Для средних профессиональных учебных заведений

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АНГЛИЙСКИЙ ЯЗЫК

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Цель пособия – обучение студентов энергетических специальностей устной речи, чтению и переводу по специальности.

Тексты пособия, подобранные из оригинальной литературы, расположены в определенной логической последовательности: от описания отдельных деталей к объяснению работы приборов и далее – к описанию современных энергетических установок и электростанций, в том числе атомных. Пособие содержит серию тренировочных и контрольных упражнений (тестов), краткий грамматический раздел по грамматическим темам пособия с упражнениями, а также материалы для чтения и обсуждения прочитанного.

Предназначается для студентов энергетических специальностей вузов и техникумов.

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Предисловие

Вашему вниманию предлагается пособие для учебных заведений энергетического профиля. Пособие соответствует требованиям программы по английскому языку для учебных заведений данного профиля и рассчитано на обучаемых, имеющих начальную языковую подготовку.

В число учебных целей пособия входят формирование умений беседовать на профессиональную тематику и развитие умения читать специальную литературу средней трудности и извлекать из нее нужную для практики информацию. Для достижения поставленных целей в пособии предусмотрена регулярная, от урока к уроку, учебная деятельность по созданию словаря активной лексики, включающего наиболее употребительные для данной специальности термины и слова общетехнического значения. Кроме того, предусмотрена учебная деятельность, направленная на формирование основ потенциального словаря. Специальный раздел пособия посвящен повторению и тренировке грамматических явлений и синтаксических структур, типичных для современной научно-технической литературы.

Материалы, составляющие пособие, отобраны из оригинальной и переводной литературы по данной отрасли. Последовательность текстовых материалов пособия имеет логическую направленность, соответствующую логике структуры данной специальности, а именно: от описаний отдельных деталей и элементов оборудования – к описанию действующих устройств разного назначения, построенных из этих деталей.

Пособие состоит из трех частей: 1. Основной курс (Essential Course);
2. Повторение и тренировка грамматики (Grammar Revision); 3. Материалы для чтения и обсуждения (Material for Reading and Discussing).

Основной курс состоит из 34 уроков, имеющих аналогичную структуру. Цель этой части – формирование у обучаемых навыков устной речи по профессиональной тематике. Этим определяется подбор учебных материалов, их расположение и характер тренировочных заданий. В начале каждого урока

предлагается задание на тренировку новых слов в их английском и русском вариантах. Следует отметить, что при переводе этих слов мы, главным образом, придерживались их терминологических значений. Выполняя первое задание, следует добиваться уровня владения словарем, указанного в задании. Показателем того, что искомый уровень достигнут, служит готовность обучаемых свободно, в нормальном речевом темпе воспроизвести каждое слово в его английском и русском вариантах. Только после этого рекомендуется переходить к активизации слов в контексте и к работе над текстом. Заключительные задания, построенные в вопросо-ответной форме, служат для контроля и самоконтроля степени усвоения лексики и структур данного урока. Неспособность обучаемого выполнить эти задания в требуемом речевом темпе указывает на то, что материал урока не усвоен и цель урока не достигнута. А так как это создает препятствия для дальнейшей деятельности, рекомендуем сделать шаг назад и ликвидировать выявленный пробел.

Следует отметить, что в первой части пособия реализована полная, от урока к уроку, преемственность слов и их многократная повторяемость в разных контекстах. Число новых слов в уроках строго дозировано и определено закономерностями памяти человека. Формируемый на этой основе словарный запас используется для достижения учебной цели первой части пособия – развития умений устного общения. Кроме того, он помогает и в создании потенциального словаря, что составляет одну из задач второй части, содержащей материал и задания по словообразованию. Лексический минимум является основой чтения и активного обсуждения материалов третьей части пособия.

Во вторую часть пособия включены упражнения на повторение и тренировку грамматики. Выполнение этих упражнений помогает активизировать знание грамматических форм и синтаксических оборотов, употребительных в специальной литературе. Кроме того, приводятся серии заданий на запоминание разных способов словообразования, что помогает расширению словарного запаса и образованию основ потенциального словаря. Тесты по основным темам грамматики позволяют преподавателю проконтролировать, усвоена ли тема

учащимися или необходимы дополнительные пояснения и упражнения для закрепления знаний по грамматике.

Содержание третьей части составляют текстовые материалы для чтения и задания на извлечение информации из них и устное обсуждение. По уровню языковой и понятийной сложности материалы третьей части пособия можно условно разделить на две группы. В первую входят краткие статьи описательного характера, несложные по содержанию и по характеру синтаксических построений. Статьи построены на широко употребительной лексике – популярной отраслевой терминологии и частотных словах общетехнического значения. Преподаватель, по своему усмотрению, может использовать эти статьи уже на ранней ступени обучения. Во вторую группу входят материалы более сложные как по содержанию, так и по языковым характеристикам. К работе с этими статьями целесообразно приступать после выполнения заданий, представленных во второй части пособия.

Кроме чтения и перевода текстовых материалов разной понятийной и языковой сложности, в число задач заключительного раздела входит развитие и углубление навыков устной речи по темам специальности. Для этого предлагаются вопросо-ответные задания, выступления с сообщениями по темам текстов и их последующее обсуждение. Специальные задания направлены на активизацию мыслительной деятельности учащихся.

1. Essential Course

Основной курс

Unit One [1]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

addition	[əˈdɪʃən]	сложение
subtraction	[səbˈtrækʃn]	вычитание
plus	[plʌs]	плюс
minus	[ˈmaɪnəs]	минус
to add	[æd]	складывать, прибавлять
to subtract	[səbˈtrækt]	вычитать
to equal	[ˈiːkwəl]	равняться
to be equal		быть равным

Addition and Subtraction

5 + 7 = 12	– five plus seven equals twelve
66 + 13 = 79	– sixty-six plus thirteen is equal to seventy-nine
a + b = c	– a plus b is equal to c
15 - 6 = 9	– fifteen minus six equals nine
81 - 33 = 48	– eighty-one minus thirty-three is equal to forty-eight
c - b = a	– c minus b equals a

2. Solve these problems and read them:

99 + 77 = _____	8 - 3 = _____	315 + 145 = _____
61 - 50 = _____	47 - 18 = _____	859 - 600 = _____
114 + 316 = _____	1,203 + 419 = _____	4,444 + 7,777 = _____
b + d = _____	d - c = _____	a - b = _____

3. Pair work. Think of six problems of your own. Put them down. Ask your groupmate to solve them.

Unit Two [2]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

multiplication	[ˌmʌltɪplɪˈkeɪʃn]	умножение
to multiply	[ˈmʌltɪplaɪ]	умножать
multiplied by		умноженное на
once	[wʌns]	один раз
twice	[twaɪs]	дважды, два раза
three times		три раза
four times		четыре раза
division	[dɪˈvɪʒn]	деление
to divide	[dɪˈvaɪd]	делить
divided by		деленное на

Multiplication and Division

1 × 1 = 1	– once one is one
2 × 2 = 4	– twice two is four
3 × 3 = 9	– three times three equals nine
4 × 4 = 16	– four times four is equal to sixteen
12 × 10 = 120	– twelve multiplied by ten (by) is equal to one hundred and twenty
a × b = ab	
35 : 7 = 5	– thirty-five divided by seven equals five
1000 : 25 = 40	– one thousand divided by twenty-five is equal to forty
d : b = c	

2. Solve these problems and read them:

10 × 7 = _____	49 : 7 = _____	13 × 3 = _____	749 : 7 = _____
100 × 100 = ____	175 : 25 = _____	618 : 6 = _____	3,550 × 5 = ____
234 × 6 = _____	12 × 12 = _____	33 : 33 = _____	10,660 : 10 = ___
b × c = _____	n : m = _____	1 × k = _____	1 × 1= _____

3. Pair work. Think of five problems of your own. Put them down. Ask your groupmate to solve them.

Unit Three [3]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

fractions	[ˈfrækʃənz]	дроби
decimal fractions	[ˈdesıməl ˈfrækʃənz]	десятичные дроби
common fractions	[ˌkɔmən ˈfrækʃənz]	простые дроби
numerator	[ˈnju:məreıtə]	числитель
denominator	[dıˈnɔmıneıtə]	знаменатель
nought	[nɔ:t]	нуль
zero	[ˈzıərou]	нуль
0	[ou]	нуль
point	[pɔınt]	точка

Common and Decimal Fractions

(see page 98)

$\frac{1}{2}$ – one half (a half)

$\frac{1}{3}$ – one third (a third)

$\frac{2}{7}$ – two sevenths

$3\frac{1}{2}$ – three and a half

0.7 { 0 point seven / nought point seven / zero point seven

0.002 – zero point two zeros two

1.1 – one point one

5.36 – five point three six

$5\frac{1}{7}$ – five and a seventh

65.57 – sixty-five point five seven

$6\frac{5}{7}$ – six and five sevenths

2. Read these common and decimal fractions:

1/3	2/5	5/8	7 1/2	9 5/8	15 8/9
0.23	0.009	10.01	205.35	79.31	0.0003

Unit Four [4]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

current	[ˈkʌrənt]	электрический ток
resistance	[rɪˈzɪstəns]	сопротивление
voltage	[ˈvoultɪdʒ]	вольтаж, напряжение
to suppose	[səˈpouz]	предполагать
law	[lɔː]	закон

Ohm's Law

$R = \frac{V}{I}$ Resistance equals voltage divided by current.

$I = \frac{V}{R}$ Current equals voltage divided by resistance

$V = IR$ Voltage equals current times resistance.

	Problem	**Solution**
V = 1V	Suppose that resistance equals one	$R = \frac{V}{I}$
I = 1 amp	volt and current equals one ampere.	
R = ?	How much is the resistance?	$\frac{1V}{1\ amp} = 1\ ohm$

2. Solve the following problems and read them.

Model: – How much is 10 times 4?

– 10 times 4 equals 40.

1) 7 × 7 =	5) 350 × 2 =	9) 49 : 7 =	13) 20.2530
2) 2.5 × 3 =	6) 3.5 × 10 =	10) 75 : 25 =	14) 7.5 : 5 =
3) 10,050 × 2 =	7) 2,000 × 5 =	11) 3,500 : 35 =	15) 40.8 : 4 =
4) 100 × 0.5 =	8) 0.12 × 2 =	12) 10.25 : 10 =	16) 15.5 : 3=

3. Solve the following problems using the formulas of Ohm's Law.

Model: – Current equals 5 amp; resistance equals 10 ohms. How much is the voltage?

– Voltage equals current times resistance. 5 × 10 = 50 V

1) R = 80 ohms V = 55 V I = ?	2) R = 10.25 ohms I = 35 amp V = ?	3) V = 50.05 V I = 120 amp R = ?
4) I = 10,500 amp V = 2,000 V R = ?	5) V = 20.05 V R = 0.015 ohm I = ?	6) I = 0.24 amp R = 1.36 ohms V = ?

4. Pair work. Make up similar problems of your own. Ask your groupmate to solve them.

Unit Five [5]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

circuit	[ˈsəːkɪt]	цепь, контур
conductor	[kənˈdʌktə]	проводник
function	[ˈfʌŋkʃn]	назначение
difference	[ˈdɪfrəns]	разница
open		обрыв
short		короткое замыкание
trouble	[ˈtrʌbl]	повреждение
no	[nou]	никакой, нисколько
to reduce	[rɪˈdjuːs]	сокращать
to supply	[səˈplaɪ]	снабжать
to connect	[kəˈnekt]	связывать
to compare (with)	[kəmˈpɛə]	сравнивать (с)
to pass through	[ˈpɑːs ˈθruː]	проходить через
to result in		приводить к, иметь результатом
to result from		следовать, проистекать из

2. Translate into Russian:

1. An open and a short are troubles in a circuit.
2. A trouble in a circuit results in no current in it.
3. What does an open in a circuit result in?
4. What does a short in a circuit result in?
5. What does a trouble in a circuit result from?

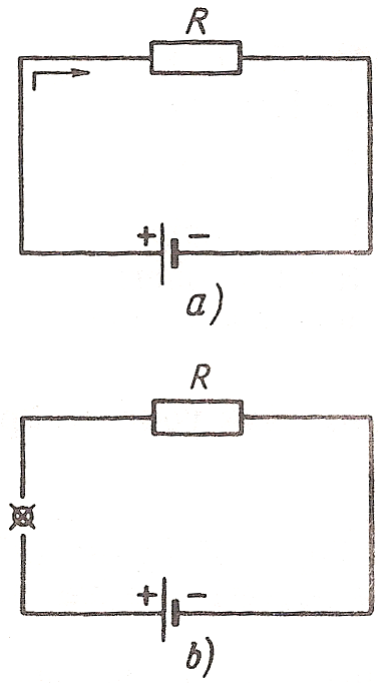


Fig. 1

Electric Circuit

This is a circuit. Its elements are a voltage source, a resistor and a conductor. The circuit consists of a voltage source, a resistor and a conductor. A voltage source supplies current. A resistor reduces current. A conductor connects the elements of the circuit.

Compare circuit *a* with circuit *b*. What is the difference between them? Current passes through circuit *a* while no current passes through circuit *b*. Circuit *b* has an open. No current through circuit *b* results from an open. An open and a short are troubles in a circuit. A trouble in a circuit may result in no current in it.

3. Complete these sentences, using the correct variant:

1. Circuit *a* consists of
   a) resistors and conductors.
   b) a voltage source and resistors.
   c) a voltage source, a resistor and a conductor.

2. A voltage source
   a) conducts current.
   b) reduces current.
   c) supplies current.

3. A conductor
   a) connects the elements.
   b) supplies voltage.
   c) conducts current.

4. A resistor
   a) connects the elements.
   b) supplies current.
   c) reduces current.

5. No current results from
   a) an open.
   b) a short.

4. Answer the following questions:

1. What elements does a circuit consist of?
2. What is the function of a voltage source?
3. What is the function of a conductor?
4. What is the function of a resistor?
5. When is there no current in a circuit?
6. What does an open or a short result in?
7. What does no current in a circuit result from?

5. Solve these problems:

1. How much is the current in the circuit if a 60-volt source is connected to a resistance of 1,600 ohms?
2. How much is the voltage in a circuit having a current equal to 25 amp, if a 25-ohm resistance is connected to it?
3. A 70.35-ohm resistance is connected to the circuit. How much is the voltage if the current equals 4.5 amp?

6. Pair work. Ask your groupmate to compare circuits *a* and *b* (see Fig. 1).

1. What do they have in common?
2. Which of the circuits has a trouble?
3. What does the trouble result from?
4. What does it result in?

Unit Six [6]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

branch	[brɑːntʃ]	отвод
line		линия
value	[ˈvæljuː]	величина
voltage drop		падение напряжения
series	[ˈsɪəriːz]	последовательное
parallel	[ˈpærələl]	параллельное
main	[meɪn]	главный, основной
to use	[juːz]	использовать
in order (to)		для того чтобы

Series Circuit and Parallel Circuit

Compare circuits *a* and *b*. Circuit *a* consists of a voltage source and two resistors. The resistors are connected in series. Circuit *a* is a series circuit.

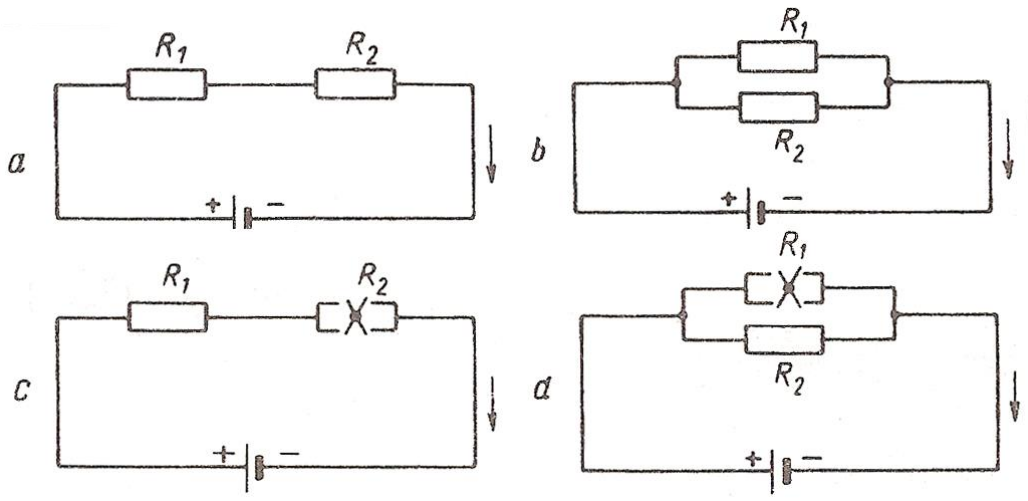


Fig. 2

Circuit *b* consists of a voltage source and two resistors. The resistors are connected in parallel. Circuit *b* is a parallel circuit.

A parallel circuit has the main line and parallel branches.

In circuit *b* the value of voltage in R_1 equals the value of voltage in R_2. The value of voltage is the same in all the elements of a parallel circuit while the value of current is different. A parallel circuit is used in order to have the same value of voltage.

In circuit *a* the value of current in R_1 equals the value of current in R_2. The value of current is the same in all the elements of a series circuit while the value of voltage is different. A series circuit is used in order to have the same value of current. In R_1, $V_1 = I \times R_1$ is the voltage drop in R_1. In R_2 the voltage equals $I \times R_2$; $I \times R_2$ is the voltage drop in R_2. In circuit *c* a trouble in one element results in no current in the whole circuit. In circuit *d* a trouble in one branch results in no current in that branch only, a trouble in the main line results in no current in the whole circuit.

2. Complete these sentences using the correct variant:

1. A parallel circuit has
   a) parallel branches only.
   b) the main line and parallel branches.

2. A parallel circuit is used in order
   a) to have the same value of current in all the elements.
   b) to have the same value of voltage in all the elements.

3. In a parallel circuit a trouble in one branch
   a) results in no current in that branch only.
   b) results in no trouble in the whole circuit.

4. No current in a parallel circuit
   a) results from a trouble in one branch.
   b) results from a trouble in the main line.

5. The sum of IR voltage drops	a) equals the value of voltage in the circuit. b) is less than the smallest voltage drop. c) is more than the value of voltage in the circuit.

3. Complete the sentences using *while*. Follow the model:

Model: Resistors connected **in series** have the same value of **current** ... .

Resistors connected **in series** have the same value of current *while* resistors connected **in parallel** have the same value of **voltage**.

1. Resistors connected **in series** have **different** values of voltage while ... .
2. A trouble in one element of a **series** circuit results in no current in the **whole circuit** while ... .
3. In order to have the same value of **current** in all the elements, a **series** circuit is used while ... .
4. No current in a **parallel** circuit results from a trouble in the **main line** while ... .

4. Answer the following questions:

1. What type of circuit has the main line and parallel branches?
2. What type of circuit is used in order to have the same value of current in all the elements?
3. What type of circuit is used in order to have the same value of voltage in all the elements?
4. What does a trouble in the main line result in?
5. What does a trouble in a branch result in?
6. What does no current in a series circuit result from?
7. How much does the sum of IR voltage drops equal?
8. What is the difference between series and parallel circuits?

5. Pair work. Ask your groupmate to draw and describe a series-parallel circuit.

Unit Seven [7]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

meter	[ˈmiːtə]	измерительный прибор
battery	[ˈbætərɪ]	батарея
scale	[skeɪl]	шкала
readings		показания на шкале (прибора)
terminal	[ˈtəːmɪnl]	клемма
positive	[ˈpɔzɪtɪv]	положительный
negative	[ˈnegətɪv]	отрицательный
to measure	[ˈmɛʒə]	измерять
to take into consideration		принимать во внимание
in this way	[weɪ]	таким путем, таким образом

2. Translate into Russian (see page 98):

1. **One** should take into consideration the difference between these circuits.
2. **One** should take into consideration that the ammeter is connected to the circuit in series.
3. What should **one** take into consideration using the ohmmeter?

Meters

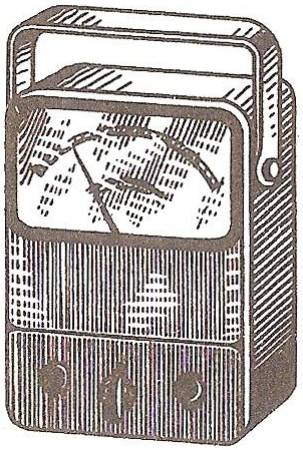


Fig. 3

Among the most common meters used there are the ohmmeter, the ammeter and the voltmeter. The ohmmeter is used to measure the value of resistance. It consists of a milliammeter calibrated to read in ohms, a battery and resistors. The meter is connected in parallel and the circuit is not opened when its resistance is measured. The readings on the scale show the measured value.

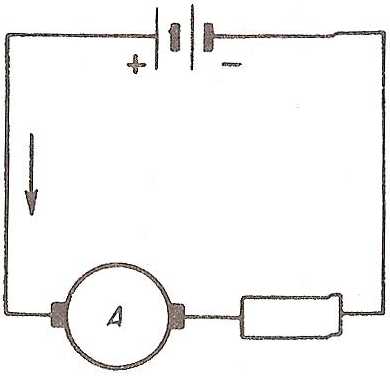


Fig. 4

The ammeter is used to measure the value of current. When the ammeter is used the circuit should be opened at one point and the terminals of the meter should be connected to it. One should take into consideration that the positive terminal of the meter is connected to the positive terminal of the source; the negative terminal – to the negative terminal of the source.

The ammeter should be connected in series. The readings on the scale show the measured value.

3. Complete the sentences using the correct variant:

1. The ammeter is	a) a common meter. b) an uncommon meter.
2. In order to measure the value of current	a) the ohmmeter is used, b) the voltmeter is used. c) the ammeter is used.
3. A meter has	a) positive terminals only. b) negative terminals only. c) positive and negative terminals.

4. When the ammeter is used	a) the circuit should be opened. b) the circuit should not be opened.
5. The ammeter should be connected	a) in series. b) in parallel.
6. One should take into consideration that	a) the positive terminal should be connected to the negative terminal. b) the positive terminal should be connected to the positive terminal of the source.

4. Complete these sentences using *while*. Follow the model.

Model: The ammeter is used to measure the value of current … .

The ammeter is used to measure the value of current **while** the ohmmeter is used to measure the value of resistance.

1. The **ohmmeter** is used to measure the value of resistance … .
2. The **ammeter** is connected in **series** … .
3. When the **ammeter** is used to measure the value of **current** the circuit **should be opened** … .

5. Pair work. Put these questions to your groupmate. Let him/her answer them.

1. What is the ammeter used for?
2. What is the voltmeter used for?
3. What is the ohmmeter used for?
4. What terminals does a meter have?
5. Should the measured circuit be opened when the voltmeter is used?
6. Should the measured circuit be opened when the ammeter is used?
7. In what way should the voltmeter be connected to the circuit?
8. In what way should the ammeter be connected to the circuit?

9. What is the difference between a voltmeter and an ammeter?
10. What common meters are used to measure the values in a circuit?

6. Solve the following problems:

1. Suppose the ammeter scale reads 1.9 amp, the voltmeter scale reads 2.4 V; how much is the value of resistance in the measured circuit?
2. Suppose the ohmmeter scale reads 75 ohms, the voltmeter scale reads 220 V; how much is the value of current in the measured circuit?
3. Suppose that you have a series circuit consisting of three resistors and a voltage source. R_1 = 0.18 ohm, R_2 = 1.15 ohms, R_3 = 2 ohms, I = 10 amp. Find the voltage drop across each resistor; find the value of voltage in the circuit. Suppose R_1 gets open. What does it result in?
4. Two resistors are connected in series. R_1 = 7,000, R_2 = 2,200, I = 110 amp. Find the voltage drop across each resistor. Suppose no current passes through the circuit, what does it result from?

Unit Eight [8]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

capacity	[kəˈpæsɪtɪ]	емкость
power	[ˈpauə]	мощность
heat		теплота, нагрев
rate		скорость, степень
to produce	[prəˈdjuːs]	производить
to change	[tʃeɪndʒ]	менять(ся)

to vary	[ˈvɛərɪ]	варьировать(ся)
low	[lou]	низкий
high	[haɪ]	высокий
fixed	[fɪkst]	постоянный
any		(*зд.*) любой
variable	[ˈvɛərɪəbl]	переменный
the (more) … the (more)		чем (больше) ... тем (больше)

2. Read the words and put down their Russian equivalents:

[ˈtemprətʃə]	temperature	_____
[ˈenədʒi]	energy	_____
[wɔt]	watt	_____
[ˈkɔnstənt]	constant	_____
[pouˈtenʃəl]	potential	_____

3. Translate into Russian using *чем ... тем*.

1. The more one studies nature, the better one knows its laws.
2. The longer one learns, the more one knows.
3. The higher the atmosphere, the less is its pressure.
4. The heavier the object, the more work one has to do in order to lift it.
5. The greater the number of free electrons in any metal, the higher is its conductivity.

2. Translate into Russian. Mind *no*.

1. There is no energy in this machine.
2. No charges move through an open circuit.
3. No material is a perfect conductor of electricity.
4. No electric machinery is used without protection.
5. No special material is needed in this case.

Resistors

A resistor is one of the most common elements of any circuit. Resistors are used:

1. to reduce the value of current in the circuit;

2. to produce IR voltage drop and in this way to change the value of the voltage.

When current is passing through a resistor its temperature rises high. The higher the value of current the higher is the temperature of a resistor. Each resistor has a maximum temperature to which it may be heated without a trouble. If the temperature rises higher the resistor gets open and opens the circuit.

Resistors are rated in watts. The watt is the rate at which electric energy is supplied when a current of one ampere is passing at a potential difference of one volt. A resistor is rated as a 1-W resistor if its resistance equals 1,000,000 ohms and its current-carrying capacity equals 1/1,000,000 amp, since $P = E \times I = IR \times I = I^2R$ where P – power is given in watts, R – resistance is given in ohms and I – current is given in amperes.

If a resistor has a resistance of only 2 ohms but its current-carrying capacity equals 2,000 amp, it is rated as a 8,000,000-W resistor.

Some resistors have a constant value – these are fixed resistors, the value of other resistors may be varied – these are variable resistors.

5. Complete the sentences using the correct variant:

1. A resistor is used	a) to measure the resistance. b) to reduce the current. c) to change the resistance. d) to produce IR voltage drop.
2. When current passes through a resistor	a) its temperature drops. b) its temperature rises.
3. Resistors are rated	a) in ohms. b) in volts. c) in watts.
4. Power is given	a) in amperes. b) in watts.
5. Fixed resistors have	a) a constant value. b) a variable value.
6. The value of a variable resistor	a) is fixed. b) is varied.
7. A two-ohm resistor rated as a 8,000,000-W resistor	a) has a current-carrying capacity equal to 2,000 amp. b) has a current-carrying capacity equal to 200 amp.
8. The higher the value of current,	a) the lower is the temperature of a resistor. b) the higher is the temperature of a resistor.

6. Complete the sentences using *while*. Follow the model on page 13.

1. The value of a **fixed** resistor is constant … .
2. **Current-carrying capacity** is given in amperes … .
3. The lower the value of current, the **lower** is the temperature of a resistor … .
4. An **electric source produces** energy … .

7. Pair work. Put these questions to your groupmate and let him/her answer them.

1. What is a resistor used for?
2. When does the temperature of a resistor rise?
3. What element is used to change the value of voltage?
4. How are resistors rated?
5. What types of resistors do you know?
6. When does a resistor get open?
7. What does an open resistor result in?
8. What is the difference between a fixed resistor and a variable resistor?
9. How much is the current-carrying capacity of a two-ohm resistor?
10. What resistors have a variable value?

8. Solve the problem:

What is the maximum current for a resistor having a 5-watt capacity and a resistance of 20,000 ohms?

9. Pair work. Think of three similar problems of your own. Ask your groupmate to solve them.

Unit Nine [9]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

cell	[sel]	элемент
output	[ˈautput]	емкость, мощность
bulb	[bʌlb]	электрическая лампа
to light	[laɪt]	зажигать, освещать
to increase	[ɪnˈkriːs]	увеличивать(ся), возрастать
to substitute		заменять
... and so on		и так далее

2. Read the words and put down their Russian equivalents:

[ɪˈlektroud]	electrode	_____
[ɪˈlektrəlaɪt]	electrolyte	_____
[stɑːt]	start	_____
[ˈɔpəreɪt]	to operate	_____
[ˈaɪsəleɪt]	to isolate	_____

3. Translate into Russian and put down the Russian equivalents. Then translate the Russian equivalents back into English (orally).

a. current capacity _____

resistor temperature _____

voltage output _____

current value _____

b. to start supplying energy _____

to stop operating _____

to start lightening _____

to stop lightening the bulbs _____

c. to operate well _____

to operate badly _____

to increase the voltage output _____

to substitute the resistor _____

4. Read and translate into Russian. Mind *one*:

1. The element has a trouble. It operates badly. It should be substituted by a new *one*.
2. The element with a trouble was substituted with a new *one* and the cell started operating.

Electric Cells

An electric cell is used to produce and supply electric energy. It consists of an electrolyte and two electrodes. Electrodes are used as terminals, they connect the cell to the circuit – current passes through the terminals and the bulb lights.

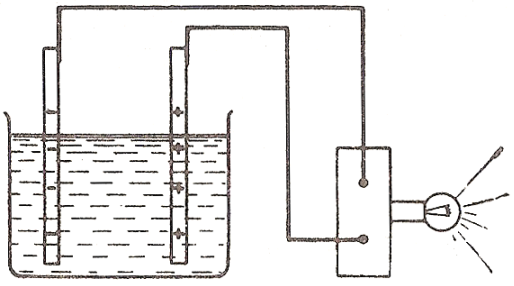


Fig 5.

Cells can be connected in series, in parallel and in series-parallel. In order to increase the current capacity cells should be connected in parallel. In order to increase the voltage output cells should be connected in series. In case a battery has a large current capacity and a large voltage output, its cells are connected in series-parallel.

When cells are connected in series the positive terminal of one cell is connected to the negative terminal of the second cell, the positive terminal of the second cell – to the negative terminal of the third ... and so on.

When cells are connected in parallel their negative terminals are connected together and their positive terminals are also connected.

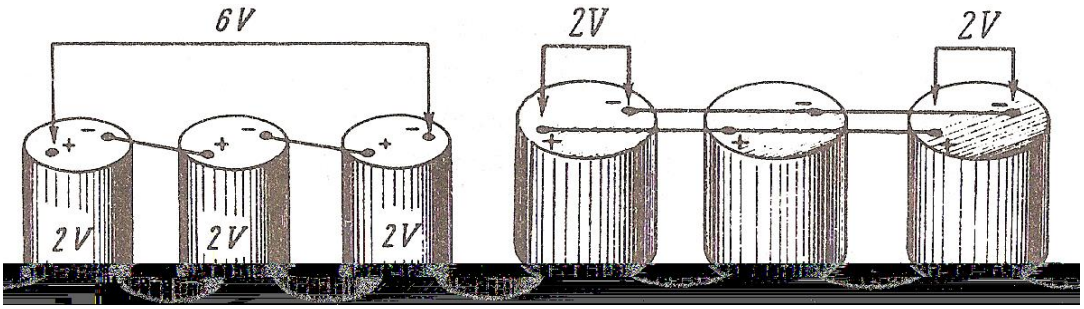


Fig. 6 *Fig. 7*

In case a cell has a trouble it stops operating or operates badly. This cell should be substituted by another one.

5. Complete the sentences using the correct variant:

1. A cell is used
   a) to increase the voltage output.
   b) to reduce the current capacity.
   c) to supply electric energy.

2. The terminals of a cell are used
   a) to conduct current.
   b) to increase voltage.
   c) to connect the battery to a circuit.

3. When cells are connected in series
   a) all the positive terminals are connected together.
   b) all the negative terminals are connected together.
   c) the positive terminal of one cell is connected to the negative terminal of the second.

4. Cells are connected in series in order	a) to increase the current capacity. b) to increase the voltage output.
5. In order to increase the current capacity	a) cells are connected in series, b) cells are connected in parallel.

6. Answer the following questions:

1. What is a cell used for?
2. What does a cell consist of?
3. What is the function of the terminals?
4. In what way are cells connected in order to increase the voltage output?
5. In what way are cells connected in order to increase the current capacity?
6. In what way are the terminals of series cells connected?
7. In what case does a cell stop operating?
8. What should be done in case it stops operating?

7. Solve these problems:

1. Suppose that you have four electric cells. The current capacity of each cell equals l.5 amp, the voltage output equals 2 V.

a) Connect the cells in series. In what way should it be done?

b) Connect the battery to a circuit whose resistance value equals 15 ohms. What is the value of current in the circuit?

2. Suppose that you have three cells of the same value.

a) Connect them in parallel. In what way should it be done?

b) Connect the second battery to the same circuit: what will it result in?

Suppose that one of the cells stops operating. What should be done in this case?

Unit Ten [10]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

capacitor	[kəˈpæsɪtə]	конденсатор
insulator	[ˈɪnsjuleɪtə]	изолятор
frequency	[ˈfriːkwənsi]	частота
distance	[ˈdɪstəns]	расстояние
advantage	[ədˈvɑːntɪdʒ]	преимущество
disadvantage		недостаток
plate		анод (лампы)
part	[pɑːt]	часть
to apply	[əˈplaɪ]	прилагать, применять
to move	[muːv]	двигать(ся)
to prevent		предотвращать
reason		причина
for this reason		по этой причине
besides		кроме того
provided that		при условии что

2. Translate into Russian and write down the Russian equivalents. Then translate the Russian variants back into English (orally).

a. paper insulators _____

air insulators _____

electrolyte capacitors _____

advantages of electrolyte capacitors _____

disadvantages of air insulators _____

b. cells under test _____

capacitors in common use nowadays _____

radio sets under test _____

PC in common use nowadays _____

c. a radioman _____

radio work _____

radio parts _____

telephone and radio work _____

3. Translate into Russian. Mind *provided that*.

1. A circuit operates well provided that it does not have any trouble.
2. The bulb lights provided that the circuit is connected to the cell.
3. A cell supplies energy provided that its electrodes are of different materials.

Capacitors

A capacitor is one of the main elements of a circuit. It is used to store electric energy. A capacitor stores electric energy provided that a voltage source is applied to it.

The main parts of a capacitor are metal plates and insulators. The function of insulators is to isolate the metal plates and in this way to prevent a short.

In the diagram one can see two common types of capacitors in use nowadays: a fixed capacitor and a variable one. The plates of a fixed capacitor cannot be

moved; for this reason its capacity does not change. The plates of a variable capacitor move; its capacity changes. The greater the distance between the plates, the less is the capacity of a capacitor. Variable capacitors are commonly used by radiomen; their function is to vary the frequency in the circuit. Fixed capacitors are used in telephone and radio work.

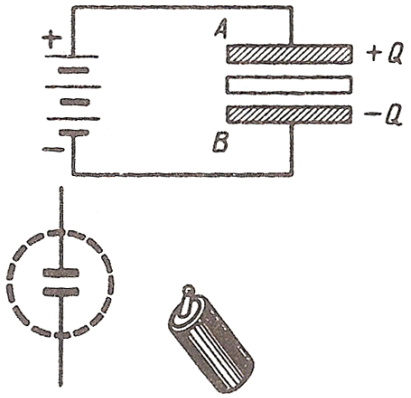


Fig. 8

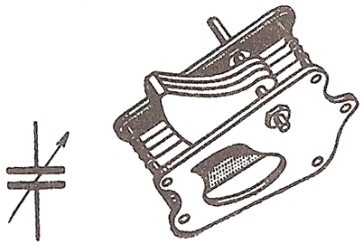


Fig. 9

Fixed capacitors have insulators produced of paper, ceramics and other materials; variable capacitors have air insulators. Paper capacitors are commonly used in radio and electronics; their advantage is their high capacity: it may be higher than 1,000 picofarad.

Besides, electrolyte capacitors are highly in use. They also have a very high capacity: it varies from 0.5 to 2,000 microfarad. Their disadvantage is that they change their capacity when the temperature changes. They can operate without a change only at temperatures not lower than -40° C.

Common troubles in capacitors are an open and a short. A capacitor stops operating and does not store energy in case it has a trouble. A capacitor with a trouble should be substituted by a new one.

4. Complete these sentences using the correct variant:

1. A capacitor is used
   a) to supply voltage.
   b) to increase the voltage output.
   c) to store energy.

2. The main parts of a capacitor are	a) insulators only. b) metal plates only. c) metal plates and insulators between them.
3. The function of insulators is	a) to store energy. b) to isolate the metal plates. c) to prevent a short between the metal plates.
4. The capacity of a capacitor depends on	a) the size of the plates. b) the distance between the plates. c) the material of the insulators.
5. The capacity of a fixed capacitor	a) is constant. b) is varied.
6. The plates of a variable capacitor	a) can be moved. b) cannot be moved.
7. In order to charge a capacitor a voltage source is applied	a) to the metal plates. b) to the insulators.
8. The greater the distance between the plates,	a) the greater is the capacity of a capacitor. b) the less is the capacity.
10. Electrolyte capacitors have	a) a very low capacity. b) a very high capacity.

11. In case a capacitor has a trouble	a) it operates. b) it stops operating.

5. Complete these sentences using *while*. Follow the model on page 13:

1. The plates of a **fixed** capacitor **cannot** be moved to vary the capacity ... .
2. The capacity of a **variable** capacitor is **varied** … .
3. **Electrolyte** capacitors **change** their capacity when the temperature changes … .
4. The **less** the distance between the plates, the **greater** is the capacity … .
5. When a capacitor has **no** trouble it **stores** energy … .

6. Pair work. Put these questions to your groupmate and ask him/her to answer them.

1. What is a capacitor used for?
2. What are the main parts of a capacitor?
3. What is the function of insulators?
4. What does the capacity of a capacitor depend on?
5. What is the difference between a fixed capacitor and a variable one?
6. What should be done in order to change a capacitor?
7. What is the relation between the value of capacity and the distance of plates?
8. What type of insulators have variable capacitors?
9. What should be done in case a capacitor has a trouble?

7. Solve these problems:

Draw a diagram of a circuit consisting of two resistors and two capacitors connected in parallel. A battery of four cells is applied to the circuit. Two ammeters are used: one is connected to the main line, the other – to a parallel branch. What is the function of each element? In what way can one increase the value of resistance in the circuit?

Suppose one of the branches stops operating. What does it result from?

Unit Eleven [11]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

cheap		дешевый
ˈcopper		медь
decrease	[ˈdɪkriːs]	уменьшение
load		нагрузка
make smb (smth) do smth		заставить кого-л. (что-л.) делать что-л.
thus		таким образом, так
difficulty		трудность
ˈrubber		резина
since		так как
to decrease	[dɪˈkriːs]	уменьшать
increase	[ˈɪnkriːs]	увеличение

2. Read the words and put down their Russian equivalents:

[ˈdaɪəgræm]	diagram	_____
[ˌkouɪˈfɪʃənt]	coefficient	_____
[ˈfʌŋkʃən]	function	_____
[trænsˈfɔːmə]	transformer	_____
[trænsˈfəː]	to transfer	_____

3. Form adverbs. Follow the model.

Model: wide – wide**ly**

cheap – _____ positive – _____

high – _____ negative – _____

4. Put down the Russian for:

load resistance _____

wire conductors _____

silver wire conductors _____

temperature ˈdecrease _____

temperature ˈincrease _____

5. Translate into Russian. Mind *since*.

1. Copper conductors are widely used *since* they are much cheaper than silver ones.
2. A minimum voltage drop is produced in copper wire conductors *since* they have a low resistance.
3. A bulb connected to an open circuit does not light *since* an open circuit has no current.

Conductors and Insulators

Conductors are materials having a low resistance so that current easily passes through them. The lower the resistance of the material, the more current can pass through it.

The most common conductors are metals. Silver and copper are the best of them. The advantage of copper is that it is much cheaper than silver. Thus copper

is widely used to produce wire conductors. One of the common functions of wire conductors is to connect a voltage source to a load resistance. Since copper wire conductors have a very low resistance a minimum voltage drop is produced in them. Thus, all of the applied voltage can produce current in the load resistance.

It should be taken into consideration that most materials change the value of resistance when their temperature changes.

Metals increase their resistance when the temperature increases while carbon decreases its resistance when the temperature increases. Thus metals have a positive temperature coefficient of resistance while carbon has a negative temperature coefficient. The smaller is the temperature coefficient or the less the change of resistance with the change of temperature, the more perfect is the resistance material.

Materials having a very high resistance are called **insulators**. Current passes through insulators with great difficulty.

The most common insulators are air, paper, rubber, plastics.

Any insulator can conduct current when a high enough voltage is applied to it. Currents of great value must be applied to insulators in order to make them conduct. The higher the resistance of an insulator, the greater the applied voltage must be.

When an insulator is connected to a voltage source, it stores electric charge and a potential is produced on the insulator. Thus, insulators have the two main functions:

1. to isolate conducting wires and thus to prevent a short between them and
2. to store electric charge when a voltage source is applied.

6. Find answers to these questions in the text above:

1. What materials are called conductors?
2. What is the advantage of copper compared with silver?
3. What is the most common function of wire conductors?
4. Why is a minimum voltage drop produced in copper conductors?

5. What is the relation between the value of resistance and the temperature in carbon?
6. What materials are called insulators?
7. What are the most common insulators?
8. What are the two main functions of insulators?

7. Complete the sentences using the correct variant:

1. Insulators are materials having	a) low resistance. b) high resistance.
2. Current passes through conductors	a) easily. b) with great difficulty.
3. Copper and silver are	a) common conductors. b) common insulators.
4. Air, paper and plastics are	a) common insulators. b) common conductors.
5. In case a high voltage is applied to an insulator	a) it does not conduct current. b) it conducts current.
6. Insulators are used	a) to store electric charge. b) to reduce voltage. c) to prevent a short between conducting wires.
7. Metals increase their resistance	a) when the temperature decreases. b) when the temperature increases.

8. Carbon decreases its resistance	a) when the temperature increases. b) when the temperature decreases.
9. Metals have	a) a positive temperature coefficient of resistance. b) a negative temperature coefficient of resistance.

8. Complete the sentences using *while*. Follow the model on page 13.

1. **Conductors** have a **low** resistance … .
2. Current passes through **insulators with great difficulty** … .
3. **Metals** are common **conductors** … .
4. To make **insulators** conduct, currents of **great** value must be applied … .
3. **Carbon decreases** its resistance when the temperature increases … .
6. **Metals** have a **positive** temperature coefficient of resistance … .

9. Pair work. Put these questions to your groupmate, and ask him/her to answer them:

1. What is the difference between conductors and insulators?
2. How does current pass through insulators?
3. What materials are commonly used to produce insulators?
4. What materials are commonly used to produce conductors?
5. In what case do insulators conduct current?
6. How does resistance change when the temperature decreases?

Unit Twelve [12]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

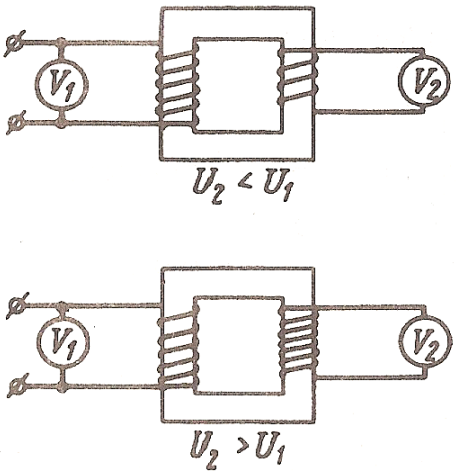
core		сердечник
winding	[ˈwaɪndɪŋ]	обмотка
turn		виток
to step up		повышать
to step down		понижать
frequency	[ˈfriːkwənsɪ]	частота
due to	[ˈdjuː tə]	благодаря, из-за

2. Put down the Russian for:

iron core	_____	primary winding	_____
closed core	_____	secondary winding	_____
input voltage	_____	step-up transformer	_____
output voltage	_____	step-down transformer	_____

Transformers

A transformer is used to transfer energy. Due to the transformer electric power may be transferred at a high voltage and reduced at the point where it must be used to any value. Besides, a transformer is used to change the voltage and current value in a circuit.



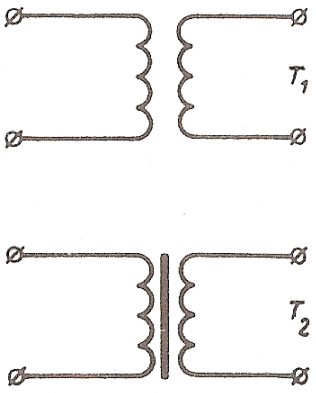


Fig. 10 *Fig. 11*

A two-winding transformer consists of a closed core and two coils (windings). The primary winding is connected to the voltage source. It receives energy. The secondary winding is connected to the load resistance and supplies energy to the load.

The value of voltage across the secondary terminal depends on the number of turns in it. In case it is equal to the number of turns in the primary winding the voltage in the secondary winding is the same as in the primary.

In case the secondary has more turns than the primary the output voltage is greater than the input voltage. The voltage in the secondary is greater than the voltage in the primary by as many times as the number of turns in the secondary is greater than the number of turns in the primary. A transformer of this type increases or steps up the voltage and is called a step-up transformer. In case the secondary has fewer turns than the primary the output voltage is lower than the input. Such a transformer decreases or steps down the voltage, it is called a step-down transformer.

Compare T_1 and T_2 in the diagram. T_1 has an iron core. For this reason it is used for low-frequency currents. T_2 has an air core and is used for high frequencies.

Common troubles in transformers are an open in the winding, a short between the primary and the secondary, and a short between turns. In case a transformer has a trouble it stops operating or operates badly. A transformer with a trouble should be substituted.

3. Complete the sentences using the correct variant:

1. A transformer is used	a) to store charge. b) to prevent the change of energy. c) to transfer energy. d) to change the voltage and current value in a circuit.
2. Electric power is transferred at a high voltage and reduced to any value	a) due to resistors. b) due to capacitors. c) due to transformers.
3. A transformer consists of	a) cores only. b) the primary and the secondary windings. c) a core and the primary and the secondary windings.
4. The function of the primary is	a) to prevent the change of voltage. b) to supply energy. c) to receive energy.
5. The function of the secondary is	a) to receive energy. b) to supply energy. c) to transfer energy. d) to decrease the value of charge.
7. A step-down transformer is used	a) to step down the secondary voltage. b) to step down the primary voltage.

8. A transformer with an iron core	a) is used for high-frequency currents. b) is used for low-frequency currents.
9. A transformer with an air core is used	a) for high-frequency currents and for low-frequency currents. b) for high-frequency currents only.
10. In a step-up transformer	a) the number of turns of the secondary winding is greater than the number of turns of the primary. b) the number of turns of the primary winding is greater than the number of turns of the secondary.
11. A transformer should be substituted	a) in case it has an open in the winding. b) in case it has a short between the primary and the secondary. c) in case it has a short between turns.

4. Complete these sentences using *while*. Follow the model on page 13.

1. **The secondary winding** of a transformer is connected to **the load resistance** … .
2. The **primary** winding **receives** energy … .
3. **A step-down** transformer **decreases** the primary voltage … .
4. An **air** core transformer is used for **high**-frequency currents … .
5. In a **step-up** transformer the number of turns of the **secondary** winding … . is greater than the number of turns of the **primary** winding … .

5. **Pair work. Put these questions to your groupmate and ask him/her to answer them.**

1. What is a transformer used for?
2. What does a transformer consist of?
3. What is the function of the primary winding?
4. What is the function of the secondary winding?
5. What type of transformer is called a step-up transformer?
6. What type of transformer is used for high-frequency currents?
7. What type of transformer is called a step-down transformer?
8. What type of transformer is used for low-frequency currents?
9. What is the relation between the number of turns in the windings and the value of current?
10. What are common troubles in a transformer?
11. What should be done in case a transformer has a trouble?

6. Read about current transformers. Answer the questions that follow.

Current Transformers

Current transformers are used for operating ammeters, wattmeters, and other measuring devices. They produce in the meters a current lower than the measured current but proportional to it.

Current transformers also insulate the instrument from the circuit which is being measured. This is necessary for high voltage circuits.

1. What is a current transformer used for?

2. What type of current does it produce?

Unit Thirteen [13]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

alternating	[ˌɔːltəˈneɪtɪŋ]	переменный
diˈrect		прямой
diˈrection		направление
flow	[flou]	течение
necessary	[ˈnesɪsərɪ]	необходимый
to con'sider		рассматривать
use	[juːs]	использование

2. Read the words and write down their Russian equivalents:

[ˈsaɪkl]	cycle	_____
[taɪp]	type	_____
[pə ˈsekənd]	per second	_____

3. Put down the Russian for:

one time	_____	direct voltage source	_____
five times	_____	alternating voltage source	_____
sixty times	_____	direction of flow	_____

Types of Current

Current is a flow of electricity through a circuit. Let us consider two main types of current: direct and alternating. A direct current (d.c.) flows through a conducting circuit in one direction only. It flows provided a direct voltage source is applied to the circuit.

An alternating current (a.c.) is a current that changes its direction of flow through a circuit. It flows provided an alternating voltage source is applied to the circuit. Alternating current flows in cycles. The number of cycles per second is called the frequency of the current. In a 60-cycle alternating current circuit the current flows in one direction 60 times and in the other direction 60 times per second.

It is easy to transform a.c. power from one voltage to another by a transformer. Transformers are also used to step down the voltage at the receiving point of the line to the low values that are necessary for use.

When necessary a.c. can be changed into d.c. but this is seldom necessary.

4. Complete the sentences using the correct variant:

1. D.c. is a current that	a) changes its direction of flow. b) flows in one direction.
2. A.c. flows provided	a) a direct voltage source is applied. b) an alternating voltage source is applied.
3. In an alternating current circuit	a) current flows in one direction 60 times per second. b) current flows in one direction 60 times and in the other direction 60 times per second.

4. A.c.	a) can be changed into d.c. b) cannot be changed into d.c.

5. Complete these sentences using *while*. Follow the model on page 13.

1. An **alternating** current **changes** its direction of flow … .
2. A **direct** current flows provided a **direct** voltage source is applied … .

6. Answer the following questions:

1. What is current?
2. What types of current do you know?
3. When does a direct current flow?
4. What type of current is called an alternating current?
5. What type of current is called a direct current?
6. What is called the frequency of current?
7. What device is used to transform a.c. power from one voltage to another?
8. Is it often necessary to change a.c. into d.c.?

7. Read about frequency, answer the question that follows.

Frequency

The number of cycles per second is the frequency of an alternating current. There are two frequencies: the standard for Europe is 50 cycles per second while the standard for the USA is 60 cycles per second. A standard frequency has a great advantage since different systems can be interconnected.

What is the advantage of a standard frequency?

Unit Fourteen [14]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

inˈductance		индуктивность
coil	[kɔıl]	катушка
size	[saız]	размер
unit	[ˈjuːnıt]	единица
fast	[fɑːst]	быстрый
mutual	[ˈmjuːtʃuəl]	взаимный
to induce	[ınˈdjuːs]	индуктировать
to provide	[prəˈvaıd]	обеспечить
to touch	[tʌtʃ]	касаться
to bring		приносить, подносить
that is		то есть
definite	[ˈdefınıt]	определенный

2. Translate into Russian and put down the Russian equivalents. Then translate them back into English (orally).

a. definite value _____

primary coil _____

wire coil _____

mutual inductance _____

varying current _____

one ampere per second _____

b. 1. Coils of wire are called inductors.

_____

2. Two coils are brought close together.

_____

3. A source of current is applied to one of the coils.

_____

4. Mutual inductance is measured in henries.

_____

3. Which of the words are nouns and which are verbs?

resistor, resist, resistance; induce, induction, inductor, inductance;
conductor, conduct, conductance; compute, computer

Inductance and Mutual Inductance

Any conductor has some definite value of inductance. The inductance of a conductor shows how well it can provide induced voltage.

Elements of a circuit with a definite value of inductance are coils of wire called *inductors*. The inductance of a coil depends upon its size and material. The greater the number of turns of a coil, the higher is its inductance. An iron core also increases the value of inductance. Coils of this type are used for low-frequency currents while coils with an air core are used for high-frequency currents.

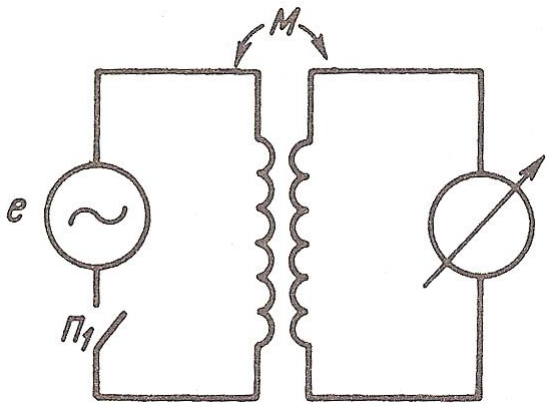


Fig. 12

Two coils A and B are brought close together and a source of varying current is applied to coil A. If a measuring device is

connected across the terminals of coil B it will be found that a voltage is induced in this coil though the two coils do not touch. The secondary voltage, that is the voltage in coil B, is called induced voltage and energy from one coil to the other transfers by induction. The coil across which the current is applied is called *the primary*; that in which voltage is induced is called *the secondary*. The primary and the secondary coils have **mutual inductance**. Mutual inductance is measured in the same units as inductance, that is in henries.

Thus, when a rate of change of one ampere per second in the primary coil will produce one volt in the secondary coil, the two coils have one henry of mutual inductance.

It should be taken into consideration that induction by a varying current results from the change **in current** not in the current **value**. The faster the current changes, the higher the induced voltage.

4. Complete the sentences using the correct variant:

1. Any conductor has	a) some definite value of resistance. b) some definite value of inductance.
2. Any conductor can provide	a) electric power. b) induced voltage.
3. Elements with a definite value of inductance	a) are called inductors. b) are called coils. c) are called sources.
4. The inductance of a coil depends upon	a) its size. b) its core. c) its material. d) its number of turns.

5. An iron core	a) increases the value of inductance. b) decreases the value of inductance.
6. The value of mutual inductance is measured	a) in watts. b) in henries.
7. Induction by a varying current	a) results from the change in current. b) results from the change in the current value.
8. The faster the current changes,	a) the lower is the induced voltage. b) the higher is the induced voltage.

5. Complete these sentences using *while*. Follow the model on page 13.

1. An **air** core **decreases** the value of inductance … .
2. An **iron** core is used for **low**-frequency currents … .
3. The coil in which voltage is **induced** is called the **secondary** … .

6. Answer the following questions:

1. What value of inductance do conductors have?
2. What is the function of inductors?
3. What are elements with a definite value of inductance called?
4. What does the inductance of a coil depend upon?
5. How does the inductance of a coil depend upon the material of its core?
6. In what units is the value of mutual inductance measured?
7. What does induction by a varying current result from?
8. What is the relation between the current changes and the value of induced voltage?
9. What is the unit of resistance?
10. What is the unit of potential difference?

11. For what type of current is an air core used?
12. What is the relation between the number of turns of a coil and its inductance value?

7. Pair work. Tell your groupmate about mutual inductance. Let him/her put the questions of Exercise 6 to you and answer them.

Unit Fifteen [15]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

device	[dɪˈvaɪs]	прибор
field	[fiːld]	поле
loose	[luːs]	свободный, нежесткий
tight	[taɪt]	плотный
self-inductance		самоиндукция
to couple	[ˈkʌpl]	соединять, сцеплять
to separate	[ˈsepəreɪt]	отделять
to transfer	[trænsˈfəː]	переносить
therefore	[ˈðɛəfɔː]	поэтому

2. Put down the words with the opposite meaning and translate them into Russian.

Model: inconstant – constant

incompetent – _____ inactive – _____

incorrect – _____ inconsistent – _____

indirect – _____ unable – _____

indefinite – _____ inability – _____

3. Put down Russian equivalents of these word combinations. Then translate them back into English.

loose coupling – _____

tight coupling – _____

transformer coupling – _____

electromagnetic fields – _____

Coupling

When circuits are indirect-inductively coupled energy is transferred from one circuit to another using electromagnetic field of the inductance through which a varying current is flowing. The coupling device is a transformer. It is not in series with the elements of the circuit, therefore the coupling is indirect. The transformer consists of two windings: the primary and the secondary. The primary circuit is connected to the voltage source, the secondary – to the load circuit.

The coupling may be tight and loose. In case the coils of the coupling element are close together, the coupling is tight. In case the coils are separated the coupling is loose. In the loose coupling the mutual inductance is small compared with the self-inductance.

4. Complete the sentences using the correct variant:

1. The circuit connected to the voltage source is called
   a) the secondary circuit.
   b) the primary circuit.

2. The circuit receiving its energy through a coupling is	a) the primary circuit. b) the secondary circuit.
3. The function of a coupling element is	a) to separate the circuits. b) to transfer energy. c) to prevent a short between the circuits.
4. When the coupling is tight	a) the coils are separated. b) the coils are close together.
5. When the coils are close together	a) the coupling is loose. b) the coupling is tight.
6. The circuits are indirectly coupled when	a) the coupling element is common to both circuits and is in series with their other elements. b) the coupling element is not common to the circuits and is not in series with their other elements.

5. Complete these sentences using *while*. Follow the model on page 13.

1. The circuit **receiving** energy is the secondary circuit … .
2. The coupling is **loose** when the coils are **separated** … .
3. When the coupling element is **not common** to the circuits and not in series with their elements, the circuits are indirectly coupled … .

6. Answer the following questions:

1. What type of circuit is called the primary?
2. What type of circuit is called the secondary?
3. What is the function of a coupling element?
4. What type of coupling is called loose?
5. What type of coupling is called tight?
6. In what case are the circuits directly coupled?
7. In what case are the circuits indirectly coupled?
8. What is the difference between a tight and loose coupling?
9. In what case should a coupling element be substituted?

7. Pair work. Draw a scheme of 1) a loose coupling, 2) a tight coupling. Describe the schemes to your groupmate.

Unit Sixteen [16]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

filter	[ˈfɪltə]	фильтр
bypass	[ˈbaɪpɑːs]	шунт
choke	[tʃouk]	дроссель
high-pass	[ˈhaɪpɑːs]	высокопроходной
low-pass	[louˈpɑːs]	низкопроходной
to oppose	[əˈpouz]	оказывать сопротивление
on the other hand		с другой стороны
choke coil		дроссельная катушка

bypass coil	шунтовая катушка
bypass condenser	шунтирующий конденсатор
high-pass filter	фильтр верхних частот
low-pass filter	фильтр низких частот
opposing coils	противодействующие витки
opposed current	противоток

Filters

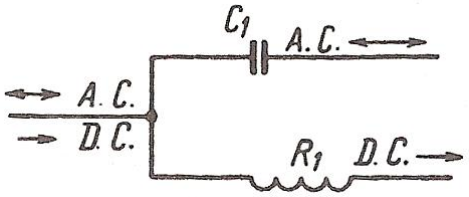


Fig. 13

This filter is used to separate direct current from alternating current. It consists of a capacitor and a choke coil. Direct current cannot flow through the capacitor since its insulators oppose the flow of direct current. Therefore, it flows through the choke coil. Its windings easily pass direct current through them. Alternating current, on the other hand, passes through the capacitor, since it cannot easily pass through the choke coil. In this way the direct and the alternating currents are separated.

I. **A high-pass** filter is used to pass high frequencies and to prevent the flow of low frequencies. It consists of a condenser and an inductance coil. The condenser passes currents of high frequencies and opposes the flow of low frequency currents. Low frequencies must be returned to the source and the inductance coil is used for a bypass.

II. **A low-pass filter** is used to pass low frequencies and to prevent the flow of high frequencies. It consists of an inductance coil and a condenser. The inductance coil passes low frequencies and opposes the flow of high frequencies. To return the high frequencies back to the source, a condenser is used for a bypass. Its capacity opposes the flow of low frequencies through it.

2. Complete the sentences using the correct variant

1. A filter is used in order	a) to separate d.c. from a.c. b) to transfer energy from the primary to the secondary. c) to separate low frequencies from high frequencies.
2. A filter consists of	a) a resistor and a transformer. b) a choke coil and a capacitor. c) an inductance coil and a capacitor.
3. Direct current easily passes	a) through a choke coil. b) through a capacitor.
4. Alternating current easily passes	a) through a capacitor. b) through a choke coil.
5. A low-pass filter is used	a) to pass high frequencies and to prevent the flow of low frequencies. b) to pass low frequencies and to prevent the flow of high frequencies.
6. In a low-pass filter	a) a capacitor is used as a bypass. b) an inductance coil is used as a bypass.
7. In a high-pass filter	a) an inductance coil is used as a bypass. b) a capacitor is used as a bypass.

3. Complete these sentences using *on the other hand*. Follow the model.

Model: Direct current passes through the choke coil of a filter; alternating current, *on the other hand*, passes through the capacitor.

1. A **low**-pass filter is used to pass **low** frequencies … .
2. In a **high**-pass filter an **inductance** coil is used as a bypass … .
3. A **high**-pass filter is used to prevent the **flow** of low frequencies … .
4. **Alternating** current passes through a **capacitor** … .

4. Answer the following questions:

1. What is a filter used for?
2. What does a filter consist of?
3. What is the function of a low-pass filter?
4. What is the function of a high-pass filter?
5. What is the difference between a low-pass filter and a high-pass filter?
6. What elements are used as a bypass?
7. What is the function of a choke coil?
8. What is the function of an inductance coil?

5. Draw schemes of a choke input filter and a capacity input filter. Describe the schemes and the function of the filters.

6. Read the text and answer the question that follows it.

Choke Input Filter and Capacity Input Filter

rectify	[ˈrektɪfaɪ]	выпрямить
eliminate	[ɪˈlɪmɪneɪt]	устранить

A choke input filter and a capacity input filter are used in rectifiers. Filters of this kind are connected to rectifiers in order to eliminate pulsations produced in rectified current.

1) **Choke input filter** is a low-pass filter. A choke coil is in series with the rectifier output.

2) **Capacity input filter** is a high-pass filter. A capacitor is connected directly across or in parallel with the rectifier output.

What is the difference between a choke input filter and a capacity input filter?

Unit Seventeen [17]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

tube	[tjuːb]	электронная лампа
bulb	[bʌlb]	баллон
grid		сетка
screen		экран

to contain	[kənˈteɪn]	вмещать
to collect	[kəˈlekt]	собирать
to emit	[ɪˈmɪt]	излучать
to suppress	[səˈpres]	глушить, подавлять
control circuit		контрольная цепь
control grid		управляющая сетка
screen grid		экранирующая сетка
screen grid tube		экранированная лампа
suppressor grid		защитная сетка
counter flow		противоток
oscillatory circuit		колебательный контур

2. Form nouns adding *-er* and translate them.

Model: to heat – heater

to emit – _____

to control – _____

to suppress – _____

3. Distribute the words below into the three columns.

Model:	**action**	**process**	**doer**
	emit	emission	emitter

collector, heat, collection, suppress, collect, suppressor, suppression, contain, reaction, container, react, heater, reactor, computer, compute, oscillate, oscillating, oscillator

4. Read the words and put down their Russian equivalents. Then translate them back into English.

diode	[daɪəd]	_____	cathode	[ˈkæθoud]	_____
triode	[traɪəd]	_____	metal	[ˈmetl]	_____
tetrode	[tetˈroud]	_____	glass	[glɑːs]	_____
pentode	[penˈtoud]	_____	oscillator	[ˈɔsɪleɪtə]	_____

Electron Tubes

Let us consider electron tubes. Among the electron tubes in use nowadays there are a diode, a triode, a tetrode and a pentode. The main parts of electron tubes are electrodes. Electrodes are placed into a glass or metal bulb.

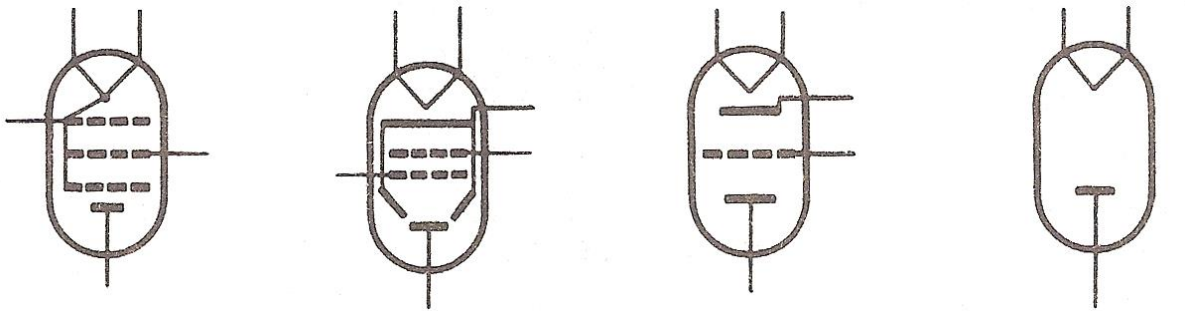


Fig. 14

A diode contains the cathode and the plate. When a diode operates the cathode emits electrons, the plate collects them.

A triode contains the cathode, the plate and the control grid. When the tube operates the cathode emits electrons, the plate collects them and the grid controls the flow of electrons. Therefore, the grid is called a *control grid*.

A tetrode contains the cathode, the plate, the control grid and the screen grid.

When a tube operates it may oscillate. The function of the screen grid is to eliminate oscillations. Therefore it is called a *screen grid*.

A pentode contains two electrodes and three grids: the control grid, the screen grid and the suppressor grid. When a pentode operates the suppressor grid eliminates the secondary emission.

Common troubles in tubes are an open heater and low emission. These troubles result from constant use or from some other reason. In case a tube has a trouble it stops operating or operates badly. A tube with a trouble should be replaced by another one.

5. Complete the sentences using the correct variant:

1. A pentode contains	a) the cathode, the plate, two screen grids and the suppressor grid. b) the cathode, the plate, the control grids, the screen grid and the suppressor grid.
2. A tetrode contains	a) the cathode, the plate, the suppressor grid and the screen grid. b) the cathode, the plate, the screen grid and the control grid.
3. A triode contains	a) the cathode, the plate and the screen grid. b) the cathode, the plate and the control grid.
4. The function of the cathode is	a) to collect electrons. b) to eliminate the secondary emission. c) to emit electrons.
5. The function of the plate is	a) to eliminate oscillations. b) to emit electrons. c) to collect electrons.

6. The function of the control grid is	a) to emit electrons. b) to control the electron flow. c) to eliminate secondary emission.
7. The function of the screen grid is	a) to collect electrons. b) to reduce the capacity. c) to eliminate oscillations.
8. The function of the suppressor grid is	a) to control the electron flow. b) to eliminate secondary emission. c) to eliminate oscillations.
9. Constant use of a tube results in	a) high emission. b) low emission. c) an open heater.

6. Answer the following questions:

1. What types of electron tubes are used nowadays?
2. How many electrodes does a diode (a triode, a tetrode, a pentode) contain?
3. What is the function of the cathode (the plate, the control grid, the screen grid, the suppressor grid)?
4. What does the constant use of a tube result in?
5. What does low emission result from?
6. When must a tube be replaced?

7. Pair work. Think of five questions covering the article given below. Put these questions to your groupmate and ask him/her to answer them.

Pentode

When in an operating tube the screen-grid voltage is high, secondary emission does not return to the plate and passes to the screen grid. This results in a counter flow of electrons. To eliminate this counter flow, a third grid was placed between the plate and the screen grid and connected to the cathode. This grid is called a suppressor grid. Since the suppressor grid has a negative potential it returns the secondary emission back to the plate and thus eliminates it in the tube. The tube containing electrodes – the cathode, the plate, the control grid, the screen grid and the suppressor grid – is called a pentode. The cathode emits electrons, the plate collects them, the control grid controls the flow of electrons, the screen grid helps the plate to collect electrons and reduces the capacity between the control grid and the plate, the suppressor grid eliminates the secondary emission.

Unit Eighteen [18]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

half	[hɑːf]	половина
to rectify	[ˈrektɪfaɪ]	выпрямлять
to amplify	[ˈæmplɪfaɪ]	усиливать
to convert	[kənˈvəːt]	преобразовывать, обращать
by means of		посредством, с помощью
that is why		вот почему

to put into operation	приводить в действие, запускать
half	половина

2. Read the words and put down their Russian equivalents:

pulse	[pʌls]	_____	electron	[ɪˈlektrɔn]	_____
cycle	[ˈsaɪkl]	_____	radio	[ˈreɪdɪou]	_____

3. Distribute the words below into the three columns:

action	process	doer

[juːs] use, [juːz] use, rectifier, rectification, amplifier, amplify, convert, user, converter, application, apply, pulse, pulsation, operate, operator

4. Translate these word combinations into Russian:

a. half-wave _____

half-cycle _____

half-wave rectifier _____

positive half-cycles _____

electron tube application _____

negative half-cycles _____

by means of a filter _____

b. by means of the suppressor grid _____

tubes used as rectifiers _____

tubes used as oscillators _____

Use of Electron Tubes

Let us consider some cases of electron tube application. Tubes are common elements of radio and electronic devices. Tubes are used

as **rectifiers** – to convert a.c. into d.c.,

as **oscillators** – to produce oscillating waves and

as **amplifiers** – to amplify the input voltage and current.

Half-Wave Rectifier

Alternating current is converted into direct current by means of a rectifier.

A half-wave rectifier consists of a diode in series with a resistance. In order to put a rectifier into operation, a source of a.c. should be applied to it. When an a.c. source is applied the diode begins to conduct. The rectifier passes currents during positive half-cycles of the applied voltage. That is why it is called a half-wave rectifier. When the device operates d.c. flows in the same direction. It is a pulsating current. Since pulsations should be eliminated, a filter is applied. Pulsations are eliminated by means of this filter.

5. Complete the sentences using the correct variant:

1. Electron tubes are used	a) as amplifiers only. b) as oscillators only. c) as rectifiers, amplifiers and oscillators.
2. A.c. is converted into d.c.	a) by means of a rectifier. b) by means of an amplifier.
4. In order to put a rectifier into operation	a) d.c. is applied. b) a.c. is applied.

5. A half-wave rectifier passes currents	a) during positive and negative half-cycles. b) during positive half-cycles of the applied voltage.
6. Rectified current is	a) direct oscillating current. b) direct pulsating current.
7. Pulsations are eliminated	a) by means of a choke coil. b) by means of a filter.

6. Answer the following questions:

1. How are electron tubes used?
2. What type of device is called a rectifier?
3. By what means is alternating current rectified into direct current?
4. What elements does a half-wave rectifier consist of?
5. What current should be applied to put a half-wave rectifier into operation?
6. When does a half-wave rectifier pass current?
7. By what means are pulsations eliminated?

7. Draw a scheme of a half-wave rectifier and describe its operation.

Unit Nineteen [19]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

end		конец, конечный
tap		отвод, ответвление
filament	[ˈfɪləmənt]	нить накала
lower	[ˈlouə]	нижний
upper	[ˈʌpə]	верхний
secondary	[ˈsekəndərɪ]	вторичный
end capacity		конечная емкость
end coils		концевые витки
filament battery		батарея накала
filament current		ток накала
secondary circuit		вторичный контур
secondary resistance		дополнительное сопротивление
secondary battery		аккумуляторная батарея
frequency waves		длинные волны

2. Read the words and put down their Russian equivalents. Translate them back into English (orally).

[kəmˈpounənt]	component	_____
[ˈsentə]	centre	_____
[ˈmæksıməm]	maximum	_____

[ˈmɪnɪməm] minimum _____

[sʌm] sum _____

3. Put down the Russian for:

centre tap _____

low voltage winding _____

tube plate _____

filament winding _____

Full-wave Rectifier

In a full-wave rectifier two diodes are used. They are connected to a common load resistance. The secondary of the transformers has a centre tap to which the load is connected. Current flows through the tubes from their plates to their cathodes. When the upper end of the high-voltage winding is positive, current flows through die upper tube.

During the opposite half cycle the lower end of die high voltage winding becomes positive. The plate of the lower tube becomes positive and the plate of the upper tube – negative. Thus now the lower tube conducts current. Current flows through the filament winding to its centre tap, then through the load to the centre tap of the high-voltage winding and to the tube plate which is positive.

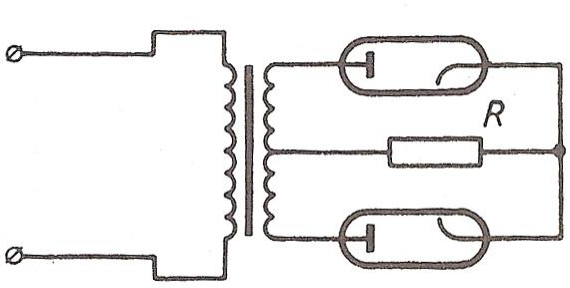


Fig. 15

4. Complete the sentences using the correct variant:

1. A full-wave rectifier contains	a) one diode. b) two diodes.
2. The load is connected to	a) the centre tap of the primary. b) the centre tap of the secondary.
3. Current flows through the tubes	a) from the plates to the cathodes. b) from the cathodes to the plates.
4. When the upper end of the high-voltage winding is positive	a) current flows through the upper tube. b) current flows through the lower tube.
5. During the negative half-cycle	a) the plate of the lower tube becomes positive. b) the plate of the lower tube becomes negative.
6. During the positive half-cycle	a) the lower tube conducts current. b) the upper tube conducts current.

5. Complete the sentences using *while*. Follow the model on page 13.

1. A **half**-wave rectifier contains **one** diode … .
2. When the upper end of the high-voltage winding is **positive**, current flows through the **upper** tube … .
3. During the **negative** half-cycle the **lower** tube conducts current … .

6. Pair work. Put these questions to your groupmate and let him/her answer them.

1. How many diodes does a full-wave rectifier contain?
2. What element is the load connected to?
3. What is the direction of current in the tubes?
4. During which cycle does the plate become negative?
5. When does the lower tube conduct current?
6. When does the upper tube conduct current?
7. What is the difference between a half-wave and a full-wave rectifier?
8. What is the difference in their construction?
9. In what way does a full-wave rectifier operate?
10. In what way does a half-wave rectifier operate?
11. What are the main parts of a half-wave rectifier?
12. What are the main parts of a full-wave rectifier?

Unit Twenty [20]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

to feed (fed)		питать
to include	[ɪnˈkluːd]	содержать, заключать (в себе)
to remain	[rɪˈmeɪn]	оставаться
to push	[puʃ]	толкать
to pull	[pul]	тянуть
push-pull		пушпул, пушпульный
push-pull amplifier		двухтактный усилитель

push-pull circuit	двухтактная схема
push-pull transformer	пушпульный трансформатор
feedback	обратная связь
feedback amplifier	регенеративный усилитель
feedback coil	катушка обратной связи
feeding transformer	силовой трансформатор

2. Put down the Russian for:

plate current supply _____

alternating current components _____

maximum grid voltage _____

transformer secondary winding _____

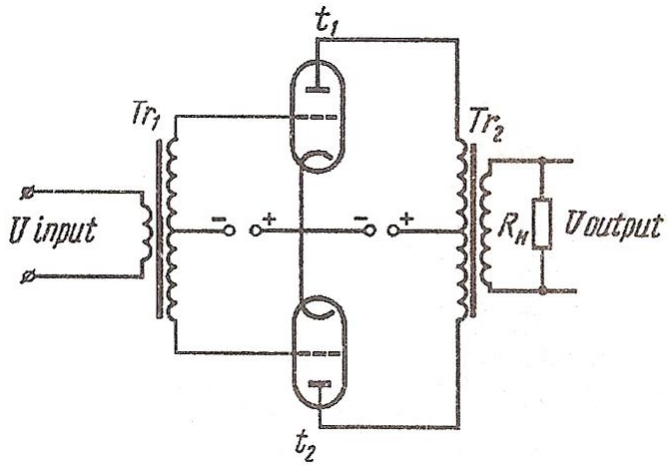


Fig. 16

Push-pull Amplifier

An amplifier is used to produce the output voltage greater than the input voltage. A push-pull amplifier includes two tubes. Their control grids are connected to the opposite ends of the input transformer secondary winding. The centre of this winding is connected to the tube cathodes. When maximum grid voltage is produced in one tube, minimum grid voltage is produced in the other tube. Thus, the sum of the plate currents remains constant.

The plate currents are fed into the opposite ends of the output transformer or a choke coil. It has its centre connected through the plate current supply to the cathodes. Thus direct current plate components are eliminated but alternating current components add in the circuit.

3. Complete these sentences, using the correct variant:

1. An amplifier is used	a) to separate a.c. from d.c. b) to change the value of the input voltage.
2. The input voltage is increased	a) by means of a rectifier. b) by means of an amplifier.
3. A push-pull amplifier includes	a) only one tube. b) two tubes.
4. When maximum grid voltage is produced in one tube	a) maximum grid voltage is produced in the other tube. b) minimum grid voltage is produced in the other tube.
5. The sum of the plate currents	a) changes. b) remains constant.
6. D.c. components	a) are eliminated. b) add in the circuit.
7. A.c. components	a) add in the circuit. b) are eliminated.

4. Complete the sentences using *while*. Follow the model on page 13:

1. **An amplifier** is used to **increase** the value of the input voltage … .
2. When **maximum** grid voltage is produced in **one** tube … .
3. **Direct** current plate components are **eliminated** … .

5. Answer the following questions:

1. What is an amplifier used for?
2. By what means is a greater output voltage produced?
3. What are the main parts of a push-pull amplifier?
4. In what way are the tubes and the transformer connected?
5. Why does die sum of the plate currents remain constant?
6. Where are the plate currents fed?
7. What type of current is amplified by a push-pull amplifier?
8. What is the difference between a rectifier and an amplifier?

6. Say a few words about an amplifier and a rectifier. What do they have in common? What is the main difference between them?

Unit Twenty-One [21]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

bias	[ˈbaɪəs]	дополнительное (смещающее) напряжение
stage		каскад, ступень
to follow	[ˈfɔlou]	следовать (за)
stage of amplification		ступень (каскад) усиления
grid bias		напряжение смещения
grid bias battery		сеточная батарея
grid plate capacitance		емкость анодной сетки

2. Put down the Russian for:

the main parts of the device _____

the following change of voltage _____

the main components of the plate voltage _____

the following stage _____

plate voltage supply _____

grid bias _____

voltage variations _____

Amplifier Stages in Series

Amplifiers in use nowadays contain several stages. Sometimes their number is very great. Let us consider an amplifier including three stages. Its circuit uses three triodes connected in series. The circuit has a resistance as the plate load. A common plate voltage supply and a common grid bias are employed. The grid of each tube is insulated from the direct current component of the plate voltage by means of a capacitor. When the amplifier operates the voltage operation of the load of one tube is applied to the grid of the next tube. The voltage variation is transferred to the grid of the following tube through a capacitor.

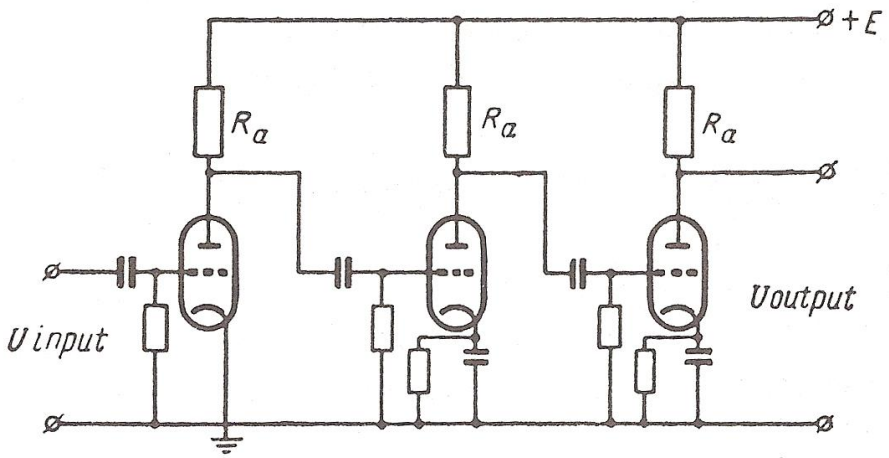


Fig. 17

A change of voltage on the first grid circuit results in an amplified plate current in the third stage.

3. Complete these sentences, using the correct variant:

1. Amplifiers in use nowadays	a) include only one stage. b) include several stages.
2. A three-stage amplifier uses	a) three triodes connected in parallel. b) three triodes connected in series.
3. The grid of each tube is insulated	a) by means of a coil. b) by means of a capacitor.
4. The voltage variation is transferred	a) through a tube. b) through a capacitor.
5. The circuit uses	a) a different grid bias. b) a common grid bias.

4. Answer the following questions:

1. How many stages do amplifiers include?
2. What are the main parts of a three-stage amplifier?
3. By what means are the grids of the tubes insulated?
4. What type of grid bias is employed?
5. In what way is the voltage variation transferred?

Unit Twenty-Two [22]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

spring		пружина
cross-section		поперечное сечение
to close	[klouz]	замыкать, закрывать
close to	[ˈklous tə]	близко к (от)
to move		двигаться), приводить в движение
to switch on		включать
to switch off		выключать
various	[ˈvɛərɪəs]	различный, разнообразный

2. Read the words and put down their Russian equivalents. Then translate them back into English (orally).

[rɪˈleɪ]	relay	_____
[ɪˌlektrouˈmægnɪt]	electromagnet	_____
[ˈɑːmətʃə]	armature	_____
[ˈkɔntækt]	contact	_____
[ˈsɪstɪm]	system	_____
[ˌɔːtəˈmætɪk]	automatic	_____
[ˈpænl]	panel	_____

3. Change the adjectives into adverbs by adding *-ly*. Put down their Russian equivalents.

Model: automatic – automatically

wide – _____

economical – _____

unprogressive – _____

unnecessary – _____

uneconomical – _____

4. Put down the Russian for:

a. to start flowing _____

to start moving _____

to start operating _____

to start powering the motor _____

_____

b. various branches of industry _____

small cross-section _____

relay's primary circuit _____

Electromagnetic Relay

Electromagnetic devices called *relays* are widely used in various branches of industry.

The main parts of a relay are an electromagnet, a spring and an armature. When a current starts flowing in the electromagnet winding, the armature moves and the spring closes the contacts. The primary circuit of a relay is its electromagnet circuit and the secondary circuit is the one closed by the contacts.

When there is no current in the relay's primary circuit, the spring pulls the armature and the contacts open.

Fig. 18 shows how a relay is used to control the work of an electric motor. The relay is placed close to the motor which is connected to its secondary circuit. The armature closes the contacts of the secondary circuit, and the motor starts operating; it will stop when the relay opens.

Without a relay, conductors with a large cross-section would have to be brought to the motor. This would be very uneconomical. The current in a relay is tens and even thousands of times smaller than that used to power the motor. Therefore, the connecting wires can have small cross-sections.

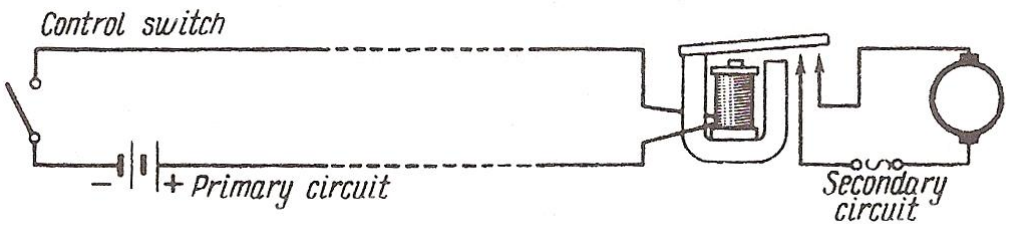


Fig. 18

In many systems the relay primary circuit operates automatically. Every evening and morning street lights are switched on and off from the main control panel by means of a great number of relays.

5. Complete the sentences using the correct variant:

1. The main parts of a relay are
   a) an electromagnet, a capacitor, and a spring.
   b) an electromagnet, an armature, and a spring.

2. When current starts flowing
   a) the spring opens the contacts.
   b) the spring closes the contacts.

3. The spring pulls the armature	a) when there is current in the primary circuit. b) when there is no current in the primary circuit.
4. The wires connecting the panel with the relay	a) have a large cross-section. b) have a small cross-section.
5. Street lights are switched on and off	a) by means of relays. b) by means of electric motors.

6. Complete these sentences using *while*. Follow the model on page 13:

1. The **primary** circuit of a relay is its **electromagnetic** circuit … .
2. When there is **no current** in the relay's **primary** circuit the contacts **open** … .
3. **Without** a relay conductors with a **large** cross-section should be used … .
4. Every **evening** street lights are switched **on** … .

7. Answer the following questions:

1. What are the main parts of a relay?
2. How is a relay put into operation?
3. When does the spring pull the armature?
4. What wires connect the panel with the relay?
5. By what means are street lights switched on and off?

8. Pair work. a) Match the questions and the answers, b) Ask the questions and let your groupmate answer them.

1. In what position does die switch have high (low) resistance?	a) Switches are used to open and close the circuits.
2. What are die functions of the switch?	b) Closed is the on-position; open is the off-position.
3. In what position is the switch open? Closed?	c) The switch is connected in series with the load.
4. In what way is the switch connected to the circuit?	d) In the on-position the closed switch has a very low resistance, which results in maximum current in the load with zero voltage loss across the switch. When the switch is off it has a very high resistance and no current flows through the circuit.

Unit Twenty-Three [23]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

fuse	[fjuːz]	плавкий предохранитель
link	[lɪŋk]	звено, связь
fault	[fɔːlt]	дефект, неисправность
faulty		неисправный
equipment	[ɪˈkwɪpmənt]	оборудование
installation	[ˌɪnstəˈleɪʃn]	установка; *pl.* сооружения
to protect	[prəˈtekt]	защищать, предохранять

to utilize	[ˈjuːtɪlaɪz]	использовать
to equip	[ɪˈkwɪp]	оборудовать, снаряжать
to serve		служить
to melt		плавить
up to		вплоть до

2. Read the words and put down their Russian equivalents. Then translate them back into English (orally).

quartz	[kwɔːts]	_____	quartz-sand fuse	_____
base	[beɪs]	_____	fusible link	_____
principle	_____		faulty protection device	_____
stress	_____		faulty fusible link	_____

3. Form the words according to the model and translate them.

Model: charge – overcharge – перегрузка

connect – disconnect – разъединять

pressure	– _____	– _____
heat	– _____	– _____
stress	– _____	– _____
current	– _____	– _____
load	– _____	– _____
organize	– _____	– _____
place	– _____	– _____
stress	– _____	– _____

4. Form the nouns from the given verbs according to the model. Translate them.

Model: to protect – protection – защита

to utilize – _____ –_____

to install – _____ –_____

to reduce – _____ – _____

current – _____ – _____

to connect – _____ –_____

5. Distribute the words below into the three columns:

action	process	doer

utilizer, utilize, installation, displace, overheater, displacement, overproduction, starter, equip, protection, disorganize

6. Translate into Russian. Mind *both … and, in case, up to*:

1. Both solid and gaseous insulators are highly in use.
2. In case a fuse gets faulty it should be replaced by a new one.
3. Capacitors of very high capacity – up to 1000 and more mF – are utilized in modem installations.

Fuses

Fuses are widely used nowadays as protection devices. They are utilized in various circuits, electrical equipment and installations. Fuses serve to protect them against overcurrents and short-circuits.

There are different types of fuses in use nowadays. Of them, quartz-sand fuses serve for voltages up to 500 volts; fuses of this kind are produced with current ratings of 15 to 60 amp and of 100 to 350 amp.

Fuses are commonly used in low-voltage industrial installations rated up to 1,000 V.

Fuse protection is based on a very simple principle: in case of a short-circuit or overcurrent, when the maximum value of current has been exceeded, the fusible link of a fuse is heated to its melting point. This opens the circuit and disconnects the circuit from the power source. In case of a fault, one should replace the faulty fusible element by a new one.

Fuses are used both in direct current (d.c.) and alternating current (a.c.) circuits.

7. Complete the sentences using the correct variant:

1. A fuse serves	a) as a load. b) as a protection.
2. Fuses are used	a) for d.c. only. b) for both a.c. and d.c.
3. In case of a fault	a) the whole fuse should be replaced. b) the faulty link should be replaced.
4. Fuse protection is based on	a) a simple principle. b) a complex principle.

8. Memorize the questions. Use them in a talk with your groupmate:

1. What does a fuse serve for?
2. For what type of current are fuses used?
3. What should be done in case of a faulty fuse?
4. What principle is fuse protection based on?

Unit Twenty-Four [24]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

incandescence	[ˌɪnkænˈdesns]	накал, накаливание
incandescent lamp	[ˌɪnkænˈdesnt læmp]	лампа накаливания
copper		медь
steel		сталь
to convert	[kənˈvəːt]	преобразовывать
to deliver	[dɪˈlɪvə]	питать, подавать
according to	[əˈkɔːdɪŋ tə]	согласно
etc. = et cetera	[ˌet ˈsetərə]	и так далее

2. Read the words and put down their Russian equivalents:

[ˌæljuˈmɪniəm]	aluminium	_____
[ˈkemɪkəl]	chemical	_____
[ˈdʒenəreɪtə]	generator	_____
[məˈtɪərɪəl]	material	_____
[mɪˈkænɪkəl]	mechanical	_____
[ˈθəːml]	thermal	_____
[ˈmoutə]	motor	_____

3. Translate into Russian:

a. convertible values, protected power source, various fuses, variable resistors, chemical cells

b. cells delivering electric power
generator converting mechanical energy
circuits utilizing common fuses

c. Primary cells deliver electric power.
Different kinds of energy can be converted into electric energy.
Protection devices are utilized in any circuit.

Components of Electric Circuits

The main components of any circuit are devices that produce and utilize electric energy. They are: 1. power sources, 2. utilizing loads, 3. connecting conductors.

The most common power sources are electric generators and primary cells. Electric generators convert chemical energy into electric energy.

Loads include electric heaters, electric motors, incandescent lamps, etc. Motors convert electric energy into mechanical, incandescent lamps and heaters convert electric energy into light and heat. Utilizing devices or loads convert electric energy into thermal, mechanical or chemical energy.

Electric power is delivered from power sources to loads by electric wires. According to their material, wires can be aluminium, copper, steel, etc.

Besides, electric circuits use different types of switches, protection devices (relays and fuses), and meters (ammeters, voltmeters, wattmeters, etc.).

2. Complete the sentences using the correct variant:

1. The main components of electric circuits are	a) loads and wires. b) power sources, load and wires.
2. Power sources are used	a) to produce electric energy. b) to deliver it to the loads.
3. Electric conductors are used	a) to connect the circuit elements. b) to deliver electric power.
4. Protection devices are utilized	a) in some circuits. b) in any circuit.
5. A switch is utilized	a) in some circuits. b) in any circuit.

5. Answer these questions:

1. What are the main components of an electric circuit?
2. What is the function of an electric source?
3. What is the function of a load?
4. What is the function of wire conductors?
5. What other devices are utilized in a circuit?

6. Say a few words about your electrical engineering laboratory. Say what power sources and what loads are utilized there. Have a talk with your groupmate about their types and their operation.

Unit Twenty-Five [25]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

efficiency	[ɪˈfɪʃənsi]	отдача, эффективность
ignorance		незнание, неведение
dependence		зависимость
cost		стоимость
loss		потеря
length		длина
to ignore		не принимать во внимание
to depend (on)		зависеть (от)
to exceed	[ɪkˈsiːd]	превышать
long		длинный
exceedingly		чрезвычайно, очень
per cent		процент

2. Read the words and put down their Russian equivalents:

[laɪn]	line	_____
[ˈsteɪʃən]	station	_____
[ˌendʒɪˈnɪə]	engineer	_____
[ˌendʒɪˈnɪərɪŋ]	engineering	_____

3. Put down the nouns corresponding to these verbs. Follow the model.

Model: to act – action

to ignore – _____ to produce – _____

to depend – _____ to use – _____

to cost – _____ to lose – _____

4. Translate into Russian:

a. line efficiency _____

voltage loss _____

power station _____

b. interdependent values _____

interconnected sources _____

changing power efficiency _____

c. exceedingly high power losses _____

exceedingly inefficient energy sources

_____

d. One can ignore these exceedingly low power losses.

_____

One should take into consideration the interdependence of these values.

_____

One should not ignore the high cost of these installations.

_____

Electric Lines and Their Efficiency

Wires are used to deliver electric power and to interconnect different components of electrical installations. Conductors used for electric wiring are commonly produced of copper and aluminium. Aluminium is widely used nowadays due to its low cost. Copper is also widely used in electrical engineering but its cost is much higher.

Wires connecting the components of various installations may be insulated. They may also be used without insulation. Since in short lengths of wire power loss is exceedingly low one can ignore it. In long wires (longer than 10 m), power loss cannot be ignored since it is rather high. Power loss in a line should not exceed a definite value. If this value is exceeded the line becomes inefficient.

One should know that the efficiency of a line is not constant – it may change. The value of the line efficiency depends on the load: the greater the load the lower is the line efficiency. At voltage losses of 2 to 5 per cent the efficiency of a line is 98-95 per cent. Protecting devices, fuses and relays are used to protect the circuit against overcurrents and short-circuits.

5. Complete the sentences using the correct variant:

1. Aluminium is used due to its	a) high cost. b) low cost and high efficiency.
2. Cross-section of different conductors	a) varies. b) is the same.
3. Power loss can be ignored	a) in short wires. b) in long wires.
5. Electric lines nowadays are	a) efficient.

	b) inefficient.
6. Installations are protected	a) by switches.
	b) by fuses.

6. Complete these sentences using *while*. Follow the model on page 13:

1. The cost of aluminium is comparatively **low** while … .
2. In a **short** length of wire power loss is extremely **low** while … .
3. The **greater** the load the **lower** is the efficiency of the line … .

7. Answer these questions:

1. Why is aluminium widely used nowadays?
2. Is its cost very low or comparatively low?
3. What is the cross-section of copper conductors?
4. May one ignore power loss in short wire? Why?
5. What does the efficiency of a line depend on?
6. What are fuses used for?
7. When does a line become inefficient?

8. Think of three questions about this extract and put them to your groupmate.

consumer – потребитель; **relation** – отношение

When electric energy is produced at the power station, it is to be transmitted over electric wires to the consumer. Wire conductors offer resistance to the current flow; the longer the wire, the greater is its resistance to the current flow. Accordingly, the higher the offered resistance, the greater are the heating losses in the wire.

Unit Twenty-Six [26]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

area	[ˈєəгɪə]	площадь, область
distance		расстояние
network		сеть электролиний
support		опора, мачта
cord		провод
bus		шина
enterprise	[ˈentəpraɪz]	предприятие
to term		называть, именовать
to divide	[dɪˈvaɪd]	делить, разделять
to support		поддерживать
to distribute		распределять
accordingly		соответственно
as to		… что касается; … что до
long distance		большое расстояние
length of transmission lines		длина линий передачи
power consumption		потребление энергии
distribution centre		распределительный центр
city area		район городской застройки

2. Put down the Russian for:

interdependent city areas _____

interacting underground lines _____

interconnected overhead lines _____

transmitting power lines _____

transmission and distribution lines _____

overhead lines _____

step-down transformer _____

indoor lines _____

underground lines _____

Transmission Lines

A power system is an interconnection of electric power stations by high voltage power transmission lines. Nowadays the electricity is transmitted over long distances and the length of transmitting power lines varies from area to area.

A wire system is termed a power line in case it has no parallel branches and a power network in case it has parallel branches.

According to their functions, power lines and networks are subdivided into transmission and distribution lines.

Transmission lines serve to deliver power from a station to distribution centres. Distribution lines deliver power from distribution centres to the loads.

Lines are also classed into: 1) overhead; 2) indoor; 3) cable (underground).

Overhead lines include line conductors, insulators, and supports. The conductors are connected to the insulators, and these are connected to the supports. The greater the resistance, the higher are the heating losses in the conducting wires. In order to reduce the losses, a step-down transformer can be used.

Indoor lines include conductors, cords, and buses. The conductor may include one wire or a combination of wires not insulated from one another. They deliver electric current to the consumers.

As to underground lines, they are used in city areas. Accordingly, they are used in cities and towns, and in the areas of industrial enterprises.

3. Complete these sentences using the correct variant.

1. Electric power is transmitted	a) by electric lines. b) by power networks.
2. Lines are divided into	a) overhead and underground. b) overhead, indoor and underground.
3. An overhead line includes	a) conductors and supports. b) conductors, insulators and supports.
4. The insulators are connected	a) to the buses. b) to the supports.
5. Conductors consist of	a) bare wire. b) insulated wire.
6. Underground lines are used	a) in cities. b) in areas of enterprises. c) in agricultural areas.

4. Complete the sentences using *while* or *as to*. Follow the model on page 13.

1. The system is termed a **power line** in case it **has no parallel branches** … .
2. **Transmission lines** deliver power from a station to **distribution centres** … .
3. **Low** current results in **decreased** heating losses … .
4. **Overhead** lines are used in open areas … .

5. Answer these questions:

1. By what means is electric power system transmitted?
2. Which system has no parallel branches?
3. Into what groups are all the transmitting lines classed?
4. What components does an overhead line have?
5. What elements do conductors consist of?
6. In what areas are overhead (underground) lines used?

Unit Twenty-Seven [27]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

safe		безопасный
safety		безопасность; предохранительный
danger	[ˈdeɪndʒə]	опасность
strength	[streŋθ]	сила
earth	[ə:θ]	заземление, земля
ground		земля, почва
dead	[ded]	выключенный

dangerous	[ˈdeɪndʒrəs]	опасный
strong		сильный, яркий (*о свете*)
to save		спасать
to disappear		исчезать
to appear		появляться
live	[laɪv]	под напряжением
dry		сухой
wet		сырой, мокрый

2. Read the words and put down their Russian equivalents. Then translate them back into English (orally).

[ˈætməsfɪə]	atmosphere	_____
[ˌpəːsəˈnel]	personnel	_____
[ˈkɔntækt]	contact	_____
[ˈregjulə]	regular	_____
[kənˈtroul]	control	_____
[dɪˈtekt]	detect	_____

3. Put down the corresponding nouns. Form nouns from these adjectives and translate them into Russian.

Model: wide – wid**th**

strong –	_____	broad –	_____
long –	_____	high –	_____

4. Put down the Russian for:

under voltage _____

under 20 V _____

over 30 V _____

the power is on _____

the power is off _____

great strength _____

dry air _____

dead conductor _____

live conductors _____

5. Choose the suitable words and translate the sentences:

1. The danger of electric shock (*appears*, *disappears*) when the conductor becomes (*live*, *dead*).
2. Current passes through faulty (*earthed*, *unearthed*) part of installations when the power is on.
3. Low accuracy of measurement is (*an advantage*, *a disadvantage*) of the measuring device.
4. The danger of electric shock (*increases*, *decreases*) in the wet and hot atmosphere.
5. No current flows through a (*dead*, *live*) conductor.

6. Fill in using the verbs *to detect, to appear, to disappear, to decrease*:

1. When resistance increases, the risk of electric shock … .
2. Faults in electric installations are … by means of special devices.
3. Electric power … only on live conductors with power on.
4. When the device is switched off electric power … .

Safety Earthing System. Electric Shock

The strength of current depends on both the voltage and the resistance in a circuit. A current of 50 mA is dangerous for a man and a current of 100 mA and higher is lethal.

a) Contact with an ungrounded motor frame

b) Contact with a grounded motor frame

Fig. 19

Earthing system serves to protect attending personnel from electric shocks when voltage appears on parts that are normally dead. The risk of an electric shock decreases with decreasing voltage. In wet and hot atmosphere the risk of electric shock increases. Safe voltage for circuits used in dry atmosphere is under 36 V. When the power is on, contacts with live conductors are dangerous for life. Thus, measures are taken to protect attending personnel from contacts with live parts of installations under voltage.

The danger of an electric shock disappears provided the metal parts of installations under voltage are connected with ground by means of safety earthing.

Connecting to ground is made by means of earthing electrodes which are connected directly with ground.

The insulation resistance of any installation should be regularly controlled by means of measuring devices. The faulty parts should be detected, eliminated, and replaced by new ones.

7. Complete the sentences using the correct variant:

1. Earthing system serves	a) as protection from an electric shock. b) as connection with ground.
2. Voltage appears on	a) dead parts. b) live parts.
3. Contact with live conductors is	a) dangerous. b) safe.
4. Connection to ground is made	a) by means of wire conductors. b) by means of earthing electrodes.
5. Danger of an electric shock disappears if the frame	a) is earthed. b) is unearthed.

8. Complete the sentences using *while*. Follow the model on page 13.

1. The insulation resistance of a faulty **unearthed** frame is extremely **low** … .
2. Danger of an electric shock **disappears** when the faulty parts are **earthed** … .
3. One should work on the circuit when the power is **off**. One should not work on the circuit when the power is … .
4. Contact with **dead** conductors is **safe** … .
5. In **dry** air the risk of an electric shock **decreases** … .

9. Answer these questions:

1. What does an earthing system serve for?
2. What parts are termed dead (live)?
3. In what air does the risk of an electric shock decrease?

4. By what means is connection to ground made?
5. What does an electric shock result from?
6. Is a current of 50 mA dangerous for a man?
7. Is wet and hot atmosphere dangerous for the attending personnel?
8. Does the risk of an electric shock decrease with increasing current?

10. Read the text and write four questions about it. Ask your groupmates to answer them.

A man can get an electric shock when he comes into contact with the electric fish. One of this kind is found in the tropical waters of South America: it is the electric eel. Small electric eels, one inch long, give a small shock. When the fish is 6 inches long its internal battery gives as much as 200 volts. A very big fish can generate 600 volts! When it is short-circuited, a current of one ampere can be obtained. A two-meter long eel can light a dozen 50 watt lamps. The eel's head is positively charged and the opposite end is negatively charged.

Unit Twenty-Eight [28]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

condition	[kənˈdɪʃn]	условие
plant	[plɑːnt]	завод
pole		полюс
torque	[tɔːk]	вращение, момент вращения
poor	[puə]	бедный, плохой
nameplate	[ˈneɪmpleɪt]	(заводская) табличка

2. Read the words and put down their Russian equivalents. Then translate them back into English.

[ˈɪndəstrɪ]	industry	_____
[ˈsəːvɪs]	service	_____
[ˈtrænspɔːt]	transport	_____
[ˈmoutə]	motor	_____
[ˈpræktɪkəl]	practical	_____
[pouˈtenʃəl]	potential	_____

3. Give the Russian for:

magnet pole	_____
different conduit	_____
machine ratings	_____
rated torque	_____
service life	_____
poor operation	_____

4. Form adjectives and adverbs. Translate them into Russian.

a. care – care**ful** _____

use – _____ _____

power – _____ _____

b. care – care**less** _____

use – _____ _____

power – _____ _____

wire – _____ _____

c. normal – normal**ly** _____

practical – _____ _____

potential – _____ _____

abnormal – _____ _____

poor – _____ _____

5. Answer these questions:

1. What types of magnets are used in heavy industry?
2. How long is motors' service life under normal conditions?
3. Are motors used in every branch of industry?
4. What are the main types of motors in use nowadays?

Electric Motors

Motors are used for converting different forms of energy into mechanical energy.

The main part of a motor is a coil or armature. The armature is placed between the poles of a powerful magnet. When a motor is put into operation current starts flowing through the coil (armature) and the armature starts rotating.

Electric motors are used practically in every branch of industry, transport, and agriculture. Naturally, they are produced in many different designs. They are used in industrial plants, aim operate under different conditions.

Each motor is supplied with a nameplate which bears machine ratings: output power, voltage, the rated current, the starting current, the power factor, the efficiency, and the rated torque.

These motor ratings should be taken into consideration since they are necessary for the users. On them depends the length of motors' service life, which is normally equal to about 10 years, provided that the operating conditions are normal. Naturally, under abnormal conditions the service life becomes much shorter: motors operate poorly and may have different faults.

6. Complete the sentences using the correct variant:

1. Motors are used	a) for transmitting energy. b) for converting energy.
2. Motor's main part is	a) the frame. b) the armature. c) the stator.
3. The armature is placed	a) between the poles of the magnet. b) about the poles of the magnet.
4. Motors' service life becomes shorter	a) under normal conditions. b) under abnormal conditions.
5. Faulty motors operate	a) normally. b) poorly.

7. Answer these questions. Use them in a talk with your groupmate:

1. What are motors used for?
2. What is the motor's main part?
3. Where is the armature placed?
4. What ratings does the nameplate of a motor bear?
5. Under what conditions does a motor operate normally (poorly)?

8. Read about energy resources of today. Write three questions about the text and ask your groupmate to answer them.

Energy Resources of Today

People are energy-rich today. Solar energy is considered to be a potentially limitless source of clean energy. The waters of the world contain potential fuel – in the form of a special isotope of hydrogen – deuterium. It is sufficient to power fusion reactors for thousands of years.

Unit Twenty-Nine [29]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

to repair	[rɪˈpɛə]	ремонтировать
brush	[brʌʃ]	щетка
gap		зазор, люфт
spark		искра
speed		скорость
noise	[nɔɪz]	шум
slow		медленный
excessive	[ɪkˈsesɪv]	избыточный
check		проверка
to adjust		регулировать, подгонять

2. Read the words and put down their Russian equivalents:

[ˈkɔmjuːteɪtə]	commutator	_____
[ˈsteɪtə]	stator	_____
[ˈroutə]	rotor	_____
[ˈkɔntækt]	contact	_____
[kənˈtækt]	to contact	_____
[ˈprouses]	process	_____

3. Put down the verbs corresponding to the given nouns and translate them:

check	to check	проверять
spark	_____	_____
brush	_____	_____
repair	_____	_____
slow (*adj*)	_____	_____

4. Put down the Russian equivalents of these word combinations. Translate them back into English (orally).

air gap	_____
brush sparks	_____
slow speed	_____
excessive speed	_____
safety devices	_____

5. Answer these questions:

1. What do motors' faults result from?
2. Are there any faults that can be ignored?
3. What makes motors' service life shorter?
4. What does voltage supply stop result in?
5. What processes show the (dis)advantages of devices?

6. Are the words: *spark, short, slow, brush, fault, load, test* nouns? Are they verbs? Translate the sentences into Russian:

1. New motors are given a no-load and under a load tests.
2. When the motor is tested it should produce no abnormal noise.
3. In case this noise appears the motor must be disconnected.
4. This generator must be checked; one should give it a test.
3. The motor's brushes seem to be sparking. Can you see the sparks?
6. The windings of the coil are shorted. I have detected a short in the windings.
7. The armature rotates slowly; let's check it up!
8. The speed of rotation is too excessive; it must be slowed down.
9. In case the rotor brushes against the stator, the motor operates slowly. The faulty brushes should be replaced.

Faults of Motors and Ways of Their Repair

Motors may have different faults. A faulty motor does not start, or, when it is started, it operates at an excessive speed.

Its brushes may spark and its windings and the commutator may be overheated and burnt. Besides, a motor may produce an abnormal noise, etc. All these and other faults should be detected and repaired.

In case the motor does not start it may have different faults (see the table):

Table

Possible causes of faults	*Ways of repair*
1. Fuses are faulty.	1. Replace the fuses.
2. Motor is overloaded.	2. Reduce motor load.
3. Circuit in armature winding has an open.	3. Repair the armature winding.
In case the motor, when started, stops:	
1. Rheostat is shorted.	1. Check the rheostat and repair it.
2. Rheostat switches from one position to another.	2. Slow down operation of rheostat handle.
Brushes may spark in case:	
1. Motor is overloaded.	1. Reduce the load and remove overload.
2. Brushes are in poor condition.	2. Replace the brushes.
3. Pressure is low.	3. Adjust the pressure.
4. Pressure is excessive.	4. Adjust the pressure.
In case the armature winding is overheated:	
1. Motor is overloaded.	1. Remove the overload.
2. Ventilation fails to operate properly.	2. Check for slowing down the speed of the motor.
In case of abnormal motor speed:	
1. Motor is overloaded.	1. Reduce the load.
2. Rotor circuit has poor contact.	2. Repair the shorting mechanism.
In case rotor brushes against stator:	
Rotor brushes against stator.	Adjust air gap.

7. Complete the sentences using the correct variant:

1. A motor with a fault	a) operates normally. b) operates poorly.
2. Motor brushes spark in case	a) they are in normal conditions. b) they are in poor conditions.
3. Burnt commutator should be	a) replaced. b) repaired.
4. Brushes may spade in case	a) pressure is low. b) pressure is excessive.
5. Air gap is adjusted in case	a) the rotor brushes against the stator. b) the stator brushes against the rotor.

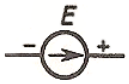
8. Answer these questions:

1. When does a motor operate poorly?
2. What should be done in case the motor is overloaded?
3. What should be done in case the fuses are faulty?
4. What should be done in case the rheostat is shorted?
5. What should be done in case the brushes spark?
6. What should be done in case the pressure is low?
7. What should be done in case the ventilation does not operate?
8. What should be done in case the rotor brushes against stator?

9. Say a few words about your electrical engineering laboratory. Are there any faulty devices in it? Have a talk with your groupmate about the faults and the ways to repair them.

10. You know that all electrical devices and installations are constructed of a certain number of components. To these components belong electric power sources, wires, cables, buses, switches, fuses, resistors, rheostats, capacitors, transformers, motors and others.

Let us have a talk about these components. Speak with your groupmates about their types, their use, operation, possible faults and ways of their repair. Use the table below:

Circuit components	*Symbols*
Electric energy source	
D.c. generator	
D.c. motor	
Chemical power source (primary or storage cell)	
Electric lamp	
Electric connection, removable and permanent	
Switches, single- and double-pole switches	
Fuse	
Load, resistor	

Safety earthing system	
Rheostat, or variable resistor	
Transformer, air-core T	
Iron-core T	
Capacitor, fixed C, variable C	

11. Draw schemes of circuits and devices constructed from these components. Have a talk with your groupmates about them:

1. Connect four resistors, two voltage sources and a switch in series. Speak about the construction and the operation of the circuit.
2. Connect several resistors and cells in series-parallel. Suppose that one of the resistors gets open; what does it result in? Suppose that a whole set gets open. What does it result in?
3. Measure the value of current (voltage, power, resistance) in the circuit. Use proper meters. Speak about the way you connect the meters to the circuit.
4. Take the proper components and construct an earthing protection system. Draw its scheme. Speak about its operation.
5. Draw a scheme of a thermal relay. What components are necessary for it?
6. Draw a scheme of an overhead transmission line. Speak about its operation. What are its possible faults?
7. Draw a scheme of a substation. Speak about its operation and about its possible faults. What are the ways of their repair?

Unit Thirty [30]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

to achieve	[əˈʧiːv]	достигать
to belong (to)		принадлежать, относиться (к)
to feed		снабжать, питать
to determine	[dɪˈtəːmɪn]	определять
to relate		относиться (к), быть связанным (с)
predominant	[prɪˈdɔmɪnənt]	преобладающий
graph	[grɑːf]	кривая, график
national		народное хозяйство

2. Read the words and put down their Russian equivalents. Then translate them back into English (orally).

[ˌkærɪktəˈrɪstɪk]	characteristic –	_____
[mjuːˈnɪsɪpl]	municipal –	_____
[ɪˈlektrɪfaɪ]	to electrify –	_____
[ˈhaɪdrou]	hydro –	_____
[ˈpɪərɪəd]	period –	_____

3. Distribute the words below into three columns:

action	process	doer

utilizer, protect, distribution, utilize, protection, distributor, consumption, consume, utilization, consumer

4. Put down the Russian equivalents of these word combinations. Translate them back into English (orally).

a. load graph _____

lighting load _____

power load _____

b. power utilizing devices _____

parallelly operating plants _____

enterprises utilizing power _____

5. Complete the sentences translating the words in brackets:

1. Water-turbine (заводы) are called hydroturbines.
2. Load graph (определяет) the operating load (условия).
3. Economical (потребление) of electric power (достигается) by interconnected operation of power plants.

Electric Power Consumers and Power Systems

An electric power consumer is an enterprise utilizing electric power. Its operating characteristics vary during the hours of day, days and nights, days of week and seasons.

All electric power consumers are divided into groups with common load characteristics. To the first group belong municipal consumers with a predominant lighting load: dwelling houses, hospitals, theatres, street lighting systems, mines, etc.

To the second group belong industrial consumers with a predominant power load (electric motors): industrial plants, mines, etc.

To the third group belongs transport, for example, electrified railways. The fourth consists of agricultural consumers, for example, electrotractors.

The operating load conditions of each group are determined by the load graph. The load graph shows the consumption of power during different periods of day, month, and year. On the load graph the time of the maximum loads and minimum loads is given.

Large industrial areas with cities are supplied from electric networks fed by electric power plants. These plants are interconnected for operation in parallel and located in different parts of the given area. They may include some large thermal and hydroelectric power plants.

The sum total of the electric power plants, the networks that interconnect them and the power utilizing devices of the consumers, is called a power system. All the components of a power system are interrelated by the common processes of protection, distribution, and consumption of both electric and heat power.

In a power system, all the parallelly operating plants carry the total load of all the consumers supplied by the given system.

The building up of a power system is of great importance for the national economy. An economical utilization of the power plant installations and of the sources of power is achieved by interconnected operation of a series of power plants in a common power distribution system.

6. Answer these questions:

1. What enterprises are called electric power consumers?
2. When do their operating characteristics vary?
3. What consumers belong to the four different groups?
4. What conditions does the load graph determine?
5. What type of system is called a power system?
6. What processes interconnect the components of a power system?
7. In what way is an economical utilization of power installations achieved?

7. Describe a power system and its operation.

Unit Thirty-One [31]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

auxiliary	[ɔːgˈzɪlɪərɪ]	вспомогательный, добавочный
breaker		выключатель, прерыватель
busbar		собирательная шина
feeder		фидер
flexible		гибкий
to comprise	[kəmˈpraɪz]	включать в себя
to distribute	[dɪˈstrɪbjuːt]	распределять
as ... to		что касается
as well as		так же, как и

2. Put down the Russian equivalents of these word combinations. Translate them back into English (orally).

circuit breaker	_____
auxiliary units	_____
distribution centre	_____
flexible construction	_____
reliable operation	_____
switch gear bus	_____
hydraulic as well as solar sources of energy	_____
as to phase-word motors	_____

3. Fill in *as well as*, *as to* and translate the sentences:

1. Excessive starting current may result in fluctuations in the voltage ... in other faults of the motor.
2. ... A.C. motors they are subdivided into single- and three-phase motors.

Substations

A substation is designed to receive energy from a power system, convert it and distribute it to the feeders. Thus a substation serves as a distribution centre. Substations feed (supply) various consumers provided that their basic load characteristics are similar. Therefore the energy is distributed without transformation of the voltage supplied.

Common substations comprise isolators, switchgear buses, oil circuit breakers, fuses, power and instrument transformers and reactors.

Substations are classed into step up and step down ones. The step up substation includes transformers that increase the voltage. Connected to the busbars of the substation are the power transmission lines of power plants of the system.

As to step down substations, they reduce the voltage to 10 or 6 kV. At this voltage the power is supplied to the distribution centres and to the transformer substations of power consumers.

A transformer substation serves for transmitting and distributing electric power. It comprises a storage battery, control devices and auxiliary structures.

Transformer substations are classed into indoor and outdoor; both types are used for feeding industrial enterprises. Compared to other types of substations, transformer substations have certain advantages. They have flexible construction and easy and reliable operation. In case of a fault in the left-hand section, the main circuit breaker opens while the normally open section circuit breaker closes and puts the voltage of the section to normal. Power from a substation is delivered to distribution centres.

4. Complete the sentences using the correct variant:

1. A substation serves	a) to consume energy. b) to distribute energy. c) to convert energy.
2. A substation feeds consumers	a) with various load characteristics. b) with similar load characteristics.
3. The lines of power plants are connected	a) to the busbars. b) to the switchgear.
4. A substation comprises	a) the main elements. b) the main and auxiliary elements.
5. Flexible construction is	a) an advantage. b) a disadvantage.

5. Pair work. Put these questions to your groupmate, and ask him/her to answer them.

1. What does a substation serve for?
2. What type of consumers does a substation feed?
3. What parts are the power transmission lines connected to?
4. What components does a substation comprise?
5. What types are substations classed into?
6. What are advantages of a transformer substation?

Unit Thirty-Two [32]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

blade		лопасть
level		уровень
magnitude	[ˈmægnɪtjuːd]	величина
head	[hed]	(*зд.*) верх, верхушка
plant	[plɑːnt]	станция, завод
runner		ротор
shaft	[ʃɑːft]	привод, вал
to rotate	[rouˈteɪt]	вращать(ся)
to influence		влиять
to fluctuate	[ˈflʌktʃueɪt]	колебаться

2. Put down the Russian equivalents of these word combinations. Then translate them back into English (orally).

runner blade	_____
turbine runner	_____
turbine shaft	_____
water level	_____
water head	_____
large capacity power plant	_____
magnitude of the water head	_____
daily inflow of water	_____
turbine runner shaft	_____

Hydroelectric Power Plants

Hydroelectric power plants are built on rivers. Large-capacity hydroelectric power plants are commonly located at considerable distances from the consumers of electric power.

The production process at these plants is rather simple: the water flows into the hydroturbine runner, acts upon the runner blades and rotates the runner and the turbine shaft.

The generator shaft is connected to the turbine runner shaft. The difference in the water level influences the power capacity of a plant, i.e. the magnitude of the water head and the daily inflow of water fluctuates considerably according to the season.

The production process is different at power plants of different constructions and of different kinds. In atomic power plants, for example, it is not so simple as in hydroelectric plants.

3. Complete the sentences using the correct variant:

1. Hydroelectric power plants are built	a) on rivers. b) on waterfalls.
2. Large-capacity power plants are located	a) at a short distance from consumers of power. b) at a considerable distance from consumers of power.
3. The production	a) is very complex. process at the plants b) is rather simple.
4. The power capacity of a plant	a) remains constant. b) changes considerably. c) is influenced by the difference in the

water level.

5. The daily inflow of water	a) fluctuates according to the consumption. b) fluctuates according to the season.
6. The production process	a) depends upon the construction of the plant. b) is the same at power plants of different constructions.

4. Pair work. Put these questions to your groupmate and ask him/her to answer them:

1. On what sites are hydroelectric power plants built?
2. Are large-capacity plants located far from consumers of power?
3. Is the production process at the plants simple or is it complex?
4. What influences the power capacity of a plant?
5. According to what factors does the daily inflow of water fluctuate?
6. Does the production process at the plant depend on its construction?
7. Do you know that a thermal power plant seldom has an efficiency more than 40%?

Unit Thirty-Three [33]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

exchanger	[ɪksˈtʃeɪndʒə]	теплообменник
steam		пар
tube		труба, лампа
dust		пыль
attending personnel	[ˌpəːsəˈnel]	обслуживающий персонал
to deliver		поставлять
to pollute		загрязнить
to shield	[ʃiːld]	защищать

2. Put down the Russian equivalents of these word combinations. Then translate them back into English (orally).

a. auxiliary units _____

steam generator _____

heat exchanger _____

fuel consumption _____

b. water to be heated in the reactor _____

water to be converted into steam _____

steam to be fed into the turbogenerator _____

c. the polluted atmosphere _____

utilized nuclear fuel _____

shielded concrete walls _____

Atomic Power Plant

Atomic power plants are modem installations. They consist of several main units and a great number of auxiliary ones.

In a nuclear reactor uranium is utilized as a fuel. During operation process powerful heat and radioactive radiation are produced. The nuclear reactor is cooled by water circulation. Cooling water circulates through a system of tubes, in which the water is heated to a temperature of 250-300°C. In order to prevent boiling of water, it passes into the reactor at a pressure up to 150 atmospheres.

A steam generator includes a series of heat exchangers comprising tubes. The water heated in the reactor is delivered into the heat exchanger tubes. The water to be converted into steam flows outside these tubes. The steam produced is fed into the turbogenerator.

Besides, an atomic power plant comprises a common turbogenerator, a steam condenser with circulating water and a switchboard.

Atomic power plants have their advantages as well as disadvantages. The reactors and steam generators operate in them noiselessly; the atmosphere is not polluted by dust and smoke. As to the fuel consumption, it is of no special importance and there is no problem of fuel transportation.

The disadvantage of power plants utilizing nuclear fuel is their radiation. Radioactive radiation produced in the reactors is dangerous for attending personnel. Therefore, the reactors and steam generators are installed underground. They are also shielded by thick (up to 1.5 m) concrete walls. All their controls are operated by means of automatic devices. These measures serve to protect people from radioactive radiation.

3. Complete the sentences using the correct variant:

1. A nuclear reactor is used in	a) wind-power plants. b) atomic power plants.
2. A nuclear reactor is cooled by	a) water circulating in tubes. b) oil circulating in tubes.
3. Water is passed into the reactor	a) at a low pressure. b) at a high pressure.
4. High pressure	a) activates boiling of water. b) prevents boiling of water.
6. Circulating water flows	a) inside the heat exchangers. b) outside the heat exchangers.
7. Attending personnel is shielded by	a) thick concrete walls. b) thick metal walls.

4. Pair work. Put these questions to your groupmate and ask him/her to answer them:

1. What are the main units of an atomic power plant?
2. By what means is the nuclear reactor cooled?
3. At what pressure does the water pass into the reactor?
4. What types of power plants pollute the air with dust and smoke?
5. Why is it necessary to protect attending personnel?
6. By what means is it done?

Unit Thirty-Four [34]

1. a) Cover the right column and read the English words. Translate them into Russian and check your translation.

b) Cover the left column and translate the Russian words back into English.

concrete	[ˈkɔːŋkriːt]	бетон
environment	[ɪnˈvaɪərənmənt]	окружающая среда
fission	[ˈfɪʃən]	расщепление
(stainless) steel		(нержавеющая) сталь
vessel		сосуд
waste		отходы
to confine	[kənˈfaɪn]	заключать
to release	[rɪˈliːz]	выпускать, освобождать
to withstand		противостоять
to dispose		устранять, убирать

2. Put down the Russian equivalents of these word combinations. Then translate them back into English (orally):

nuclear fuel _____

nuclear fission _____

steel vessel _____

reactor vessel _____

fission release _____

sealed tubes _____

concrete housing _____

waste products _____

nuclear waste _____

shielded cylinders _____

Protection Against Environmental Pollution

Any operating nuclear power plant releases fission products into the environment, which causes environmental pollution.

To prevent the harmful effects of nuclear power release, the nuclear power plants are supplied with protective installations that serve as barriers to the pollution.

First, the nuclear fuel and the fission products are confined within sealed tubes made of stainless steel or zirconium. Then the assembly of tubes is placed in a steel reactor vessel. And finally the steel reactor vessel is placed in a large steel and concrete housing.

As to the hot radioactive waste products they are disposed in heavily shielded cylinders. The cylinders are buried 305 to 610 metres underground.

3. Complete the sentences using the correct variant:

1. A nuclear power plant releases
   a) liquid products.
   b) fission products.

2. Operating nuclear power plants
   a) pollute the environment.
   b) prevent the pollution.

3. The protective power plant installations
   a) produce the release of fission products.
   b) prevent the release of fission products.

4. The sealed tubes are made of	a) bronze. b) stainless steel.
5. The fission products are confined	a) within sealed tubes. b) within open tubes.
6. The steel reactor vessel is placed	a) in a concrete housing. b) in a zirconium housing.
7. The waste products are disposed	a) in an open vessel. b) in shielded cylinders.

4. Pair work. Put these questions to your groupmate and let him/her answer them:

1. What kind of products does the operating nuclear power plant release?
2. What installations are used to prevent the harmful effects of a nuclear power plant operation?
3. What material are the tubes made of?
4. Where are the fission products confined?
5. In what part of the installation is the reactor vessel placed?
6. In what way are the hot radioactive waste products disposed?

2. Grammar Revision

Повторение грамматики

Word Formation

Словообразование

Чтобы различать части речи, надо знать суффиксы, с помощью которых они образуются.

Suffixes of Nouns

Суффиксы существительных

Who? What?

Суффиксы	*Примеры*	*Перевод*
-acy	supremacy	главенство
-age	advantage; damage	преимущество; повреждение
-ance/-ence	resistance; existence	сопротивление; существование
-ancy/-ency	discrepancy; efficiency	разногласие; эффективность
-ation	foundation	основание
-dom	freedom	свобода
-er/-or	consumer; conductor	потребитель; проводник
-ics	electronics	электроника
-ion/-tion	installation; direction	установка; направление
-ment	equipment; requirement	оборудование; требование
-ness	readiness; usefulness	готовность; полезность (польза)
-ship	leadership	руководство
-th	length	длина
-tude	magnitude	величина

-ty/-ity	capacity; conductivity	емкость; проводимость
-ure	measure; nature	мера; природа
-ist	scientist	ученый

1. Underline the stems in the following words:

leader, ability, contribution, carrier, compactness, development, altitude, width, mechanics, pessimist, relation, friendship, storage, boredom, quantity

Suffixes of Verbs

Суффиксы глаголов

What to do?

Суффиксы	*Примеры*	*Перевод*
-ate	to generate	генерировать
-ute	to contribute	содействовать
-en	to shorten	укорачивать
-ize	to magnetize	намагничивать
-ify	to simplify	упрощать

2. Which of the given words are nouns, verbs? Why?

practice, wide, wilderness, practise, electrifier, compute, amplitude, electrify, pretence, organize

Suffixes of Adverbs

Суффиксы наречий

How?

Суффиксы	*Примеры*	*Перевод*
-ly	mainly	главным образом
-ward(s)	afterward(s)	впоследствии, потом
-wise	clockwise	по часовой стрелке

Suffixes of Adjectives

Суффиксы прилагательных

What kind of?

Суффиксы	*Примеры*	*Перевод*
-able/-ible	considerable,	значительный, возможный
-al	possible fundamental	основной
-(an)eous	simultaneous; advantageous	одновременный; благоприятный
-ous	various; dangerous	различный; опасный
-ant/-ent	important, efficient	важный, действенный
-ate	aggregate	общий, совокупный
-que	unique	уникальный
-ic/-ical	basic	основной
-ior	superior	высший, лучший
-ive	positive	положительный
-ful	useful	полезный
-less	useless	бесполезный
-like	humanlike	человечный
-ory	compulsory	обязательный
-y	noisy	шумный

3. Which of the words are adjectives, adverbs? Why?

easily, equal, noisy, numerous, faulty, anticlockwise, eastwards, well, carelessly, powerful, traceable, good, simply, comfortable, useful, northward, dangerous, businesslike, naturally, inferior, bad

4. Distribute the words into four columns.

Model:	what?	what kind of?	what to do?	how?
	use	useful	to use	usefully

insulator, failure, fail, addition, additional, overestimate, equal, equalize, equality, equally, different, differ, difference, resist, resistance, resistivity, resistant, commonly, consumer, faulty, impossibility, carelessly, number, numerous, possible, clockwise

5. a) How many parts does each word consist of? What are the stems?

Model: un-**doubt**-ed-ly

failure, indifferent, uncommonly, unequality, numerously, uselessly, noiseless, advantageous

b) Translate the words and their stems.

6. Form nouns by adding the suffixes *-er, -or*.

to work, to invent, to compose, to calculate, to operate, to act, to react, to emit, to transmit, to use, to combine

7. Form adverbs from adjectives by adding the suffix *-ly*:

easy, reasonable, usual, special, physical, functional, real, regular, magnetical, different, logical, mathematical, subsequent, consequent

8. a) Choose the proper suffixes and add them to the stems.

stems: equal-, foil-, add-, differ-, success-, common-, resist-
suffixes: *-ure, -ly, -ence, -ition, -ful, -less, -ance, -ness*

b) Translate the new words.

9. Form adjectives. Choose the proper suffixes and add them to the stems.

stems: differ, advantage, metal, structure, resist, use, reason, control, base
suffixes: *-ous, -ic, -less, -ful, -able, -ent, -ant*

10. Translate into Russian in writing:

1. Oxygen combines directly with nearly all elements.
2. Plastic materials are relatively new insulating materials.
3. Polythene cables have numerous advantages.
4. The importance of semiconductors for modem science cannot be underestimated.
5. Semiconductors conduct electricity less efficiently than metals.
6. The method proved to be efficient.
7. What resistance materials are in common use today?

Prefixes

Приставки

Приставки	*Примеры*	*Перевод*
a-/ab-	aperiodic; abnormal	непериодичный; ненормальный
anti-	anti-aircraft	противовоздушный
co-/con-	co-axial; convergent	имеющий общую ось; сходящийся
counter-	to counteract	противодействовать
de-	to desalt	обессолить
dis-	disadvantage	недостаток
en-	to enlarge	увеличивать(ся)
ex-	ex-president	бывший президент
im-/in-/ir-	impossible; insignificant; irregular	невозможный; незначительный; нерегулярный
inter-	interconnection; interdependence	взаимосвязь; взаимозависимость
mis-	mislead	вводить в заблуждение
non-	non-conductor	непроводник
out-	output	мощность; выпуск
over-	to overestimate	переоценивать
re-	to reconstruct	перестраивать
semi-	semiconductor	полупроводник
sub-	submarine	подводный; подводная лодка
super-	superconductor	сверхпроводник
un-	unequal	неравный
under-	to underestimate	недооценивать

11. Read the following words. What are their prefixes, stems, suffixes? Translate the words into Russian:

generate, inefficient, abnormally, underproduction, anticlockwise, counteraction, demagnetize, superconductor, unequality, misunderstand, unequally, equality, interrelation, non-conductor, input, simplify, waterless, irregularity, redden, enlargement, unreadable, southward, clockwise, fully, noisy, typically, impossible, superconductor

12. Translate the following commands:

1. Learn the rule, please.
2. Use additional resistors, please.
3. Include the data into the common list.
4. Do not underestimate the advantages of the new resistors!
5. Do not use the instrument.

13. Learn the following commands:

1. Heat the magnet, please!
2. Switch off the power, will you?
3. Use the superconductor!

14. Translate into Russian in writing:

Energy is the capacity for doing work. The various forms of energy, interconvertible by suitable means, include potential, kinetic, electrical, heat, chemical, nuclear, and radiant energy. Interconversion between these forms of energy occurs only in the presence of matter.

In the absence of matter energy can only exist in the form of radiant energy.

Test

Choose the correct form:

1. The aluminium plant is a (*consumer*, *consumption*) of the (*local*, *locally*) generated electric power.
2. The (*new*, *newly*) built shops are (*importance*, *important*) for the future of the power plant.
3. Nuclear energy is energy released during a nuclear (*reactor*, *reaction*) as a result of (*convertible*, *conversion*) of mass into energy.
4. Uranium is a (*comparison*, *comparable*, *comparatively*) rare element.
5. The most (*importance*, *important*) problems in (*atom*, *atomic*) power (*generator*, *generation*) are connected with the reactor. Reactor (*technologist*, *technology*) is still in (*progressive*, *progress*). The light-water reactor types seem most (*usefulness*, *usefully*, *useful*).

Conversion

Конверсия

В отличие от русского языка, в английском языке одно и то же слово может выступать в предложении в качестве разных частей речи. Так, в данных ниже предложениях слово water является существительным (1), глаголом (2), играет роль прилагательного (определения) (3), является частью сложного слова (4).

1. Water is necessary for life. – Вода необходима для жизни.
2. Water the flower-bed, please. – Полей(те), пожалуйста, клумбу.
3. Water mills served a source of energy. – Водяные мельницы служили источником энергии.
4. water-supply system – система водоснабжения
   water-proof watch – водонепроницаемые часы

Значения подобных слов и их перевод на русский язык зависят от того, каким членом предложения они являются. Они могут быть подлежащим, сказуемым (или его частью), определением, обстоятельством. Функцию слова помогает определить твердый порядок слов в английском предложении и контекст.

15. Look up the meanings of these words in a dictionary, if necessary. How are they translated in the sentences below? Mind the word order.

a) ***place, iron, lift, house, light, heat, use, form, change, wire***

1. The conductor wires are placed high up.
2. Electromagnets lift iron weights.
3. The plastic box houses the conducting and the insulating elements of the apparatus.
4. The house is lighted and heated by solar energy.
5. The light went out. Light the candle, please.
6. After the metal was heated it changed its colour to a red heat.
7. Numerous changes are taking place in the uses of atomic energy.
8. Electric power is used universally.
9. The newly made invention has a great number of uses.
10. The wire and the source form a circuit.

b) ***balance, amount, water, fuel, control, measure, cause, increase***

1. The fuel-and-energy balance is important for industry.
2. Conductivity increases with heating.
3. The machine should be re-fuelled.
4. The amount of power used in the world in a year amounts to 12,000 million tons of equivalent fuel.
5. Water barriers are crossed by submarine cables.
6. The instrument is foot-controlled by a pedal.

7. Force and motion go together; one is a cause, the other, a result.

8. An electromotive force causes the electrons to move.

9. Control of the apparatus is placed on the panel.

10. The volt is a measure of electromotive force.

Numerals

Числительные

0	**zero**	[ˈziːrou], [ou]	**11**	**eleven**	[ɪˈlevn]
1	**one**	[wʌn]	**12**	**twelve**	[twelv]
2	**two**	[tuː]	**13**	**thirteen**	[ˈθəːˈtiːn]
3	**three**	[θriː]	**14**	**fourteen**	[ˈfɔːˈtiːn]
4	**four**	[fɔː]	**15**	**fifteen**	[ˈfɪfˈtiːn]
5	**five**	[faɪv]	**16**	**sixteen**	[ˈsɪksˈtiːn]
6	**six**	[sɪks]	**17**	**seventeen**	[ˈsevnˈtiːn]
7	**seven**	[ˈsevn]	**18**	**eighteen**	[ˈeɪˈtiːn]
8	**eight**	[eɪt]	**19**	**nineteen**	[ˌnaɪnˈtiːn]
9	**nine**	[naɪn]	**20**	**twenty**	[ˈtwentɪ]
10	**ten**	[ten]			

30	**thirty**	[ˈθəːtɪ]	**80**	**eighty**	[ˈeɪtɪ]
40	**forty**	[ˈfɔːtɪ]	**90**	**ninety**	[ˈnaɪntɪ]
50	**fifty**	[ˈfɪftɪ]	**100**	**hundred**	[ˈhʌndrəd]
60	**sixty**	[ˈsɪkstɪ]	**1000**	**thousand**	[ˈθauzənd]
70	**seventy**	[ˈsevntɪ]			

27 twenty-seven

51 fifty-one

118 one hundred and eighteen

365 three hundred and sixty-five

1,674 one thousand six hundred and seventy-four

5,803 five thousand eight hundred and three

75,000 seventy-five thousand

16. Read the following extracts aloud:

1. The initial world supply of minable coal amounted to 7.64×10^{12} metric tons, of which 65 percent occur in Asia, 27 percent in North America, 5 percent in Western Europe, and only 2.4 percent in the three countries of Africa, South America and Australia.

2. There has been a continuous trend toward higher transmission voltages ever since the first a.c. power plant was built in 1886. By 1900 transmission lines at 40,000 volts were carrying power for distances up to 75 miles (120 km). In 1916 a 132,000-volt line was built to carry power for a distance of 55 miles (90 km). In 1948 the record was held by a 220,000 volt line. In 1948 the Hoover Dam's hydroelectric plant was sending power over a 287,000-volt line to Los Angeles, about 275 miles (440 km) away. By 1959 maximum transmission voltages had increased to 345,000 volts. In that year, in the United States there were 320,000 miles (515,000 km) of transmission lines carrying power at voltages above 23,000 volts and more than 3 million miles (4.8 million km) of distribution lines at 22,000 volts or less. By 1970, 560 miles (900 km) of transmission lines carrying power at 765,000 volts had been constructed. A transmission line operating at such a high voltage has the capability to carry enough power to meet the needs of a city with a population of one million people.

By 1990 10,200 miles (16,400 km) of 765,000-volt transmission lines had been built in the US.

Простые и десятичные дроби

В простых дробях числитель выражается количественным числительным, а знаменатель – порядковым. Если числитель больше единицы, то знаменатель имеет окончание **-s**: two fifths – *две пятых*. В смешанном числе целое число читается как количественные числительные, а дробь присоединяется при помощи союза **and**: five and two fifths – *пять и две пятых*.

В десятичных дробях «нуль» произносится **zero** или **o**, за ним следует слово **point** (*точка*) и затем дробь: o point five – *ноль целых и пять десятых*. Между целым числом и десятичной дробью в английском языке ставится точка, а не запятая, как в русском языке.

Pronoun *One*

Местоимение one

Значения one	*Примеры*	*Перевод*
… один из …	Nuclear energy is **one of** the forms of energy.	Ядерная энергия – одна из форм энергии.
Заменитель ранее упомянутого существительного	The old turbine was a water turbine and the new **one** is a steam turbine.	Старая турбина была водной турбиной, а новая – паровая турбина.
Неопределенно-личное подлежащее	**One** should control the chain reaction.	Следует контролировать цепную реакцию.

17. Translate the sentences. Mind *one*.

1. The second sputnik was launched about a month after the first one.
2. There are many insulating materials from which one may choose.
3. Some substances are efficient conductors, others, poor ones.
4. One uses special devices to measure current, voltage, and resistance.
5. The new method proved to be much more efficient than the old one.
6. One knows that these installations do not operate on nuclear power.
7. One must choose only one of those variants.

The Verb

Глагол

The English Tenses

Времена глагола

Active Voice

Действительный (активный) залог

Вид	**Время**		
	Present	*Past*	*Future*
Indefinite	supply supp**lies**	supp**lied**	**shall** / **will** } supply
Continuous	**am** / **is** / **are** } supply**ing**	**was** / **were** } supply**ing**	**shall** / **will** } **be** supply**ing**

Perfect	**have** / **has** } suppl**ied**	**had** suppl**ied**	**shall** / **will** } **have** suppl**ied**
Perfect Continuous	**have** / **has** } **been** supply**ing**	**had been** supply**ing**	**shall** / **will** } **have been** supply**ing**

18. State the tense forms of the following verbs.

Model: link – Present Indefinite (active voice)
does not link – Present Indefinite (negative form)

is circulating, have not moved, transmits, emitted, did not emit, has burnt, will not operate, act

19. Put down the tense forms of the verbs.

Model: to lower – *Pres. Perf.* <u>have (has) lowered</u>

to heat – *Past Indef.* – _____
to discharge – *Pres. Contin.* – _____
to remove – *Pres. Perf.* – _____
to bum – *Pres. Perf. Contin.* – _____
to waste – *Future Ind.* – _____
to demand – *Past Perf.* – _____
to move – *Future Perf.* – _____

20. Translate these negative sentences into Russian. What is the difference between the English constructions and the Russian ones?

1. No charges can move in an open circuit.
2. Nothing less than a map of the Universe is planned by the research.
3. No special equipment is necessary to carry out the experiment.
4. A current which does not change its polarity is called a direct current.
3. A dry battery is a type of a small battery containing no free liquid.
6. The efficiency of a machine can never be greater than unity; it is often given as a percentage.
7. A fast reactor is a reactor in which little or no moderator is used and in which, therefore, the nuclear fissions are caused by fast neutrons.
8. Electrically safe locations are those where conditions causing extremely high danger of electric shock do not exist.
9. No electric device has only advantages. All of them have also disadvantages.

21. Put down the negative form of the following verbs.

Model: moved – <u>did not move</u>

required – _____

was operating – _____

links – _____

has demanded – _____

will have been replaced – _____

release – _____

is transmitting – _____

fissioned – _____

Passive Voice

Страдательный (пассивный) залог

Вид	**Время**		
	Present	*Past*	*Future*
Indefinite	**am / is / are** } supp**lied**	**was / were** } supp**lied**	**shall / will** } **be** supp**lied**
Continuous	**am / is / are** } **being** supp**lied**	**was / were** } **being** supp**lied**	**–**
Perfect	**have / has** } **been** supp**lied**	**had been** supp**lied**	**shall / will** } **have been** supp**lied**

22. State the voice and the tense form of the following verbs.

Model: was removed – Past Indefinite Passive

is discharged – _____

was being discharged – _____

has discharged – _____

had not been attached – _____

is circulating – _____

will not be heated – _____

extends – _____

does not maintain – _____

is not maintained – _____

will be linked – _____

will release – _____

will have been removed – _____

23. Change the sentences into questions:

1. There are various types of nuclear reactors.
2. The use of underground transmission lines must be increased.
3. The fuel can be enriched uranium.
4. The fission heat is used to generate steam, which drives a turbine generator.

24. Think of three questions of your own about each of the given sentences. Put them down.

1. Electric charges are acted upon by forces when they move in the magnetic field.

   _____

2. Copper has been used as a conductor since the beginning of the industry.

   _____

3. Nuclear reactors decrease air and land pollution but they increase thermal and radiation pollution.

   _____

25. Use the required tense form. What are the meanings of the word time in the sentences?

1. The experiment (*repeat*) many times.
2. The power which (*radiate*) as light is almost three times as great as that

radiated as heat.

3. It (*know*) that iron molecules are magnets at all times.
4. Under ordinary room lightning the resistance of transistors (*decrease*) millions of times.
3. Ruby crystals about ten centimetres long can (*intensify*) light ten times.
6. The density of a semiconductor laser radiation (*be*) hundreds of times as great as that of the ruby laser.
7. The power which (*transmit*) along a wire is the product of the voltage times the amperage.

Рекомендации по переводу

Перевод английского предложения не следует начинать с первого слова. Любое предложение надо дочитать до конца и лишь после этого осмыслить его и оформить средствами русского языка.

Если понимание (перевод) предложения вызывает затруднение, рекомендуется прежде всего определить в нем сказуемое. Сказуемое составляет смысловой центр предложения, занимает относительно постоянное место и обычно имеет формальные признаки.

Формальные признаки сказуемого

- *s*	… makes …
-	… make …
- *ed* (или особая форма у неправильных глаголов)	… made … dried … played …
am, is, are	… is (are) making …
was, were	… was (were) made …
have, has, had	… have (has, had) made …
must, should	… must (should) make …

have (has, had) to	… have to make …
am (is, are) to	… are to be made …
was (were) to	… was to make …
do, does, did	… does not make …
can, could	… can (could) make
may, might	may (might) have made
will, would	will (would) make
shall, should	shall (should) make
ought to	ought to make

26. Copy the following sentences. Underline the predicates (ones in the Passive Voice with two lines). Translate the sentences into Russian.

1. A gas-cooled reactor is a nuclear reactor in which the coolant is a gas.
2. The lowest temperature theoretically possible is called the absolute zero.
3. What do substation power supply circuits depend on?
4. The transmission lines are interconnected in switching stations. These network interconnections are referred to as buses.
5. In a power network the large blocks of electric power are transmitted on the grid of transmission lines. From the grid, power is being subdivided into smaller blocks and fed into the subtransmission parts of the power network. Finally, the consumers are being serviced from the distribution network.
6. The energy industry is undergoing considerable development.
7. The world power capacity is doubling about per decade.
8. Development of nuclear power plants for civil use began in the mid-1950s.
9. In order to meet demands for power during the day, utilities have been turning to other forms of hydroelectric systems.
10. In the electric generating field as well as in the electric transmission and storage-technology areas considerable attention is concentrated on the use

of superconducting conductors because of their ability of losing their resistance under certain conditions, namely at temperatures close to absolute zero (-273°C).

11. The maximum voltage applied to a dielectric material without causing it to break down and expressed in volts per mm is termed its dielectric strength.
12. Electrical loads or consumers in power installations are the various arrangements and installations that are used to transform electric power into mechanical, heat and chemical power, or energy.

27. Give negative answers to the following questions. Follow the model.

Model: Will the circuit be powered by the DC supply? No, it will not.
The circuit will not be powered by the DC supply. It will be powered by the AC supply.

1. Is the energy industry decreasing its activity?
2. Do nuclear power stations produce smoke?
3. Does the radioactive pollution from a reactor have only one form?
4. Is the result of pollution measurable by weight and volume?

28. Think of questions about the following sentences:

1. The first central electric power station was installed in 1882.

When _____ ?

What station _____ ?

2. Radioactive wastes damage man and his generation.

Who(m) _____ ?

What wastes _____ ?

3. The use of water power and wind power began more than 2,000 years ago.

   The use of what kind of power _____ ?

   When _____ ?

4. The cooling water is drawn from a source and passed through the condenser.

   What kind of water _____ ?

   What _____ from?

   What _____ through?

29. Translate and compare. Mind variants of the predicate.

1. The device is faulty; you cannot/should not rely on its readings.
2. The cable is to/will be used to test the transmission line.
3. The electric field can be/may be thought of as consisting of a number of lines of force.
4. Nowadays one must/can connect power stations into power grids.
3. One has to/should take safety precautions.
6. Deserts are to/may be turned into gardens by solar energy.
7. The current must/should be as small as possible not to melt the wires.
8. A fast reactor has to/is to/must be designed to produce more fuel than it consumes.
9. The heat from the nuclear chain reactor can/is to be removed by the coolant.

Test

Choose the correct form:

1. One can (*reduce, be reduced*) heat losses in a transmission line.
2. Heat losses should (*reduce, be reduced*) constantly and effectively.
3. The output of machinery is steadily being (*increasing, increased*).
4. Man has been constantly (*increasing, increased*) the output of machinery.
5. The main principles of energy production has (*being, been*) known to science for a long time.
6. The energy industry (*undergoes, is undergoing*) considerable development.
7. Development of nuclear power plants for civil use (*began, has began*) in the mid-1950s.

Полнозначные и служебные слова

Все слова в языке подразделяются на полнозначные и служебные. К полнозначным относятся существительные, смысловые глаголы, прилагательные, наречия, числительные. Служебные слова не обозначают конкретных предметов, действий, качеств. В предложениях они связывают полнозначные слова и помогают обратить их в связную речь. К числу служебных (их называют и «короткие слова» – «small words») относятся артикли, предлоги, служебные и модальные глаголы, их заменители, союзы, послелоги. Знание служебных слов и понимание их роли необходимы для грамотного осмысления английского текста. Не следует, выписав из словаря полнозначные слова, пытаться связывать их «по смыслу». Перевод следует осуществлять только с опорой на значения «коротких слов».

30. In the following examples the verb *to be* has different meanings. What are they?

1. These stations can be linked up into a network.
2. It is advisable to link up these stations into a single network.
3. These stations are to be linked up into a single network.
4. Will the stations be linked up into a single network?
5. They are linking up the stations into a network.

31. Complete the sentences using the required prepositions: *according to, because of, through, of, at, for, by, during, in, in case of, into*:

1. The power transmitted … a wire is the product … the voltage times the amperage. … resistive losses, it is desirable to transmit power … low amperage and high voltage. … doubling the voltage, the capability … a given circuit can be quadrupled.
2. Devices are classed … the operation they are intended … .
3. This type … aerial is useful and popular … its small size.
4. … a faulty device its readings are not to be relied … .
3. Coal and oil contain sulfur … concentrations … a few percent.
6. As these fuels are burned, the sulfur is converted … sulfur-dioxide gas. … the operation … a plant, the sulfur-dioxide and other products are discharged … the air stacks, some … which are about 303 metres high.

32. Complete the sentences using the required conjunctions (*both … and, than, until, since, provided, before*).

1. Some devices work equally well … on direct … alternating current.
2. The set is used in regions without electricity … it operates without a battery.
3. One should turn the knob … a click is heard.
4. … one flies to other planets one should collect as much information as possible about them.

3. Glass becomes a conductor … it is heated to a red hot.
6. A small current is cheaper … great because the wires need not be so thick.

33. Give the English equivalents of the prepositions and conjunctions in brackets and translate the sentences.

1. The energy (для) a nuclear power plant comes (из) the heat released (во время) fissioning of uranium (в) a nuclear reactor.
2. There are two main differences (между) a nuclear power plant and a steam-electric power plant. The nuclear power plant uses a nuclear fuel (вместо) a fossil fuel, and it uses a reactor (вместо) a boiler.
3. (Из-за) their high fuel consumption gas turbines are more expensive to operate than steam turbines.
4. The radioactive pollution produced (в) a reactor has all three forms: gaseous, liquid and solid.
3. The beta particles are dangerous for man (так как) they penetrate deep (в) the matter.
6. Pump-turbine units are used (как для) pumping the water (так и для) driving electric generators.

The Verbals

Неличные формы глагола

The Infinitive

Инфинитив (неопределенная форма глагола)

В английском языке имеется шесть форм инфинитива:

	Active	*Passive*
Indefinite	to emit	to be emitted
Continuous	to be emitting	–
Perfect	to have emitted	to have been emitted
Perfect Continuous	to have been emitting	–

Перевод инфинитива на русский язык зависит от его функции в предложении и от его формы.

34. Underline the infinitives in the sentences. Translate the sentences into Russian.

1. To magnetize a body requires some energy.
2. In order to build the power plant near Northfield (USA), three miles of tunnels were drilled.
3. The distance to be covered was equal to ten miles.
4. To reduce the power losses, thick wires should be used.
5. No additional components were used since they were not needed to actuate the relay.
6. Various installations were used in order to transform electric power into mechanical, heat, and chemical power.
7. At least 90 per cent of electric energy to be generated at present is a.c.

8. A.c. can be increased, or decreased to meet industrial requirements.
9. Gas turbines can be started within minutes, while steam plants may require hours to be put into operation.

35. What forms of infinitives are used in the Infinitive Complexes given below – Complex Subject or Complex Object?

1. Communication is supposed to have no limits nowadays.
2. The line appeared to be demagnetized.
3. Every battery is known to possess two terminals.
4. The output of machinery is known to be steadily increasing all over the world.
5. In some countries, the nuclear power plants are believed to produce about 80 per cent of the whole amount of energy.
6. The capacity of generating units was said to have been doubled.
7. What two conditions are necessary to cause an electric current to flow?
8. Ebonite, rubber, and glass are considered to be good insulators.
9. Nuclear plants are expected to be located away from urban areas.
10. The use of underground transmission lines is known to have been increased.
11. By 1959, maximum transmission voltages were proclaimed to have been increased to 345,000 volts.
12. The most important problems in atomic power generation are known to be concerned with the reactor. The light-water reactor types seem to be most promising.

The Participle

Причастие

В английском языке имеется пять форм причастия:

	Active	*Passive*
Participle I	using	being used
Participle II	–	used
Perfect Participle	having used	having been used

36. Copy the sentences below and underline participles. Say what forms of participles are used. Translate the examples into Russian in writing.

1. The energy lost in the capacitor appears in the form of heat being generated in the dielectric.
2. The problem being discussed is of no great importance for practice.
3. The generators constructed at the plant have no commutators.
4. The code widely used is called Morse code.
5. While passing through the conductor, resistance results in the production of heat.
6. Having been insulated with polythene, the line was tested under unfavourable conditions.
7. Having made a number of tests, the researcher got some useful results.
8. Having been tested under different conditions, the motors were put to use.
9. When being rubbed, some substances produce electric charges.
10. Decelerating trains and descending elevators use negative, or braking, torque.
11. In what way is the transmitter controlled in an amplitude-modulated system?

37. Say which *-ing* and *-ed* forms are parts of the predicates and which are participles.

1. Water-turbine plants are called hydroturbines.
2. The measures discussed are to be used for determining the faults in the conducting wires.
3. The transmission system selected for everyday use is based on the combined activity of telecommunication and computers.
4. Being a semiconductor, germanium is widely used in transistors.
3. Switch board is an assemblage of controlling and indicating devices mounted upon a frame.
6. The data obtained formed the basis for further activity.
7. Gas coolants used to remove heat losses help to increase the current-carrying capacity of the motor's main parts.
8. Water power is being used to drive a dynamo.
9. Nuclear fuel is undergoing nuclear fission.

38. Which of the examples contain the Nominative Absolute Construction? Underline «the doer» in the constructions.

1. The reflected signal having been received, the distance to the object was counted.
2. Having been impregnated, paper is used as resistor.
3. What is an electric arc? It is a discharge accompanied by a temperature of over 3,000°C, produced when an electric current flows through a gap between two electrodes, the current being carried by the vapour of the electrode.
4. Various kinds of windings used depend on the type of building and location. The supplies required include metal conduits, boxes, fuses, and other elements.
3. Other factors being constant, the current is known to be directly proportional to conductivity.

The Gerund

Герундий

Герундий имеет четыре формы:

	Active	*Passive*
Indefinite	supplying	being supplied
Perfect	having supplied	having been supplied

39. What are the forms of the gerund in the examples given below? Translate the sentences into Russian.

1. Programming is the process of preparing, testing and correcting instructions for a computer.
2. Is any metal capable of being drawn out into a wire?
3. After having been subjected to severe testing the material was recommended for use.
4. A motor-starter is a device for starting motors from rest by the simple act of closing the switch.
5. A constant speed of the device is maintained by supplying it with energy.
6. Steam is an important factor in producing usable energy because of the power being created by its expansion.
7. One of the problems modem research laboratories are working at is the problem of finding materials that can serve as electrical conductors in fusion reactors.
8. On having lost some of its electrons, the atom has a positive charge.

40. Use Participle I, Participle II or the Gerund of the verb in brackets and translate the sentences.

1. (*Cool*) an electric conductor results in its reduced resistance to electric current.
2. What is the name of an (*insulate*) material (*use*) to prevent an electric shock?
3. The (*apply*) technique brought about quite unexpected results.
4. Mica is used as a dielectric due to (*have*) high voltage strength.
5. The world's first tidal power station, a plant on the Rance River in France, began (*operate*) in 1966.
6. Solar energy has been converted to electricity by (*use*) solar cells, which are semiconductor devices (*produce*) from thin slices of silicon.

The Subjunctive Mood

Сослагательное наклонение

41. Read the following sentences, containing the Subjunctive Mood forms. Which of the sentences refer to the Present (the Future) and which to the Past?

1. Zero-resistance transmission lines would be very economical!
2. Without these means of communication the scientists would have great difficulties in observing man-made satellites.
3. If thin wires had been used in this device the wires would have melted.
4. If the operators had used some additional components they would have been able to actuate the relay.
5. We know a moving magnet to induce a current in a wire, the effect being stronger if the wire were in the form of a coil.
6. It was a job one could have done much better.
7. Without the Sun there would be no light, no heat, no energy of any kind.
8. Oxygen is an element of greatest importance to the Earth as all living things would die without it.

9. If it were not for lasers a great number of technological developments would not have taken place.
10. In some hot countries the use of only one percent of the solar energy would serve an enormous source of energy.
11. No subject is more surprising than magnetism; what would you think if you found that on mixing ebonite and bakelite in some definite proportions a good conductor is formed or that a mixture of copper and iron forms a good insulator?

The Emphatic Construction

Эмфатическая конструкция

42. Translate the sentences into Russian.

1. It is from the Greek word *electron* that the word *electricity* is formed.
2. It is the force of gravitation that makes the satellites move round the Earth.
3. It was the need for large-scale ballistic computations which gave rise to the development of electronic computers.
4. It was in 1882 that P. Chebyshev invented the arithmometer performing multiplication and division.

43. Change the following sentences into the emphatic ones in writing.

Model: B. Pascal invented the mechanical computer.
It was B. Pascal that invented the mechanical computer.

1. N. Wiener is considered to be the father of cybernetics.
2. The special terms in any subject serve the keys to understanding it.
3. Oil, natural gas and nuclear power each have important roles to play in the energy industry.
4. The most precise clocks are being produced due to the invention of radio frequency quantum generators.

Punctuation Marks

Знаки препинания

Правила постановки запятых в английском языке отличаются от этих правил в русском языке.

Запятая ставится:

1) для выделения вводных элементов предложения:

Big power stations, up to 4,800,000 kW, were being constructed.

2) для отделения самостоятельного причастного оборота:

Measuring devices being widely used, their characteristics are constantly improved.

3) для выделения придаточных предложений, если они сообщают дополнительные сведения или служат пояснением к главной мысли:

The insulation, that may be of air or of a solid dielectric, separates the conductor from the axis.

4) после обстоятельственного причастного оборота в начале предложения:

When tested, the motor broke down.

5) запятая ставится перед словом *which*, если оно относится не к одному слову, а к предыдущей части предложения:

New plastic materials had been produced, which led to producing new types of isolators.

6) однородные члены предложения отделяются друг от друга запятой. Перед завершающим перечисление союзом *and* часто также ставится запятая:

Frequency is known to be the number of cycles, oscillations, and vibrations of a wave motion or oscillations in unit time, usually one second

Common faults in a transformer are an open in the winding, a short between the primary and the secondary, and a short between turns.

Запятая не ставится:

1) перед придаточными предложениями:

Devices are classed according to the use they are designed for.

Fijitsu transmission systems (Japan) can carry information very effectively. It is done by transmission systems which get it across the city and into the home.

2) перед союзами *but, because, provided, as, since …* :

The discharge of heated water into natural water systems has not developed any big problems as yet but continued growth in electrical power production may result in damaging environmental processes.

44. Insert commas where necessary:

1. Wattmeter is an instrument for the direct measurement of the power in watts of a circuit.
2. If two conductors are placed in contact or joined by a conductor of much lower resistance than the rest of the circuit most of the current will flow direct between these conductors which are then said to be short-circuited or «shorted».

3. Alternating current is a flow of electricity which after reaching a maximum in one direction decreases, finally reversing and reaching a maximum in the opposite direction.
4. A few pounds of uranium can supply a medium-sized town with power it needs for a year.
5. Since the energy sources of the world are decreasing it is necessary to turn to atomic energy.
6. The engine cannot be restarted until its oil level is brought up to the correct level.
7. Pierre Curie examined properties of crystals which led him to the discovery of piezoelectric properties.
8. The capacity of the generating units has been increased which made it possible to build super-high-capacity power stations.
9. Each transformer has a nameplate attached to the tank. It bears the transformer's ratings its type its capacity number of phases group of winding frequency method of cooling indoor or outdoor mass the name of the plant and some other data.
10. The instrument should be packed in a box which will prevent dust and dirt from getting inside its mechanism.
11. The article the speaker referred to is known to be published in the magazine «Modem Means of Communication».
12. The amount of heat depends on the current and the time it flows.
13. New plastic materials were invented which led to producing new types of isolators.
14. The device was connected to the cable under test which made it possible to detect the fault.

3. Materials for Reading and Discussing

Материалы для чтения и обсуждения

Work with a Dictionary

Работа со словарем

English Alphabet

Английский алфавит

Aa	[eɪ]	Hh	[eɪtʃ]	Oo	[ou]	Vv	[viː]
Bb	[bɪ]	Ii	[aɪ]	Pp	[piː]	Ww	['dʌbljuː]
Cc	[sɪː]	Jj	[dʒeɪ]	Qq	[kjuː]	Xx	[eks]
Dd	[diː]	Kk	[keɪ]	Rr	[ɑː]	Yy	[waɪ]
Ee	[iː]	Ll	[el]	Ss	[es]	Zz	[zed]
Ff	[ef]	Mm	[em]	Tt	[tiː]		
Gg	[dʒiː]	Nn	[en]	Uu	[juː]		

English Sounds

Звуки английского языка

Гласные: [eɪ], [æ], [ɑː], [ə], [iː], [ɪ], [e], [əː], [ɔː], [ɔ], [juː], [uː], [u], [ʌ], [aɪ], [au], [ɔɪ], [ou], [ɪə], [ɛə], [uə].

Согласные: [b], [d], [f], [g], [dʒ], [ʒ], [h], [j], [k], [l], [m], [n], [ŋ], [θ], [ð], [p], [r], [ʃ], [s], [t], [tʃ], [v], [w], [z].

Для успешной работы с англо-русским словарем необходимо твердое знание последовательности расположения букв в английском алфавите. Выполняя приведенные ниже упражнения, проверьте свое знание английского алфавита. Сделайте выводы!

• Rewrite the vowels and the consonants in the alphabetical order:

1. I, E, Y, A, O, U _____
2. F, B, H, J, M, L, D, G, K, C _____

• What two letters follow the following letters?

B, …, …, G, …, …, F, …, …, H, …, …, L, …, …, S, …, …, T, …, …, W, …, …

• Name the last five letters of the alphabet.

Слова в словаре даются в их исходной форме: для имени существительного – общий падеж; для прилагательного и наречия – положительная степень (сравнения); для глагола – инфинитив (неопределенная форма).

Исходную форму слова мы устанавливаем, отбрасывая его грамматическое окончание. Это могут быть словоизменительные суффиксы *-(e)s, -(e)r, -(e)st, -(e)d, -ing*.

Как и русское, английское слово многозначно. В словарях обычно приводятся несколько значений слова. Иногда их количество весьма велико (см., к примеру, такие многозначные слова, как *take, set, get, put*). Наша задача – выбрать из данных значений то, которое соответствует контексту. Однако среди значений, данных в словаре, такового может и не быть! В этом случае надо самому найти нужное русское слово, осмыслив его значение в контексте. Если в словаре отсутствует производное слово, надо выбрать его корневую основу, отбросив суффиксы и приставки. К примеру, слово uselessness имеет три компонента: корень **use** (*польза*), отрицательный суффикс прилагательного **-less** и суффикс существительного **-ness**, имеющий абстрактное значение. При переводе получаем существительное *бесполезность, ненужность*, заметим, что значение отрицания в русском слове часто передается приставкой *бес-*.

Texts and Assignments

Тексты и задания

1. Read the text and find in it the answers to the questions that follow it.

An electric cell supplies electric energy provided its electrodes are of different materials. In case the electrodes are of the same material they become charged but there is no difference of potential across the terminals. Iron and zinc plates are commonly used for producing negative electrodes since these materials produce a high charge. Carbon is commonly used to produce positive electrodes.

The voltage output of cells in use nowadays is from 1 to 2 V. The value of the output depends only on the materials used for the electrodes. Besides, it depends on the electrolyte of a cell. It does not depend on the size of a cell and its construction, while the current capacity of a cell depends on the size of the electrodes. The larger the size of the electrodes, the more current capacity they can supply. When the size of the electrodes is increased the current capacity also increases while the voltage output does not increase. Such is the relation between the size of the electrodes and the current capacity.

1. **What element is described in the text?**
2. **In what case does a cell supply energy?**
3. **What materials are commonly used for producing negative electrodes?**
4. **Explain why iron and zinc are used.**
5. **What is the voltage output of cells in use nowadays?**
6. **What does the value of the output depend on?**
7. **What is the relation between the size of the electrodes and the current capacity?**
8. **Give the title to the text.**

2. Read the text and find in it the answers to the questions that follow it.

The capacity of a capacitor is measured in farads. A capacitor has a capacity of one farad when a charge of one coulomb increases the potential between its plates by one volt.

The capacity depends on four things:

first, the higher the voltage used to charge the capacitor the more energy it will store;

second, the larger the size of plates and the greater their number the more energy will be stored;

third, the closer are the positive and negative plates the greater is the charge;

fourth, some insulators store greater charge than others.

1. What does the capacity of a capacitor depend on?

2. Give the title to the text.

3. Read the text and find in it the answers to the questions that follow it.

Wattmeter

A wattmeter is used to measure the value of power. It is connected to the circuit directly. A wattmeter consists of coils: two fixed coils and a coil which moves in the magnetic field produced by the fixed coils. Wire used for the coils must have a high resistance; the fixed coils are in series with the load, the moving coil is connected across the line in series with a resistance. When a wattmeter is used, the readings on its scale show the value of power being used.

1. What is the wattmeter used for?

2. What does it consist of?

3. In what way are the elements connected?

4. What do the readings on the scale show?

4. Read the text and find in it the answers to the questions that follow it.

Rheostat

A rheostat is a resistor whose resistance value may be varied. Thus, a rheostat is a variable resistor.

It is used to change the resistance of circuits, and in this way to vary the value of current.

A rheostat consists of a coil and a switch. Take into consideration that wire used for the coil must have a very high resistance. When a rheostat is used its terminals are connected in series with the load. The switch is used to change the length of the wire through which the measured current passes. The resistance may be changed to any value from zero to maximum.

The longer the rheostat wire used in the circuit, the greater is the resistance.

1. What type of resistor is a rheostat?

2. What is a rheostat used for?

3. In what way does a rheostat vary the value of current?

4. What elements does a rheostat consist of?

5. In what way are the terminals connected with the load?

6. What is the function of the switch?

5. Read the text and find in it the answer to the question that follows it.

Voltage Values

Voltages up to about 250 V are called low. The common electric lighting circuit operates either at about 127 or 200 V, and the voltage used on the main circuit of large houses is usually the same. One can get an electric shock, when one touches an uninsulated wire of such a circuit.

Voltages above 250 V are high voltages. They are used in industry. Medium-powered motors are usually operated at 380 V. Large motors are supplied by voltages of from about 500 up to 6,000 V.

What have you read about?

6. Read the text and find in it the answer to the question that follows it.

High-Frequency Current

Alternating current with frequency of 50 c/s is widely used in industry. Therefore this frequency is called an industrial frequency and' the current, an industrial frequency current.

During sound transmission, current flowing in telephone wires changes with the frequency of sound oscillations, which ranges from 50 to 10,000 c/s. The currents of such frequencies are called audio- or low-frequency currents.

Radio transmission is based on the use of alternating currents with frequencies of hundreds, thousands, millions and even tens of million cycles per second. These currents called high-frequency currents are produced by means of an oscillatory circuit consisting of a coil and a capacitor. Moving along the turns now in one direction now in another, the electric charges oscillate in an oscillatory circuit.

By what means are high-frequency currents obtained?

7. Read the text and find in it the answers to the questions that follow it.

HV Power Transmission

A high-capacity hydrogenerator produces an a.c. current at 22,000 V. The current with the potential difference of 220,000 V is produced by means of the transformers at a step-up station and then transmitted over the power lines.

The current potential difference is lowered to medium 6,600 V at the main step-down substation at the end of the line. From here the power is transmitted to

the next substations. Transformers stepping the voltage down from 6,600 V are installed at those substations.

Due to voltage conversion, alternating current is used widely in industry. Direct current for battery charging for trams, trolleybuses and electric locomotives is changed from alternating current by means of rectifiers.

1. Where is the current potential difference lowered?

2. Where is the main step-down substation installed?

8. Read the text and find in it the answers to the questions that follow it.

Meters

One of the important things that an engineer should take into consideration is «how much»? How much current is this circuit carrying? What is the value of voltage in the circuit? What is the value of resistance? In fact, to measure the current and the voltage is not difficult at all. One should connect an ammeter or a voltmeter to the circuit and read off the amperes and the volts.

Common ammeters for d.c. measurements are the ammeters of the magneto-electric system. In an ammeter of this type an armature coil rotates between the poles of a permanent magnet; but the coil turns only through a small angle. The greater the current in the coil, the greater the force, and, therefore, the greater the angle of rotation of the armature. The deflection is measured by means of a pointer connected to the armature and the scale of the meter reads directly in amperes.

When the currents to be measured are very small, one should use a galvanometer. Some galvanometers detect and measure currents as small as 10^{-11} of an ampere per 1 mm of the scale.

A voltmeter is a device to be used for measuring the potential difference between any two points in a circuit. A voltmeter has armatures that move when an electric current is sent through their coils. The deflection, like that of an ammeter, is proportional to the current flowing through the armature coil.

A voltmeter must have a very high resistance since it passes only very small currents which will not disturb the rest of the circuit. An ammeter, on the other hand, must have a low resistance, since all the current must pass through it. In actual use the ammeter is placed in series with the circuit, while the voltmeter is placed in parallel with that part of the circuit where the voltage is to be measured.

In addition to instruments for measuring current and voltage, there are also devices for measuring electric power and energy.

1. What is the above article about?

2. What is a voltmeter used for?

9. Read the text and find in it the answers to the questions that follow it.

Negative Transconductance Oscillator

A negative transconductance oscillator consists of a pentode with the screen and suppressor grids coupled together. The screen is more positive than the plate. The cathode supplies electrons to both the screen and the plate. If the screen voltage rises, this increase is transferred over to the suppressor. It becomes more positive than before. A large quantity of electrons passes to the plate and a small quantity of electrons passes to the screen. Thus, the screen current is reduced. A negative resistance characteristic is produced in the screen circuit at the terminals.

A tuned circuit is connected to the terminals and in this way oscillations are produced.

1. In what way is the screen current reduced?

2. What does negative transconductance oscillator consist of?

10. Read the text and find in it the answer to the question that follows it.

What are the names of the Oscillators?

Many types of oscillator circuits are used nowadays. Their tube types, tank circuits, and feedbacks are different.

Examine the diagrams given below. To answer this question read the following texts.

1. **The Electron-coupled Oscillator** uses a multi-grid vacuum tube with a cathode and two grids operating in common. In this device the plate circuit load is coupled to the oscillator through the electron stream. The diagram shows a tetrode variant using a series-fed oscillator.

2. **The Dynatron Oscillator** uses the negative resistance characteristic of a tetrode tube to eliminate the resistance of its tank circuit in order to keep oscillations.

3. **The Blocking Oscillator** uses a plate transformer to provide the feedback voltage.

4. **A Multivibrator** is a form of oscillator using two RC-controlled triodes.

5. **The Tuned Plate – Tuned Grid** oscillator has parallel or resonant circuits in both plate and grid circuits. The necessary feedback is supplied by the plate-to-grid interelectrode capacitance.

Name the five oscillators in Fig. 20.

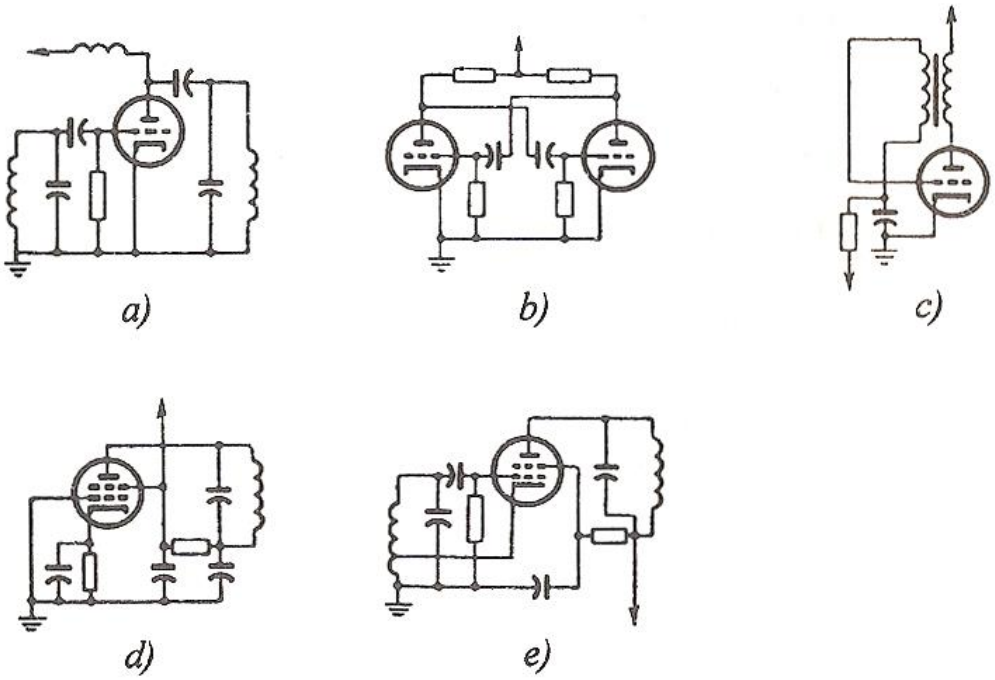


Fig. 20

11. Read the text and find in it the answer to the question that follows it.

Solar Energy

The Sun radiates to our planet great amounts of energy. This energy input fuels all our biological processes and is the original source for hydropower, wind power, and fossil fuel resources. Environmentally and economically, die Sun is our greatest energy source. Why then is the direct use of solar energy so limited for industrial, domestic, commercial, and transportation purposes?

First, solar energy arrives in small quantities – only about one kW per square meter; second, it does not arrive at all during night hours. Third, it is very difficult to transform it into useful energy forms except low-grade heat.

Why is the direct use of solar energy limited nowadays?

12. Read the text and find in it the answer to the question that follows it.

Superconductivity

In the electric generating field, as well as in the electric-transmission and storage-technology areas, considerable attention is focused on the use of superconductivity conductors. Cooling an electric conductor to temperatures close to absolute zero (-273°C) results in the conductors' losing their resistance to electric current. Accordingly, their ohmic losses also drop greatly. Current densities of tens of millions amperes per sq. cm can be tolerated in such conductors.

Cryogenic technology being now mastered, one can foresee the possibility of supercooling not only generators but also underground transmission lines and storage coils.

Are these statements true or false?

a) Conductors can never lose their resistance to the flow of electric current.

b) Generators and underground transmission lines can be supercooled.

13. Read the text and find in it the answer to the question that follows it.

Metals Used as Conductors

The use of electricity depends upon a means of conducting it from its source to the point where it is to be used. Copper has been used as a conductor since the beginning of the industry and no proper substitute has been found. Only one metal, silver, is more efficient, but it has too high cost to be extensively used.

Aluminium, because of its lightness, is used in common practice for transmission lines where long spans are necessary. It has, compared to other metals, a conducting capacity of about 60 per cent of that of copper.

Why cannot silver be extensively used?

14. Read the text and find in it the answers to the questions that follow it.

Switchboard

Switchboard is an assemblage of switches, controlling or indicating devices mounted upon a frame for the purpose of control or an inspection of an electric path, circuit or system of circuits. Usually it is a metal frame carrying vertical slabs with switches, controlling handles and indicating or controlling instruments mounted thereon in an electric central station or distributing centre.

1. What is described in the text?

2. Where is the device used?

15. Read the text and find in it the answers to the questions that follow it.

Dynamo

Dynamo is a common device for converting mechanical energy into electric energy. This process depends on the fact that if an electrical conductor moves across a magnetic field, an electric current flows in the conductor.

Usually a dynamo includes an electromagnet, called the field mag net, between the poles of which a suitable conductor, usually in the form of a coil, called the armature, is rotated. The mechanical energy of the rotation, in the form of a current in the armature, is thus converted into electric energy.

1. What device is described in the text?

2. What types of the device do you know?

16. Read the text and find in it the answers to the questions that follow it.

Test Blocks Types B-4 and B-6

The types B-4 and B-6 test blocks with test plugs are designed as multipole connectors in the circuits of protective relays and measuring instruments.

The test blocks provide an easy and safe checking and replacement of relays and instruments during operation without breaking connections in wiring and on terminal blocks.

The test blocks are made in several versions which differ in the number of poles and in the way of wire connection.

Design. The test blocks consist of two units: the base and the removable cover.

While testing, the cover is removed and is replaced by the test plug which is inserted into the base and is electrically connected to the circuit for testing purposes.

Technical data. Rated voltage: 250 V; rated current: 5 A. Test voltage: 2 kV, a.c. 50 c.p.s. Transient stability: 300 A. The insulation resistance at ambient temperatures of 20±5°C should be not less than 2 megohms at relative humidity up to 80%, and not less than 2 megohms at relative humidity of 95%.

Mounting. Test blocks are mounted on the front panel. Before mounting, blocks should be provided with current-carrying pins.

Operating conditions. The blocks are designed for indoor use in stationary installations at ambient temperature and relative air humidity which are indicated. The blocks are produced in three types of designs: 1. conventional; 2. export; 3. tropicalized. Ambient temperatures for the blocks of the first type of design are from -20 up to +35; for blocks of the second type – from -10 up to +35, and for the third type – from -10 up to +55. As to relative air humidity, it is also different for different types of devices. For the first type it is 80% at 20±5°C; for the second type it is also up to 80% in the same range of temperatures, and for the third type it is 95% at 40°C.

The test blocks are not to be used a) in an atmosphere containing current-conducting dust or gases which damage metals and insulation; b) where shock and vibration can take place; c) in an explosion-hazardous atmosphere.

The delivery set includes a) base; b) cover; c) fastenings for mounting blocks and connections of wires.

Order form. When ordering, state the type of the block, kind of wire connection and number of units. For example, ORDER: Test block type B-6 for back connection – 3 pcs (= pieces).

1. What are the main characteristics of test blocks types B-4 and B-6?

2. When are the test blocks described not to be used?

17. Read the text and find in it the answers to the questions that follow it.

Compressed-gas-insulated Transmission

Transmission lines in which compressed gas is used as insulator have a number of advantages. The main advantages are simplicity of construction and low cost.

What is the construction of compressed-gas-insulated transmission lines? It is rather simple. They comprise a number of phase conductors; each phase conductor is placed inside a tube and centered by means of circular spacers. The tube space is filled with compressed gas − usually sulphur hexafluoride. Each tube in a 345-kV line has a diameter about 50 cm.

The system including compressed-gas-insulated transmission has the following advantages: its losses are rather low, they are considerably lower than those of cable transmission. Unlike cables, compressed-gas- insulated transmission system can be designed for ultra high frequencies. No external electric field appears in the system. The shunt capacitance is considerably less for a gas-insulated line than for a cable. A gas-insulated line can thus transmit power over larger distances than cable lines.

The system should be protected against metallic particles. In case metallic particles get into the system, they cause a fault – a dielectric breakdown.

1. Does the system described have any advantages? What are they?

2. What gas is the space filled with?

3. Why should the system be protected?

18. Read the text and find in it the answers to the questions that follow it.

Starting Resistors Types 50-51

The electrical block resistors are generally used in starting and regulating installations for motors of any type and power.

Starting resistors have the capacity to support very high temperature variations, to which they are subjected due to their operating duty, without alteration or distortion.

Resistors consist of silicon sheet-steel or of special cast iron elements. Said elements are grouped in an assembly by means of steel rods interlocked by bolts in order to obtain rigid assemblies. These units are suitable for use in any type of machine and operate under high vibration conditions. For protection purposes, the resistor units are assembled in sheet-steel cases supplied with ventilation slits.

Starting resistors have a number of advantages; they are unbreakable, light, rigid; they can withstand, without variation, vibration and shocks. They are also easily detachable; their elements are interchangeable. Resistors are intended for operation in an ambient temperature of up to 300°C.

1. What device is described in the article?

2. What is the device used for?

3. What elements does it consist of?

4. What are the advantages of the device?

19. Study Fig. 21 and complete the sentences stating what metals are used for producing the devices *a-e*.

What Metals Are Used in Making Electrical Devices?

1. *Alnico* is an alloy of iron, aluminium, nickel, and cobalt used in making … .
2. *Phosphor bronze* springs are used to produce … .
3. *Tungsten* is used in … .
4. *Nickel* and *cadmium* are used in … rechargeable.
5. *Nichrome* is high-resistance alloy of nickel and chromium used for … .

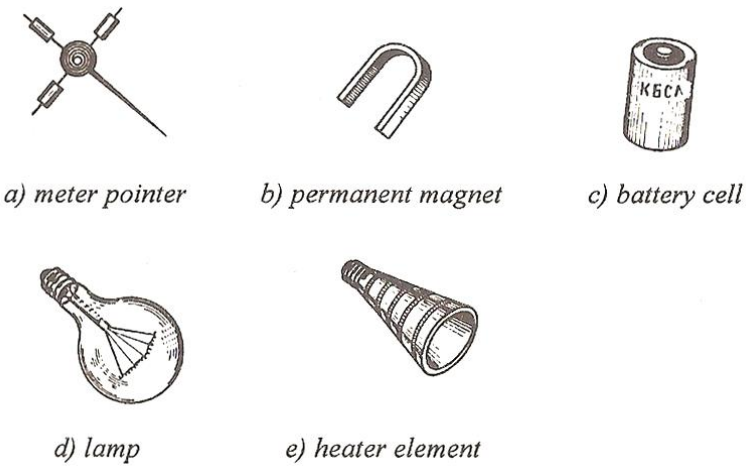


Fig. 21

20. Arrange the paragraphs of the text in the logical order.

Aviation Signal

A glass tube filled with neon gas was found to be suitable for this kind of work. Instead of a neon lamp, in some cases, a low current filament lamp may also be used as a signalling source.

In order to assist the aviator in locating the transmission line, a signal marking its position is provided; this signal is a luminous lamp attached to the conductors of the transmission line; the lamp is lighted by the potential on the line and serves to indicate its position. This signal also makes a safety device. If the line is under

tension, the attending personnel working on it will know that potential is on the line.

A high tension transmission line leading from one city to another makes a guideway for aviators during the day time, since it is visible from great distances. However, at night the high tension transmission line becomes a danger for the aviator, rather than a help.

21. Read the text and find in it the answers to the questions that follow it.

Thermal Steam-turbine Power Plants

Large steam-turbine plants have two forms: condensing plants or electric power plants.

The great masses of hot steam, having accomplished the mechanical work in the turbines of condensing steam-turbine plants, are condensed, i.e. are cooled down and turned back into distilled water, and returned to the boiler for production of steam to activate the turbine.

Condensation of steam takes place in condensers where the hot steam is cooled when it comes in contact with tubes through which cold water, supplied from a water reservoir (river or lake), is circulated. This cooling water, after it takes the heat from the spent steam, is returned to the water source carrying along with it the unutilized heat energy. This water is called the circulating water. The importance of the distilled water for feeding steam boilers is extremely great since chemically clean water decreases the formation of scale in the boiler tubes, and, thus, makes their service life longer.

Condensing plants of large generating capacity are built close to sources of fuel, in order not to transport large quantities of fuel over considerable distances.

The electric power generated in such plants is transmitted over long distances for the supply of large industrial regions. So these plants are called regional thermal power plants.

Heat and electric power plants, in addition to electric power generation, also supply heat to closely located consumers (within a radius of 50 km), i.e. serve as district heat plants. To such heat consumers belong all kinds of industrial enterprises that require heat for production purposes, and also municipal consumers such as baths, laundries and the heating systems of dwelling houses and other buildings.

The electric power developed by the generators is fed to the switchboard of the plant, whence it is delivered by overhead transmission and cable lines to the consumers.

1. In what part of the power plant does condensation of steam take place?

2. Why is distilled water used for feeding steam boilers?

22. Arrange the paragraphs of the text below in the logical order.

Testing Motors and Generators

It is of great importance, therefore, to make regular tests of insulation resistance of all machinery so as to detect possible faults. Different conditions may influence the value of the insulation resistance.

It is advisable, therefore, to make the test of the machine as soon after it has been shut down as possible, when the insulation resistance is likely to be lowest. If, after the motor has just been shut down, the insulation resistance is found to be satisfactory, it may be assumed that it will be better at any other time provided that the machine does not stand idle for long in a humid atmosphere.

Faults on electrical machinery must be due to one of two causes. One is the absence of continuity in the conductor which is supposed to be carrying the current. The other is the absence, or partial absence, of insulation. The latter is by far the more common and the more dangerous of the two. A burnt out armature, for example, is usually due to insulation failure.

A drop in insulation resistance may often be accounted for, for example, by damp weather.

As regards the effect of temperature it should be noted that the insulation resistance of motors and generators is generally lower when they are hot than when they are cold as the insulating varnishes used in the building of the machines have a lower resistance when hot than when cold.

23. Read the text and find in it the answer to the question that follows it.

How to Make Tests on Installations

a) Insulation tests to earth.

Disconnect the supply by opening the main switch and withdrawing the main fuses.

Insert all fuses at the distribution board (see Fig. 22).

Insert all lamps.

Close all single-pole switches.

Join together the two contacts on the installation side on the main switch, and connect them to one terminal of the Insulation Tester used.

Connect the other terminal of the Tester to the conduit in which the wiring is run or, if lead-covered cable is used, to the lead sheathing. A second connection should also be made to the consumer's main earth. This second connection is, however, unnecessary if the continuity and earthing of the conduit had been previously tested.

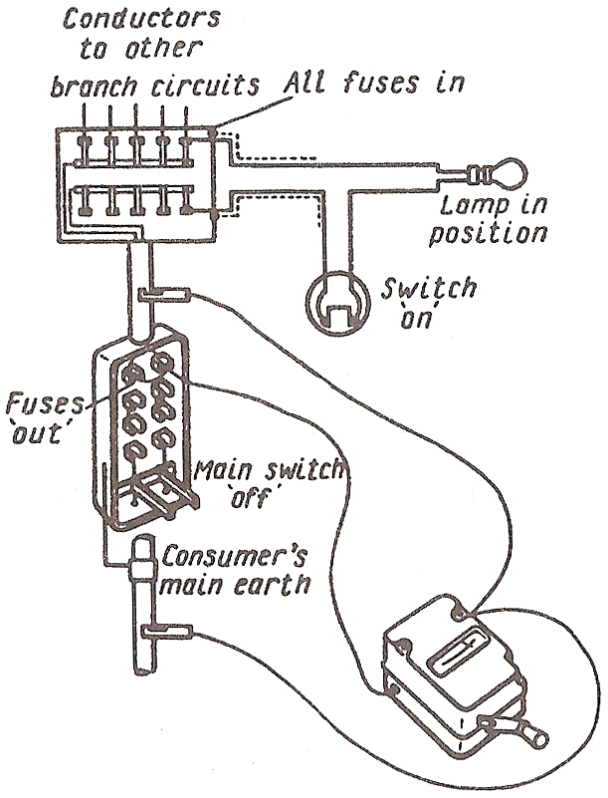


Fig. 22. Insulation test to earth

Turn the handle of the Tester at about 160 r.p.m. and take a reading.

In case the result of the test is considered satisfactory the installation is in proper order so far as resistance to earth is concerned.

If, however, the values obtained are not sufficiently high, withdraw all fuses at the distribution fuse board and test again. This test should include only the portion of the installation between the main switch and the busbars of the fuse board.

If the fault is not detected, one should proceed to the distribution fuse board and test each branch circuit in turn till the faulty circuit or circuits are discovered. These should be subjected to further tests till the actual fault is detected.

b) Insulation test between conductors.

Remove all lamps.

The main switch should be opened, all fuses inserted at the distribution board, and all single-pole switches in the closed or «on» position.

Connect one terminal of the Insulation Tester to fuse contact and the other to another contact and make a test.

Two readings should be taken on an insulation containing two-way switches, one with both switches on the «on» position and the other with both switches in the «off» position.

If the result of the test between conductors is also satisfactory, no further insulation tests are necessary and the insulation may be considered to be in order.

If, however, the results of the tests are unsatisfactory, proceed to the distribution board, withdraw all fuses and test each branch circuit individually between conductors until the faulty circuit or circuits are located.

What elements should be disconnected, inserted, closed, joined together, connected, etc. for making test on installations?

24. Read the text and find in it the answers to the questions that follow it.

Contactors Type 370

These contactors consist of the following main parts:

- one fixed bar
- one magnetic circuit which may be either a.c. or d.c.
- one or more auxiliary contacts (the maximum number of auxiliary contacts is 4)
- one or more poles for use with a.c. or d.c. loads.

These components are to be installed.

Their functions are as follows: fixed bar has the function of supporting all the stationary parts of the contactor. At both ends it is provided with holes for mounting the contactor. Moving shaft is made of steel. It is insulated for the installation of both main pole and auxiliary moving contacts.

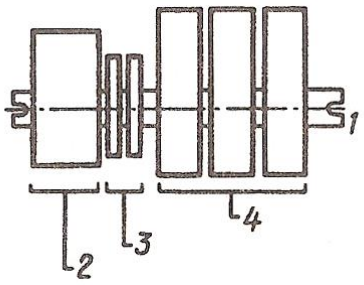


Fig. 23. Schematic positioning of the different contactor components: 1 – fixed bar; 2 – magnetic circuit: 3 – auxiliary contacts; 4 – poles

1. What are the main parts of the contactors?

2. Which are the functions of each of these parts?

3. Describe Fig. 23.

25. Read the text and find in it the answers to the questions that follow it.

Disconnecting Switches

Application. Indoor disconnecting switches are devices that are intended to make and break electric circuits rated at 6 to 10 kV, a.c. with no load currents. The single-pole disconnecting switches are controlled manually, by means of an insulated rod. The triple-pole disconnecting switches are controlled by means of manual lever-type operating mechanisms.

Mounting Instructions. 1. Clean the switch from dust and dirt. 2. Inspect it on the outside. 3. When insulating the switch, see that the bolts and switch terminals are reliably protected.

1. What are indoor disconnecting switches intended for?

2. What means are the single-pole switches controlled by?

3. What means are the triple-pole switches controlled by?

4. What recommendations do the mounting instructions include?

26. Think of 8-10 questions covering the contents of the text below. Use them in a talk with your groupmate.

Electric Power

Electric power is generated by converting heat, light, chemical energy, or mechanical energy to electrical energy. Most electrical energy is produced in large power stations by the conversion of mechanical energy or heat. The mechanical energy of falling water is used to drive turbine generators in hydroelectric stations, and the heat derived by burning coal, oil, or other fossil fuels is used to operate steam turbines or internal-combustion engines that drive electric generators. Also, the heat from the fissioning of uranium or plutonium is used to generate steam for the turbine generator in a nuclear power plant.

Electricity generated by the conversion of light or chemical energy is used mainly for portable power sources. For example, a photoelectric cell converts the energy from light to electrical energy for operating the exposure meter in a camera, and a lead-acid battery converts chemical energy to electrical energy for starting an automobile engine.

Electric power produced in large power stations generally is transmitted by using an alternating current that reverses direction 25, 50, or 60 times per second. The basic unit for measuring electric power is the watt – the rate at which work is being done in an electric circuit in which the current is one ampere and the electromotive force is one volt. Ratings for power plants are expressed in kilowatts (1,000 watts) or megawatts (1 million watts). Electric energy consumption normally is given in kilowatt-hours – that is, the number of kilowatts used times the number of hours of use. Electricity is clean, inexpensive, and easily transmitted over long distances. Since the 1880's, electricity has had an ever-increasing role in improving the standard of living. It now is used to operate lights, pumps, elevators, power tools, furnaces, refrigerators, air-conditioners, radios, television sets, industrial machinery, and many other kinds of equipment. It has been counted that in developed countries about 43% of the electric power is generally used for industrial purposes, 32% in homes, and 21% in commercial enterprises.

27. Read the text and find in it the answer to the question that follows it.

Electric Power Interruptions

On November 9, 1965, at 5:16 p.m., a back-up relay failed at one of the five main transmission lines at No. 2 station near Toronto, Canada. As the load had shifted to the other four lines, they became overloaded, and as a result the relays failed in all four lines. The failure resulted in the load being shifted to the other plants in the system. The plants got overloaded, which caused them to shut down. Within minutes, power plants in Canada, New York, and the New England states got out of service. The blackout affected 30 million people and covered an area of

306,000 sq. m. In some areas, such as New York City, power was not restored for about 13 hours.

This massive power blackout resulted in the construction of the national Electric Reliability Council in June 1958. This council sets standards for the design, operation, and maintenance of generating and transmission systems. These standards serve to prevent a failure in one power system from spreading to other systems. Yet local system failures cannot be avoided.

Nowadays in some European countries and in the US there are from 60 to 80 power interruptions per year, in which there is a loss of service for customers for more than 15 minutes. Mostly these interruptions are caused by weather conditions – ice, freezing snow, lightning or storms. There can be also failures of equipment – transformers, relays, insulators and so on. However, the reliability of electric service is extremely high.

Have you been a witness to an electric service failure? Describe it, please.

28. Read and translate the text. What do you think is meant by «Member countries»?

Give the new units for the following: röntgen, rad, rem, curie.

Quantities and Units

For many years, special measurement units for quantities of interest in radiation protection were used, which were not coherent with the International System of Units (SI). These old units (*röntgen*, *rad*, *rem* and *curie*) have been superseded in the last few years by a new set of units which are coherent with the SI system.

These new units, the *gray* for absorbed dose, the *sievert* for dose equivalent, and the *becquerel* for activity of radioactive materials, have been progressively adopted in Member countries, although some residual cases of use of the old units

are still being observed. The relationships between the new SI units and those previously used are shown in the following table:

Quantity	*SI Unit*	*New Name and Symbol*	*Old Unit and Symbol*	*Conversion Factors*
Exposure	kg^{-1}	–	röntgen (R)	1 C kg^{-1} = 3876 R 1 R = 2.5 × 10^{-4} C kg^{-1}
Absorbed dose	J kg^{-1}	gray (Gy)	rad (rad)	1 Gy = 100 rad 1 rad = 10^{-2} Gy
Dose equivalent	J kg^{-1}	sievert (Sv)	rem (rem)	1 Sv = 100 rem 1 rem = 10^{-2} Sv
Activity	s^{-1}	becquerel (Bq)	curie (Ci)	1 Bq = 2.7 × 10^{-11} Ci 1 Ci = 3.7 × 10^{10} Bq

29. Read the text and find in it the answers to the questions that follow it.

Electric Power Plants

The two main types of power plants traditionally have been the fossil-fuel steam-electric plant and the hydroelectric plant. Other types, including internal-combustion-engine plants and nuclear plants also have been built. The selection of a particular type of generating plant and its location involves consideration of a number of factors such as plant, fuel, and transmission line costs; availability of cooling water, and environmental considerations.

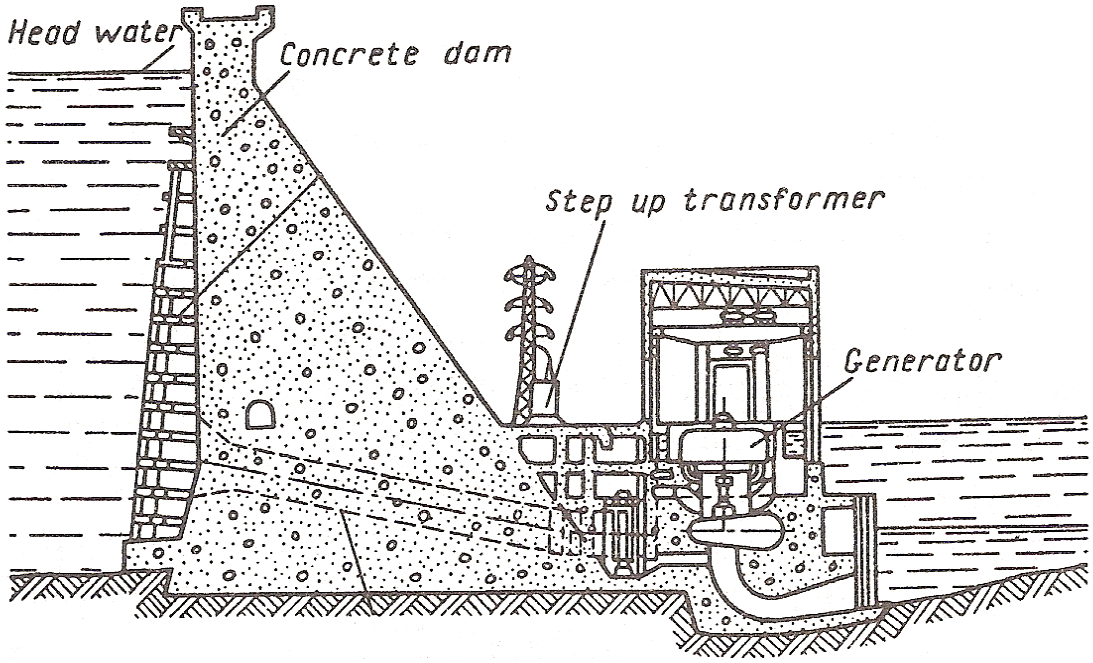


Fig. 24. Cross-section through the main structures and units of hydroelectric power plant

For several reasons, the relative importance of the various types of power plants has been shifting. Good sites for new hydroelectric plants have become scarce in many countries. Distribution networks have been extended so that less expensive power from large steam-electric stations has been replacing power from smaller diesel-generator units. Nuclear-electric power plants have been built instead of fossil-fuel steam-electric plants because the cost of coal and oil has been increasing.

In the United States in 1970, fossil-fuel steam-electric plants accounted for 76% of the power generated, hydroelectric plants for 16%, and nuclear plants for 2%.

In 2000 45% of the electric power in the United States is generated from fossil-fuel steam-electric plants, 45% from nuclear plants, and 10% from hydroelectric plants.

1. What kinds of power plants are in use nowadays?

2. What does the selection of a type of generating plant depend on?

3. For what reason are nuclear-electric power plants being built instead of fossil-fuel steam-electric plants?

30. Study Fig. 25 and read the text. Describe a nuclear power plant.

Nuclear Power Plants

The energy for operating a nuclear power plant comes from the heat released during the fissioning of uranium or plutonium atoms in a nuclear reactor. This fission heat is used to generate steam, which drives a turbine generator. Thus, there are two main differences between a nuclear power plant and a steam-electric power plant: the nuclear plant uses a nuclear fuel instead of a fossil fuel, and it uses a nuclear reactor instead of a boiler.

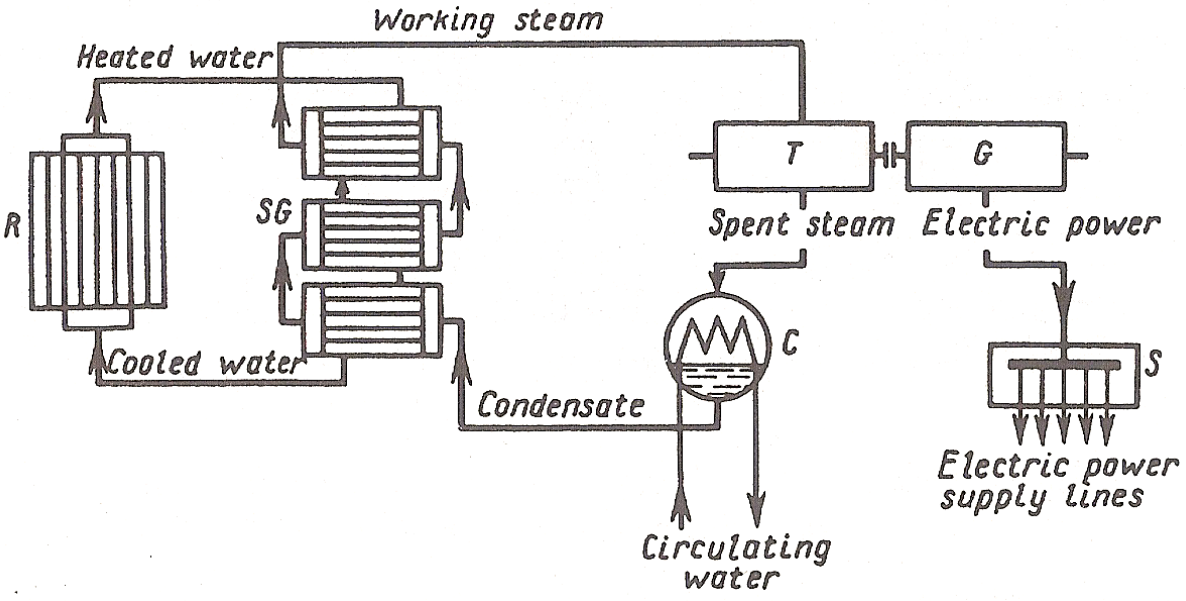


Fig. 25. Simplified production process diagram of nuclear power plant:

R – nuclear reactor; SG – steam generator; T – steam turbine; G – electric power generator; C – steam condenser; S – switchboard

The fissioning of uranium-235 or plutonium-239 atoms – the primary nuclear fuels – is caused by the impacts of neutrons on these atoms. The fission process not only produces heat but also several additional neutrons that can cause fissioning of other uranium-235 or plutonium-239 atoms. Thus, by proper arrangement of the atoms of the fuel, a sustained chain reaction can be maintained to provide a steady source of heat for operating a power plant. This chain reaction

is controlled by regulating the number and the energy of the neutrons as they proceed from one fission reaction to another.

There are various types of nuclear reactors. The major differences between them are the form of the fuel, the methods for controlling the number and energy of the neutrons, and the type of liquid or gas used to remove the heat from the reactor core.

31. Read the texts and find in them the answers to the questions that follow.

a) Windscale Accident

Throughout the years, accidents causing a release of radioactive material to the environment have occurred. Since World War II all over the world large scale nuclear facilities have been built and operated both for civil and defense purposes. Some of the sites on which these facilities were located are heavily contaminated with radioactive substances.

One of the first nuclear reactor accidents of environmental concern was the Windscale accident in October 1957. During the accident the military air-cooled graphite-moderated natural-uranium reactor used for plutonium production caught fire during the liberation of energy in the graphite. Emission from the Windscale lasted for 18 hours. Radioactive material was detectable in many parts of Western Europe but the majority of it was deposited in the United Kingdom.

1. How long did the emission from the Windscale reactor last?

2. What did the emission result in?

b) Chernobyl Accident

The accident, which was of global concern was the accident in Ukraine in the Chernobyl power plant located in Polesye on the River Pripyat.

On 26 April, 1986, Unit 4 of the Chernobyl nuclear plant suffered a major accident. The Chernobyl 4 reactor was a graphite-moderated, light-water-cooled

system. The installed electrical generating capacity was 1 GW. The accident followed some engineering tests of a generator.

During the tests, basic operating safety rules were being violated. Most control rods were withdrawn from the core and the safety systems were switched off. Two explosions and a fire that followed them damaged the reactor and the containment building. The graphite started to bum. Explosive energy was released, which resulted in the 1000 ton cover plate of the reactor being lifted up.

A prolonged release of large quantities of radioactive products transported by the cloud from Chernobyl was detected not only in northern and southern Europe but also in Canada, Japan, and the US.

The major part of the release took place over the period of' about ten days. There were two peaks in release rate (26th April and 5th May). Later on, the release continued for many weeks at a lower rate before the destroyed reactor was finally sealed, which took place some five months later.

Initially the cloud of radioactive material was carried over the Baltic Sea into Scandinavia. After a few days the wind direction rotated clockwise and the cloud travelled eastwards across the USSR and southwards to Turkey.

The total mass of the radioactive particles released in the accident was about 6000-8000 Kg. More than half of it was deposited near the plant but the rest travelled thousands of kilometres (see Fig. 26).

There is no doubt that the nuclear plant accidents offer a number of lessons to be learnt.

At present, over 200 nuclear power reactors for commercial electricity production operate in Europe.

The accident at the Chernobyl nuclear plant has shown that largescale accidents in nuclear power plants can lead to contamination of the entire continent.

1. What was the cause of the Chernobyl accident?

2. What was the path of the radioactive material released in the accident?

3. What can accidents at the nuclear plants lead to?

4. Make a talk on the Chernobyl accidents (use Fig. 26).

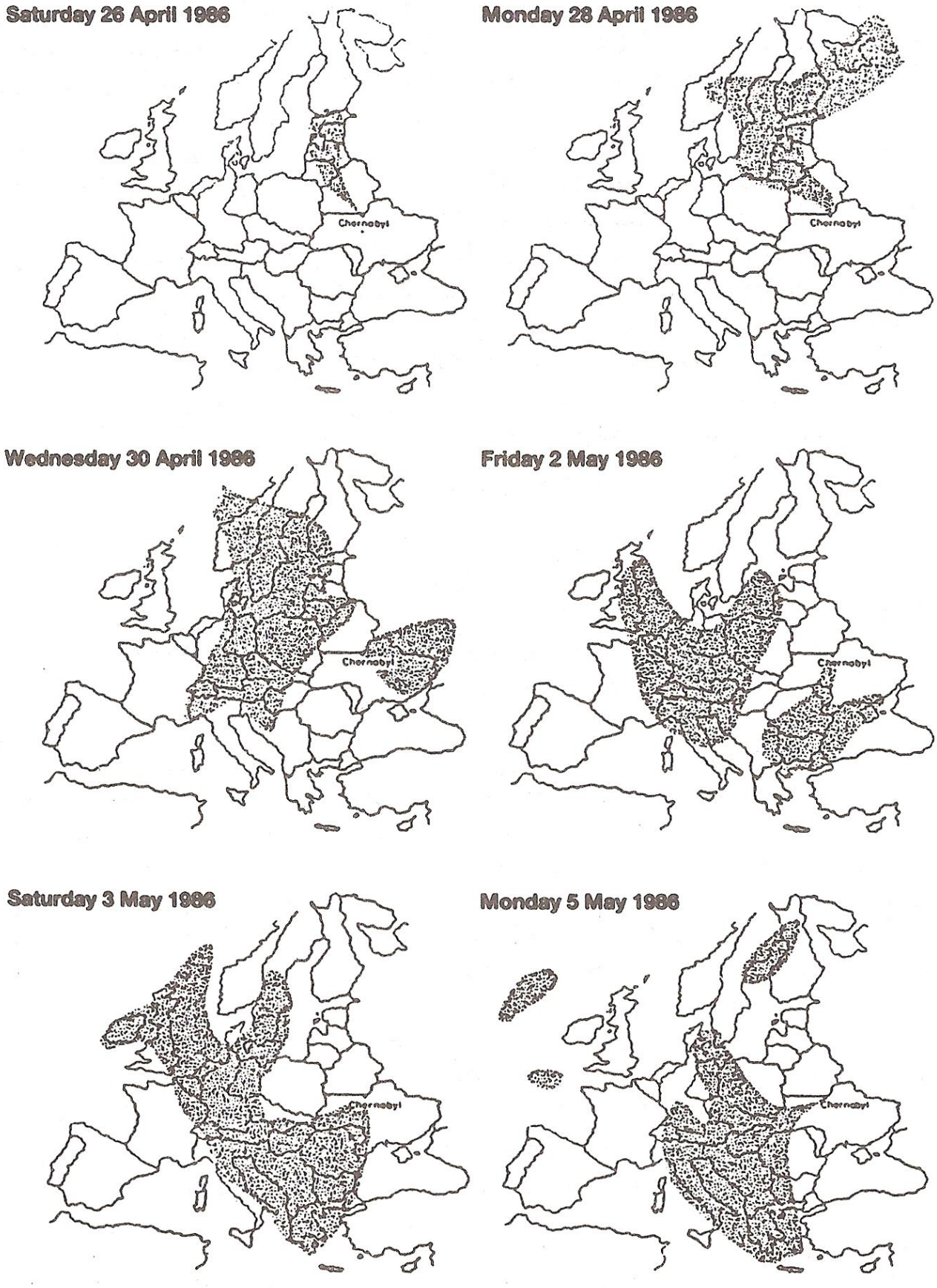


Fig. 26. Areas covered by the main body of the cloud on various days during the release.

Assignments in Writing

Письменные задания

Put down the title corresponding thematically to each of the given descriptions.

1) Titles: Two-phase System; Single-phase System, Three-phase System; Poly-phase System.

_____ 1. An a.c. distributing system employing a single phase at a.c. supplied by the generator;

_____ 2. An a.c. distributing system utilizing a number of alternating currents differing in phase;

_____ 3. An a.c. system employing three alternating currents of equal strength, differing in phase by one-third of a cycle;

_____ 4. An a.c. system employing two alternating currents of equal strength, differing in phase by a quarter cycle, or such that one current has maximum strength when the other is passing through zero.

2) Titles: Electric Current; Direct Current; Alternating Current; Continuous Current.

_____ 1. A current which always flows in one and the same direction;

_____ 2. A flow of passage of electricity along an electric circuit, usually measured in amperes;

_____ 3. A current which periodically alternates or reverses in direction;

_____ 4. A current uniform both in strength and in direction. A steady direct current.

3) Titles: Circuit Breaker; Controller; Control Power Switch; Line Switch.

_____ 1. A disconnecting or isolating switch in an a.c. or d.c. circuit;

_____ 2. A switch used for connecting or disconnecting the source or control power to and from the control bus or equipment;

_____ 3. A device for controlling an electric machine or a circuit (a controlling device);

_____ 4. A device for opening or closing a circuit, either by hand or automatically, in the case of an overload.

4) Titles: Voltage Balance Relay; Emergency Direct Current Relay; Current Balance Relay; Impedance Relay.

_____ 1. A relay which functions when the circuit impedance increases or decreases to predetermined value;

_____ 2. A relay which operates on a difference in current output or output of two circuits;

_____ 3. A device used to interrupt a direct-current power circuit under emergency conditions;

_____ 4. A relay which operates on a difference of voltage between two circuits.

5) Titles: Electric Motor; Synchronous Motor; Asynchronous Motor; Induction Motor.

_____ 1. An a.c. motor in which the rotation takes place in synchronism with the rotating element of the generator supplying the operating current;

_____ 2. A machine for transforming electric power into utilizable mechanical power;

_____ 3. An a.c. motor in which the rotation is not synchronous with the rotating element of the generator supplying the driving current;

_____ 4. An asynchronous a.c. motor in which the current flowing in the winding of the secondary winding is induced electromagnetically by the current flowing in the primary one.

6) Titles: Control Power T; Air-blast T; Oil-cooled T.

_____ 1. A T which is cooled, when operating, by a flow of oil through its framework;

_____ 2. A T which is cooled, when operating, by a blast of air delivered through its framework;

_____ 3. A T which serves as the source for a.c. control power for operating a.c. devices.

7) Titles: Feeder; Commutator; Converter.

_____ 1. A machine which operates by means of a rotating commutator to convert a.c. into d.c. for distribution;

_____ 2. In an electric distributing system, a supply conductor carrying current from a power-house to main conductors, and not itself connected to motors, lamps, or translating devices;

_____ 3. A device for changing the direction of a current.

8) Titles: Series Generator; Shunt Generator; Turbo-alternator; Compound Motor.

_____ 1. A machine which generates an electric current (usually a dynamo electric generator, both a shunt winding and a series winding are on its field magnets);

_____ 2. A machine consisting of an a.c. generator mounted upon the shaft of a steam turbine;

_____ 3. A generator whose field-magnet winding is connected in series with or in succession to its armature;

_____ 4. A generator whose field-magnet winding is connected in shunt to, or in parallel with its armature.

9) Titles: Conduction; Conductor; Conductivity; Sound; Circuit; Copper; Silver; Engine.

_____ 1. A device for converting one form of energy into another especially for converting other forms of energy into mechanical (i.e. kinetic) energy.

_____ 2. The transmission of heat from places of higher to places of lower temperature in a substance.

_____ 3. The reciprocal of the resistivity or specific resistance of a conductor.

_____ 4. A body capable of carrying an electric current.

_____ 5. A red metal. It is unaffected by water or steam.

_____ 6. The complete part with an electric current across it.

_____ 7. White, rather soft metal. The best-known conductor of electricity.

_____ 8. A physiological sensation received by the ear. It is caused by a vibrating source and transmitted as a wave motion through air.

10) Titles: Electric Field; Direct Current; Alternating Current; Electromagnetic Radiation; Continuous Wave; Electromagnetic Spectrum.

_____ 1. Radiation consisting of waves of energy associated with electric and magnetic fields. This radiation is emitted by matter in units called photons.

_____ 2. The range of frequencies over which electro-magnetic radiations are propagated. The lowest frequencies are radio waves, increases of frequency produce infrared radiation, light, ultra-violet radiation, X-rays, gamma-rays and finally the radiation associated with cosmic rays.

_____ 3. Radio or radar transmissions which are generated continuously and not in short pulses.

_____ 4. An electric current flowing always in the same direction.

_____ 5. A flow of electricity which, after reaching a maximum in one direction, decreases, finally reaching a maximum in the opposite direction, the

cycle being repeated continuously. The number of such cycles per second is the frequency.

_____ 6. The region near an electric charge, in which a force is acting on a charged particle.

11) Titles: Energy; Electrical Energy; Chemical Energy; Radiant Energy; Kinetic Energy; Potential Energy.

_____ 1. The capacity for doing work.

_____ 2. That part of the energy stored within an atom or molecule which can be released by a chemical reaction.

_____ 3. The energy which a body possesses by virtue of its position. It is measured by the amount of work the body performs in passing from that position to a standard position in which the energy is considered to be zero.

_____ 4. The energy which a body possesses by virtue of its motion.

_____ 5. The energy that is transmitted in the form of radiation.

_____ 6. The energy associated with electric charges and their movements. It is measured in watt seconds (joules) or kilowatt-hours.

12) Titles: Accumulator; Cell; Primary Cell; Solar Cell.

_____ 1. Device for producing an electric current by chemical reaction.

_____ 2. A storage battery. A device for «storing» electricity. An electric current is passed between two plates in a liquid; this causes chemical changes in the plates and the liquid. When the changes are complete, the device is charged.

_____ 3. Semiconductor devices which are made from thin slices of silicon. Almost all Russian and American satellites have used such cells to supply on-board electrical power. Although the efficiency of these cells is no more than 10%, they provide a reliable electric power source that lasts for years on a satellite.

_____ 4. A device for producing an electromotive force and delivering an electric current as the result of a chemical reaction.

13) Titles: Nuclear Fuel; Nuclear Power; Nuclear Reaction.

_____ 1. A substance which undergoes nuclear fission or nuclear fusion in a nuclear reactor, a nuclear weapon, or a star.

_____ 2. Any reaction which involves a change in the nucleus of an atom, as distinct from a chemical reaction which only involves the orbital electrons.

Such reactions occur naturally – on the Earth, in radioactive elements, and in the stars, as thermonuclear reactions. They are also produced in nuclear reactors, and nuclear weapons.

_____ 3. Electric or motive power produced from a unit in which the primary energy source is a nuclear reactor.

14) Titles: Pressured-Water Reactor (PWR); Boiling-Water Reactor (BWR).

_____ 1. This is a pressure-vessel reactor fuelled with enriched uranium. The reactor is a thermal one, moderated and cooled with ordinary (light) water. The heat in the reactor is extracted by the boiling water as it passes through the core, and the steam is passed directly to the turbine of the energy conversion cycle.

_____ 2. The primary reactor vessel of this reactor is operated at considerable overpressure, which suppresses boiling of the cooling water.

15) Titles: Nuclear Fusion; Nuclear Fission; Nuclear Charge; Nuclear Energy.

_____ 1. Energy released during a nuclear reaction as the result of the conversion of mass into energy. Energy of this kind is released in nuclear reactors and nuclear weapons.

_____ 2. A reaction between light atomic nuclei as a result of which a heavier nucleus is formed and a large quantity of nuclear energy is released. The temperatures necessary for fusion reactions are extremely high. Reactions of this kind are believed to be the source of the energy of the stars (including the Sun).

_____ 3. A nuclear reaction in which a heavy atomic nucleus (e.g. uranium) splits into two approximately equal parts, at the same time emitting neutrons and releasing very large amounts of nuclear energy.

_____ 4. The positive electric charge on the nucleus of an atom. Numerically it is equal to the atomic number of the element, to the number of protons in the nucleus, and to the number of electrons surrounding the nucleus in the neutral atom.

16) Titles: Analog Computer; Computer; Digital Computer; Central Processing Unit.

_____ 1. The central electronic unit in a computer which processes input information, and information from the store, and produces the output information. This unit and the store form die central part of the computer.

_____ 2. A computer in which numerical magnitudes are represented by physical quantities such as electric current, voltage, or resistance.

_____ 3. An electronic device which accents data, applies a series of logical processes to it, and supplies the results of these processes as information. The device is used to perform mathematical calculations at a very high speed. This makes them useful for various purposes, such as office calculations, control of industrial processes, and the control of flight paths.

_____ 4. A computer which operates on data in the form of digits rather than the physical quantities.

Приложение

Irregular Verbs

Неправильные глаголы

Внимание! Форма *Infinitive* отвечает на вопрос: *Что делать*?

Форма *Past Tens*e отвечает на вопрос: *Что сделал*?

Причастие II (для переходных глаголов) – на вопрос *Какой*?

Причастие I отвечает на вопросы: *Какой*? *Как*?

Infinitive	*Перевод*	*Past Tense*	*Participle II*	*Participle I*
to be [biː]	быть	was/were [wɔz, wəː]	been [biːn]	being
to beat [biːt]	бить	beat [biːt]	beaten [ˈbiːtn]	beating
to become [bɪˈkʌm]	становиться	became [bɪˈkeɪm]	become [bɪˈkʌm]	becoming
to begin [bɪˈgɪn]	начинать(ся)	began [bɪˈgæn]	begun [bɪˈgʌn]	beginning
to break [breɪk]	ломать	broke [brouk]	broken [ˈboukən]	breaking
to bring [brɪŋ]	приносить	brought [brɔːt]	brought [brɔːt]	bringing
to build [bɪld]	строить	built [bɪlt]	built [bɪlt]	building
to buy [baɪ]	покупать	bought [bɔːt]	bought [bɔːt]	buying
to catch [kætʃ]	ловить	caught [kɔːt]	caught [kɔːt]	catching
to choose [tʃuːz]	выбирать	chose [tʃouz]	chosen [ˈtʃouzn]	choosing
to come [kʌm]	приходить	came [keɪm]	come [kʌm]	coming
to cost [kɔst]	стоить	cost [kɔst]	cost [kɔst]	costing
to cut [kʌt]	резать	cut [kʌt]	cut [kʌt]	cutting

to do [du:]	делать	did [dɪd]	done [dʌn]	doing
to draw [drɔ:]	рисовать	drew [dru:]	drawn [drɔ:n]	drawing
to drink [drɪŋk]	пить	drank [dræŋk]	drunk [drʌŋk]	drinking
to drive [draɪv]	ехать	drove [drouv]	driven [ˈdrɪvn]	driving
to eat [i:t]	есть	ate [eit, et]	eaten [ˈi:tn]	eating
to fall [fɔ:l]	падать	fell [fel]	fallen [ˈfɔ:ln]	falling
to feel [fi:l]	чувствовать	felt [felt]	felt [felt]	feeling
to fight [faɪt]	бороться	fought [fɔ:t]	fought [fɔ:t]	fighting
to find [faɪnd]	находить	found [faund]	found [faund]	finding
to fly [flaɪ]	летать	flew [flu:]	flown [flu:]	flying
to forget [fəˈget]	забывать	forgot [fəˈgɔt]	forgotten [fəˈgɔtn]	forgetting
to get [get]	получать	got [gɔt]	got [gɔt]	getting
to give [gɪv]	давать	gave [geɪv]	given [ˈgɪvn]	giving
to go [gou]	идти	went [went]	gone [gɔn]	going
to grow [grou]	расти	grew [gru:]	grown [groun]	growing
to have [hæv]	иметь	had [hæd]	had [hæd]	having
to hear [hɪə]	слышать	heard [hə:d]	heard [hə:d]	hearing
to hide [haɪd]	прятать	hid [hid]	hidden [ˈhidn]	hiding
to hold [hould]	держать	held [held]	held [held]	holding
to hurt [hə:t]	повредить	hurt [hə:t]	hurt [hə:t]	hurting
to know [nou]	знать	knew [nju:]	known [noun]	knowing

to lead [liːd]	вести	led [led]	led [led]	leading
to leave [liːv]	оставлять	left [left]	left [left]	leaving
to let [let]	позволять	let [let]	let [let]	letting
to lie [laɪ]	лежать	lay [leɪ]	lain [leɪn]	lying
to lose [luːz]	терять	lost [lɔst]	lost [lɔst]	losing
to make [meɪk]	делать	made [meɪd]	made [meɪd]	making
to mean [miːn]	значить	meant [ment]	meant [ment]	meaning
to meet [miːt]	встречать	met [met]	met [met]	meeting
to put [put]	класть	put [put]	put [put]	putting
to read [riːd]	читать	read [red]	read [red]	reading
to ride [raɪd]	ехать	rode [roud]	ridden [ˈrɪdn]	riding
to ring [rɪŋ]	звонить, звенеть	rang [ræŋ]	rung [rʌŋ]	ringing
to rise [raɪz]	подниматься	rose [rouz]	risen [ˈrɪzn]	rising
to run [rʌn]	бежать	ran [ræn]	run [rʌn]	running
to say [seɪ]	говорить, сказать	said [sed]	sed [sed]	saying
to see [siː]	видеть	saw [sɔː]	seen [siːn]	seeing
to sell [sel]	продавать	sold [sould]	sold [sould]	selling
to send [send]	посылать	sent [sent]	sent [sent]	sending
to shake [ʃeɪk]	трясти	shook [ʃuk]	shaken [ˈʃeɪkən]	shaking
to shine [ʃaɪn]	светить	shone [ʃɔn]	shone [ʃɔn]	shining
to shoot [ʃuːt]	стрелять	shot [ʃɔt]	shot [ʃɔt]	shooting

to show [ʃou]	показывать	showed [ʃoud]	shown [ʃoun]	showing
to shut [ʃʌt]	закрывать	shut [ʃʌt]	shut [ʃʌt]	shutting
to sit [sɪt]	сидеть	sat [sæt]	sat [sæt]	sitting
to speak [spi:k]	говорить	spoke [spouk]	spoken [ˈspoukən]	speaking
to spend [spend]	тратить	spent [spent]	spent [spent]	spending
to stand [stænd]	стоять	stood [stud]	stood [stud]	standing
to steal [sti:l]	украсть	stole [stoul]	stolen [ˈstoulən]	stealing
to take [teɪk]	взять, брать	took [tuk]	taken [ˈteɪkən]	taking
to teach [ti:tʃ]	учить	taught [tɔ:t]	taught [tɔ:t]	teaching
to tell [tel]	сказать, рассказать	told [tould]	told [tould]	telling
to think [θɪŋk]	думать	thought [θɔ:t]	thought [θɔ:t]	thinking
to throw [θrou]	бросать	threw [θru:]	thrown [θroun]	throwing
to wake [weɪk]	просыпаться, будить	woke [wouk]	woken [ˈwoukən]	waking
to win [wɪn]	победить	won [wʌn]	won [wʌn]	winning
to write [raɪt]	писать	wrote [rout]	written [ˈrɪtn]	writing

Contents

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