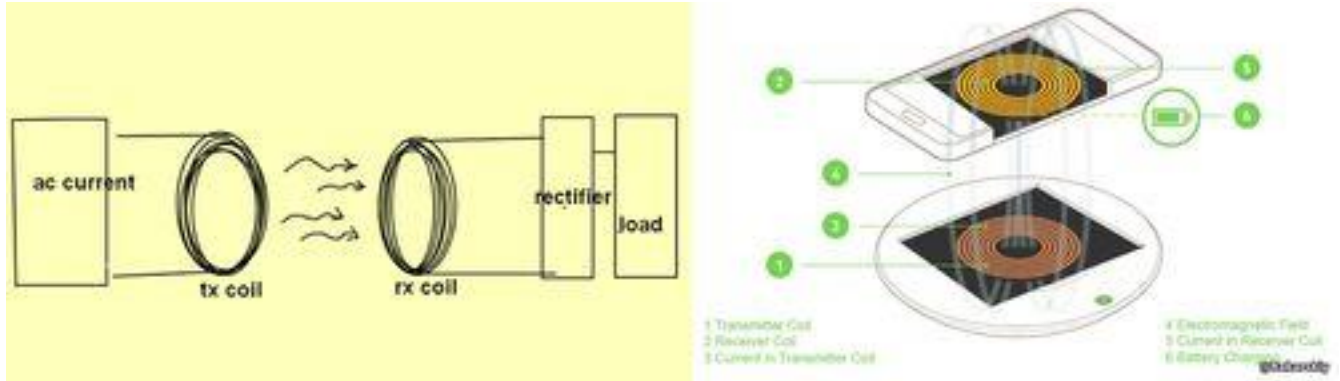
$$E = 2\pi N \Phi f / \sqrt{2} = 4.44 N \Phi f$$

We need to calculate the magnitude of the magnetic flux $\Phi = BS$ (Weber), add it to the formula and calculate:

$$E_2 = 4.44 N B S f =$$

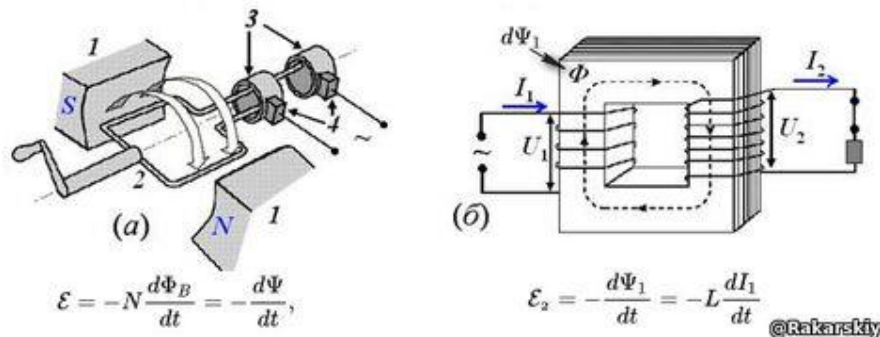
$$= 4.44 * 20 * 0.002512 \text{ Tesla} * 0.001256 \text{ m}^2 * 1000 \text{ Hz} = \mathbf{0.2801 \text{ V}}$$

As you can see, the calculation shows that this is impossible, but still the devices work quite successfully, for example, wireless charging of a smartphone battery.



Next, we continue to investigate the transformer and the phenomenon of mutual induction. [The formula of transformer EMF](#) is associated with the phenomenon of electromagnetic induction, when the difference in electrical potentials of the secondary winding appears when the magnetic field (flux) in the core of the core changes and is compared with the action of an electromagnetic generator, [example](#):

$$k = \frac{E_1}{E_2} = \frac{4.44 W_1 f \Phi_{\max}}{4.44 W_2 f \Phi_{\max}} = \frac{W_1}{W_2} \approx \frac{U_1}{U_2}$$



But from the preliminary calculation we saw that this is not true in a device without a core. I made calculations with a core, where also, the result of the calculation does not correspond to the statements in physics textbooks [\[Transformer\]](#). Transformers as devices are calculated and work in electrical engineering and other related technologies. Earlier I noted that the basic calculation is worked out on the proportion of volt-turns of the transformation coefficient.

Transformation coefficient. Formula

For transformers with parallel connection of the primary winding to the energy source, as a rule, scaling relative to the voltage is interested, and therefore, the transformation factor n expresses the ratio of primary (input) and secondary (output) voltage:

$$n = U_1/U_2 = (E \cdot W_1 + I_1 R_1) / (E \cdot W_2 + I_2 R_2)$$

where: U_1, U_2 are input and output voltages, respectively; E - EMF (turn) is given in each turn of any winding of this transformer; W_1, W_2 - the number of turns of the primary and secondary windings; I_1, I_2 - currents in the primary and secondary circuits of the transformer; R_1, R_2 - active winding resistances.

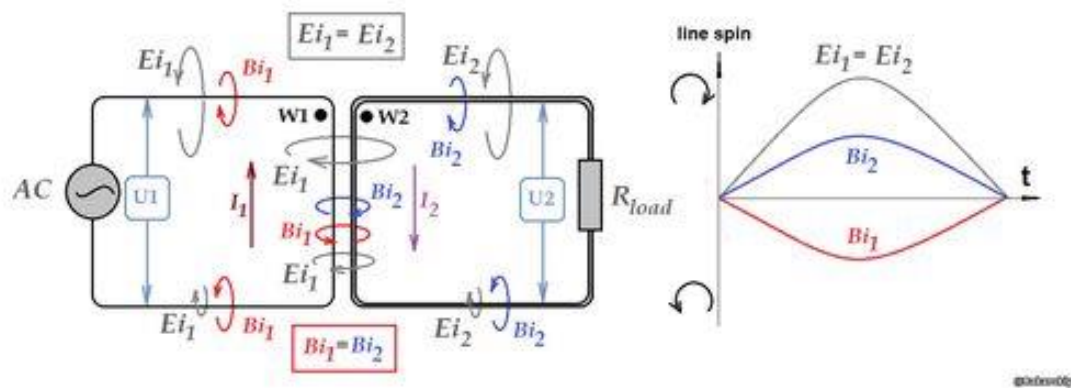
If we neglect the voltage drops in the windings, i.e., consider equal to zero, then $n = U_1/U_2 = W_1/W_2$. Such transformers are also called **voltage transformers**.

For transformers with a series connection of the primary winding to the energy source, the scaling relative to the current strength is calculated, that is, the transformation factor n expresses the ratio of primary (input) and secondary (output) currents:

$$n = I_1/I_2$$

In addition, these currents are connected by another dependence: $I_1 \cdot W_1 = I_2 \cdot W_2 + I_0$, where I_1, I_2 are the currents in the primary and secondary circuits of the transformer; W_1, W_2 - the number of turns of the primary and secondary windings; I_0 is the "no-load" current, consisting of the magnetization current and active losses in the magnetic circuit.

How does the phenomenon of wired mutual induction really work? When studying the regularities of the phenomenon, interesting comparisons of the dependence of the transformation coefficient, the ratio of primary and secondary windings on the basis of volt-turns were established / confirmed. But consider the action of mutual induction based on the lines of force of electromagnetic induction in a wire. Drawing of mutual induction of two wires that are wound by the bifilar method. The number of turns of the primary winding is equal to the number of secondary windings, so it is advisable to count as one branch.

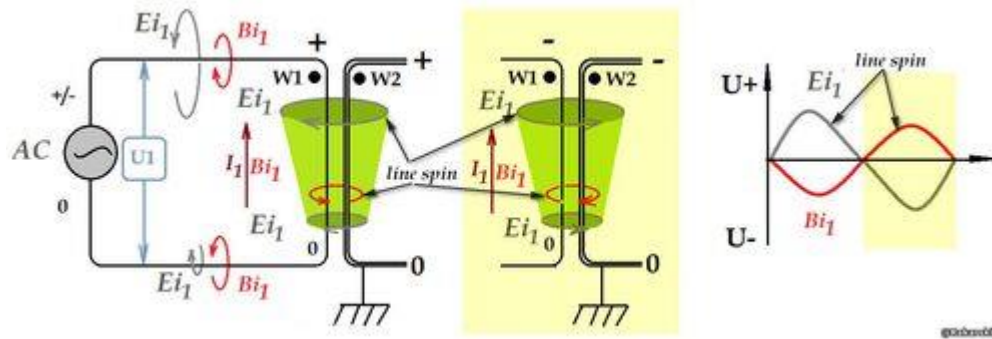


We have two separate circuits: the first with the primary winding W_1 which is connected to the AC voltage / current AC source; the second with the secondary winding W_2 is connected to the R_{load} . These circuits are connected through wires in the bifilar winding. A large dot indicates the beginnings of the windings. We do not have any iron core. If the primary winding W_1 has a working AC AC source U_1 , then taking into account the resistance R_1 of the winding W_1 , the current will be generated in the circuit according to Ohm's law $I_1 = U_1/R_1$, more precisely the phenomenon of electromagnetic induction according to the Ampère-Maxwell law

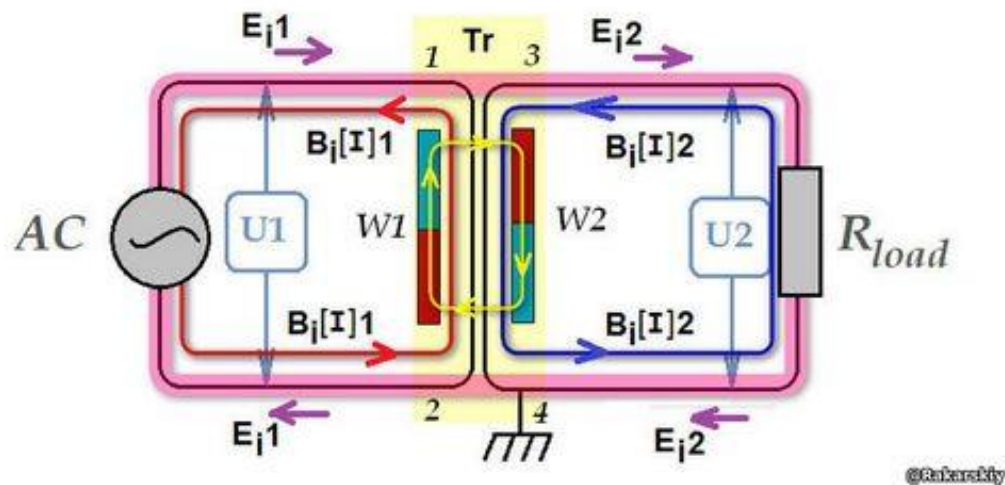
which I noted as the direct induction of the transformation of the electrical induction EMF (around the wire with current **I**) into the magnetic induction of **Vi** around the circuit wire and the primary winding **W1**.

$$[\nabla \times \mathbf{H} = \mathbf{J} + d\mathbf{D}/dt] = [\nabla \times \mathbf{B}_i = -d\mathbf{E}_i/dt]$$

What does it look like at alternating voltage / current if the **winding W1** is powered from an **AC socket** with a phase (+/-) and (**ZERO**):



Along the conductor with coils, a downward field of electrical induction EMF $[E_i]$ is formed. Magnetic induction is formed around the conductor according to Lenz's rule $[B_i]$. The conductor of the secondary winding **W1** (*parallel winding of the bifilar*) is subject to the action of capacitive coupling EMF $[E_i]$ of the primary winding. Voltage is formed at the outputs of the secondary winding according to the transformation coefficient $n=U1/U2=W1/W2$. How does it happen? Obviously, the vortex medium of electrical induction $[E_i]$ affects the secondary conductor. Logic obliges this and any experiment will say that the "+" of the input at the beginning of winding **W1** will be the "+" of the output at the beginning of winding **W2**. If you look at the following figure, I noted that the load with the source has a direct relationship by electrical induction $[E_i]$. The transformer windings only change the voltage due to the capacitive connection of the volt-turns. But the current (*magnetic induction*) goes through the excitation of magnetic induction at the secondary winding, provided that it is closed to the load. Everything happens exactly according to the principle of magnetic induction. In the figure, I marked this point with a conditional drawing of the excitation magnet **W1**, and the magnet of which W2 is excited. But magnetic induction is not transmitted in the transformer assembly of the **W1/W2** windings. Everything is as we considered a simpler closed circuit. Voltage-converted electrical induction EMF $[E_i]$ is transmitted to the load. But for stump **I** magnetic induction $[V_i]$ there are two circuits that, like two acrobat brothers, interlock. The city where they interlock is between the wired connection between the **windings W1/W2**.



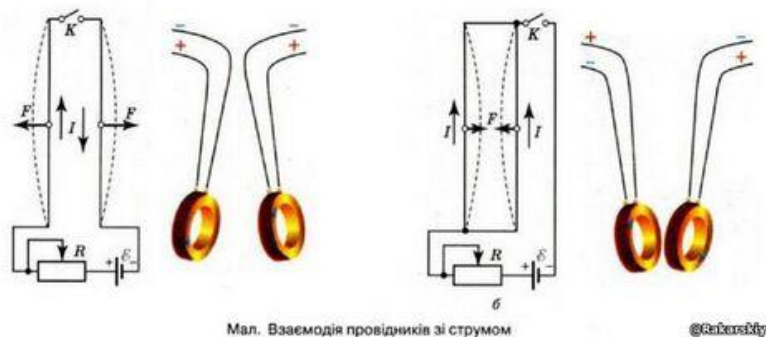
If the transformer has an iron core, then everything connected with its magnetic system is calculated either for the primary winding or secondary, because in the core the magnetic field will correspond to the ampere turns of the primary or secondary windings. When both windings are connected to the circuit, the iron core does not see the current (magnetic induction) of the secondary winding, but it can clearly see the current (magnetic induction) of the primary winding. If the secondary winding is opened from the circuit, then the primary winding works like a conventional electromagnet or choke, which has an inductance parameter. If the windings are operating at full power, there is no inductance of the flow coupling of the transformer windings. That is, the statement that the transformer induces EMF in the secondary winding due to a change in the magnetic field in the core or primary winding is erroneous. This misconception already has very large roots in education.

What conclusions can we draw? First, the primary action between wired induction is "capacitive electrical coupling", we will call it that. The action differs from electrostatic induction in conductors *"The redistribution of charges in well-conductive metals under the action of an external electric field occurs until the charges inside the body almost completely compensate for the external electric field."* Most likely, in this phenomenon, the action of the vortex transmission system of electrical induction EMF between wires under appropriate focus conditions where the center is the wire. The action of the EMF drop (electrical induction E_i) of the source and the appearance of current I (magnetic induction B_i) occurs in a common electrical circuit, where the transformer is a converter of the voltage level (electrical tension or EMF) on a section of the circuit wire. The action of current generation on the load (in 1/2 of the circuit with a load) is possible express by the formula:

$$I_R = (U_{W2} = k \cdot U_{W1}) / R_{LOAD},$$

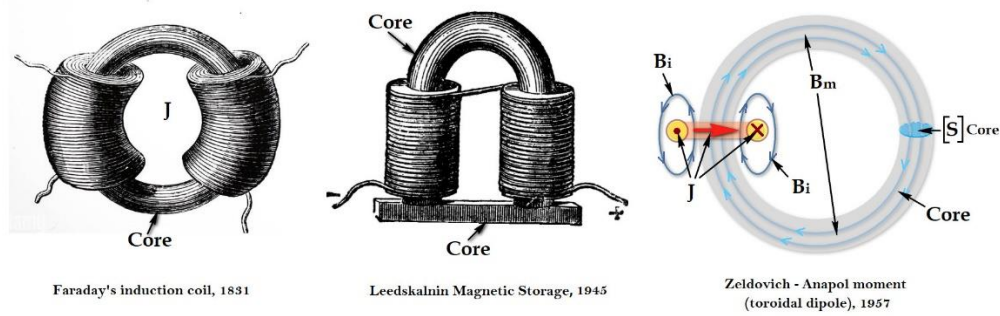
Where k is the voltage transformation coefficient between the windings.

In a transformer, the electric flux of F_e induction between the windings has a single component: $F_e = W1 = W2$, not two separate phenomena, but one field that is transformed by voltage. Magnetic fluxes in two circuits of a circuit with **windings $W1 / W2$** can be expressed in [Ampere-turns \(A-w\) of the Magnetic Motive Force \[MRS\]](#) are equal to each other: $A-w(W1) = A-w(W2)$. These magnetic fluxes are opposite, but the magnetic flux of the secondary circuit does not form a counteraction to the magnetic flux in the core, which is formed by the action of magnetic induction of the primary winding $W1$. as it should be with the EMI phenomenon. In addition, the windings themselves [have the phenomenon of repulsion](#) between themselves, which indicates [the opposite spin of magnetic induction on the winding wires](#).



Let's return to Michael Faraday's experiment with a coil on an iron ring.

As we compare the core of Michael Faraday's coil (1831) and the core of the magnetic storage of Leedskalnin (1945), we see that the magnetically conductive iron core has a circuit closure. The excitation coil, with a current $[J]$ in both cases, forms a magnetic induction $[Bi]$ around the coil wire, followed by the excitation of magnetic induction in the core $[Bm]$. The peculiarity of this action is that the direction of the vector $[Bi]$ and $[Bm]$ have the same directions.



This is completely consistent with the [Anapole structure \(toroidal dipole\)](#) or the phenomenon of the anapole moment vector. Changing the anapole moment over time leads in the general case to the emission of an electromagnetic wave by the Anapole system (toroid dipole). How this happens, and what we have as a structure, which physics calls an "electromagnetic wave". Consider this action in the algorithm of the self-induction module for the Faraday induction coil, no better for the coil and core of the magnetic storage Leedskalnina. When the core is forcibly disconnected (opening the magnetic circuit) in which the Anapole phenomenon is created, a short-term EMF pulse will be induced at the ends of the winding. In the figure below, I indicated Anapolis and the wire that runs at the focus of the closed magnetic line of the iron core (A, B).

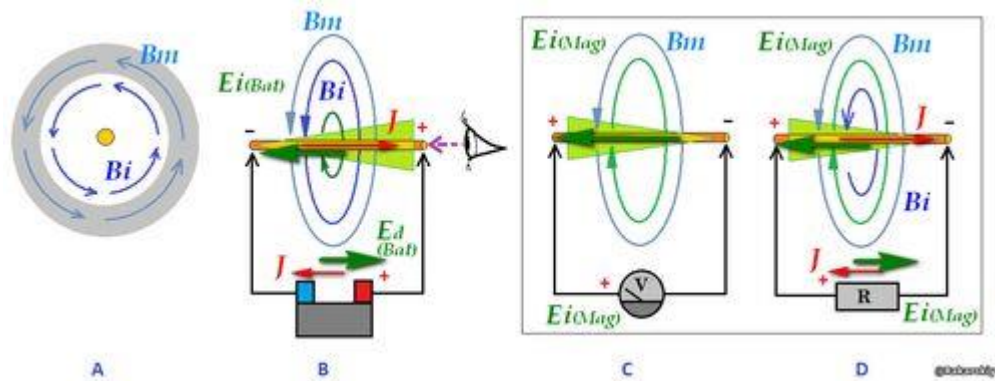


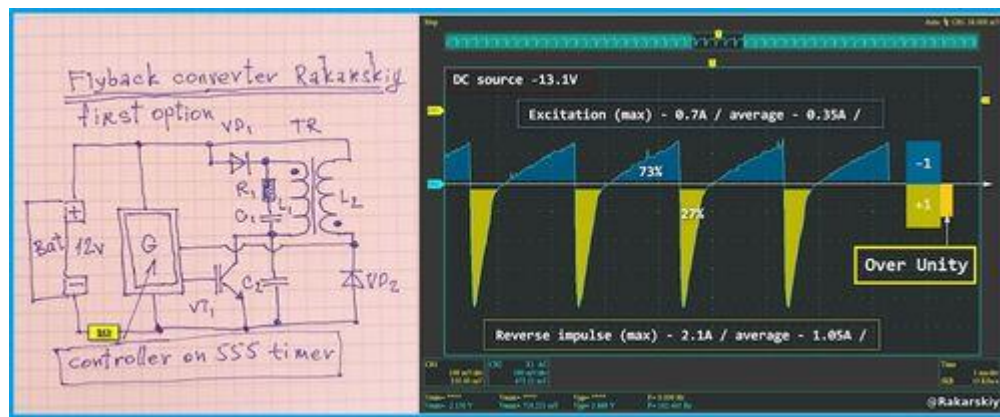
Figure B), reveals the mechanism of excitation of the magnetic field in the core [Bm], through the excitation of magnetic induction around the wire of which the focus of the iron ring core is laid everywhere. Figure A) is a projection of the core with a wire when viewed at the center of focus of the core, as shown in Figure B). It is necessary to pay attention to the direction in the current circuit I and $D = E_i[Bat]$. The line of force E_i has a corresponding spin around the wire and a direction between the electrodes of the electrical source. At the same time, in the focus of the core, the wire is a load, so the line of force $E_i[Bat]$ is the one that is converted into a line of force of magnetic induction [Bi]. Further, magnetic induction [Bm] is already formed in the core. We know the mathematical expression, we have already analyzed what this phenomenon of electromagnetic induction is:

$$B_m = \mu B_i \quad (B_m = \mu \mu_0 H), \text{ or } \nabla \times B_i = - \frac{dE_i}{dt} \quad (\nabla \times H = J + \frac{dD}{dt}).$$

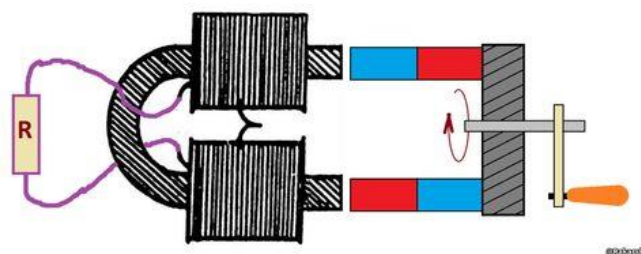
The directions $E_i[Bat]$ and the current I in the source have the opposite direction. Note this. Then we open the power circuit, and direct self-induction occurs. The part of the magnetic induction [Bi] that is around the wire is instantly converted into EMF E_i with the corresponding direction of the vector, the mathematical expression is as follows:

$$\nabla \times E_i = - \frac{dB_i}{dt}$$

The general vector of action will be the opposite of the excitation vector, but the spin around the wire does not change. When excited, it was a loss, when converting self-induction, magnetic induction [Bi] has a loss, and an EMF gain [Ei]. But we still have magnetic induction [Bm] in the core. If the winding is not a short circuit, then the EMF [Ei] dissipates, and the magnetic induction [Bm] remains in the core. Figure C). If we begin to open the core in which there is magnetic induction [Bm], the phenomenon of changing the anapole moment to decreasing occurs, then EMF [Ei] will be induced on the wire, the mathematical expression is the same as in self-induction, but the cause will already be a change in the anapole moment of magnetic induction [Bm]: $\nabla \times E_i = -dB_m/dt$. If the winding is connected to the load, then the formula will look like this: $\nabla \times E_i = -d(B_m + B_i)/dt$. Also, if the coil system has two windings, one opens, and the second has a connection to the load, then the EMF that is formed in the opening winding will transmit electrical voltage to the second winding. Just the same thing that takes place in the experiment of MaFaraday. I conducted a slightly different experiment, I did not have the phenomenon of mutual induction between the windings during excitation, but the formation of EMF in the primary with transmission to the secondary occurred very brightly.

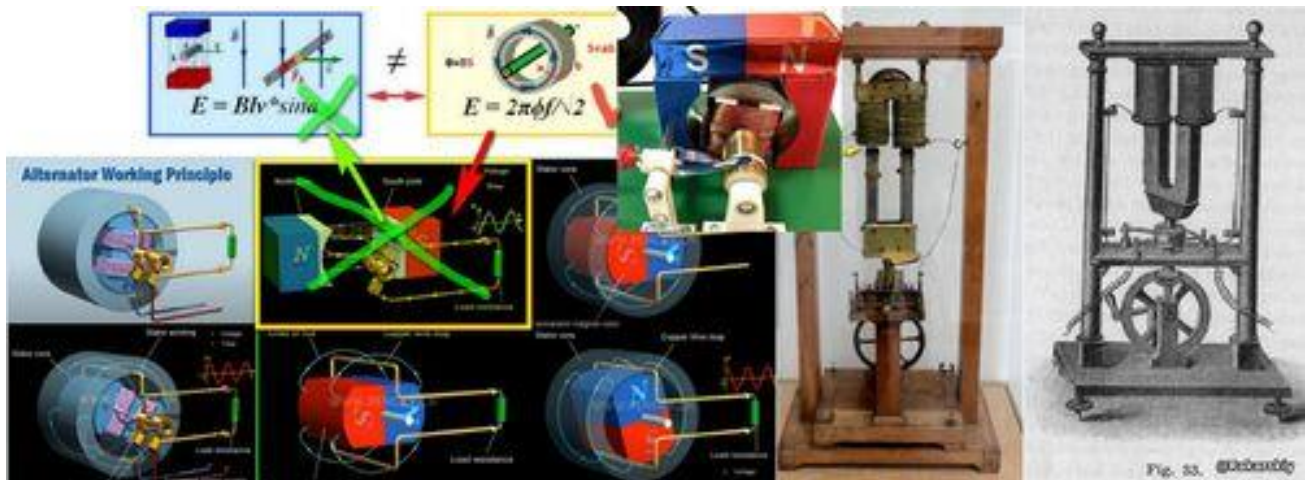


We come to another phenomenon of electromagnetic induction, which is the main one in generation in all power plants of our planet where synchronous electromagnetic alternators (alternators) using an iron core are used. Let's take the U-like core of the Leedskaalnin magnetic storage and instead of the closing core, we add a permanent magnet, which should rotate to change the closure of magnetic induction to the opposite according to the switching principle. The picture is below:



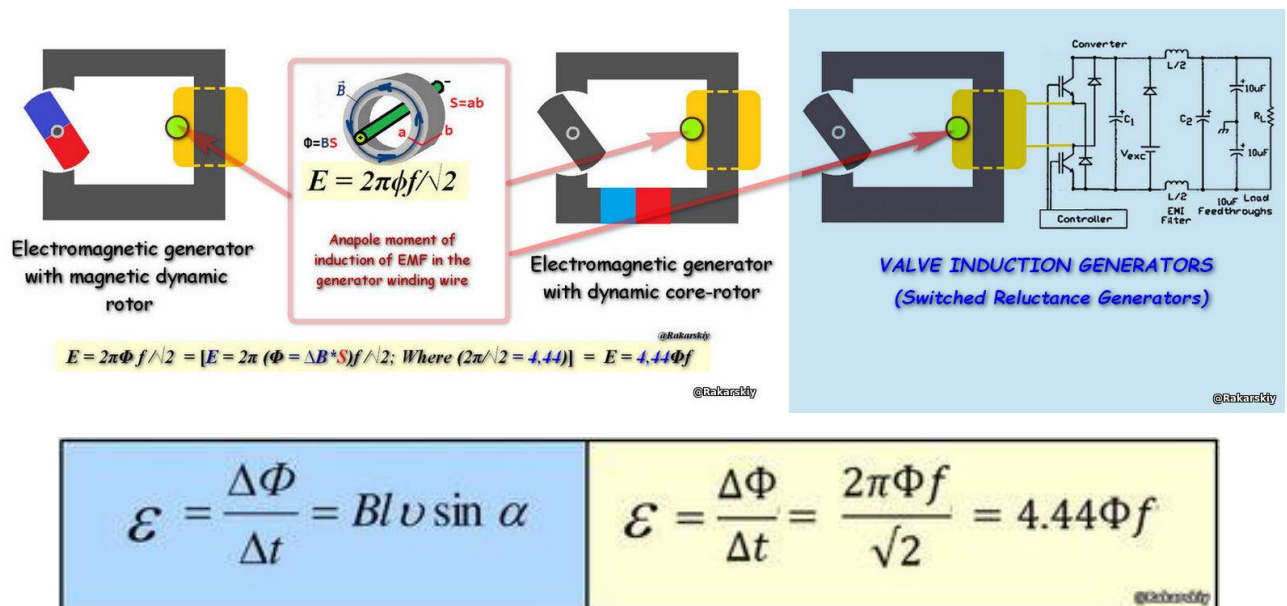
When rotating permanent magnets or cores with coils in the latter, EMF will be induced based on a change in the Anapole moment of the magnetic circuit of the cores with coils and cores with permanent magnets. The formula for calculating EMF in this process is just transformer EMF. When rotating permanent magnets or cores with coils in the latter, EMF will be induced based on a change in the Anapole moment of the magnetic circuit of the cores with coils and cores with permanent magnets. The formula for calculating EMF in this process is just transformer EMF. But such a generator was built earlier, in 1832. I talked about all this in detail in my publication "[Invention of the electromagnetic generator](#)", where he actually stated that the generator Hippolyte Pixii (1832) and the unknown R. M. (1832), who wrote a letter to Faraday describing his generator design, worked on the principle of changing the Anapole moment, a closed magnetic flux in a closed core. The

fact that the condition for transformer EMF is fulfilled in this alternator, I proved in another study "[Hippolytus Pixia's first generator was an alternator.](#)".».

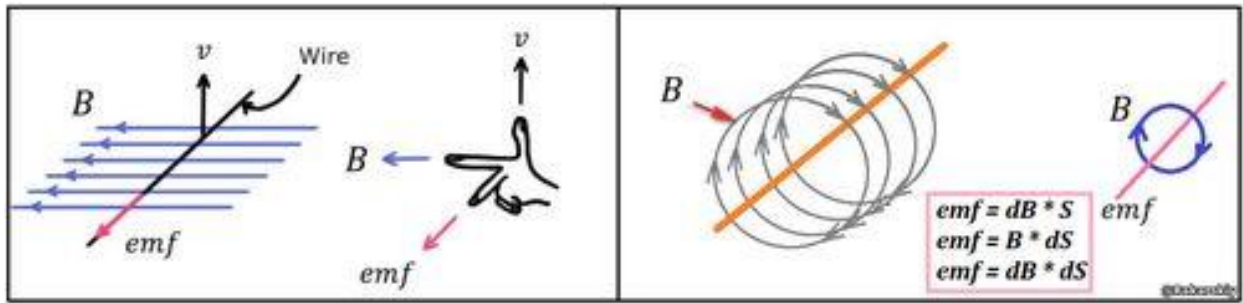


The mechanical rotation of a permanent magnetic rotor relative to a stator with phase windings, or an armature with phase windings relative to a constant magnetic excitation, where the wire is wound on the core rods or embedded in the groove of the stator or armature, is the action of generation according to the principle of changing the anapole moment. The following is a slide of the main design solutions of such machines.

*



These two formulas are completely different in principle of operation. If during movement in a magnetic field it is more or less clear, but with the phenomenon of the transformer formula in the general formation of materials. It is used to calculate EMF XX in alternators with closed magnetic circuits. Such generators are installed at all power plants on the planet where a drive turbine is used. A striking example of such an alternative is a turbogenerator.



The mechanical power required to rotate a rotor or armature is not energy converted into electrical power (energy). Rotation is a condition for performing a change in magnetic flux relative to the inductor wires (phase windings). Why do I say so? Mechanical power in watts is expressed by the formula $P_k = Fv$, where the force is in newtons [H], and the speed is [m/s] ($1W = 1J \cdot 1sec$). Electric power in watts is expressed by another formula $W = IU$, where I force of the stump in amperes [A], U is the voltage in volts [V]. No one has ever answered me how it is to convert [Fv] to [IU]. The fact that the electromagnetic moment of the magnetic rotor of the alternator is somewhere proportional to the mechanical moment of the drive motor is not at all a basis for the statement of physics in the form of a constant that the electromagnetic generator is a converter of mechanical energy into electrical energy. The electromagnetic generator works on the phenomenon of electromagnetic induction, where a change in the magnetic field gives rise to an electric one. It is known that the excitation power of a turbine generator at power plants has 0.5-3% of the output power of the generator. That is, the direct transformation of magnetic induction into the induction of electricity can be expressed:

$$\eta = W_{\text{generation}} / W_{\text{excitation}} = (100 / 3) * 100\% = 3333\%$$

Are you surprised? But I use only well-known information about the distribution of power during the operation of a turbine generator. In electrical engineering, there is a case when an engineering solution led to the distribution of more output electrical power to the mechanical power that we apply to rotate the magnetic rotor - [Forgotten RLG Tewari Generator 275% efficiency!](#)

There is a solution without physically rotating the moving part of the alternator. Examples are the Clemente Figuera generator (1902), and the Robert Holcomb generator (2021). My research publication: [Static electromagnetic generators of Clemente Figueras, Robert Holcomb, Park Jae-Sun and Shoji Haneda](#).

I am interested in the possibility of a garage master. One of the options based on a possible solution by Clemente Figuera in my publication: "[Motionless ALTERNATOR](#)", in which I explained how alternators work, why mutual induction should be avoided. He gave examples and calculations of generators without moving parts, added the simplest version of the generator based on the E-core from the transformer.

Serge Rakarskiy - Ukraine

2025-06-24

A sequel will be coming soon, in which we will consider other options for induction and engineering solutions for creating electricity.:

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