Direction of current in an electrical circuit

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Abstract. The accepted direction of the current in the electrical circuit does not correspond to theory and practice. The examples show the direction of the current in an electrical circuit according to the data of today's science. The current in the electrical circuit is directed from the negative pole to the positive pole of the current source.

Keywords: electric current, electric circuit, current source, electromotive force, direction of current, direction of electromotive force.

Content. The direction of motion of positively charged particles was taken as the direction of electric current when elementary particles with an electric charge were not yet discovered. Today it is considered to be known that an electron has a negative charge, and a positron has a positive charge. But a positron arises and can exist under certain conditions: it is not in our environment and electrical networks. When they talk about a positive charge, they mean an ion – an atom that has lost an electron. In metals, the positive ion is located in the nodes of the crystal lattice and is bound to other ions by means of electrons loosely bound to the atom and filling the interatomic spaces. Therefore, ions cannot move in metals, but electrons move under the action of the interaction forces of charges that create an electric field.

In order to characterize the electric field, the direction of the force action of a charged particle (body) on a single positive (trial) charge was conditionally accepted, the charge of which is numerically equal to the charge of an electron [1, p.35, Fig.1.9; p.148, Fig.4.19] and [2, p.20; 2, p.77, Fig.3.2 and 3.3]. And such a particle is a positron, but it is impossible to experiment with it and determine the nature of the electric field and the kind of electric charge of the particle (body) creating the electric field under normal conditions. Despite this, this conditional approach of determining the direction of current as the direction of movement of a positively charged elementary particle – positron (although it is not called that) from a positively charged particle (body) to a negative particle (body) has been preserved so far. In fact, this contradicts theory and practice, as clearly evidenced by the simple example we give to the students in Fig. 1: where A and B are charged bodies; e^{+} – the charge of a positive ion; e^{-} – the charge of an electron.

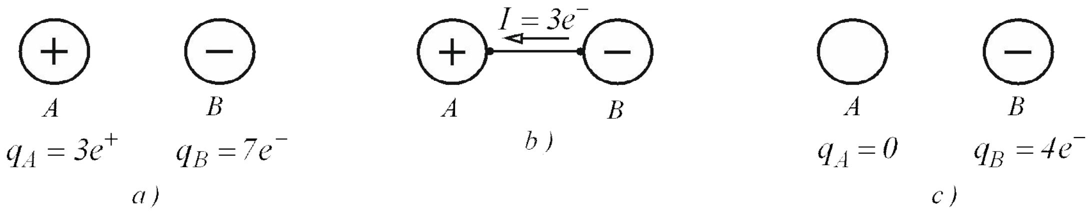


Fig.1

Due to the above, when these bodies are connected by a wire (Fig.1b), under the action of electric field forces between these bodies, part of the electrons from body B, whose charge is electrons, will move to body A, whose charge is determined by positively charged ions, that is, the electric current will be directed from a negatively charged body to a positively charged body.

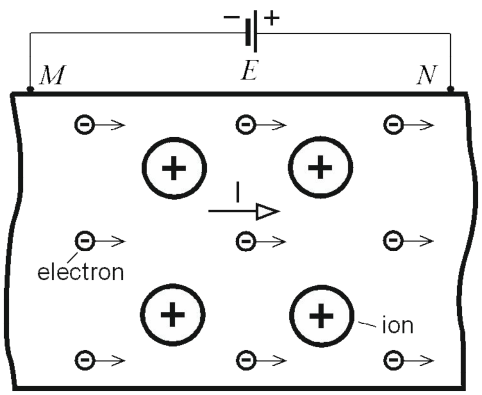


Fig.2

In the wire of an electric circuit, the current is also directed from the end (point M, Fig.2), which has a negative charge, to the other end (point N, Fig.2) having a positive charge.

The path length of an electron in a metal conductor – from the orbital of an electron of one atom to the orbital of another atom freed from the electron,

is 1 ...7 nm, that is, about the parameter of the crystal lattice of the wire material. This explains the high speed of the electric current, since the transitions of electrons do not occur sequentially, but simultaneously along the entire length of the wire of the electrical network.

The effect of the electric field on the atoms and electrons of the wire of an electric circuit is considered instantaneous. Thus, no matter how long the electric line was, for an electric current it is about 1...7 nm.

The resulting force Fn (Fig.3), consisting of repulsive forces Fr acting on the electron from the negatively charged end of the wire, and attractive forces Fa acting from the positively charged end of the wire, remains constant along the entire length of the wire.

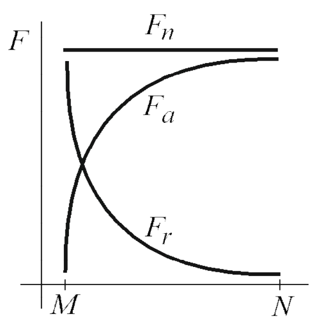
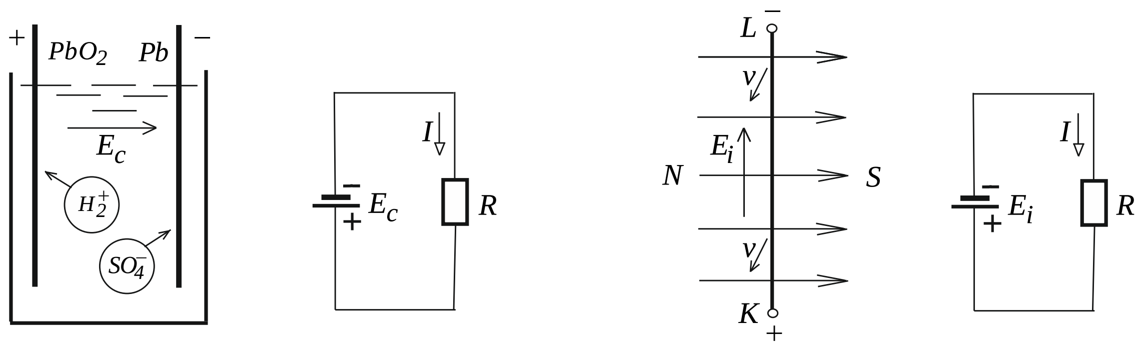


Fig. 3

Therefore, the intensity of the electric field E on the section of the wire where one current flows also remains constant. This means that in such a section of the circuit, the field strength is uniform. The force acting on an electron in an electric circuit and the electric field strength are directed from the negatively charged end of the wire to the positively charged end. Each positively charged end of the wire in the direction of the current has a low potential, compared to the previous beginning. It turns out that the electric field lines in the wire of the electric circuit come out from the negative pole, and enter the pole of positive polarity. In an electrical circuit where the conductor of the electric charge is a metal wire, and the carrier of the electric charge is an electron, it would be logically incorrect to assume the opposite. An electron should be considered a test single charge. It is necessary to accept reality according to theory and practice. An electron should be considered a test single charge. It is necessary to accept reality according to theory and practice.

On E_c chemical current sources (for example, on a lead battery, Fig.4a), the electric field between the electrodes is also directed from the negative pole to the positive pole. Inside, complex processes occur in the sulfuric acid solution, but it can be assumed that mainly negative ions SO_4^- of the acid residue move to the lead electrode Pb, and positive hydrogen ions H_2^+ move to the lead dioxide electrode PbO_2, thereby determining the polarity of the electrodes.



a) b)

Fig.4

According to the direction of the current in the external circuit, inside the chemical current source, it can be assumed that the electromotive force (EMF) of the E_c is directed from the positive pole to the negative pole. It is impossible to specify the specific direction of the current inside the chemical current source between the electrodes. However, in an external circuit, electrons will move from a negatively charged lead electrode to a positively charged lead dioxide electrode.

On induction current sources E_i (for example, on the winding KL of the generator moving towards the reader, Fig.4b), under the action of external forces, the electrons will be displaced from one end of the winding K to the other end L, ensuring the opposite polarity of the ends. In the external circuit, the electric current will be directed from the negatively charged end L to the positively charged end K, and inside the induction source, i.e. along the generator winding, under the action of external forces, the current and the electromotive force are directed from the positively charged end K to the negatively charged end L.

The position that only electrons can move in metals under the action of some forces determines that in an electric field they can move only in the direction from the negative electric pole, being attracted to the positive electric pole.

It is necessary to distinguish that an electron in an external circuit is affected by a force from the electric field between the electrodes (between the ends of the winding), and outside forces inside the current source. The effect of electric and magnetic fields from chemical and induction current sources on atoms and electrons of an electrical circuit wire is considered instantaneous.

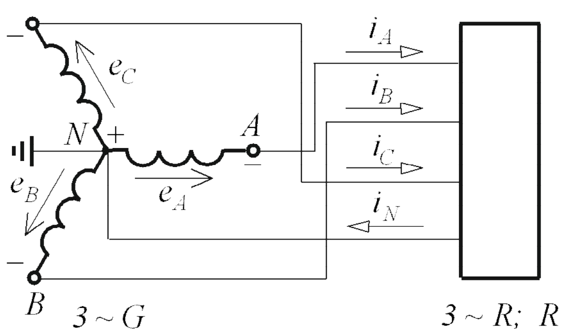


Fig.5

The same thing happens on a three-phase current source (Fig.5): in networks with a voltage of up to 1 kV, the neutral points of the generator and transformers are grounded [3, p.77], therefore they acquire a positive polarity; third-party forces act on the electrons of the phase windings, as in Fig.4, and this leads to the fact that the beginnings of the windings will acquire a negative polarity.

During the half-period, the currents will be directed from the beginning of the windings A, B, C of negative polarity to the positively polar end of N. In the next half-cycle, the process will repeat with a change in the ends of the windings and their polarity, but maintaining the phase ratios of EMF and winding currents. The EMF and current directions are consistent with the generally accepted directions.

Conclusions.

1. To characterize the electric field, an electron must be taken as a test unit charge.

2. The electric field strength lines inside the wire of the electric circuit and the force acting on the electron are directed from the negative pole to the positive pole.

3. No matter how long the electric line was, for an electric current it is about 1...7 nm.

4. The electric current in the external section of the electrical circuit is directed from the negative pole to the positive pole of the current source.

5. The electromotive force and the electric current inside the induction current source under the action of external forces are directed from the positive pole to the negative pole.

6. Accepting the real direction of the current from the negative pole to the positive pole of the current source will eliminate the illogical position about the source of electrons from the positive pole of the source.

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