ELECTROMAGNETIC INDUCTION. LENZ RULE. SOBER LOOK

The modern topology of electromagnetic induction does not suit me, because of the very narrow and too confusing interpretation of this process in different schools and directions.

1) **Electromagnetic or magnetic induction** is the creation of an electromotive force on an electrical conductor in a changing magnetic field.

(*https://en.wikipedia.org/wiki/Electromagnetic_induction*)

2) **Electromagnetic induction** - the phenomenon of the occurrence of an electric current, electric field or electric polarization when the magnetic field changes over time or when a material medium moves in a magnetic field.

(*https://ru.wikipedia.org/wiki/Электромагнитная_индукция*)

3) **Electromagnetic induction** - the phenomenon of creating a vortex electric field in space by an alternating magnetic flux. One of the consequences of electromagnetic induction is the connection between alternating electric and magnetic fields in an electromagnetic wave, another consequence is practically important for the generation of electric current - the emergence of an electromotive force in the leading circuit, the magnetic flux through which changes. Units of measurement of electromagnetic induction - ***tesla*** (*in the SI system*), ***gauss*** (*in the CGS system*); ***1 T = 104 Gs***.

(*https://uk.wikipedia.org/wiki/Електромагнітна_індукція*)

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

$$E = -\frac{d\boldsymbol{\Phi}}{dt}$$

Where ***E*** is the ***EMF*** (*volt*) and ***Φ*** = ***BS*** is the **magnetic flux** (*weber*).

The differential vector representation of this process will look like:

$$E = -\frac{dB}{dt}$$

Where ***E*** is the ***EMF*** vector and ***B*** is the **magnetic induction** vector.

We have two interacting systems **Electric** and **Magnetic**.
These systems are based on their units of measurement..

Electrical measuring system:

Parameter	Measuring Unit	Symbol	Description
Voltage	Volt	V or E	V = I × R
Current	Ampere	I or i	I = V ÷ R
Resistance	Ohm	R or Ω	R = V ÷ I

Magnetic measurement system:

Quantity	Symbol	Unit of Measurement and abbreviation		
		CGS	SI	English
Field Force	mmf	Gilbert (Gb)	Amp-turn	Amp-turn
Field Flux	Φ	Maxwell (Mx)	Weber (Wb)	Line
Field Intensity	H	Oersted (Oe)	Amp-turns per meter	Amp-turns per inch
Flux Density	B	Gauss (G)	Tesla (T)	Lines per square inch

In both measuring systems, there is a gradation that supposedly explains everything.

I have a question about the CURRENT measure in the SI electric measurement system (*Ampere*) and with the MAGNETO-DRIVE FORCE in the SI magnetic measurement system (*Amp-turn*).

If we take the parameter of magnetic intensity - ***N***, and look at the formula for calculating this parameter:

$$H = \frac{B}{\mu\mu 0}$$

Where: ***B*** is the magnetic induction (*T*), and ***μ*** and ***μ0*** are the magnetic permeabilities of the media.

There are more methods for calculating this parameter for a live wire (1) and a solenoid (2):

$$H = \frac{I}{2\pi r}; (1) \qquad H = \frac{Iw}{l}; (2)$$

Единицей измерения параметра магнитной напряженности Б в системе СИ является: Ампер на метр.

Another episode in physics directly related to this direction Maxwell's equations:

Name	Integral equations	Differential equations
Gauss's law	$\oiint_{\partial\Omega} \mathbf{E}\cdot\mathrm{d}\mathbf{S} = \frac{1}{\varepsilon_0}\iiint_{\Omega}\rho\,\mathrm{d}V$	$\nabla\cdot\mathbf{E} = \frac{\rho}{\varepsilon_0}$
Gauss's law for magnetism	$\oiint_{\partial\Omega} \mathbf{B}\cdot\mathrm{d}\mathbf{S} = 0$	$\nabla\cdot\mathbf{B} = 0$
Maxwell–Faraday equation (Faraday's law of induction)	$\oint_{\partial\Sigma} \mathbf{E}\cdot\mathrm{d}\boldsymbol{\ell} = -\frac{\mathrm{d}}{\mathrm{d}t}\iint_{\Sigma}\mathbf{B}\cdot\mathrm{d}\mathbf{S}$	$\nabla\times\mathbf{E} = -\frac{\partial\mathbf{B}}{\partial t}$
Ampère's circuital law (with Maxwell's addition)	$\oint_{\partial\Sigma} \mathbf{B}\cdot\mathrm{d}\boldsymbol{\ell} = \mu_0\left(\iint_{\Sigma}\mathbf{J}\cdot\mathrm{d}\mathbf{S} + \varepsilon_0\frac{\mathrm{d}}{\mathrm{d}t}\iint_{\Sigma}\mathbf{E}\cdot\mathrm{d}\mathbf{S}\right)$	$\nabla\times\mathbf{B} = \mu_0\left(\mathbf{J} + \varepsilon_0\frac{\partial\mathbf{E}}{\partial t}\right)$

The law of electromagnetic induction that interests us is described differentially and integrally.

Science relates the magneto motive force (system of magnetic measurements) with EMF or voltage (system of electrical measurements).

In my understanding of the process, an unrelated chain of events formed, and so everything is in order. The parameters below are also official physics, where the CURRENT strength is where it should be, in terms of the magnetic field strength:

E - is the electric field strength (*in SI units - V/m*);
D - electrical induction (*in SI units - C / m²);*
H - is the magnetic field strength (*in SI units - A/m*);
B - magnetic induction (*in SI units - T = Wb / m² = kg•s^{-2}•A^{-1}*).

I assumed that the eddy magnetic field around a conductor under current included in a closed circuit, and the current strength of this conductor, are one and the same phenomenon, namely a vortex magnetic field.

Why did I decide so.

Modern science repels in measurements from the unit of electric charge (Coulomb):

1 Coulomb is the amount of charge that has passed through the cross section of the conductor, at a current of ***1 A*** for ***1 s***, or a current of ***1A*** = ***1 Coulomb*** for ***1 s***.

Science further relates this action to the volt: by definition, the difference in electrical potential between two points is 1 volt if it takes 1 joule of work to move a charge of 1 coulomb from one point to another. A volt is also equal to the electrical voltage that induces a direct current of 1 ampere at a power of 1 watt in an electrical circuit.

Now the following: by definition, a change in the magnetic flux through a closed circuit at a rate of ***one Weber*** per second induces an ***EMF*** in this circuit equal to ***one volt***. (*actually Faraday's formula for electromagnetic induction*).

All this is a vicious circle, a logical chain from science, which determines that Ampere is a unit of measurement of the strength of an electric current as the movement of electrically charged particles.

How does this very Current Force manifest itself in reality?

This is manifested in the action of electromagnetic induction around a conductor closed in a circuit.

The fact that all orthodox people agreed to consider this phenomenon as the movement of electrically charged particles is not confirmed in any way.

The strength of the current is directly related to the vortex magnetic field around the conductor.

From this we conclude that the current strength in the electrical system and the eddy magnetic field around the conductor are one and the same phenomenon, only in different electrical and magnetic measuring systems.

The movement of the electric field is carried out between the potentials along the channel of the conductor, more precisely, along the surface of the conductor - electric induction, and the magnetic vortex field (current strength) is a consequence of reverse induction, only magnetic and with a different "rotation" vector.

The whole problem is that the resistance of the conductor and the load is the resistance of its crystal lattice to the formation of a vortex magnetic field.

The electric field is a surface phenomenon for metallic conductors. You know perfectly well that these fields are parasitic for electrical engineering. To protect electrical appliances, electric field formations flow into the ground. This is a grounding device. Electromagnetic induction is a circuit phenomenon when an existing electric field (internal element for dielectrics) is formed with a potential difference on metal contacts (surface element) closed in a circuit between the terminals and, in contrast to the movement of an electric field (EMF), arising for equilibrium. There is a magnetic vortex field "as an element of counteraction". It is this moment that is written in the formula of electromagnetic induction:

$\boldsymbol{E} = \boldsymbol{-B}$ or $\boldsymbol{E} = \boldsymbol{-\Phi} = [\boldsymbol{1V} = \boldsymbol{-1Wb}]$

1V is the magnitude of the potential difference of the electric field.

This chain is missing ***D*** - electrical induction (*in SI units - C / m²*);

In physics, there is such a phenomenon as electrostatic induction on a conductor, when the potential difference on the conductor is induced due to electrostatic induction.

The movement of the electric field is vortex. First you need to consider the issue of the formation of a vortex electric field E from an electric field source with a difference in electric potentials, for example, a charged electric capacitor. The capacitor is considered charged. When there is a difference in electrical potentials at its terminals, measured in volts.

The force that balances the potential difference of the electric field of the source, in our case, the capacitor, most likely arises from the condition of Coulomb's law

https://en.wikipedia.org/wiki/Coulomb%27s_law

Thus, the first position of electromagnetic induction lies precisely in the formation of a vortex magnetic flux around the conductor, at the moment the source of the electric field with a potential difference is turned on in a closed circuit.

$\boldsymbol{E} = \boldsymbol{-\,d\Phi\,/\,dt}$, where: $\boldsymbol{\Phi} = \boldsymbol{B\,l}$ - magnetic flux along the conductor under current

Electromagnetic induction of EMF guidance from a magnetic flux, this is the reverse process:

$\boldsymbol{d\Phi} = \boldsymbol{-E}$, only already from the external magnetic flux is primary $\boldsymbol{\Phi} = \boldsymbol{BS}$.

1 Volt = 1 Coulomb = 1 Ampere = 1 Weber in a time interval of 1 second.

Thus, the current strength in Amperes is actually a vortex magnetic shelf around the conductor

The emerging magnetic vortex field, in fact, does not oppose the movement of the electric vortex flow, but accelerates this process. The material of the conductor influences the formation of this vortex magnetic field.

By increasing the resistance of the circuit, introducing the load of the consumer, we ourselves slow down this process. This is actually the useful electrical energy of the consumer circuit in order to stretch the process of balancing the potential difference of the electric field, and use the magnetic vortex flow for consumer purposes. If we do not introduce an increase in resistance, then we will get a very powerful balancing process with the formation of a very strong and "destructive" magnetic field, which you know as a "short circuit", i.e. our conditional twisting of the rope leads to its destruction. The conductor and load resistance work like a twisted rope. By the way, those who are well versed in the topic and know everything about the skin effect will understand me more, I hope.

That is why the movement of the electric field is associated with a vortex. EMF is a vortex structure, a spiral around a conductor. The conductor material creates an obstacle to create a counter vortex magnetic field (current strength).

Lenz's rule.

In the formula of Faraday and Maxwell's Electromagnetic Induction there is one more "stroke", which we haven't talked about yet. This is the minus sign before the derivative of the magnetic flux. True, it is not Maxwell or Faraday who is “responsible” for this sign, but the Russian academician E. Lenz, who in 1833 introduced it into the Faraday-Maxwell formula to determine the direction of the induction current in a closed circuit.

Lenz's law in electromagnetism, the statement that ***an induced electric current flows in such a direction that the current opposes the change that caused it*** [1]. This law was derived in 1834 by the Russian physicist Heinrich Friedrich Emil Lenz (1804–65). *https://www.britannica.com/science/Lenzs-law*

True, we know another formulation, in relation to induction by the method of intersection, for this rule:

The direction of the electric current induced in the conductor by the changing magnetic field is such that the magnetic field created by the induced current opposes the changes in the initial magnetic field.) [2]

https://en.wikipedia.org/wiki/Lenz%27s_law

There is a very significant difference in definitions. Who and for what purpose needed to adjust the expression? Lenz's rule specifies the direction of the current, but since the authors assumed that the current in the circuit is created by the EMF of the inductor, then it is applicable to the direction of the EMF. For harmonic processes, this means that in a closed induction circuit, the induction EMF and the potential current are in phase. Is it so?

And here the recognition bumps begin, for anyone who has ever made an electromagnet with the arrangement of the North-South poles to turn the electromagnet circuit into an electrical circuit. Secondly, there are a lot of materials stating that the current is the movement of negatively charged electrons, which move from a smaller electric potential to a larger one. In any case, this question is very dependent, as a statement of fact in electrodynamics.

The first definition [1] is correct, and it is obvious that Lenz himself had in mind precisely the spin vectors of the electric flux and magnetic flux. If you set the right hand rule separately for electric flow and separately for current strength, then reverse directions will occur. What actually sags in the equation of electromagnetic induction.

Where did he come from, you ask? This is very simply manifested in Ohm's law.

In one work "Resultant Ampère Force" I simply change the analysis of the dependence on pressure and settings to the opposition of a vortex magnetic field

Let's take the formula for calculating the current power for the generator, the available power

$$I = \frac{E - U}{R + r}$$

Where: ***I*** - current strength in the circuit (*A*); ***E*** - generator idling EMF (*V*); ***U*** - effective voltage at the generator terminals with a connected load (*V*); ***R*** - load resistance (*Ohm*); ***r*** - resistance of the generator phase (Ohm).

As we can see the expression in the numerator is the difference between the EMF and the operating voltage, which is defined as a voltage drop. According to Ohm's law, on a section of the conductor with active resistance R, the current I, creates a voltage drop U = IR. In any case, the POWER of current in Amperes is equal to the amount of Electricity which is no longer there. This is the moment of transformation, which we all know as electromagnetic induction.

According to my given expression, the correct understanding of the Law of Lenz and the Law of Conservation of Energy of the transformation of one type of energy into another is determined.

By the way, it is not Lenz's rule that is responsible for braking in electromechanical generators, but Ampère's law and electromagnetic attraction.

Best regards, Serge Rakarsky
Glory to Ukraine!