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Induction and Parametric Properties of Radio-Technical Elements and Chains and Property of Charges and their Flows

By F. F. Mende

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Induction and Parametric Properties of Radio-Technical Elements and Chains and Property of Charges and their Flows

F. F. Mende

Abstract- In the article the electrical and current self-induction of radio-technical elements and chains is examined and it is shown that such elements can present the effective resistance, which depends on the time. Is introduced the concept of parametricself-induction. On the basis of the concepts indicated is obtained the wave equation for the long lines, which gives the possibility to establish the velocity of propagation of the front of stress with the connection to the line of dc power supply. The concept of the potential and kinetic flows of charges is introduced.

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I. Electrical And Current Self-Induction

To the laws of self-induction should be carried those laws, which describe the reaction of such elements of radio-technical chains as capacity, inductance and resistance with the galvanic connection to them of the sources of current or voltage. To such elements let us carry capacities, inductances, effective resistance and long lines.

By self-induction of reactive elements we will understand the reaction of such elements as capacity and inductance with the constant or changing parameters to the connection to them of the sources of voltage or current. Subsequently we will use these concepts: as current generator and the voltage generator. By ideal voltage generator we will understand such source, which ensures on any load the lumped voltage, internal resistance in this generator equal to zero. By ideal current generator we will understand such source, which ensures in any load the assigned current, internal resistance in this generator equally to infinity. The ideal current generators and voltage in nature there does not exist, since both the current generators and the voltage generators have their internal resistance, which limits their possibilities.

If the capacity C is charged to a potential difference U, then the charge oQ, accumulated in it, is determined by the relationship

$$Q_{C,U}=CU .$$

When the discussion deals with a change in the charge, determined by relationship, then this value can change with the method of changing the potential difference with a constant capacity, either with a change in capacity itself with a constant potential difference, or and that and other parameter simultaneously.

If the value of a voltage drop across capacity or capacity itself depends on time, then the strength of current, which flows in the chain, which includes the voltage source and capacity, is determined by the relationship:

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$$I(t)=\frac{dQ_{C,U}}{dt}=C\frac{\partial U}{\partial t}+U\frac{\partial C}{\partial t}.$$

This expression determines the law of electrical self-induction. Thus, current in the circuit, which contains capacitor, can be obtained by two methods, changing voltage across capacitor with its constant capacity either changing capacity itself with constant voltage across capacitor, or to produce change in both parameters simultaneously.

When the capacity C_0 is constant, we obtain expression for the current, which flows in the chain:

$$I(U)=C_0\frac{\partial U}{\partial t} \quad (1.1)$$

when changes capacity, and at it is supported the constant stress U_0, we have:

$$I(C)=U_0\frac{\partial C}{\partial t}. \quad (1.2)$$

This case to relate to the parametric capacitive self-induction, since the current strength it is connected with a change in the capacitance value.

Let us examine the consequences, which escape from relationship (1.1).

If we to the capacity connect the direct-current generator I_0, then stress on it will change according to the law:

$$U(t)=\frac{I_0 t}{C_0}. \quad (1.3)$$

Using to this relationship Ohm's law

$$U=IR,$$

we obtain the value of the effective resistance of the chain in question

$$R(t)=\frac{t}{C_0}.$$

Thus the capacity, connected to the current source, plays the role of the effective resistance, which linearly depends on the time. Thes it should be noted that obtained result is completely obvious; however, such properties of capacity, which customary to assume by reactive element they were for the first time noted in the work [1].

From a physical point of view this property of capacity is connected with the fact that, charging capacity, current source to expend energy. Capacity itself in this case performs the role of storage battery.

Charging capacity, current source expends the power

$$P(t)=\frac{I_0^2 t}{C_0} \quad (1.4)$$

the energy, accumulated by capacity in the time t, we will obtain, after integrating relationship (1.4) with respect to the time:

$$W_C(t)=\frac{I_0^2 t^2}{2C_0}.$$

Ref

1. Ф. Ф. Менде. Непротиворечивая электродинамика. Харьков, НТМТ, 2008, – 153 с.

Substituting here the value of current from relationship (1.4), we obtain the dependence of the value of the accumulated in the capacity energy from the instantaneous value of stress on it:

$$W_C(U)=\frac{1}{2}C_0U^2.$$

Notes

Now we will support at the capacity constant stress U_0, and change capacity itself, then

$$I(C)=U_0\frac{\partial C}{\partial t}.$$

Using to this relationship Ohm's law

$$R_C=\left(\frac{\partial C}{\partial t}\right)^{-1}$$

Value R_C plays the role of the effective resistance. The derivative, entering this expression can have different signs. This result is intelligible. Since with a change in the capacity change the energy accumulated in it, capacity, it can extract energy in the current source, or return energy into the external circuit. The power, expended by current source, or output into the external circuit, is determined by the relationship:

$$P(C)=\frac{\partial C}{\partial t}U_0^{\ 2}.$$

Let us examine one additional process, which earlier the laws of induction did not include, however, it falls under for our extended determination of this concept. If the charge Q_0, accumulated in the capacity, remains constant, then stress on it can be changed by changing the capacity. In this case the relationship will be carried out:

$$Q_0=C_0U_0=CU=const,$$

where C and U - instantaneous values, and C_0 and U_0 - initial values of these parameters. The stress on the capacity and the energy, accumulated in it, will be in this case determined by the relationships:

$$U=\frac{C_0U_0}{C},$$

$$W_c(C)=\frac{1}{2}\frac{(C_0U_0)^2}{C}. \qquad (1.5)$$

It is natural that this process of self-induction can be connected only with a change in capacity itself, and therefore it falls under for the determination of parametric self-induction.

Let us examine the processes, proceeding in the inductance. If the current strength through the inductance or inductance itself depend on time, then the value of stress on it is determined by the relationship:

$$U(t)=L\frac{\partial I}{\partial t}+I\frac{\partial L}{\partial t}.$$

Let us examine the case, when the inductance L_0 is constant then

$$U(I)=L_0\frac{\partial I}{\partial t}. \tag{1.6}$$

After integrating expression (1.6) on the time, we will obtain:

$$I(t)=\frac{Ut}{L_0}. \tag{1.7}$$

Using to this relationship Ohm's law, we obtain, that the inductance, connected to the dc power supply, presents for it the effective resistance

$$R(t)=\frac{L_0}{t}.$$

The power, expended in this case by source, is determined by the relationship:

$$P(t)=\frac{U^2t}{L_0}. \tag{1.8}$$

After integrating relationship (1.8) on the time, we will obtain the energy, accumulated in the inductance

$$W_L(t)=\frac{1}{2}\frac{U^2t^2}{L_0}. \tag{1.9}$$

After substituting into expression (1.9) the value of stress from relationship (1.7), we obtain the value of the energy, accumulated in the inductance:

$$W_L(I)=\frac{1}{2}L_0I^2.$$

Now let us examine the case, when the current I_0, which flows through the inductance, is constant, and inductance itself can change. In this case we obtain

$$U=I_0\frac{\partial L}{\partial t}. \tag{1.10}$$

Consequently, the value

$$R(t)=\frac{dL}{dt}$$

as in the case the electric flux, effective resistance can be (depending on the sign of derivative) both positive and negative. This means that the inductance can how derive energy from without, so also return it into the external circuits.

If inductance is shortened outed, and made from the material, which does not have effective resistance, for example from the superconductor, then

$$L_0I_0=const,$$

where L_0 and I_0- initial values of these parameters, which are located at the moment of the short circuit of inductance with the presence in it of current.

Notes

This regime we will call the regime of the frozen flow. In this case the relationship is fulfilled:

$$I_0 = \frac{I_1 L_1}{L_0},$$

where I_1 and L_1 - the instantaneous values of the corresponding parameters.

Notes

In flow regime examined of current induction remains constant, however, in connection with the fact that current in the inductance it can change with its change, this process falls under for the determination of parametric self-induction. The energy, accumulated in the inductance, in this case will be determined by the relationship

$$W_L(L) = \frac{1}{2}\frac{(L_0 I_0)^2}{L}.$$

where L - the instantaneous value of inductance.

The capacity of the vacuum capacitor, which consists of the flat parallel plates, is determined by the relationship:

$$C = \frac{\varepsilon_0 S}{d},$$

where ε_0, S and d - dielectric constant of vacuum, the area of plates and the distance between them respectively. Substituting in this relationship equality (1.5), we obtain

$$W_c = \frac{1}{2}\;\frac{d\left(C_0 U_0\right)^2}{\varepsilon_0 S}. \tag{1.11}$$

Is evident that with the constant charge, stored up in the capacitor, an increase in the distance between the plates leads to an increase in its energy. This is connected with the fact that in order to increase the distance between the plates, it is necessary to spend the work, which will pass into the energy of its electrical pour on. As this occurs, evidently from Fig.1.

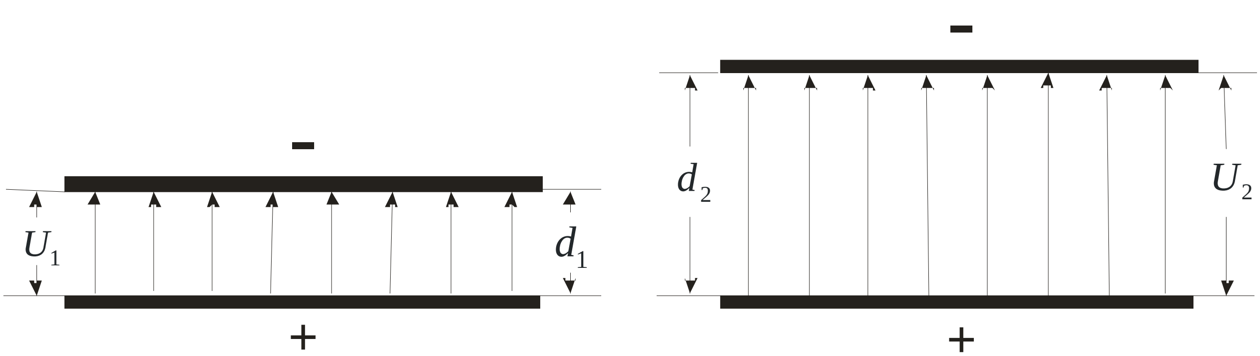

Fig. 1: The electric fields of parallel-plate capacitor with the different distance between its plates Taking into account that the work of capacity and stress is equal to charge, accumulated in the capacitor, relationship (1.9) can be rewritten

$$W_c = \frac{1}{2}\frac{d(Q_0)^2}{\varepsilon_0 S} = \frac{1}{2}\varepsilon_0 E^2 Sd \quad , \qquad (1.12)$$

where E - tension of electric field in the line.
From relationship (1.12) follows

$$E = \frac{Q_0}{\varepsilon_0 S}.$$

Thismeans that in the parallel-plate capacitor the field strength does not depend on the distance between the plates, but it is determined by the surface density of charge on them. Let us note that with this examination we do not consider edge effects that correctly when the distance between the plates much less than their length and width. Consequently, voltage across capacitor is determined by the distance between the plates

$$U_d = \frac{Q_0 d}{\varepsilon_0 S}.$$

From the carried out analysis escapes the interesting property of the electrons, which compose the charge Q_0. Their quantity is equal

$$N = \frac{Q_0}{e},$$

where e is a charge of one electron. Thus, energy of one electron, which is located on the plate of capacitor, is equal

$$W_e = \frac{de}{\varepsilon_0 S} \quad .$$

This energy depends on the distance between the plates, but since no limitations on d they are superimposed, this energy can be as desired to large.

In the case examined the electric fields of each separate electron are located in the tube, located between the planes of capacitor. The cross-sectional area of this tube is equal and its height it is respectively equal: $\frac{S}{N}$ and d. When an increase in the size occurs d, volume of this tube increase, and, therefore, it grows and energy pour on. In this case the mechanical energy, spent on the displacement of the plate of capacitor, passes into the energy of electrical pour on electron. Analogous situation will be observed, also, in the coaxial capacitor. Difference will be only the fact that the fields of electron will occupy not tube with the constant section, but annular disk.

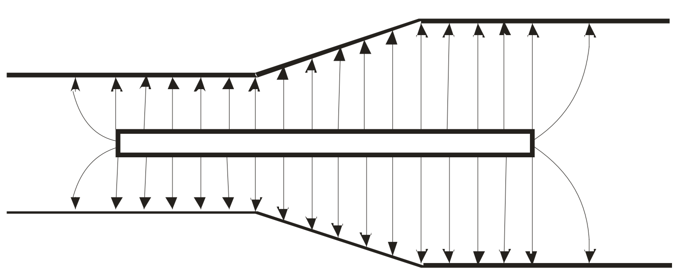

Fig. 2: Coaxial capacitor with the variable section

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Let us load coaxial capacitor with the variable section, as shown in Fig. 2. If we move the charged rod from left to right, then the volume of electrical pour on it will be grow, and for this will have to expend energy. But if rod will be moved in the reverse direction, then volume pour on it will decrease, and rod will carry out external work. If we as the rod take the section of the moving electron beam, then picture not change. During the motion from left to right, kinetic energy of beam will pass into the energy of electrical pour on, and beam will slow down and vice versa. But when we deal concerning the moving electron beam, picture there will be somewhat different, since with the flow in the tubular part of the capacitor the return current will exist.

II. Propagation Of Signals In The Long Lines

The processes of the propagation of voltages and currents in the long lines it is described with the aid of the wave equations

$$\frac{\partial^2 U}{\partial z^2} = \frac{1}{v^2}\ \frac{\partial^2 U}{\partial t^2}$$

$$\frac{\partial^2 I}{\partial z^2} = \frac{1}{v^2}\ \frac{\partial^2 I}{\partial t^2},$$

which are obtained from the telegraphic equations

$$\frac{\partial U}{\partial z} = -L\ \frac{\partial I}{\partial t}$$

$$\frac{\partial I}{\partial z} = -C\ \frac{\partial U}{\partial t}.$$

But as to enter, if to the line is connected dc power supply or source of voltage, which is changed according to the linear law, when the second derivatives of voltages and currents do be absent? In the existing literary sources the answer to this question is absent.

The processes, examined in two previous paragraphs, concern chains with the lumped parameters, when the distribution of potential differences and currents in the elements examined can be considered uniform.

We will use the results, obtained in the previous paragraph, for examining the processes, proceeding in the long lines, in which the capacity and inductance are the distributed parameters. Let us assume that the linear capacity and the inductance of line compose C_0 and L_0. If we to the line connect the dc power supply U , thus will begin to charge the capacity of long line and the front of this stress will be extended along the line some by the speed v. The moving coordinate of this front will be determined by the relationship $z=vt$. In this case the total quantity of the charged capacity and the value of the summary inductance, along which it flows current, calculated from the beginning lines to the location of the front of stress, will change according to the law:

$$C(t) = zC_0 = vtC_0,$$

$$L(t)=zL_0=vtL_0.$$

The source of voltage of will in this case charge the being increased capacity of line, for which from the source to the charged line in accordance with relationship (1.2) must leak the current:

$$I = U\frac{\partial C(t)}{\partial t} = UvC_0 \qquad (2.1)$$

This current there will be the leak through the conductors of line, that possess inductance. But, since the inductance of line in connection with the motion of the front of stress, also increases, in accordance with relationship (1.10), on it will be observed a voltage drop:

$$U_1 = I\frac{\partial L(t)}{\partial t} = IvL_0 = v^2UC_0L_0 .$$

But a voltage drop across the conductors of line in the absolute value is equal to the stress, applied to its entrance; therefore in the last expression should be placed $U = U_1$. We immediately find taking this into account that the rate of the motion of the front of stress with the assigned linear parameters and when, on, the incoming line of constant stress U is present, must compose

$$v = \frac{1}{\sqrt{L_0C_0}} \; . \qquad (2.2)$$

This expression corresponds to the signal velocity in line itself. Consequently, if we to the infinitely long line connect the voltage source, then in it will occur the expansion of electrical pour on and the currents, which fill line with energy, and the speed of the front of constant stress and current will be equal to the velocity of propagation of electromagnetic vibrations in this line. This wave we will call electriccurrent. It is interesting to note that the obtained result does not depend on the form of the function U, i.e., to the line can be connected both the dc power supply and the source, whose voltage changes according to any law. In all these cases the value of the local value of voltage on incoming line will be extended along it with the speed, which follows from relationship (2.2). This result could be, until now, obtained only by the method of solution of wave equations. This process occurs in such a way that the wave front, being extended with the speed of v, leaves after itself the line, charged to a potential difference U_1, which corresponds to the filling of line with electrostatic electric field energy. However, in the section of line from the voltage source also to the wave front flows the current I_1, which corresponds to the filling of line in this section with energy, which is connected with the motion of the charges along the conductors of line, which possess inductance.

The current strength in the line can be obtained, after substituting the values of the velocity of propagation of the wave front, determined by relationship (2.2), into relationship (2.1). After making this substitution, we will obtain

$$I_1 = U_1\sqrt{\frac{C_0}{L_0}} ,$$

where $Z = \sqrt{\frac{L_0}{C_0}}$ - line characteristic.

The regularities indicated apply to all forms of transmission lines.

If we to the line with the length z_0 connect the effective resistance, equal to line characteristic, then the voltage of the power source will appear on it with the time delay

Notes

$\Delta t = \frac{z_0}{v}$. This resistance will be coordinated with the line and entire energy, transferred by the line, will be in it absorbed. This connected with the fact that the current, which flows in the line is equal to the current, which flows through the resistance, when stress on it is equal to voltage on incoming line.

Notes

Thus, the processes of the propagation of a potential difference along the conductors of long line and current in it are connected and mutually supplementing each other, and to exist without each other they do not can. This process can be called elektriccurent spontaneous parametric self-induction. This name flow expansion they connected with the fact that occur spontaneously.

For different types of lines the linear parameters depend on their sizes. For an example let us examine the coaxial line, whose linear capacity and inductance are expressed by the relationships:

$$C_0 = \frac{2\pi\varepsilon_0}{\ln\left(\frac{D}{d}\right)}, \quad L_0 = \frac{\mu_0}{2\pi}\ln\left(\frac{D}{d}\right);$$

where D and d - inside diameter of the cylindrical part of the coaxial and the outer diameter of central core, and ε_0 and μ_0 - dielectric and magnetic constant of vacuum.

Exist coaxial lines with the variable section both the cylindrical part and the internal conductor. The sections of such coaxials are used as the matching devices devices between the coaxials with different diameters of cylindrical part and central core. Propagation of signals in such adapter has its specific character (Fig. 3).

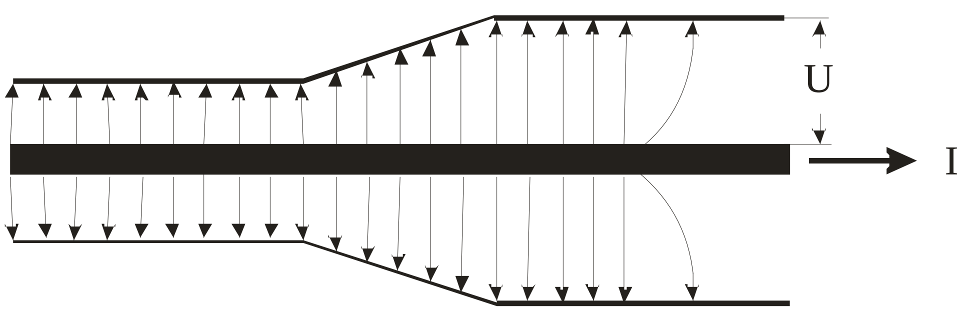

Fig. 3: Propagation of signal along the coaxial line with the variable section

A change in the dimensions of coaxial leads to the fact that the linear parameters begin to depend on coordinate. Begins to depend on coordinate and the wave drag

$$Z=\sqrt{\frac{L}{C}}=\ln\left(\frac{D}{d}\right)\sqrt{\frac{\mu_0}{\varepsilon_0}}.$$

At the same time velocity of propagation, both in the limits of the sections of coaxials and in the transition section it remains constant

$$v=\sqrt{\frac{1}{CL}}=\sqrt{\frac{1}{\varepsilon_0\mu_0}}.$$

Penetrating this adapter, signal changes its parameters.

Since wave drag gives the relation between the voltage and the current in the line

$$Z = \frac{U}{I} .$$

That changes the relationship between the voltage and the current in the initial and final section of coaxial. Consequently, such adapter is the current transformer and voltage. And this transformation occurs both with the propagation on the line of alternating voltage so and the constant. Thus this device is the configurative voltage transformer and currents. It is in the literature accepted to call such devices impedance transformers, but it is more correct them to call the voltage transformers and currents.

III. Properties Of The Flows Of The Charges

If charges can move without the losses, then equation of motion takes the form:

$$m\frac{d\vec{v}}{dt} = e\vec{E} ,$$

where m - mass electron, e - electron charge, $\vec{E}$ - the tension of electric field, $\vec{v}$ - speed of the motion of charge.

Using an expression for the current density

$$\vec{j} = ne\vec{v} ,$$

we obtain the current density of the conductivity

$$\vec{j}_L = \frac{ne^2}{m}\int \vec{E}\ dt = \frac{1}{L_k}\int \vec{E}\ dt ,$$

where

$$L_k = \frac{m}{ne^2} ,$$

where L_k - kinetic inductance of charges [5,6].

In the real transmission lines kinetic inductance is not calculated on the basis of that reason, that their speed is small in view of the very high density of current carriers in the conductors and therefore field inductance always is considerably greater than kinetic. Let us show this based on simple example.

Let us examine processes in the line, which consists of two superconductive planes (Fig. 4).

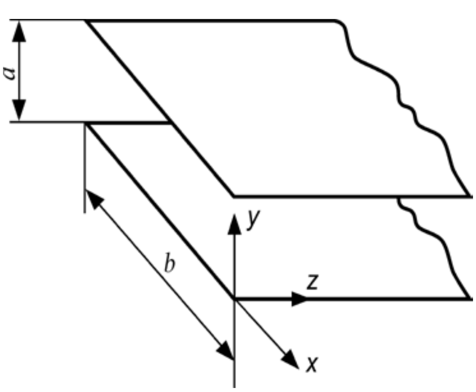

Fig. 4: The two-wire circuit, which consists of two ideally conducting planes

Ref

5. Ф. Ф. Менде. Роль и место кинетической индуктивности зарядов в классической электродинамике, Инженерная физика, №11, 2012. с. 10-19.

The magnetic field on the internal surfaces of this line, equal to specific current, is determined from the relationship:

$$H = nev\lambda\,,$$

where n, e, v - density, charge and the velocity of the superconductive electrons, and $\lambda = \sqrt{\frac{m}{ne^2\mu}}$ - depth of penetration of magnetic field into the superconductor.

If we substitute the value of depth of penetration into the relationship for the magnetic field, then we will obtain:

$$H = v\sqrt{\frac{nm}{\mu}}\,.$$

Thus, specific kinetic the kinetic energy of charges in the skin-layer

$$W_H = \frac{1}{2}\mu H^2 = \frac{nmv^2}{2}$$

is equal to specific the energy of magnetic pour on. But the magnetic field, connected with the motion of current carriers in the skin-layer of superconductor, there is not only in it. If we designate the length of the line, depicted in Fig. 4 as l, then the volume of skin-layer in the superconductive planes of line will compose $2lb\lambda$. Energy of magnetic pour on in this volume we determine from the relationship:

$$W_{H,\lambda} = nmv^2 lb\lambda\,.$$

Energy of magnetic pour on, accumulated between the planes of line, it will comprise:

$$W_{H,a} = \frac{nmv^2 lba}{2} = \frac{1}{2} lba\mu_0 H\,.$$

If one considers that the depth of penetration of magnetic field in the superconductors composes several hundred angstroms, then with the macroscopic dimensions of line it is possible to consider that the total energy of magnetic pour on in it they determine by relationship.

Is obvious that the effective mass of electron in comparison with the mass of free electron grows in this case into $\frac{a}{2\lambda}$ of times. Thus, becomes clear nature of such parameters as inductance and the effective mass of electron, which in this case depend, in essence, not from the mass of free electrons, but from the configuration of conductors, on which the electrons move.

The kinetic flow of charges we will consider such flow, whose kinetic inductance is more than field. Let us examine this question in the concrete example [7,8].

For the evacuated coaxial line linear inductance is determined by the relationship

$$L_0 = \frac{\mu_0}{2\pi}\ln\left(\frac{D}{d}\right).$$

With the current I, which flows along the internal conductor, energy accumulated in the linear inductance will compose

$$W_L = \frac{1}{2}L_0 I^2 = \frac{\mu_0}{4\pi}\ln\left(\frac{D}{d}\right)I^2\,.$$

Ref

7. Ф. Ф. Менде, А. С. Дубровин. Особые свойства реактивных элементов и потоков заряженных частиц. Инжененрная физика, №11, 2016, с. 13-21.

The same relationship we can obtain by field method, using Maxwell's equations. since the magnetic field of straight wire, along which flows the current of , we determine by the relationship

$$\oint \vec{H}d\vec{l} = 2\pi r H = I$$

it is possible to find energy of magnetic field, concentrated between the central and external conductor of coaxial line. In this relationship r there is a distance from the axis of center conductor to the observation point. Introducing cylindrical coordinate system and taking into account that the specific energy of magnetic field it is equal

$$W_0 = \frac{1}{2}\mu_0 H^2,$$

we find linear energy of the magnetic field

$$W_H = \frac{\mu_0 I^2}{8\pi^2}\int_d^D\int_0^{2\pi}\frac{r\ d\ rd\varphi}{r} = \frac{\mu_0}{4\pi}\ln\left(\frac{D}{d}\right)I^2.$$

As we see, the linear energy, calculated by field method, and with the aid of the linear inductance they coincide.

We will consider that the current is evenly distributed over the section of center conductor. Then kinetic energy of charges in the conductor of unit length composes

$$W_k = \frac{\pi d^2 nmv^2}{8},$$

where n, m, v - electron density, their mass and speed respectively.

$$I = \frac{nev\pi d^2}{4}$$

it is possible to write down:

$$W_L = \frac{1}{2}L_0 I^2 = \frac{\mu_0}{4\pi}\ln\left(\frac{D}{d}\right)\frac{n^2e^2v^2\pi^2d^4}{16}.$$

From these relationships we obtain, that to the case, when

$$W_k \geq W_L$$

the condition corresponds

$$\frac{m}{ne^2} \geq \frac{\mu_0}{8}\ln\left(\frac{D}{d}\right)d^2.$$

From where we find for the charge density.

$$n \leq \frac{8m}{d^2e^2\mu_0}.$$

In such a way that the flow would be kinetic, is necessary that the specific kinetic inductance would exceed linear inductance, which is carried out with the observance of the given condition. From this relationship it is possible to estimate, what electron density in the flow corresponds to this of the case.

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Let us examine the concrete example: $d = 1mm$ then we obtain

$$n \le \frac{8m}{e^2 \mu_0 \ln\left(\frac{D}{d}\right) d^2} \approx 10^{20} \frac{1}{m^3}.$$

With the observance of condition W_k it is considerably more than W_L field inductance it is possible not to consider. Specifically, this case is carried out in the case of using the electron beams for the electro-welding.

Such densities are characteristic to electron beams, and they are considerably lower than electron density in the conductors. Therefore electron beams should be carried to the kinetic flows, while electronic current in the conductors they relate to the potential flows.

Therefore for calculating the energy, transferred by electromagnetic fields they use Poynting's vector, and for calculating the energy, transferred by electron beams is used kinetic energy of separate charges, this all the more correctly, when the discussion deals with the calculation of the energy, transferred by ion beams, since. the mass of ions many times exceeds the mass of electrons.

Thus, the reckoning of the flows of charges to one or the other form depends not only on density and diameter of beam itself, but also on the diameter of that conducting tube, in which it is extended. It is obvious that in the case of potential beam, its front cannot be extended at a velocity, which exceeds the speed of light. It would seem that there are no such limitations for the purely kinetic beams. There is no clear answer to this question as yet. The mass of electron to usually connect with its electric fields and if we with the aid of the external conducting tube begin to limit these fields, then the mass of electron will begin to decrease, but the decrease of mass will lead to the decrease of kinetic inductance and beam will begin to lose its kinetic properties. And only when the part of the mass of electron does not have electrical origin, there is the hope to organize the purely kinetic electron beam, whose speed can exceed the speed of light. If we take the beam of protons, then picture will be the same. But here, if we take, for example, the nuclei of deuterium, which contain the neutron, whose mass is located, but electrical pour on no, then with the aid of such nuclei it is possible to organize purely kinetic beams, and it is possible to design for the fact that such beams can be driven away to the speeds of the large of the speed of light.

IV. Conclusion

In the article the electrical and current self-induction of radio-technical elements and chains is examined and it is shown that such elements can present the effective resistance, which depends on the time. Is introduced the concept of parametric self-induction. On the basis of the concepts indicated is obtained the wave equation for the long lines, which gives the possibility to establish the velocity of propagation of the front of stress with the connection to the line of dc power supply. The concept of the potential and kinetic flows of charges is introduced.

References Références Referencias

1. Ф. Ф. Менде. Непротиворечивая электродинамика. Харьков, НТМТ, 2008, – 153 с.
2. F. F. Mende. New Properties of Reactive Elements, Lines of Transmission of Energy and the Relaxation Properties of Electronic Fluxes and Conductors, AASCIT Journal of Physics, Vol.1, No. 3, Publication Date: June 12, 2015, Page: 190-200.

3. F. F. Mende, New Properties of Reactive Elements and the Problem of Propagation of Electrical Signals in Long Lines, American Journal of Electrical and Electronic Engineering, Vol. 2, No. 5, (2014), 141-145.
4. F. F. Mende. Nominal and Parametric Self-Induction of Reactive Elements and Long Lines, Engineering and Technology, Vol.2 , No. 2, Publication Date: April 3, 2015, Page: 69-73
5. Ф. Ф. Менде. Роль и место кинетической индуктивности зарядов в классической электродинамике, Инженерная физика, №11, 2012. с. 10-19.
6. F. F. Mende. Kinetic Induktance Charges and its Role in Classical Electrodynamics. Global Journal of Researches in Engineering (J), General Engineering, Volume 14, Issue 5, Version 1.0, Year 2014.
7. Ф. Ф. Менде, А. С. Дубровин. Особые свойства реактивных элементов и потоков заряженных частиц. Инжененрная физика, №11, 2016, с. 13-21.
8. F. F. Mende. Induction and Parametric Properties of Radio-Technical Elements and Lines and Property of Charges and Their Flows, AASCIT Journal of Physics Vol.1, No. 3, Publication Date: May 21, 2015, Page: 124-134.

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