Contents

Future Power Sources

Magnetohydrodynamic Generators

Раздел III

Предисловие

Настоящее пособие предназначено для студентов электромеханических и электроэнергетических специальностей и рассчитано на второй этап обучения английскому языку в техническом вузе.

Основной задачей пособия является научить студентов читать оригинальную литературу по специальности с целью получения нужной информации, вести беседу по прочитанному тексту и делать сообщения на английском языке. Пособие также помогает студентам овладеть рядом технических терминов электромеханических и электроэнергетических специальностей.

Пособие состоит из трех разделов. Первый раздел содержит 19 текстов и упражнений к ним. Каждый текст охватывает приблизительно 1500–2000 печатных знаков. Тексты подобраны из оригинальной технической литературы. Для большей наглядности тексты снабжены рисунками и чертежами.

Во втором разделе даны тексты для внеаудиторного чтения.

В третьем разделе дан словарь-минимум. Словарь имеет цель облегчить и унифицировать процесс обучения чтению, переводу и реферированию научных текстов по специальности. Он может быть использован и как справочник при самостоятельной работе.

Язык, с помощью которого излагаются научные и технические факты, ставит перед студентами ряд проблем, и одной из самых важных является «вокабуляр». Научные и технические тексты содержат большое количество терминов. Эта проблема решается с помощью существующих различного рода отраслевых словарей, кроме того, большое количество слов являются международными.

Наибольшую же трудность представляют полунаучные, полутехнические слова (некоторые методисты называют их общенаучными словами), которые характерны для всех отраслей науки, имеют ряд значений и часто используются идиоматически. Существует также ряд глаголов, прилагательных, наречий, которые, по существу, не являются научными, но принадлежат к научной фразеологии. Максимальное количество таких слов и вошло в данный лексический минимум.

Все слова расположены в алфавитном порядке. Каждое отдельное слово, будь то основное или производное, даётся как самостоятельная лексическая единица. Слова, одинаковые по написанию и произношению, например существительное и глагол, даются один раз. Слово, одинаковое по написанию, но имеющее другое произношение, выделяется в отдельную словарную статью. Предлог, характерный для данного глагола, ставится в скобках после перевода этого глагола. Неправильно образующиеся формы глаголов приводятся в скобках. Если в скобках дана одна форма глагола, значит Past и Participle II совпадают. В словарных статьях приводятся некоторые фразеологические сочетания, которые часто встречаются в английской научной литературе.

Раздел I

TEXT ONE

GENERATION OF ELECTRICITY

Our study of electricity will be limited to methods of generation, distribution and application in furnishing motive power for machinery. As this is not a highly technical study, the electron theory of the nature of electricity will not be discussed.

Historically, knowledge of electrical manifestation goes back to the early Greeks who noticed that amber, after being rubbed, had the power to attract feathers or small bits of straw. Through the ages many people have experimented with and studied the nature of this strange power, and by their efforts it has been brought under control and made one of man's most useful servants.

Before studying the way in which electrical power is generated, certain terms must be explained and certain manifestations must be discussed in order to make the study meaningful. The explanations given here are made as simple and nontechnical as possible.

Electromotive force (emf) is the force or pressure that causes electric current to flow. The unit of measure of this force is the volt. Electromotive force is sometimes called "potential" or "voltage". Electric current will flow in a wire when sufficient voltage is present. The unit of measurement of electric current flow is the ampere. Volts and amperes are measured by dial instruments called voltmeters and ammeters.

The amount of electric power that is delivered by a generator or is consumed by a motor or other power device is the product of the pressure and the flow. Thus, power = volts x amperes. The unit of measure of power is the watt. Therefore, watts = volts x amperes. Instruments for indicating or recording watts are called wattmeters. For designating large amounts of power the term "kilowatt" or kw, which means one thousand watts, is used.

EXERCISES

I. Read and translate the text.

Remember the words which are new for you.

II. Give Russian equivalents.

Electromotive force; the measure of electric power; wattmeter; dial instrument; voltmeter; ammeter.

III. Give Russian equivalents, paying attention to the suffixes in English words:

to explain-explanation; to consume-consumer-consumption; to indicate-indicator-indication; to generate-generator-generation.

IV. Answer the following questions:

1. What is electromotive force?
2. What electrical units do you know?
3. What is the volt?
4. What is the ampere?
5. What is the watt?
6. What instruments are used for measuring emf and the electric current flow?
7. What is the kilowatt and when is it used?

V. Speak on:

1) electromotive force;
2) the measure of electric power.

TEXT TWO

RESISTANCE

Resistance is the property of any material to oppose the flow of electricity through it. The unit of measure of this resistance is the ohm. The resistance of a conductor varies directly to its length and inversely to its cross-sectional area. Thus a long thin wire would have a high resistance in ohms and a short thick wire would have a low resistance.

The voltage required to make a current flow in a conductor depends upon the resistance. A pressure of 1 volt will make a current of 1 ampere flow through a resistance of 1 ohm. This relationship is expressed in the formula

$$I = U/R,$$

where I is the current in amperes, U — pressure in volts and R – resistance in ohms. This formula may be transposed

$$U = IR \text{ or } R = U/I,$$

so that when any two of the values in the formula are known the other may be found. This formula is known as Ohm's Law.

Electric conductors usually consist of wires or cables made of copper. Copper is used because it is the best conductor and relatively cheap. Every substance is a conductor to some degree, but the metals are the best.

Electric insulators are materials that allow almost no electricity to pass through them. These materials are also called nonconductors. Typical commercial insulators are rubber, silk, cotton, mica, porcelain, glass, dry paper and etc. Dry air and oils are good insulators too. Wire conductors are usually covered with insulation.

Electric circuits. – In order to use electric currents for transmitting power they must be sent through insulated conductors arranged to form complete paths. That is, the conductor must start at the generator, go to the motor, through it and return to the generator. If there is a break in the path, current will not flow. These paths are called electric circuits. Circuits may be series, shunt or compound. (For example, see diagrams shown in Figure 1.)

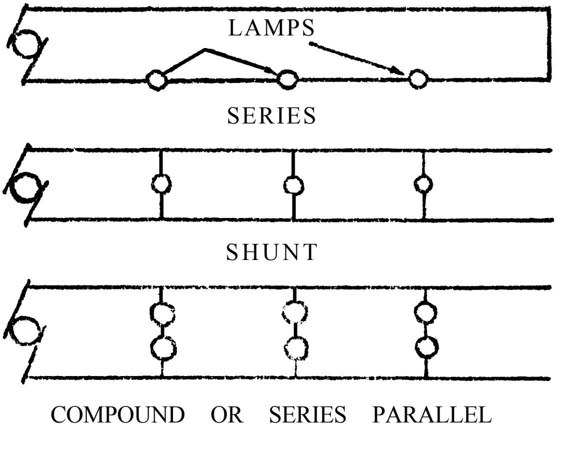


Fig. 1. Circuits

EXERCISES

I. Read and translate the text.

II. Give Russian equivalents:

cross-sectional area, to be directly proportional to, to be inversely proportional to, relationship, in order to, the arrangement of conductors, series circuit, shunt circuit, compound circuit.

III. Answer the following questions:

1. What is the resistance?
2. In what units is the electrical resistance measured?
3. How does the resistance of a conductor vary?
4. We have two wires. One of them is long and thin.

The other is short and thick. Which of them will have higher resistance?

5. What is Ohm's Law?
6. What is a conductor?
7. What is an insulator?
8. What substance is widely used as a conductor?
9. What substances are used as insulators?
10. What is an electric circuit?
11. What kinds of electric circuits do you know?

IV. Speak on:

1. resistance; 2. electric conductors; 3. electric insulators; 4. electric circuits.

V. Look at Fig. 1 and describe three kinds of electric circuits.

TEXT THREE

ELECTROMAGNETISM

We are all familiar with permanent magnets. Permanent magnets, however, are not suitable for use in large electric generators, and so the electromagnets must be used.

Magnetism can be produced by electric currents. In fact every current-carrying conductor has a magnetic field about it. When a current-carrying wire is formed into a coil the magnetic field, which is the space occupied by magnetic lines of force, passes through the coil and around the outside, as shown in Fig. 2.

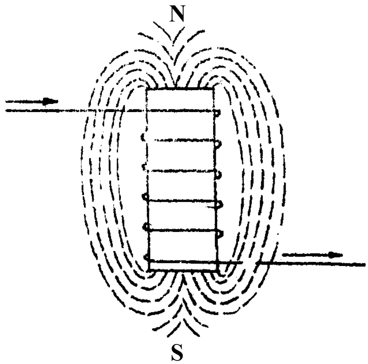


Fig. 2. Electromagnet

If a bar of iron or steel is placed within the coil, the field is concentrated in it and it becomes a magnet, or, more properly, an electromagnet. If the iron or steel core and the coiled wire are arranged as shown in Fig. 3, the magnetism follows the core and is concentrated at the gap G. This concentrated form of the magnet field is very useful in generators, as will be shown. The strength of any magnetic field thus produced depends on the amount of current flowing in the wire, and the number of turns of wire. Many turns of wire and a strong current will produce a strong electromagnet and thus a strong field.

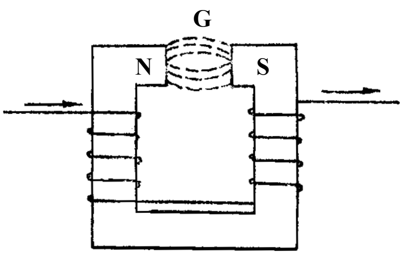


Fig. 3. Electromagnet with concentrated field

EXERCISES

I. Read and translate the text.

II. Read the words and give Russian equivalents:

magnet, magnetic, magnetism, electromagnetism, electromagnet, magnetic field, magnetic lines of force, current-carrying conductor, the number of turns of wire.

III. Speak on electromagnetism using Figs. 2 and 3.

TEXT FOUR

ELECTROMAGNETIC INDUCTION

If a conductor (wire) is moved across this magnetic field so that, in effect, it cuts across "the lines of magnetic force" a voltage will be produced in it. This action is illustrated in Fig. 4.

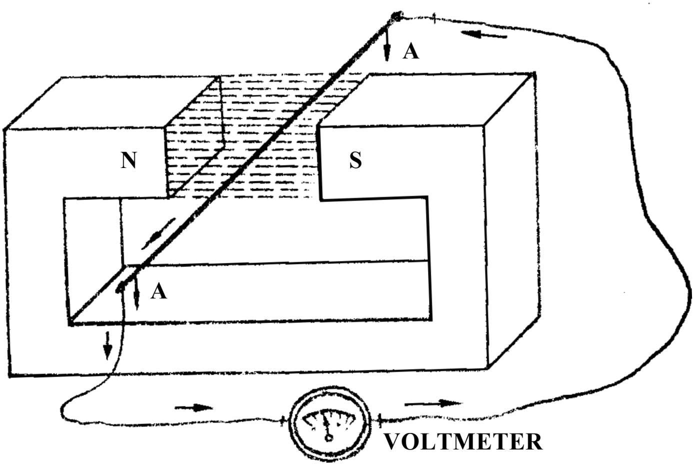


Fig. 4. Principle of electromagnetic induction

The effect would be the same if the conductor were stationary and the field were moved. This phenomenon illustrates the principle of electromagnetic induction which is stated as follows:

"When a conductor cuts or is cut by a field of magnetic force an electromotive force is produced in that conductor". The direction in which the current will flow in the conductor is determined by the direction of motion of the conductor. As shown in Fig. 4, the field direction is from N to S (north to south pole of the magnet); the direction of the motion of the conductor is down and the current direction is as shown by the arrows. If the movement of the conductor were upward the direction of the current would be the opposite of that shown in the illustration.

The voltage produced in the conductor depends on the strength of the field and the speed of the conductor. The stronger the field and the faster it is cut by the conductor the greater will be the voltage.

Alternating and direct currents. – In alternating-current systems the voltage and the current reverse their direction from zero to maximum value and back to zero in one direction, to maximum value and back to zero in the other direction, many times per second. The complete double reversal is called a cycle.

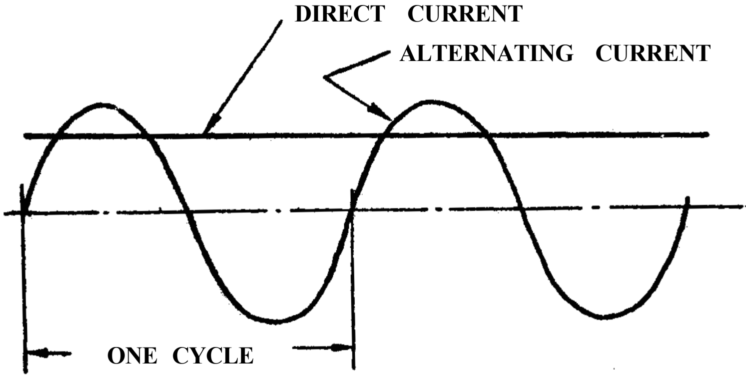


Fig. 5. Comparison of AC and DC

If there are sixty reversals per second the current is called "60-cycle". Alternating current in common use is usually "60-cycle". In direct-current systems the voltage is usually constant and the current always flows in the same direction.

The diagram in Fig. 5 shows a comparison of alternating and direct currents.

EXERCISES

I. Read and translate the text.

II. Give Russian equivalents:

electromagnetic induction, in effect, upward, downward, outside, inside, alternating-current system, direct-current system, the complete double reversal.

III. Describe Fig. 4 according to the plan given below:

1. What does Fig. 4 illustrate?
2. What do you see in this figure?
3. When will a voltage be produced in a conductor AA?
4. What is the direction of the current in the conductor determined by?

IV. Speak on alternating and direct currents using Fig. 5.

TEXT FIVE

ALTERNATING CURRENT GENERATOR

Fundamentally, a generator is a device used to convert mechanical power into electrical power. In other words, the mechanical power put into turning the rotor of a generator is delivered at the output terminals of the generator in the form of electrical power (minus some mechanical and electrical losses).

Diagram 6 shows that

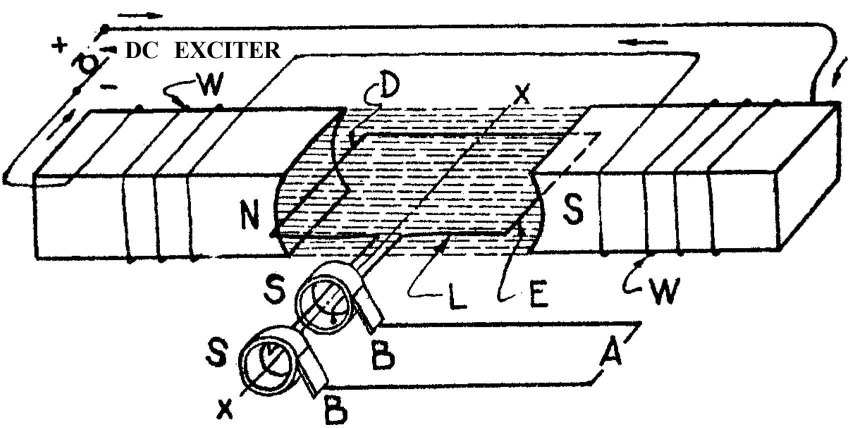
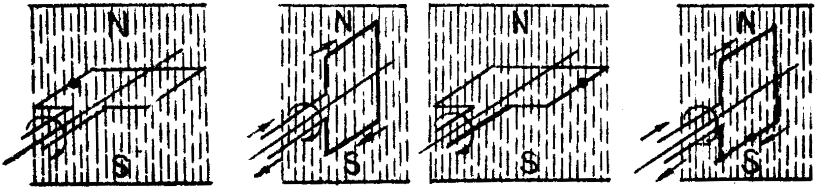


Fig. 6. Single-phase two-pole revolving armature generator

the generator is a device made to take advantage of the principle of electromagnetic induction to generate an alternating current. A magnetic field (shown by dotted lines) is established between the N and S poles by means of the "exciting" current flowing through winding W. A loop of wire L is suspended in this field so that it can be rotated on the axis **x-x** and its ends are brought out to the "slip rings" S-S on which the brushes B-B slide. The circuit of this loop is completed from B-B through A. When this loop is rotated so that its conductors D and E cut across the field a voltage is produced in it (principle of electromagnetic induction). Since a circuit is completed through A, current will flow.

Fig. 7 shows a series of simplified diagrams in which the magnetic field is merely indicated.



START 1/4 CYCLE 1/2 CYCLE 3/4 CYCLE

Fig. 7. Why the current generated is alternating

The loop of wire is assumed to be rotating as shown by curved arrows. Considering only the conductor marked with a spot, one may see that at "start" the voltage will be zero, since a conductor is moving parallel to the direction of the field. Gradually it begins to cut across the field and at "1/4 cycle", it is cutting across the field and the voltage in the conductor is at maximum. This voltage decreases again to zero as the loop reaches "1/2 cycle" and increases again to maximum in the opposite direction as the loop reaches "3/4 cycle". The voltage finally returns to zero when the loop again reaches the original or "start" position.

Thus, as the conductor passes across the faces of the N and S poles a cycle of voltages takes place, first in one direction and then in the other. The unmarked conductor forming the opposite side of the loop always has a voltage of opposite direction induced in it as it passes across the pole of opposite polarity.

The voltages of these two conductors, added together, produce the total voltage of the loop.

Figure 5 shows a graph of the changes in voltage through two cycles. The curved line represents the voltage at any instant in the cycle by its distance above or below the horizontal zero line. The generator diagrammed in Figure 6 is a two-pole single-phase revolving-armature alternating-current machine. The magnetic field, the coils of wire, and the iron core are called its "field".

EXERCISES

I. Read and translate the text.

II. Give Russian equivalents:

output terminals shown by dotted lines; exciting current winding; a loop of wire; armature; slip rings; brush; curve; alternating-current machine; single-phase two-pole revolving armature generator.

III. Retell the text using Figs. 6 and 7.

TEXT SIX

THREE-PHASE GENERATOR

In a three-phase generator, three single-phase windings are combined on a single rotor and rotated in the same magnetic field. The voltage in each winding alternates exactly one-third of a cycle after the one ahead of it, due to the arrangement of the windings. The diagram in Fig. 8 shows this.

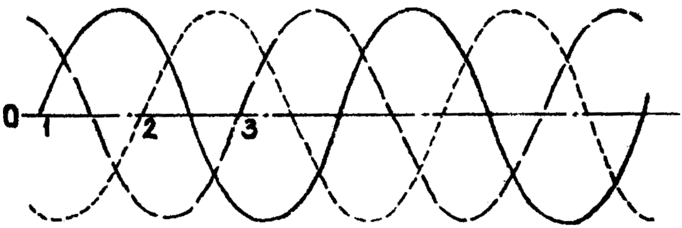


Fig. 8. Distribution of phases in a three-phase generator

Compare this diagram with the single-phase diagram. As a rule, the end of each phase winding is not brought out to a separate slip ring, but the windings are connected together inside of the machine and only three leads are brought out as shown in Fig. 9.

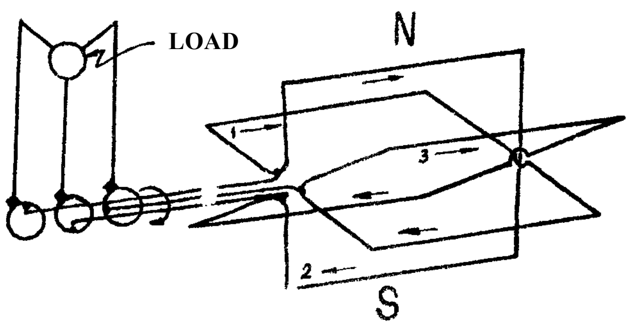


Fig. 9. Diagram of three-phase revolving armature generator

This makes only three wires necessary for transmitting three-phase current. Perhaps you have noticed some three-wire transmission lines.