ИННОВАЦИОННАЯ ОБРАЗОВАТЕЛЬНАЯ ПРОГРАММА

Проект 2: индивидуальная траектория обучения и качество образования
Цель: ориентированное на требования рынка образовательных услуг улучшение качества подготовки и переподготовки специалистов

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Владимирский государственный университет

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ПРАКТИКУМ ПО ОБУЧЕНИЮ ЧТЕНИЮ И УСТНОЙ РЕЧИ ПО ТЕМЕ «РАДИОТЕХНИКА» НА АНГЛИЙСКОМ ЯЗЫКЕ

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Практикум включает 17 разделов, упражнения к ним и тексты для самостоятельной работы, предназначен для развития навыков чтения и устной речи на английском языке по избранной специальности, обеспечивает накопление лексического запаса, необходимого для активного владения речью. Грамматические материалы практикума охватывают все основные явления английской грамматики.

Предназначен для студентов 1-го и 2-го курсов радиотехнических специальностей.

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ПРЕДИСЛОВИЕ

Данный практикум предназначен для использования в учебном процессе студентами I и II курсов радиотехнических специальностей. Цель практикума - развитие навыков чтения и перевода специальной литературы, устной речи и правильного восприятия информации в процессе делового общения.

Практикум включает 17 разделов, состоящих из основного и дополнительного текста, грамматических и лексических упражнений.

Основной текст А предназначен для изучения выделенного лексико-грамматического материала. После каждого основного текста приводится лексика, подлежащая активному усвоению.

Дополнительные тексты В тематически связаны с текстом А и нацелены на понимание основного содержания.

Тексты для самостоятельного чтения отражают языковой материал и тематику основных уроков.

UNIT I. THE TRIODE VALVE

Revision of the Passive Voice

Text 1 A. The Triode Valve

In this text a three-electrode valve, or triode (fig.1), will be considered. This vacuum tube consists of three electrodes known as the cathode, the anode and the grid. This third electrode is a mesh of fine wire inserted between cathode and anode in such a way that before they can get to the anode all the electrons emitted from the cathode have to pass through this extra electrode. The grid controls the flow of electrons going through it from the filament (cathode) to the plate (anode). This control is accomplished by changing the potential of the grid. It is evident that if the grid is made positive it will assist the anode to neutralize the space charge, so increasing the anode current. If, on the other hand, it is made negative it will assist the space charge in repelling electrons back towards the cathode. Consequently, when the grid is made alternately positive and negative by joining the input terminals to a source of alternating potential, the electron flow from the cathode to the anode is increased or decreased accordingly thereby varying the direct current in the plate circuit. It should be mentioned that when the grid was inserted between the filament and the

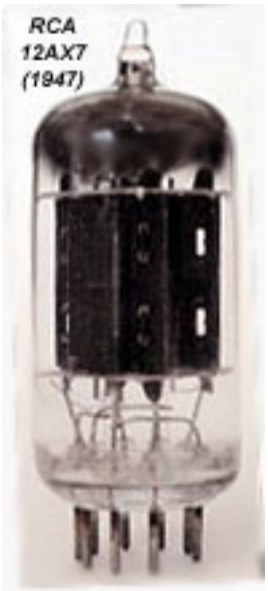

fig. 1

plate, the electron tube became more versatile. The insertion of the grid gave the tube the property of amplifying and oscillating.

Notes:

1. on the other hand - с другой стороны

2. alternately - попеременно

Active Vocabulary

1.	to accomplish	-	выполнять, завершать
2.	to assist	-	помогать
3.	consequently	-	следовательно
4.	to emit	-	излучать, испускать, выделять
5.	extra	-	дополнительный
6.	filament	-	нить накала; катод прямого накала
7.	fine wire	-	тонкая проволока
8.	grid	-	сетка (электронной лампы)
9.	to insert	-	вставлять
10.	insertion	-	вставка
11.	to neutralize	-	нейтрализовать
12.	space charge	-	объемный (пространственный) заряд
13.	terminal	-	зажим; клемма; вывод
14.	tube	-	(электронная) лампа; трубка
15.	valve	-	(электронная) лампа; электронный прибор
16.	versatile	-	многосторонний; универсальный

<u>Упражнение 1</u>. Ответьте на следующие вопросы:

1. What elements does a triode consist of?

2. What is a grid?

3. Between what elements is the grid placed?

4. What does the grid control?

5. In what way is this control accomplished?

6. What are triodes used for?

<u>Упражнение 2</u>. Сгруппируйте попарно слова с противоположными значениями.

positive, after, to attract, before, input, to receive, negative, to repel, output, to increase, conductor, to transmit, insulator, to decrease.

<u>Упражнение 3.</u> Заполните пропуски словами, данными ниже.

1. A .... contains three electrodes.

2. The insertion of the third electrode between the filament and the plate made the electron tube more ...

3. When the grid is ... charged, it attracts electrons and increases their flow from the filament to the plate.

4. The third electrode of a triode is a mesh of ... wire inserted between cathode and anode.

5. If the grid is made positive it will assist the anode to ... the space charge.

6. When the ... is negatively charged, it repels the electrons and they cannot go to the plate.

7. A diode is a tube which has two electrodes, known as the ... and the plate.

8. A vacuum diode has three ... for external connections.

---

a) terminals, b) positively, c) triode, d) versatile, e) grid, f) filament, g) neutralize, h) fine.

<u>Упражнение 4.</u> Найдите русские эквиваленты для английских слов.

1. evident	а) совершать, выполнять
2. to result in	б) следовательно

3. electromotive force	в) очевидный, явный
4. phenomenon	г) добавочный, дополнительный
5. to accomplish	д) последовательность
6. consequently	е) вызывать
7. extra	ж) посредством
8. to give rise to	з) явление
9. succession	и) приводить к
10. by means of	к) ЭДС

<u>Упражнение 5.</u> Определите предложения, в которых форма с "ed" употребляется для образования страдательного залога.

1. Triodes are used for amplification.
2. They produced many new devices at our plant.
3. Many new devices were produced at our plant.
4. Most tubes are indirectly heated.
5. He heated this metal to a high temperature.
6. Great research work is carried out by the engineers of our laboratory.
7. He carried out his first experiment in our laboratory.
8. The grid was inserted between the cathode and the plate.

<u>Упражнение 6.</u> Откройте скобки и употребите глагол в страдательном залоге. Переведите предложения.

1. At present semiconductors widely (to use) in radio-receiving and radio-transmitting devices. 2. A third element inserted between cathode and anode (to call) a grid. 3. The first experiments in television transmission (to carry out) in our country in 1924. 4. A lot of research and technical

problems (to solve) by Russian scientists next year. 5. When a third electrode called the grid (to place) between the cathode and the plate, the tube is known as a triode. 6. This machine (to test) by them tomorrow. 7. When a tube is used as an amplifier, a negative DC voltage usually (to apply) to the grid. 8. This research institute (to build) two years ago.

Text 1 B

Задание 1. ***Прочитайте следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять содержание текста.*** incandescent lamp - лампа накаливания, patent - патент, carbon rod - угольный стержень, to fix - укреплять, life - срок службы, holder - держатель, spiral - спираль, melting point -точка плавления, to fill - заполнять, to avoid - избегать, pocket torch - карманный фонарик.

Задание 2. ***Прочитайте текст, стараясь понять основное содержание.***

The Incandescent Lamp

The first incandescent lamp for practical use was made by Russian inventor Alexander Lodygin in 1872. Later he received a patent for his lamp. Lodygin's lamp was a glass envelope with a small carbon rod of about 2 mm in diameter. The carbon rod was fixed between two copper conductors. The lamp's air envelope was evacuated. But vacuum at that time was not perfect and Lodygin's lamps had no long life. Their life was measured in hours. In 1890 Lodygin made his first lamps with a metal

filament using for the purpose metals with high melting point such as tungsten, molybdenum. A few years later Thomas Edison, an American inventor, improved lamps with a metal filament. He invented the lamp holder, the switch and other elements of the lighting network.

Today the filament of the incandescent lamp is a tungsten spiral. The melting point of tungsten is 33OOº C. It can be heated to 3000º. At the temperature higher than 3000º C tungsten begins to evaporate. To avoid rapid evaporation of tungsten lamps today are filled with chemically inert gas, i.e. argon or krypton.

Industry manufactures incandescent lamps for 220 and 127 V (for lighting networks), 50 V (for railway wagons), 12 and 6 V (for motor-cars) and 3.5 and 2.5 V (for pocket torches).

<u>Задание 3.</u> Ответьте на вопросы к тексту:

1. When was the first incandescent lamp made for practical use?
2. What was Lodygin lamp like?
3. Why did Lodygin's lamps have a short life?
4. What metals were used to produce filaments?
5. What inventors improved Lodygin's lamps?
6. Who invented the lamp holder, the switch and other elements of the lighting network?
7. What happens to the filament at the temperature higher than 3000ºC?
8. What is the purpose of filling lamps with chemically inert gases?
9. What kind of lamps does our industry manufacture?

<u>Задание 4.</u> Передайте содержание текста, используя следующие слова и группы слов:

the first incandescent lamp, to be made for practical use, to evacuate the lamp's envelope, to be not perfect, to have a short life, a metal filament, high melting point to improve lamps, to avoid rapid evaporation, to manufacture.

UNIT II. SEMICONDUCTORS

Participle I

<u>Упражнение I.</u> Переведите следующие предложения, обращая внимание на причастие I.

1. A diode is a two-element electron tube that consists of a cathode and an anode or plate acting as an electron collector. 2. The experiment being conducted in our laboratory is of great importance. 3. Finishing his project he thought of his future machine. 4. Being well insulated the wire may be used as a conductor. 5. The simplest combination of elements constituting an electron tube is the diode. 6. The vacuum diode consists of an evacuated glass envelope containing an emitter and an anode or plate. 7. Being asked he answered that he had inserted the additional electron device. 8. A semiconductor is a solid material containing fewer mobile electrons than a metal but more than an insulator.

<u>Упражнение 2.</u> Образуйте причастие I Active и Passive от следующих глаголов.

Model*: to make - making - being made*

To build, to produce, to bring, to give, to write, to send, to show, to discover.

Text 2 A. Semiconductors

What is a semiconductor? It is a solid material containing fewer mobile electrons than a metal but more than an insulator. We consider semiconductors to occupy an intermediate place between metals and insulators. Among the semiconductors the most important at present are silicon and germanium. Pure semiconductors are usually of interest only from a theoretical point of view. In research much interest centres about the effects produced by the addition of impurities. For example, the electrical properties of silicon and other semiconductors can be affected by the addition of foreign atoms (impurities).

Introducing the impurity material into the growing crystal you can obtain two types of semiconductors: ***n***-type material and ***p***-type material. In ***n***-type electrons predominate, the impurity atoms being referred to as donors.

In ***p***-type material holes are in the majority, the impurity atom being referred to as an acceptor.

Solid-state devices are usually manufactured from semiconducting materials, doped with donor or acceptor impurities. Typical donor impurities for silicon are arsenic, phosphorus, antimony and typical acceptor impurities are gallium, indium, boron and aluminium. The boundary layer between two semiconductor materials with different types of conduction is termed as ***p-n*** junction. A ***p-n*** junction is formed when ***p***- and ***n***-type materials are brought together in the same-crystal. This ***p-n*** junction constitutes a semiconductor diode.

Active Vocabulary

acceptor impurity - акцепторная примесь

to add - прибавлять, присоединять

addition	-	добавление; присоединение
to affect	-	воздействовать, влиять
boundary layer	-	(по)граничный слой
to constitute	-	составлять; образовывать
to dope	-	легировать
hole	-	дырка
to introduce	-	вводить
junction	-	переход
mobile	-	подвижный, мобильный
to obtain	-	получать
point of view	-	точка зрения
to predominate	-	преобладать
pure semiconductor	-	собственный полупроводник
same	-	тот же самый
silicon	-	кремний
solid	-	твердый
solid-state device	-	твердотельный прибор
to term	-	называть

<u>Упражнение 3.</u> Ответьте на следующие вопросы:

1. What is a semiconductor?
2. What are the most frequently used semiconductors?
3. What happens to the electrical properties of pure semiconductors when you introduce the impurity material into the growing crystal?
4. What can you say about ***n***-type material (***p***-type material)?
5. What is termed as ***p-n*** junction?
6. When can you say that a ***p-n*** junction is formed?

<u>Упражнение 4.</u> Переведите следующие прилагательные, обращая внимание на суффиксы и префиксы:

measurable, variable, movable, comparable, producible, reducible, motionless, endless, useless, wireless, moveless, powerful, useful, helpful, invariable, indefinite, immovable, irregular, unusual.

<u>Упражнение 5.</u> Заполните пропуски в предложениях, выбрав одно из трех слов, подходящих по смыслу. Переведите предложения.

1. ... are substances whose electrical conductivity lies between that of conductors and that of insulators.

a) metals; b) semiconductors; c) dielectrics.

2. A semiconductor in which ***n***-type impurities ... is called ***n***-type.

a) radiate; b) predominate; c) separate.

3. A semiconductor without ... is termed a pure semicondoctor.

a) impurities; b) envelope; c) insulators.

4. Modern solid-state devices are ... with the use of such materials as germanium, silicon, selenium and others.

a) eliminated; b) evacuated; c) manufactured.

5. A ... ***Ge*** or ***Si*** crystal conducts only small amounts of current.

a) doped; b) divided; c) decreased.

6. The main part of any semiconductor device is ...

*a) **p**-type material; b) **n**-type material; c) **p-n** junction.*

7. Some new results were ... by a group of engineers.

a) obtained; b) weakened; c) attenuated.

Упражнение 6. ***Определите функции причастий I и переведите предложения.***

1. The simplest electric circuit consists of a source of energy, receiver of energy or load and two conductors connecting the receiver and power-source terminals. 2. The plant producing semiconductor devices was built 2 years ago. 3. The device being manufactured can be used in your experiment. 4. Being obtained in the laboratory the new substance had some valuable properties. 5. Being heated to high temperatures the metal changed its colour. 6. When working with these substances one must be very attentive. 7. Introducing the impurity material into the growing crystal you can obtain two types of semiconductors. 8. A pure semiconductor, having neither donors nor acceptors, is called intrinsic.

Text 2 B

Задание 1. ***Прочтите следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять содержание текста.*** solid-state physics - физика твердого тела, solid - твердый, твердое тело, prominent - выдающийся, as well as - а также, to recognize - признавать, planar - планарный, attractive - привлекательный.

Задание 2. ***Прочитайте текст, стараясь понять основное содержание***

Semiconductors

The functions of solid-state physics and semiconductor theory were laid between 1925 and 1933 mainly in Europe where physicists used the new quantum mechanics to develop an understanding of electrical conduction in solids.

Up to the end of the first half of last century our electrical engineering and radio engineering used mainly metals and dielectrics. A great contribution to the study of semiconductor physics has been made by the prominent Russian scientist academician A.F. Yoffe. In 1930 A.F. Yoffe and his group of scientists started a systematic research of semiconductor physics. They noticed that semiconductors could be used for the direct conversion of heat and light into electric power. Semiconductor thermoelectric systems as well as photocells with a high efficiency were developed by a group of researchers headed by A.F. Yoffe (fig.2).

fig. 2

In recent years semiconductor electronics played a leading role in our national economy. The Russian academicians N. Basov and A. Prokhorov carried out the work in the field of solid-state physics and their discovery of semiconductor laser was internationally recognized by the Nobel Prize award in 1964. New technological principles are very important for the modern electronics development. The new planar technology is of great importance for the future semiconduction electronics. About 90 per cent of the world output of semiconductor devices will be planar in the near future. What is a semiconductor? A semiconductor is often defined as an electrical conductor that has a conductivity intermediate between that of an insulator and that of a metal. The two semiconductor materials used in the manufacture of semiconductor devices are germanium and silicon. Some characteristics which make the semiconductors attractive members of the electronics family are as follows:

1. Semiconductors require little power and radiate less heat than tubes.
2. Semiconductors are small and light in weight.
3. They allow microminiaturization of electronic devices.

Semiconductors have a great variety of technical applications. They are used in measuring technique, computers, rocketry, aircraft, space engineering, television, medicine, radio and TV sets, etc.

<u>Задание 3.</u> Закончите предложения, выбрав из предложенных вариантов один, соответствующий содержанию текста.

1. European physicists in the thirties worked at the problem of conduction in ...

a) gases; b) solids.

2. Up to the end of the first half of our century our electrical engineering and radioengineering used mainly ...

a) metals and dielectrics; b) semiconductors.

3. Semiconductors are ...

a) large in size; b) small in size.

4. Semiconductors require ...

a) little power; b) much power.

5. Semiconductors find wide application ...

a) only in radioengineering; b) in many spheres of industry and engineering.

6. Silicon and germanium are materials having ...

a) similar characteristics; b) different characteristics.

<u>Задание 4.</u> Ответьте на следующие вопросы:

1. When were the foundations of solid-state physics laid in Europe?
2. What basic materials were used in our electrical engineering up to the end of the first half of our century?
3. What prominent scientist made a great contribution to the study of semiconductor physics?
4. What great discovery in solid-state physics was made by two Russian scientists N. Basov and A. Prokhorov?
5. How was that discovery recognized in the world science?
6. What technology is of great importance for the development of semiconductor electronics in the near future?
7. What is a semiconductor?
8. What are the important characteristics of germanium and silicon?
9. What fields do semiconductor devices find wide application in?

UNIT III. SEMICONDUCTOR DIODES

Continuous Tenses in the Active Voice

<u>Упражнение 1.</u> Переведите следующие предложения, объясните употребление форм Continuous.

1. For years to come engineers will be conducting a wide programme of scientific research. 2. It is known that an electric current heats the body through which it is flowing. 3. If we can measure the current that is passing through a resistance and the e.m.f., we can get the resistance by dividing the e.m.f. by the current. 4. He was making an experiment when one of the resistors got open. 5. At this time yesterday they were testing a new machine. 6. The scientist was demonstrating a new device when we visited his laboratory last week. 7. The technical equipment of our industry is improving from year to year. 8. I shall be conducting this experiment from 9 till 12 tomorrow.

Text 3 A. Semiconductor Diodes

Let us consider the simplest semiconductor device the diode, represented by the diagram in fig. 3.

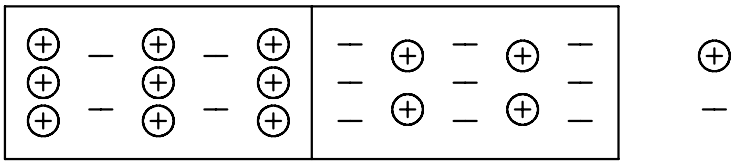

fig. 3

The diode consists of a sandwich of ***n***- and ***p***-type material. Where the two types of material touch, we have a junction which is responsible for providing both transistor and diode action. The holes carriers predominate in the ***p***-type material. The electron carriers predominate in the ***n***-type material.

With no voltage applied to the diode, no voltage difference exists between the two types of material and the current carriers stay put.

Now, connect a battery across the diode as shown in fig. 4 and observe what happens.

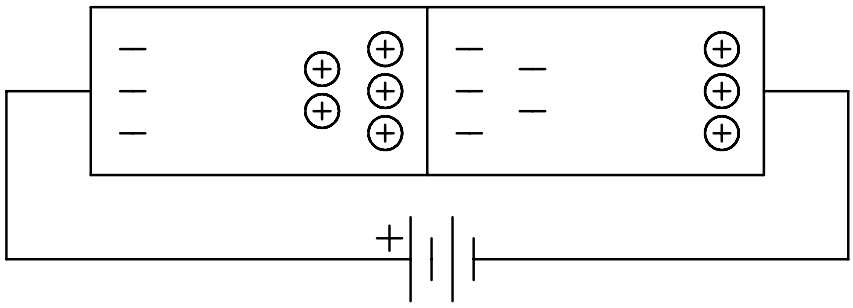

fig. 4

The positive pole of the battery repels the holes and attracts the electrons in the ***p***-material. Likewise, the negative pole of the battery repels the electrons and attracts the holes. The repelled charges move toward the junction where some of the holes and electrons combine and become neutral ***Ge*** atoms.

For every atom thus "neutralized" an atom in the ***p***-type material loses an electron to the positive pole of the battery and begins a migration towards the junction. With the battery connected to the diode as shown, the semiconductor is forward biased.

In this condition the continuous hole replacement and drift toward the junction process makes up the current flow. This process will continue until the battery is disconnected. Let us reverse the polarity of the battery to obtain the set up shown in fig. 5.

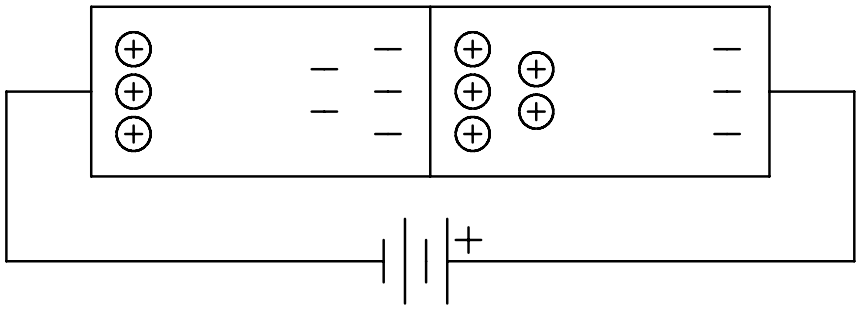

fig. 5

Here, the holes attracted by the negative pole of the battery move away from the junction in the ***p***-type material, and the electrons attracted by the positive pole of the battery move away from the junction in the ***n***-type material. No current flows and the semiconductor is back, or reverse, biased allowing a minute amount of current to flow in the reverse direction. If an alternating voltage were applied to the junction instead of DC, the current would flow each time the junction is forward biased and cease when the junction is reverse biased. This quality in a diode is used to convert, or rectify, alternating current to direct current.

Diodes are only one of the family of semiconductors, many other applications are becoming increasingly popular. It goes without saying that scientists are looking and will be looking for other applications of semiconductors.

Notes:

1. sandwich - *слоистая структура*
2. to stay put - *оставаться неподвижным*
3. forward biased - *прямо смещенный*
4. back, or reverse, biased - *обратно смещенный*
5. it goes without saying - *само собой разумеется*

Active Vocabulary

1. amount - количество; сумма
2. bias - смещение
3. carrier - носитель (заряда)
4. to cease - прекращаться, переставать
5. to disconnect - разъединять; выключать
6. drift - дрейф
7. to happen - случаться, происходить
8. instead (of) - вместо, взамен
9. likewise - также, таким же образом
10. to look for - искать
11. to lose (lost, lost) - терять
12. to make up - составлять
13. minute - незначительный
14. to observe - наблюдать, замечать

15. to rectify - выпрямлять
16. to replace - заменять, замещать
17. replacement - замена, замещение
18. responsible - ответственный
19. setup - устройство, установка

<u>Упражнение 2.</u> Ответьте на следующие вопросы:

1. What does a semiconductor diode consist of?
2. What is a junction responsible for?
3. Under what condition will the current carriers stay put?
4. What happens to the holes and electrons if a battery is connected across the diode as shown in fig. 4?
5. Is the semiconductor forward or reverse biased under this condition?
6. What makes up the current flow in a forward-biased diode?
7. What happens when the polarity of the battery is reversed?
8. What quality of a diode is used for rectifying alternating current to direct current?

<u>Упражнение 3.</u> Найдите русские эквиваленты для английских слов.

1. responsible; 2. likewise; 3. minute current; 4. current carrier; 5. reverse-biased; 6. junction; 7. rectify; 8. it goes without saying; 9. replace.

а) носитель тока, б) заменять, замещать, в) выпрямлять, г) ответственный, д) само собой разумеется, е) небольшой ток, ж) обратно смещенный, э) переход, и) также, подобным образом.

Упражнение 4. ***Сгруппируйте попарно слова со сходными значениями.***

A. 1. amount; 2. to employ; 3. to stop; 4. to call; 5. valve; 6. grid; 7. at present; 8. substance: 9. to vary; 10. instrument.

B. 1. to change; 2. material; 3. to use; 4. tube; 5. device; 6. mesh; 7. quantity; 8. now; 9. to name; 10. to cease.

Упражнение 5. ***Заполните пропуски в предложениях, выбрав одно из трех слов, подходящих по смыслу. Переведите предложения.***

1. Semiconductor devices often ... electron valves.

a) produce; b)replace; c) develop.

2. Free electrons are ... for the energy transfer in electron tubes.

a) responsible; b) steady; c) negligible.

3. The battery connection that allows current to flow across the ***p-n*** junction is known as ...

a) back bias; b) reverse bias; c) forward bias.

4. In the region of the ***p-n*** junction electrons and holes meet and combine and therefore they ... to exist as mobile charge carriers.

a) cease; b) pass; c) vary.

5. Diodes are used to ..., or rectify alternating current to direct current.

a) connect; b) convert; c) consider.

6. Let us consider now what happens when ***p***-type silicon is joined to ***n***-type silicon and a voltage is applied across the ...

a) junction; b) property; c)pole.

7. The current conducting characteristics of the silicon crystal change if a small ... of impurity is introduced into it.

a) ability; b) amount; c) achievement.

8. Semiconductor devices are often employed ... electron valves.

a) due to; b) owing to; c) instead of.

<u>Упражнение 6.</u> Употребите глаголы, данные в скобках, в одной из форм Continuous или Indefinite.

1. They usually (to demonstrate) their experiments in the laboratory.
2. The head of the research laboratory (to discuss) some important problems with a group of engineers at that time yesterday.
3. Last year they (to obtain) two new substances in their laboratory.
4. Current (to pass) through insulators with great difficulty.
5. Tomorrow at 5 o'clock they (to test) the device.
6. Our research institute (to work) on this problem now.
7. When we entered the laboratory, they (to demonstrate) their experiment.
8. They (to use) a low-pass filter in their experiment tomorrow.

Text 3 B

<u>Задание I.</u> Прочтите следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять содержание текста

extension - продолжение, развитие, junction transistor - плоскостной транзистор, junction - переход, respectively - соответственно, gain - коэффициент усиления, to inject - подавать, to be caught by the collector - попадать в поле коллектора, to yield - давать, создавать.

<u>Задание 2.</u> Прочтите текст, стараясь понять основное содержание.

Junction Transistors

Transistors are an extension of a semiconductor diode. The junction triode transistor is a sandwich which is made up of two ***p-n*** junctions. These junctions may be ***p-n-p*** form or ***n-p-n*** form. The central region is called the base and the two outer layers are called the emitter and collector respectively. The emitter junction of a transistor is always biased in the forward direction. The collector junction is biased in reverse direction.

Current conduction in a ***p-n-p*** transistor takes place by hole conduction from emitter to collector. Current conduction in a ***n-p-n*** transistor is carried out by electrons as majority charge carriers. The ratio of collector to emitter current is known as current gain and is always more than 1.

Transistors may be connected into one of three basic circuits. There are 1) common-base, 2) common-emitter. 3) common-collector circuits. The common-base connection provides a very low input resistance, a high output resistance and a current gain of less than 1. The common-emitter connection is the most efficient of the three basic connections. It provides the highest voltage and power gain. The common-collector connection provides a high input resistance, low output resistance, and a voltage gain of less than 1.

The transistor of greatest importance at present is the junction triode. The structure and basic circuit for the junction transistor is shown in fig.6.

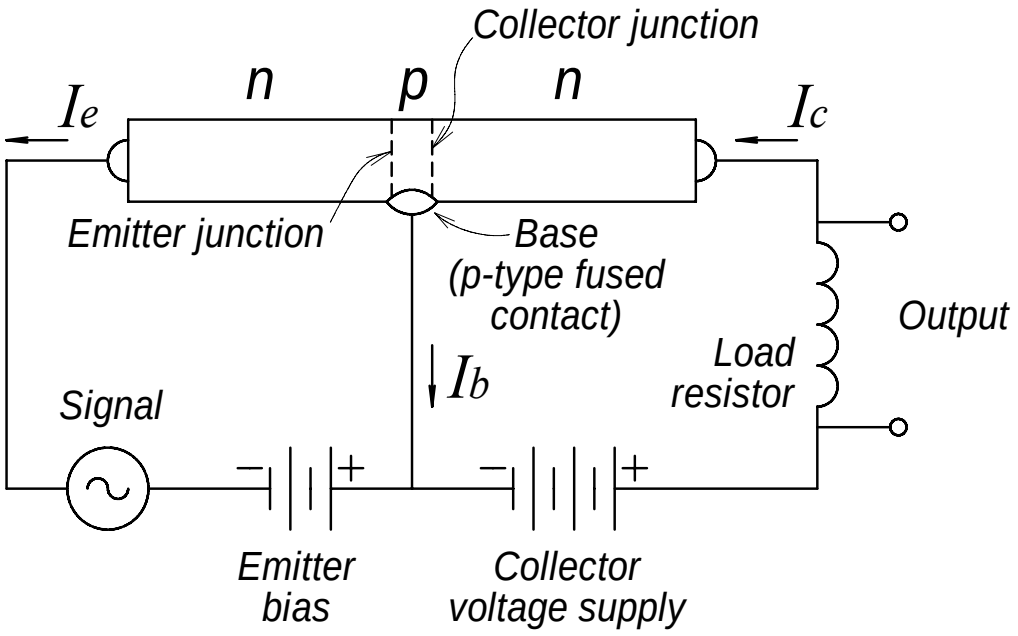

fig. 6

The device shown in fig. 6 is a power amplifier. The emitter acts as an injecting contact and injects electrons into the base region under the influence of a very small emitter signal. There they diffuse until they are caught by the collector field. The collector circuit has a much higher impedance and voltage level than those of the emitter circuit. The transfer of charge from the low impedance emitter to the high-impedance collector circuit yields power amplification.

<u>Задание 3.</u> Закончите предложения, выбрав из предложенных вариантов один, соответствующий содержанию текста.

1. Transistors are ...

a) the beginning of a vacuum tube; *b) an extension of a semiconductor diode*

2. The central region in a junction transistor is called the ...

a) emitter; *b)base*

3. The emitter junction is always biased in the ...

a) reverse direction; b) forward direction

4. The ratio of collector to emitter current is known as current gain and is always ...

a) more than 1; b) less than 1

5. The most efficient of the three basis connections is the ...

a) common-base connection; b)common-emitter connection

6. The emitter acts as an injecting contact and injects electrons into the ...

a) base region; b) emitter region

7. The electron circuit of the junction triode has ...

a) a low impedance; b) a high impedance

Задание 4. ***Ответьте на вопросы по тексту.***

1. What is a junction triode transistor? 2. What are the layers in the junction transistor called? 3. How are the emitter junction and the collector junction biased? 4. What is the current gain in a junction transistor? 5. What are the three basic circuits of connecting transistors? 6. What connection is the most efficient of the three basic connections? 7. What transistor is of great importance at present? 8. Has the collector circuit a much lower impedance and voltage level than those of the emitter circuit?

UNIT IV. TRANSISTORS

Continuous Tenses in the Passive Voice

Упражнение 1. ***Переведите следующие предложения, обращая внимание на глаголы в Continuous Passive.***

1. Much is being done to improve conditions for research work. 2. New devices which will find application in researches and industry are being

constructed. 3. When he entered the pavilion of the exhibition, a new model of portable radio-receiver was being looked at by everybody. 4. Much attention is being given at present to the development of international scientific contacts. 5. This experiment was being made for 3 hours. 6. Russian solid-state devices are being exported to many foreign countries. 7. Colour television is being continuously developed.

Text 4 A. Transistors

A transistor is the most versatile component of the semiconductor family. Its most important characteristics is current and/or voltage amplification.

It should be mentioned that before transistors, vacuum tubes were being used in radio engineering for many years. In contrast to electron tubes, which utilize the flow of free electrons through a vacuum or gas, the transistor relies for its operation on the movement of charge carriers, through a solid substance, a semiconductor.

Two materials are widely used, germanium and silicon. A ***Ge*** or ***Si*** crystal may be grown with two ***n*** regions separated by a very thin ***p*** region, or with fused regions on a very thin ***n*** section, thus forming ***n-p-n*** or ***p-n-p*** transistors. The ***p-n-p*** transistor consists of a piece of semiconducting material which has been doped to produce three distinct regions as shown in fig. 7.

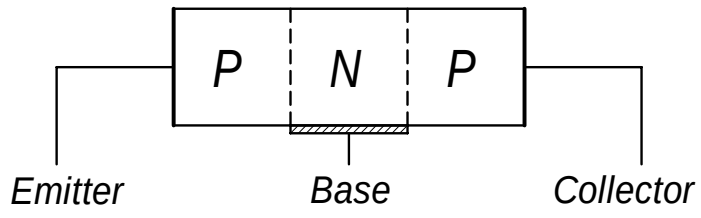

fig.7

Between each pair of these regions a ***p-n*** junction exists. To each of the three regions, a contact is soldered, as shown in fig.7. Let us call the contact on the left the emitter, the one attached to the ***n***-region the base and the one on the right the collector. The ***n-p-n*** transistor consists of an ***n***-type emitter, a ***p***-type base and an ***n***-type collector.

Transistor Requirements

There are four principal requirements for efficient transistor operation: 1) the collector must be biased in the reverse direction, 2) the emitter must be biased in the forward direction, 3) impurity concentration in the emitter must be greater than the base impurity concentration, 4) the base layer must be thin.

Advantages of Transistors over Vacuum Tubes

Transistors can be made very small, of the order of one-thousandth of the volume of a vacuum tube. They are very light, with less than one-hundredth of the weight of the vacuum tube. Unlike tubes, the transistor requires no filament supply.

The simple arrangement and small size make transistors more rugged than tubes. Finally, the life of a transistor can be many times that of a vacuum tube.

Transistors are only one of the family of semiconductors, many other semiconductor applications are becoming increasingly popular and new ones are constantly being discovered.

Active Vocabulary

1.advantage - преимущество

2.arrangement - размещение; устройство

3.to attach	-	прикреплять, присоединять
4.efficient	-	эффективный; продуктивный
5.filament supply	-	источник напряжения накала
6.to fuse	-	сплавлять, вплавлять
7.region	-	область, зона
8.to rely on	-	полагаться на
9.to require	-	требовать; нуждаться
10.requirement	-	требование; необходимое условие
11.rugged	-	стойкий, устойчивый
12.to solder	-	паять
13.to utilize	-	использовать
14.volume	-	объем
15.weight	-	вес

Упражнение 2. ***Ответьте на следующие вопросы:***

1. What is the most important characteristic of a transistor?
2. What semiconductor materials do you know and which of them are widely used for making transistors?
3. What transistors do you know?
4. What is the ***n-p-n*** transistor composed of?
5. How is the emitter junction biased?
6. How is the collector biased?
7. What advantages have transistors over vacuum tubes?
8.

Упражнение 3. ***Переведите предложения на русский язык.***

1. A semiconductor triode (transistor) has two ***p-n*** junctions. 2. The sections with ***n***- and ***p***-type conductivity may be arranged in different ways

that is why there may be two different types of transistors: ***p-n-p*** transistors and ***n-p-n*** transistors. 3. The junction with a reverse bias in a transistor is called a collector junction. 4. The junction that is forward biased in a transistor is called an emitter junction. 5. Although the collector junction is reverse biased the collector voltage is much higher than that of the emitter. 6. A transistor can function as an amplifier. 7. The transistor relies for its operation on the movement of charge carriers. 8. Transistors have some advantages over vacuum tubes. 9. Transistors are small and use little electric power.

Text 4 B

<u>Задание 1.</u> Прочтите следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять содержание текста. forerunner - предвестник, to conceive -представлять себе, to immerse - занимать мысли, постигать, to trap - улавливать, anti-submarine warfare - противолодочное оружие, field-effect transistor - полевой транзистор, razor blade - лезвие бритвы.

<u>Задание 2.</u> Прочтите текст, стараясь понять основное содержание.

Inventors of the Transistor

The forerunner of today's silicon chip was the point-contact transistor made by John Bardeen and Walter Brattain at Bell Laboratories in America in December 1947. It was followed by the junction transistor conceived about a month later by William Shockley also at Bell Labs and first made in 1950.

The transistor has been the most important invention of the 20th century. Fifty years ago electronics engineers would have included the triode in a list of the most important inventions. It is difficult to imagine now how we could manage without the transistor in its many forms.

The importance of the transistor was officially recognized when the three: John Bardeen, Walter Brattain and William Shockley were awarded the Nobel Prize for Physics in 1956. One of the three inventors, the oldest and the first to join Bell Labs was Walter Houser Brattain.

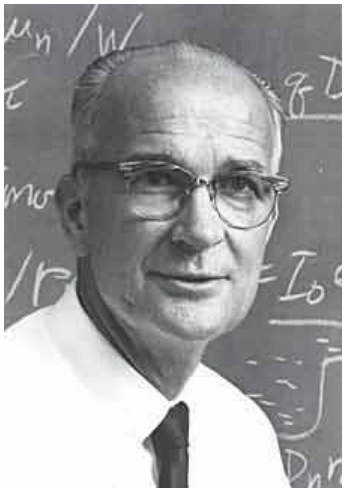

fig. 8

At that time in the United States some leading physicists were immersed in solid-state physics and quantum mechanics. The second of the trio to join Bell Labs was William Shockley (fig.8).

In 1939 he together with Brattain tried to make a semiconductor triode. The war took Shockley and Brattain away from Bell to work separately on anti-submarine warfare. After the war Shockley headed the semiconductor subgroup which now included Walter Brattain, John Bardeen who joined Bell Labs in 1945.

Shockley was thinking of ways to make a solid-state amplifier. His main idea was for a field-effect device made from a thin layer of semiconductor and a sheet of metal arranged together as a parallel plate capacitor (fig. 9).

A voltage applied to one plate, the metal, would induce charge on the other plate, the semiconductor, and so control the conductance of the semiconductor. A signal applied to the metal should modulate a current flowing through the semiconductor and so provide an amplifier. The theory

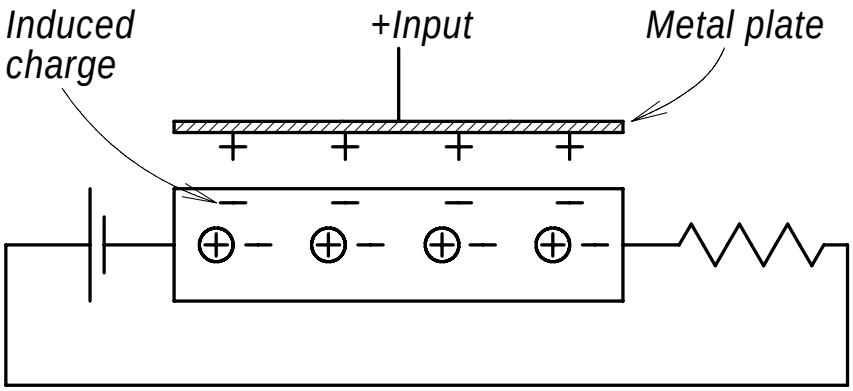

fig. 9

was fine and is the basis of today's MOS field-effect transistors, but for Shockley in 1945 the device did not work. The induced charge in the semiconductor plate was not there. It was trapped by the surface states and was unable to do the job.

This concept of surface states became the central part of their research. They managed to overcome the blocking effect of the surface states by immersing the semiconductor and the metal plate. Soon they worked out that two point contacts placed about 0.05 mm apart should succeed. How to do that was a problem but it was solved by evaporating gold on to a polystyrene wedge and separating the gold at the point of the wedge by cutting with a razor blade. The point-contact transistor was born and later the bipolar transistor had been found.

<u>Задание 3.</u> Закончите предложения, выбрав из предложенных вариантов один, соответствующий содержанию текста.

1. The forerunner of today's silicon chip was … .

a) a vacuum triode; *b) a point contact transistor.*

2. The point-contact transistor was followed by… .

a) the junction transistor; *b) a low-pass filter.*

3. In 1939 William Shockley and Walter Brattain tried to make … .

a) a vacuum diode; *b) a semiconductor triode.*

4. After the war Shockley headed a newly formed solid-state group and thought of ways… .

a) to make a solid-state amplifier; *b) to make an electromagnet.*

5. The induced charge was trapped … .

a) by the surface states; *b) by the inner states.*

Задание 4. ***Ответьте на вопросы к тексту.***

1. What device was the forerunner of today's silicon chip?

2. What three scientists worked on the transistor?

3. When was the first point-contact transistor made at Bell Laboratories in America?

4. Is it difficult to imagine our life today without the transistor in its many forms?

5. How was the importance of the transistor recognised?

6. What field were the leading scientists immersed in the thirties of the last century in?

7. Who headed a newly formed solid-state subgroup at Bell Labs after the war?

8. Why was Shockley's device immobile and unable to do the work in 1945?

UNIT V. MICROCIRCUITS

Perfect Tenses in the Active Voice

<u>Упражнение I.</u> Переведите следующие предложения и объясните употребление форм Perfect Active.

1. Semiconductor devices have replaced electron tubes in many types of radio equipment. 2. He has already seen this new device in our laboratory. 3. They have made many discoveries which are of great importance for our research. 4. Thanks to the radio it has become possible to communicate with all parts of the world. 5. He had collected some information about modern discoveries in the field of electronics by the end of the year. 6. The engineers could obtain these data after they had made numerous experiments. 7. They will have tested this device by the end of next week. 8. By the time he returns we shall have made the experiment.

<u>Упражнение 2</u>. Переведите следующие слова, обращая внимание на префиксы.

To discharge, to disconnect, to misunderstand, immeasurable, impossible, indirectly, invaluable, irresponsible, uncommon, unsatisfactory.

Text 5 A. Microcircuits

We have already discussed semiconductor diodes and transistors. Transistors have revolutionized electronics. But the transistor was only a prelude to a much greater revolution - the monolithic integrated circuit.

An integrated circuit is a special kind of microelectronics. In this text we'll consider 2 approaches to microelectronics - monolithic integrated circuits and film circuits.

In monolithic integrated circuits, all circuit elements, active and passive, are formed in a single small wafer of silicon. Transistors and diodes are active elements of the integrated circuit. The passive elements in IC are resistors and capacitors.

Film circuitry has two main technologies: thin film and thick film. In thin-film circuits the passive components and interconnection wiring are formed on glass or ceramic substrates, using evaporation techniques. The active components are fabricated as separate semiconductor devices.

Thick-film circuits are prepared in a similar manner except that the passive components and wiring pattern are formed by silk screen techniques on ceramic substrates.

There can be many instances where the microelectronics circuit may combine more than one of these approaches in a single structure, using a combination of techniques.

In multichip circuits the electron components are formed in two or more silicon wafers (chips). The chips are mounted side by side on a common header. Some interconnections are included on each chip, and the circuit is completed by wiring the chips together with a small diameter gold wire.

There had been tremendous growth in semiconductor integrated circuit technology before engineers and researchers understood that integrated circuits would not be universally acceptable for all circuit problems. IC's are most economical when they can be standardized and made in large quantities. For these and other reasons, hybrid microcircuits have become extremely popular.

Hybrid IC's are combinations of monolithic and film techniques. Active components are formed in a wafer of silicon using the planar process, and the passive components and interconnection wiring pattern are formed on the surface of silicon oxide which covers the wafer, using evaporation techniques.

Notes:

1. monolithic integrated circuit - *монолитная интегральная схема*

2. hybrid microcircuit - *гибридная микросхема*

Active Vocabulary

1. acceptable - приемлемый
2. approach - подход
3. evaporation - напыление
4. extremely - чрезвычайно; очень
5. to fabricate - изготовлять; производить
6. film integrated circuit - пленочная ИС
7. growth - рост, развитие
8. header - основание; подложка; кристаллодержатель
9. interconnection wiring - разводка; межсоединение
10. manner - способ
11. to mount - устанавливать, монтировать
12. multichip - многокристальная интегральная схема
13. to prepare - готовить(ся), подготавливать
14. researcher - исследователь
15. silk screen technique - метод шелкографии

16. substrate - подложка
17. tremendous - огромный
18. wafer - пластина; подложка
19. wiring pattern - рисунок соединений; рисунок разводки

<u>Упражнение 3.</u> Ответьте на следующие вопросы:

1. What is an integrated circuit? 2. What electronic elements are active components of the integrated circuit? 3. What electronic elements are called passive components of the intergrated circuit? 4. What types of film circuits do you know? 5. How are thin-film circuits (thick-film circuits) prepared? 6. Why are hybrid microcircuits very popular now? 7. What is a hybrid IC?

<u>Упражнение 4.</u> Найдите русские эквиваленты для английских слов и словосочетаний:

1) hybrid microcircuit; 2) film evaporation; 3) vacuum evaporation; 4) thin-film technique; 5) insulating substrate; 6) interconnection technique; 7) tremendous; 8) growth.

а) изоляционная подложка, б) рост, в) гибридная микросхема, г) тонкопленочная технология, д) технология изготовления соединений, е) напыление пленок, ж) вакуумное напыление, з) огромный.

<u>Упражнение 5.</u> Заполните пропуски словами, данными ниже.

1. The achievements of our scientists and engineers in the field of electronics are ... 2. ... in IC are transistors and diodes. 3. Capacitors and resistors are ... of integrated circuits. 4. All microelectronic units are ...

small. 5. Microelectronic ... are made by thin-film or semiconductor technique. 6. Ceramic ... are employed in the fabrication of film integrated circuits. 7. ... are combinations of monolithic and film techniques. 8. ... are used in the fabrication of thin-film circuits. 9. ... are used in the fabrication of thick-film circuits.

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a) Hybrid ICs, b) tremendous, c) units, d) substrates, e) active elements, f) passive elements, g) evaporation techniques, h) silk-screen techniques, i) extremely.

Упражнение 6. ***Переведите следующие слова:***

product, production, productivity; to invent, inventor, invention, to attenuate, attenuation; to reduce, reduction; to research, researcher; to eliminate, elimination; to fabricate, fabrication.

Упражнение 7. ***Дайте краткие ответы по образцу.***

Model I: *Have you used evaporation techniques in the fabrication of thin-film circuits? - Yes, I have. No, I haven't.*

Model II: *Has this scientist worked in the field of electronics?*

- Yes, he has. No, he hasn't.

1. Have you employed hybrid microcircuits in this electronic device? 2. Has this student taken part in this research? 3. Have transistors replaced vacuum tubes in all radio-receiving and radio-transmitting devices? 4. Have integrated circuits become the basic component of electronic equipment? 5. Have you formed the passive components and wiring pattern of thick-film circuits by silk-screen techniques? 6. Have integrated circuits become universally acceptable for all circuit problems?

<u>Упражнение 8.</u> Употребите глаголы, данные в скобках, в Past Indefinite или Present Perfect Active.

1. The student (to work) very well this week. 2. Thomson (to discover) the electron in 1897. 3. Last week the students of our group (to translate) some articles from an English newspaper. 4. In 1956 there (to be) only 1.3 million television receivers; today the number of TV sets greatly (to increase). 5. Flemming (to invent) a two-element tube in 1904. 6. He (to turn on) the light. It is light in the room. 7. We (not to see) him since he graduated from the Institute. 8. He just (to finish) the experiment. The results of his experiment will help us in our research.

<u>Упражнение 9.</u> Употребите глаголы, данные в скобках, в одной из форм Perfect Active.

1. He already (to make) many discoveries in this field. 2. When he came into the laboratory, they already (to finish) their experiment. 3. By 2 o'clock tomorrow he (to finish) this work. 4. Integrated circuits (to become) the basic component of electronic equipment. 5. We (to develop) this device by next year. 6. After scientists (to introduce) a new technology in the fabrication of IC devices, the productivity of the plant went up. 7. By last Saturday they (to obtain) all the necessary data. 8. They never (to be) to that laboratory.

Text 5 B

<u>Задание I.</u> Прочтите следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять основное содержание.

efforts - усилия; conventional - обычный; in comparison with - по сравнению с; search - поиск; reliability - надежность; packaging density - плотность монтажа.

<u>Задание 2.</u> Прочтите текст, стараясь понять основное содержание.

Basic Trends in Miniaturization and Microminiaturization

Today electronics has advanced to a point where it can solve a great variety of complex problems in the fields of radio, computers and communication. The growth in complexity has led to miniaturization and microminiaturization in electronics.

The early efforts in the field of miniaturization reduced the size of conventional circuit components and developed miniaturized vacuum tubes, semiconductor devices, resistors, capacitors, inductors and switches. These efforts resulted in modules and micromodules. The systems using these components reduced in weight and size in comparison to those using discrete components.

Microelectronics has passed some stages from the reduction in the size and weight of components to the search of new materials, technologies, improvement in reliability, simplification in manufacture. A substantial increase in reliability of electronic equipment with a decrease in its mass, size can be achieved by the use of integrated circuits.

Three main classes of integrated circuits are in wide use today: the film integrated circuits, the hybrid integrated circuits and semiconductor (or solid state) integrated circuits. According to their packaging density they are classed into small-size or simply integrated circuits, medium-integrated circuits (MSI) and large-scale integrated circuits (LSI). The term "integrated circuit" - IC - is used to describe a group of electronic elements connected together to perform a given electronic function.

<u>Задание 3.</u> Ответьте на вопросы к тексту.

1. Can electronics solve complex problems in the field of radio communication and computers today? 2. What were the results of the early efforts in the field of miniaturization? 3. What stages of development has microelectronics passed? 4. What are the advantages of using integrated circuits? 5. What classes of integrated circuits are in wide use today? 6. How are the integrated circuits classified according to their packaging density? 7. What does the term "integrated circuit" mean?

<u>Задание 4.</u> Закончите предложения в соответствии с содержанием текста.

1. Modern electronics can solve complex problems in the field of... 2. The growth in complexity has led to ... in electronics. 3. The systems using miniaturized components ...in comparison to those systems using discrete components. 4. Three main classes of integrated circuits are in wide use today ... 5. According to their ... the integrated circuits are classed into small-size, medium-scale integrated circuits and large-scale integrated circuits. 6. The term "integrated circuit" is used to describe a group of electronic elements ...

UNIT VI. FILM CIRCUIT PROCESS TECHNOLOGIES

Perfect Tenses in the Passive Voice

<u>Упражнение 1.</u> Переведите следующие предложения и объясните употребление форм Perfect Passive.

1. Many different kinds of tubes have been invented since the introduction of the two-electrode tube. 2. The properties of this semiconducting material had been improved by that time. 3. The results of the experiment will have been discussed by the time he comes. 4. The equipment had been examined by the engineers before the director came. 5. A new device will have been developed by next year. 6. The operation of this system has been studied by the engineers. 7. Good results have been achieved by Russian engineers in the field of semiconductor devices. 8. After the passive components and interconnection wiring had been formed on the substrate, the active components were attached onto it.

Text 6 A. Film Circuit Process Technologies

In thick film technology, the materials for conductors, resistors and dielectrics are specially prepared pastes (inks). Thick film technology centers around the application of pastes onto ceramic substrates by printing through a screen or an etched metal mask. After the pattern has been screened onto a ceramic substrate and dried, it is fired in a furnace at temperature from 500° C to 1200° C. The screening and firing equipment are quite simple.

Printing (screening) machines contain five basic functional systems of interest: a system to move the substrate into position; a system to hold the substrate rigidly during the printing cycle, usually by applying vacuum to

its underside; a screen mounting; an alignment system for adjusting the screen relative to the substrate; and finally a system for supplying ink and moving a squeegee across the substrate. Printing machines are classified as manual, semiautomatic or automatic.

The vacuum equipment primarily used for thin-film deposition is much more complicated and expensive than the equipment utilized in the fabrication of thick films. In the early days of film circuit technology two methods were available for thin-film deposition: evaporation of the source material in high vacuum and cathode sputtering. Evaporation through masks has been largely abandoned - at least for intricate patterns. Numerous new sputtering methods have been developed.

Active Vocabulary

1.alignment - совмещение; выравнивание
2.available - имеющийся; доступный
3.complicated - сложный
4.to dry - сушить(ся)
5.etch - травление; травить
6.film deposition - осаждение пленок; пленочное покрытие
7.to fire - обжигать
8.furnace - печь (техническая)
9.intricate - запутанный; сложный
10.manual - ручной
11.paste - паста
12.to print - печатать; делать оттиск
13.rigidly - неподвижно; жестко
14.screen - трафарет; производить трафаретную печать
15.squeegee - ракель

<u>Упражнение 2.</u> Ответьте на следующие вопросы:

1. What materials are used for conductors, resistors and dielectrics in thick film technology? 2. How are pastes applied onto ceramic substrates in thick film technology? 3. At what temperature are thick films fired in a furnace? 4. What five basic functional systems do printing machines contain? 5. Is the vacuum equipment simple or complicated? 6. What two methods were available for thin-film deposition?

<u>Упражнение 3.</u> Переведите следующие наречия:

accordingly, consequently, constantly, extremely, increasingly, indirectly, interchangeably, manually, readily, rigidly, semiautomatically, widely.

<u>Упражнение 4.</u> Заполните пропуски в предложениях, выбрав одно из трех слов, подходящих по смыслу. Переведите предложения.

1. In the screening or printing process a ... forces conductive, resistive or dielectric paste through a screen.

a) substrate; b) section; c) squeegee

2. Test systems are ... to measure many electrical parameters manually, semiautomatically, or with full automation, depending on production requirements.

a) available, b) active; c) great

3. Thick film pastes are printed onto a substrate using either a screen or an ...

a) integrated circuit; b)etched metal mask; c) silicon wafer

4. Substrates are fired in a ...

a) fabrication; b) filter; c) furnace

5. The film technique ... material on a common substrate to form passive and active components.

a) deposits; b) dries; c) decreases

6. Before the substrate passes into a firing furnace, it may be ... by a series of infrared lamps.

a) divided; b) dried; c) doped

7. An... system which is employed for adjusting the screen relative to the substrate is very important.

a) alignment; b) achievement; c)accomplishment

8. This test deals with five ... functional systems of a printing machine.

a) broadcasting; b) boundary; c) basic

Упражнение 5. Переведите предложения, обращая внимание на подчеркнутые глаголы-сказуемые.

1. Dielectrics are deposited to provide insulation between two layers of thick film conductors. 2. The main component of the printing equipment is the screen itself. 3. The materials used in thick film have been developed, and are being developed very quickly. 4. Conductor resistivity also must be considered when discussing conductor pastes. 5. Conventional screens will deposit conductor lines 4 mils in width. (1mil=0,0254mm). 6. Parallel conductors are usually separated by 8 to 10 mils. 7. 600 substrate printing operations per hour can be accomplished by using semiautomatic machines. 8. The engineers improved the operation of that system after some tubes had been replaced. 9. New methods have been used in testing the equipment. 10. The engineers will have been given the design of a new transformer by that time tomorrow.

Text 6 B.

<u>Задание 1.</u> Прочтите следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять содержание текста.

to deposit - осаждать; in an appropriate sequence - в соответствующей последовательности; to a large degree- в большей степени; to satisfy - удовлетворять; at elevated temperature - при повышенной температуре; outlays - расходы, затраты.

<u>Задание 2.</u> Прочтите текст, стараясь понять основное содержание.

Film Integrated Circuits

A film integrated circuit defines an arrangement of various films on a common base (substrate). A typical film integrated circuit will have film resistors, film capacitors and film conductors. All these elements are deposited in an appropriate sequence on the substrate by evaporation of current-conducting, magnetic and other materials.

Film components offer a number of advantages over discrete parts. For example, film resistors have low noise level and high resistivity; film capacitors show good stability and a good temperature coefficient of capacitance.

The properties of films depend to a large degree on materials used for substrates. The materials employed for substrates include various grades of glass, ceramic materials, and others. The requirements that a good substrate should satisfy are a good thermal conductivity, mechanical strength

coupled with small thickness, high resistivity, ability to withstand physical and chemical factors at elevated temperature. The substrate may be square or rectangular in shape made in standard sizes. The thickness is usually 0.6, 1, or 1.6 mm depending on the size.

Film integrated circuits are subdivided into thin-film ICs and thick film ICs. The thickness of the film in thin film ICs is units of micrometers and in thick film circuits the thickness of the film is a few tens of micrometers. A major advantage of thick film technology is simplicity as it does not require any expensive equipment.

Thin film technology is capable of making precision passive elements with better parameters than thick film technology. However it requires large capital outlays as it uses expensive equipment.

<u>Задание 3.</u> Закончите предложения, выбрав из предложенных вариантов один, соответствующий содержанию текста.

1. Film components offer a number of …

a) disadvantages over discrete parts; b) advantages over discrete parts

2. Film resistors have …

a) high noise level; b) low noise level

3. Film resistors have …

a) low resistivity; b) high resistivity

4. The substrates are usually made in …

a) non-standard sizes; b) standard sizes

5. A major advantage of thick film technology is …

a) simplicity; b) complexity

6. Thick film technology …

a) requires large capital outlays; b) does not require large capital layouts

<u>Задание 4.</u> Ответьте на вопросы к тексту.

1. What is a film integrated circuit? 2. What elements has a typical film integrated circuit? 3. What are the advantages of film components over discrete components? 4. What do the properties of films depend upon? 5. What materials are employed for substrates? 6. What requirements should a good substrate satisfy? 7. What is the usual thickness and shape of the substrate? 8. How are film integrated circuits classified? 9. What is a major advantage of thick film technology?

UNIT VII. RECTIFIERS

The Infinitive

<u>Упражнение 1.</u> Переведите следующие предложения, обращая внимание на формы и функции инфинитива.

1. The station to be used for this purpose performs various functions. 2. These are the basic principles of radio to be applied in practice. 3. A rheostat is used to change the resistance of circuits and in this way to vary the value of current. 4. To determine the magnetic field of the current was the task of our laboratory work. 5. To carry out this complicated work we are to have special knowledge in this field of science. 6. The aim of our work is to determine the resistance of the circuit. 7. This machine was the first to have performed many operations in a very short period of time. 8. We began to test a new device last week. 9. We constructed a computer to use it in our research. 10. We were happy to have been helped with this work.

Text 7 A. Rectifiers

Electronic equipment is usually powered by batteries or rectifiers which in turn draw their power from a supply line. Rectifiers draw their power from a supply line. The basic function of rectifiers is to convert alternating voltage to direct voltage. There are various rectifier circuits. They differ from one another in circuit design, power output, rectified voltage and current. Whatever its circuit or design is a typical rectifier will contain a transformer to step down or step up the supply-line voltage, a rectifying element (a vacuum tube or gas-filled rectifier diode, a crystal diode, etc), which converts alternating to direct voltage, a smoothing filter to reduce the ripple in the rectified voltage.

A rectifying element is an electron device having unilateral conduction. It presents a very high resistance to the flow of current in one direction and almost zero resistance in the other. At present, the most commonly used types of rectifying elements are semiconductor (solid-state) diodes. Owing to advances in semiconductor technology semiconductor (or crystal) diodes are widely used because they have small size, high reliability and long service life.

A rectifier power supply is a basic part of any electronic equipment and is usually mounted on the same chassis with the rest of the circuits. In special cases power supply may be built into a separate case.

One way to classify rectifiers is to divide them into single-phase and polyphase (a rectifier may have two, three or six phases). A single-phase (half-wave) rectifier usually feeds a capacitive load, for example, the anode circuits of the cathode-ray tubes used in TV receivers and oscilloscopes, which require a high rectified voltage at a low load current.

The most commonly used polyphase rectifier circuit is the two-phase (full-wave) bridge circuit. Three and six-phase rectifiers are as a rule used to energize high-power radio transmitters, radars and similar systems requiring a rectified power of 1 to 50 kW at 5 to 7 kV.

Where the primary source of power is an a.c. supply line removal of the ripple from the rectified voltage poses a special problem. Failure to filter the rectified current properly leads to the appearance of hum in the signal. The ripple is usually removed by filters. In some cases the ripple can be reduced by additional RC-networks and the rectified voltage is usually maintained at a constant value by voltage stabilizers.

Active Vocabulary

1. additional - добавочный, дополнительный
2. to maintain - поддерживать, сохранять
3. owing to - благодаря, вследствие, по причине
4. rectifier - выпрямитель
5. single-phase rectifier - однофазный выпрямитель
6. polyphase rectifier - многофазный выпрямитель
7. to remove - убирать, снимать; удалять
8. removal - удаление; устранение
9. ripple - пульсации, колебания
10. to present - показывать; представлять
11. smoothing filter - сглаживающий фильтр
12. unilateral conduction - односторонняя удельная проводимость

<u>Упражнение 2.</u> Ответьте на следующие вопросы.

1. How is usually electronic equipment powered? 2. What is the basic function of a rectifier? 3. What do various rectifier circuits differ from one another in? 4. What components does a typical rectifier contain? 5. What function has a smoothing filter? 6. What is a rectifying element? 7. What are the most commonly used types of rectifying elements? 8. How are rectifiers usually classified? 9. Where are half-wave rectifiers usually used? 10. What is the most commonly used rectifier circuit? 11. How is the rectified voltage maintained at a constant value?

<u>Упражнение 3.</u> Образуйте существительные от следующих глаголов:

to connect, to direct, to apply, to rectify, to pulsate, to require, to transmit, to produce, to regulate.

<u>Упражнение 4.</u> Заполните пропуски словами и словосочетаниями, данными ниже.

1. All ... must provide a one way path for electrical current. 2. A ... rectifies both halves of the AC input cycle. 3. ... are eliminated by means of a filter. 4. Alternating current is rectified into ... by means of a rectifier. 5. The basic principle of the rectifier is that it ... current to flow in only one direction. 6. The rectifier is called a ... when only half of the wave is rectified. 7. A … is an electron device having unilateral conduction. 8. One way to classify rectifiers is … them into single-phase and polyphase ones.

---

a) direct current; b) half-wave rectifier; c) ripples; d) to divide; e) rectifiers; f) permits; g) rectifying element; h) full-wave rectifier.

Упражнение 5. ***Переведите предложения, обращая внимание на подчеркнутые слова и словосочетания.***

1. A number of parameters of the transistor can be obtained from these characteristics. 2. In a step-up transformer the number of turns in the secondary is greater than the number of turns in the primary. 3. The principal advantage of the diode tube is that it permits the flow of current in one direction only, that is from the cathode to the anode. 4. Plate current flows in a diode when the plate is made positive with respect to the cathode. 5. A pure germanium crystal is practically a nonconductor of electricity. 6. When the grid is made alternately positive and negative by joining the input terminals to a source of alternating potential, the electron flow from cathode to plate is increased and decreased accordingly, thereby varying the direct current in the plate circuit. 7. We know the range of working temperature for germanium devices to be from 40°C below zero to 70° C above zero. 8. One-half of the electrical energy contained in the radio wave exists in the form of electrostatic energy, the remaining half being in the form of magnetic energy. 9. Some radio tubes contain two filaments and two plates, others containing as many as three or four separate grids. 10. Since a diode will permit current to flow only during the positive half-cycle of the applied AC voltage, a single diode is known as a half-wave rectifier.

Text 7 B

Задание I. Прочтите следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять основное содержание.

Excluse of – исключая, не считая, за исключением; CW transmitter –

непрерывный передатчик; wall outlet - пульсация; raucous – резкий, пронзительный.

<u>Задание 2.</u> Прочтите текст, стараясь понять основное содержание.

Silicon Diodes as Power-supply Rectifiers

We mentioned earlier that diodes can change ac to dc. Nearly every power supply (exclusive of those that use batteries) contains diodes that serve as rectifiers for changing ac to dc. Let's look at fig. 10 (a,b) to see how the diodes might be connected in a circuit to serve our need.

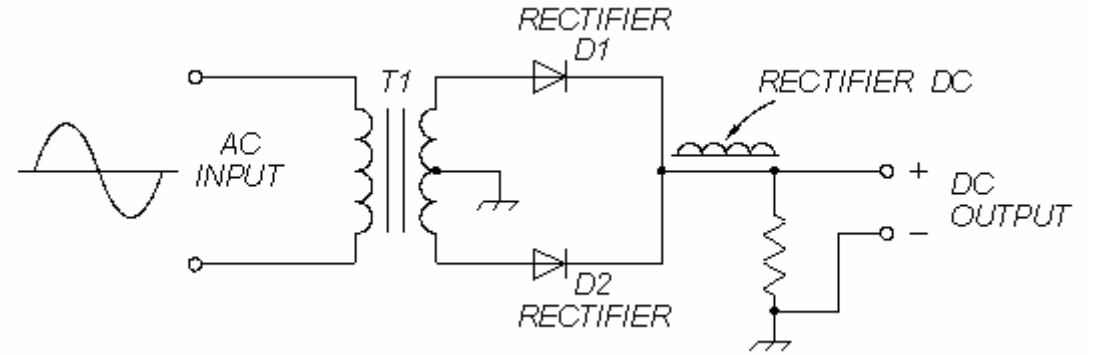

fig. 10, a

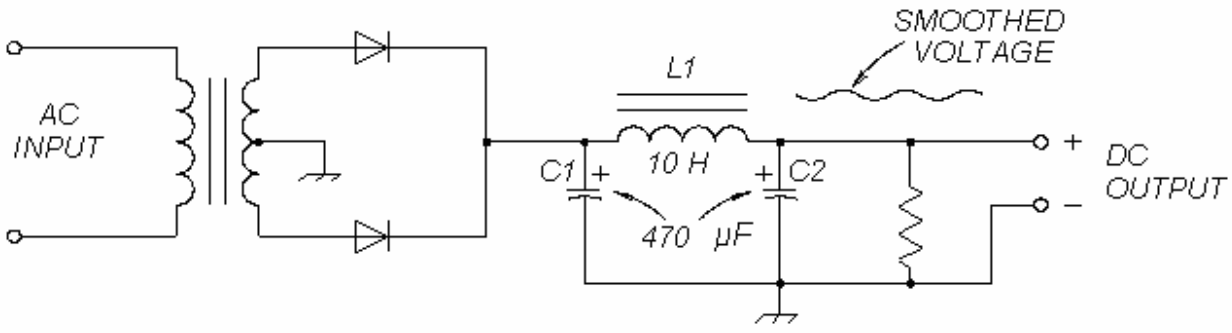

fig. 10, b

Let's suppose we wanted to develop +12 V for powering a small CW transmitter. We would have to step down the wall-outlet voltage from 117- to 12V ac. T1 of fig. 10,a would accomplish that. But we still need to

change the ac to dc. If we did not rectify the ac voltage, our transmitter signal would have a bad hum on it, caused by the 60-Hz ac wave from the wall outlet or transformer secondary winding. Similarly, we would hear a raucous hum in the speaker if we used an ac voltage to power our receiver.

So, to obtain dc output from our power supply, we will add D1 and D2 of fig. 9A. The rectifying action of the diodes will change the ac to pulsating dc, and will double the power-line frequency to 120 Hz. Remember, it is 60 Hz to start with. The pulsating dc will still cause hum on our transmitter signal, so we have to take another step in our design. Fig. 9 B shows the same circuit, but we have added two filter capacitors (C1 and C2) and a filter choke (L1). These components will smooth the pulses that otherwise could cause hum.

Notice that the dc output now has but a slight ripple. This would be so small that we might not hear it on our transmitter signal or in the speaker of a receiver. We could see the ripple if we connected a sensitive instrument (such as an oscilloscope) to the output dc line. An ideal power supply would have no ripple, and only a straight line would appear on the face of a scope. These illustrations represent the basis of all power supplies, but some use four diodes. It is called a full-wave bridge circuit. Even a single diode can be used alone to form a half-wave rectifier.

Задание 3. Ответьте на вопросы к тексту.

1. What is the main function of the silicon diodes? 2. What would happen if we did not rectify the ac voltage? 3. Would we hear a raucous hum in the speaker if we used an ac voltage to power the receiver? 4. How can we obtain dc output from our power supply? 5. What components will smooth the pulses? 6. What instrument can we use to see the ripple?

UNIT VIII. AMPLIFIERS

Infinitive and its Constructions

<u>Упражнение I.</u> Переведите следующие словосочетания, обращая внимание на инфинитив:

the first to invent; the last to come; the device to be developed: the problem to be considered; the facts to be mentioned; the losses to be minimized; the parts to be connected; the parameters to be improved; the tests to be carried out.

<u>Упражнение 2.</u> Прочтите и переведите предложения, обращая внимание на функции инфинитива.

1. The problems to be discussed at the conference are connected with the application of a new computer. 2. Emitters to be made of this material will be used in a large transmitting tube. 3. This characteristic is of great importance to obtain direct currents and voltage from AC source. 4. To operate tubes at high power certain limitations should be taken into account. 5. To reduce these oscillations is the main task of the experiment. 6. To compare these data we must take into account these parameters of the tubes.

<u>Упражнение 3.</u> Прочтите и переведите предложения, обращая внимание на объектный инфинитивный оборот.

1. They reported the conference to have been a great success. 2. We want you to take into consideration that voltage, resistance and capacity are the three important properties to influence the flow of current in an electric circuit. 3. We know an alternating current to be continually changing by rising, falling and changing direction. 4. We know copper to be distin-

guished from all other metals by its red colour. 5. We should like them to test these new devices. 6. They expect the group of young specialists to solve this problem successfully.

<u>Упражнение 4.</u> Прочтите и переведите предложения, обращая внимание на субъектный инфинитивный оборот.

1. A circuit is said to possess an inductance of 1 henry if 1 volt is induced when the current changes at the rate of 1 ampere per second. 2. May 7 is considered to be the date of the invention of radio. 3. Semiconductor devices are known to have replaced vacuum tubes in many applications. 4. Superconductivity is considered to be one of the most important properties of matter. 5. Tungsten appeared to have the highest melting point. 6. This problem is sure to be solved in the near future. 7. These tests do not seem to have been so complicated. 8. Photoelectric cells are known to be used as ordinary switches. 9. These two phenomena are supposed to be of common origin. 10. This material is expected to be used more widely in the future.

Text 8 A. Amplifiers

The term "amplifier" describes a device which steps up an electric signal in voltage, current or power without changing its waveform. The transistor amplifiers are known to be the most important devices in electrical engineering and radio engineering. They have made possible modern radio, television, long distance telephone, radar etc.

The principal application of transistors is known to be based on their ability to amplify electric signals. We know amplifiers to be devices designed to take a small electric signal from some source and produce a much larger output signal. Several successive amplifier stages are known to

be employed to increase the signal level until it attains the required level for the output. An ideal amplifier would give an output exactly duplicating the input in every respect except magnitude. A ratio of the output voltage to the input voltage is known to be called the amplification or gain of the amplifier.

In amplifiers it is possible to transfer a portion of the energy from the output back to its input. When this is done, the amplifier is said to have feedback. There are two basic types of feedback: positive feedback and negative feedback. When the feedback energy is in phase with the applied signal, positive feedback takes place. Negative feedback is the term used when the feedback signal is out of phase with the applied signal.

Positive feedback increases the gain of the amplifier. In contrast, negative feedback decreases the gain. But the loss in gain can always be compensated for by increasing the amplitude of the input signal, the net effect of negative feedback is a reduction in distortion and noise. And for this reason, we are primarily interested in negative feedback.

Negative feedback was invented by Harold S. Black of Bell Laboratories. Because Black's technique seemed to contradict many of the accepted technical concepts of the day, it took almost 10 years for a patent to be granted for his work. Black's theory attracted the attention of the electronics community so that hundreds of articles were published in popular and professional journals on feedback technology. Even today's sophisticated devices owe much to Black's invention of feedback control circuitry.

Active Vocabulary

to attain	-	достигнуть
contradict	-	противоречить
to design	-	проектировать; конструировать
distortion	-	искажение
feedback	-	обратная связь
gain	-	коэффициент усиления; усиление
loss	-	потеря, утрата
magnitude	-	величина
net	-	конечный; суммарный
ratio	-	отношение
stage	-	каскад
to step up	-	увеличивать
term	-	термин

<u>Упражнение 5.</u> Ответьте на следующие вопросы:

1. What does the term "amplifier" describe? 2. Where are amplifiers used? 3. What are the amplifiers designed for? 4. What is known as amplification or gain of the amplifier? 5. When is the amplifier said to have feedback? 6. What two basic types of feedback do you know? 7. Under what condition does positive feedback (negative feedback) take place? 8. Why are we primarily interested in negative feedback? 9. Who invented negative feedback? 10. Why is his invention very important?

<u>Упражнение 6.</u> Заполните пропуски словами и словосочетаниями, приведенными ниже.

1. The ratio of the output voltage to the input voltage is called ... of the amplifier. 2. Several successive ... are employed to increase the signal level.

3. An ideal amplifier would give an output exactly duplicating the input in every respect except .... 4. The principal application of transistors is based on their ability to ... electric signals. 5. If the voltage is fed back in phase with the grid signal we refer to ... 6. The … of gain that is caused by negative feedback is not a problem because it can be compensated for by increasing the amplitude of the input signal. 7. The results of the experiment seemed to … many of the accepted technical concepts of the day. 8. Frequency … may take place when some frequency components are amplified more that others.

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a) loss, b) gain, c) amplifier stages, d) contradict, e) magnitude, f) positive feedback, g) amplify, h) distortion.

Упражнение 7. ***Прочтите пары антонимов и запомните их:***

to step up - to step down; output - input; open - closed; with -without; to increase - to decrease; negative – positive.

Упражнение 8. ***Переведите следующие предложения, пользуясь таблицей, приведенной ниже.***

1. Известно, что усилители важные устройства в электротехнике и радиотехнике. 2. Говорят, что этот усилитель нашел широкое применение. 3. Считают, что усилители этого типа являются довольно перспективными. 4. Эти приборы, вероятно, будут широко использоваться в радиотехнике. 5. Студенты, кажется, уже изучили этот раздел электротехники. 6. Известно, что испытания этого класса усилителей закончатся через неделю.

The amplifiers	are known	to be over in a week
The amplifiers	seem	to have found wide application of this type
The students	is said	to be rather perspective
The tests of this class amplifiers	are known	to have studied this section of electrical engineering
These devices	are considered	to be important devices in electrical and radio engineering
This amplifier	are likely	to be widely used in radio engineering

Text 8 B.

<u>Задание I.</u> Прочтите следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять содержание текста.

distortion - искажение, to occur - происходить, случаться, coupling capacitor - разделительный конденсатор, distributed capacity - распределительная ёмкость, phase shift - фазовый сдвиг.

<u>Задание 2.</u> Прочтите текст, стараясь понять основное содержание

Distortion in Amplifiers

There are three main types of distortion that may occur in amplifiers: frequency distortion, phase distortion and amplitude distortion.

Frequency distortion is known to occur when some frequency components of a signal are amplified more than others. We know frequency distortion to occur at low frequencies if coupling capacitors between stages are too small

or it may occur at high frequencies as a result of the shunting effects of the distributed capacities in the circuit.

In fig. 11 an input signal consisting of a fundamental and a third harmonic is passed through a two stage amplifier. Although the amplitudes of both components are known to be amplified by identical ratios, the output waveshape is considerably different from the input signal because the phase of the third-harmonic signal has been shifted with respect to the fundamental signal. This phase shift is known as phase distortion and is caused principally by the coupling circuits between the stages of the amplifier. Most coupling circuits shift the phase of a sine wave, but this has no effect on the shape of the output wave. However, when a complex wave is passed through the same coupling circuit each component frequency of the wave shape may be shifted in phase by a different amount so that the output wave is not a faithful reproduction of the input wave shape.

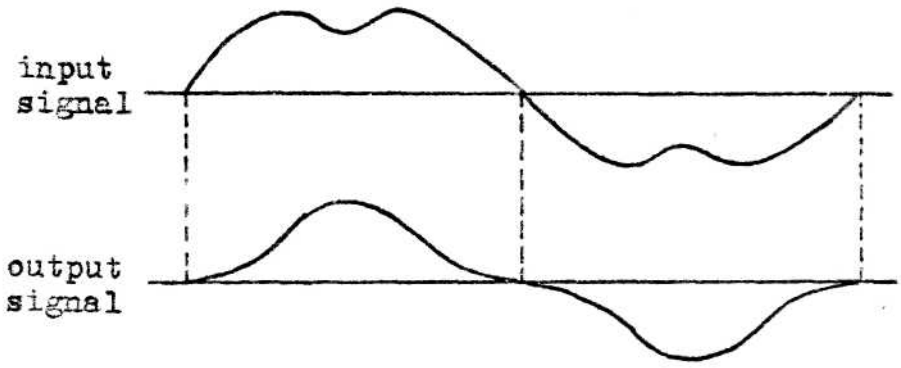

fig. 11

If a signal is passed through a transistor that is operating on any nonlinear part of its characteristic amplitude distortion will occur. In such a region a change in base voltage does not result in a change in collector current which is directly proportional to the change in base voltage. For example if an amplifier is excited with a signal that overdrives the

transistors the resultant signal is distorted in amplitude since the transistors are then operating over a nonlinear portion of their characteristic.

Задание 3. ***Ответьте на вопросы к тексту:***

1. What three main types of distortion may occur in amplifiers? 2. When may frequency distortion occur in amplifiers? 3. What does fig. 10 illustrate? 4. What is known as phase distortion? 5 When does amplitude distortion occur?

Задание 4. ***Закончите данные предложения в соответствии с содержанием текста.***

1. There are three main types of distortion in amplifiers ...
2. Frequency distortion may occur when ...
3. The phase shift is caused ...
4. If an amplifier is excited with a signal that overdrives the tubes the resultant signal ...
5. When a complex wave is passed through the coupling circuit each component frequency of the wave shape ...

UNIT IX. RADIO TRANSMITTERS AND RECEIVERS

The Gerund

Constructions with the Gerund

Упражнение I. ***Прочтите и переведите следующие предложения, обращая внимание на герундий.***

1. The main function of a transformer is changing voltage in the circuit.
2. Various systems of units have been established for measuring magnetic

flux. 3. Connecting condensers in series decreases the capacity of the circuit. 4. In building atomic power stations we have to solve many different problems. 5. There are many ways of applying high voltages. 6. Measuring resistance is necessary in many cases. 7. The principal applications of transistors are based on their ability of amplifying electric signals. 8. Different ways of sending messages over long distances have been known for thousands of years.

Упражнение 2. ***Прочтите и переведите следующие предложения, обращая внимание на функции и формы герундия***.

1. We speak about conductors being connected in series if the end of one is connected to the beginning of the next. 2. We know of silver and copper being very good conductors. 3. A radio transmitter is a device for producing radio frequency power for transmission in the form of a carrier wave. 4. On receiving good results he carried out some experiments of this kind. 5. Rectifiers are devices for converting alternating current into direct current. 6. Using Ohm's law is of great importance because of its being generally applied to many electrical phenomena. 7. We were informed of the new device having been successfully tested. 8. There were some difficulties in designing a new model of the receiver.
2.

Text 9 A. Radio Transmitters and Receivers

The two principal parts of a radio system are the transmitter and the receiver. A radio transmitter is a device for producing radio frequency power for transmission in the form of a carrier wave. It also contains means of modulating or varying the carrier wave in correspondence with the

information it is desired to transmit. Fig. 12 shows a block diagram of a typical transmitter employing amplitude modulation.

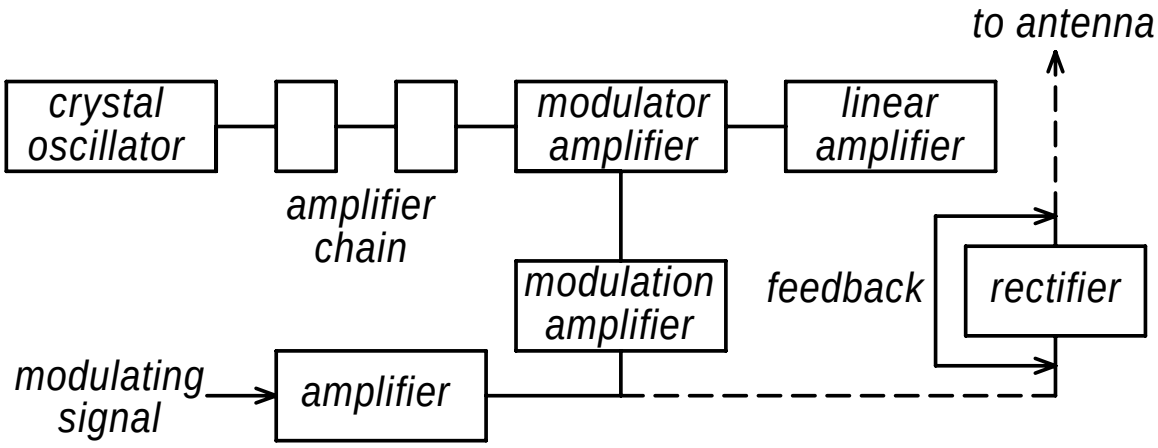

fig. 12

In an amplitude modulated transmitter the desired frequency is generated at a low power level by a stable oscillator normally employing a crystal. It is theoretically possible to design crystal controlled oscillators which would produce several hundred watts of output power. It is better practice to use a crystal oscillator with only a few watts of output followed by a chain of high gain amplifiers simultaneously increasing the power level and separating the oscillator from the modulator. When the frequency is higher than can be obtained directly from a crystal oscillator harmonic generators are included in the amplifier chain. In some cases the modulated amplifier is followed by one or more linear amplifiers. The distortion, noise, frequency characteristics of an amplitude modulated transmitter may be considerably improved by the application of negative feedback. The use of negative feedback permits high efficiency linear amplifiers to be used in services such as broadcasting where low distortion and low noise level are essential.

Amplitude modulated transmitters are rarely used at frequencies above 40 MHz. Frequency modulated transmitters find extensive use at frequencies above 40 MHz for such purposes as FM broadcasting, television systems etc.

The main advantage of frequency modulation is that transmissions are not affected by usual forms of interference. Unlike AM transmitters practice FM transmitter practice is to modulate at low power levels multiplying the frequency and the power many times. The advantage of negative feedback can be achieved also in frequency modulated transmitters. In this case the negative feedback is obtained by applying the transmitter output to an FM detector. The benefits obtained are the same as those from the feedback in an AM system: reduction of distortion, noise, etc.

A receiver is a device which accepts and demodulates radio frequency signals to obtain the intelligence contained in the signal. The waves radiated from transmitting antennas set up voltages in a receiving antenna so that the first function of a receiving set is to select the signal desired. The other principal functions of a radio receiver are to amplify the radio-frequency signal selected, to detect the signal thereby producing an audio-frequency signal, to amplify this signal and to reproduce it audibly by means of a loudspeaker. All radio receivers, except a few designed to meet specialized needs, are of the superheterodyne type. Such receivers can be represented schematically as shown in fig. 13.

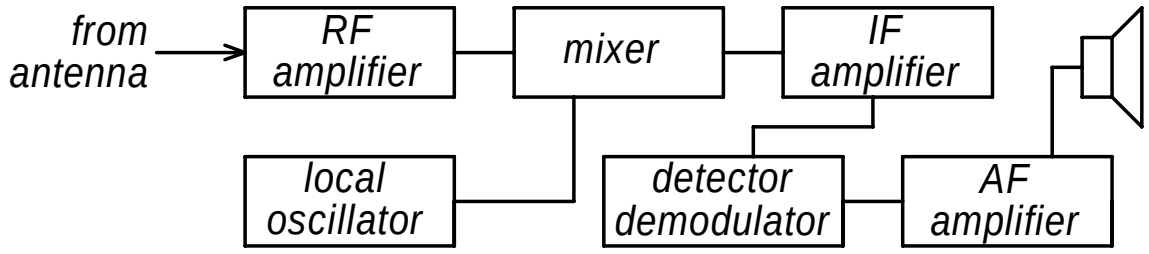

fig. 13

In this type of a receiver a mixer is used to combine the incoming signal wave with the output of a local oscillator. This variable combination of the two waves produce a frequency of fixed value called the intermediate frequency Selection of the station to be received is accomplished by adjusting the local oscillator frequency so that the difference between it and the carrier frequency of the desired station is equal to the intermediate frequency. This frequency is then amplified by means of one or more stages. Intermediate frequency amplification is more efficient than radio frequency amplification. Since the intermediate frequency is of fixed value the amplifiers can be pre-tuned thus greatly simplifying the alignment and the operation of the receiver. After amplification the detector converts the modulated intermediate frequency signal into an audio frequency signal which is fed into a loudspeaker. The receiver output may be adjusted to suit the listener by means of a volume control.

Active Vocabulary

affect - воздействовать, влиять

alignment - настройка: синхронизация

amplitude modulation - амплитудная модуляция

benefit - выгода, польза; приносить пользу

carrier wave	-	несущая волна
crystal controlled oscillator	-	кварцевый генератор
to desire	-	желать, хотеть
interference	-	помеха, помехи; интерференция
in correspondence with	-	в соответствии с
mixer	-	смеситель, преобразователь частоты
to modulate	-	модулировать
to meet needs	-	отвечать требованиям, соответствовать
rarely	-	редко
volume control	-	регулировка громкости; регулятор громкости

<u>Упражнение 3.</u> Ответьте на следующие вопросы:

1. What two devices are the main parts of any radio system? 2. What is the function of a radio transmitter? 3. What type of transmitter is shown in Figure 12? 4. How is the desired frequency generated in an amplitude modulated transmitter? 5. How is it possible to improve the characteristics of an amplitude modulated transmitter? 6. Where do frequency modulated transmitters find extensive use? 7. What is the main advantage of frequency modulation? 8. What are the functions of a receiver? 9. What does Figure 12 represent? 10. How is the selection of the desired station usually accomplished?

<u>Упражнение 4.</u> Сгруппируйте слова с одинаковым корнем и переведите их.

Transmitter, producer, oscillate, generator, transmission, produce, modulator, rectification, transmit, oscillation, transmitting, rectifier,

amplification, oscillator, production, modulate, generate, rectify, generation, amplifier, modulation.

Упражнение 5. ***Назовите глаголы, от которых образованы следующие существительные, и переведите их.***

Transmitter, carrier, information, oscillator, generator, amplifier, broadcasting, interference, receiver, combination.

Упражнение 6. ***Переведите следующие словосочетания, обращая внимание на значение приставок:*** *re-, pre-, un-, non-.*

a) to rearrange the components, to recharge the battery, to reassemble the device, to retest certain tubes, to reorganize the plant,

b) pre-war design, pre-production model, pre-tuned model.

c) unpleasant vibration, uncontrollable operation, uneconomic production, unstable oscillator, undesirable distortion;

d) non-metallic parts, non-corrosive material, non-conducting material, non-used method.

Упражнение 7. ***Заполните пропуски словами или словосочетаниями, приведенными ниже.***

1. A radio transmitter is a ... for producing radio frequency power for transmission in the form of a carrier wave. 2. The distortion, noise and frequency characteristics of an amplitude modulated transmitter may be improved by the application of ... 3. A chain of high gain amplifiers may be used ... the power output of a crystal oscillators 4. The receiver output may be adjusted to suit the listener by means of ... 5. The two principal parts of a ... are the transmitter and the receiver. 6. Frequency modulated transmitters find extensive use at ... above 40 MHz.

volume control, device, negative feedback, to increase, radio system, frequencies.

Упражнение 8. ***Выразите свое согласие или несогласие со следующими утверждениями, употребляя фразы:*** *"That's right"; "That's wrong"*

1. A radio transmitter contains means of modulating the carrier wave according to the information being transmitted. 2. In an AM transmitter the desired frequency is generated at a high power level by a stable oscillator normally of a crystal type. 3. The first function of a carrier is to amplify the voltages in the receiving antenna. 4. In superheterodyne receivers the major part of the amplification is at the audio frequency stage. 5. A chain of high gain amplifiers may be used to increase the power output of a crystal oscillator. 6. Harmonic generators are included in the amplifier chain when the frequency is lower than can be obtained from a crystal oscillator. 7. In a superheterodyne receiver a mixer is used to separate the incoming signal wave from the output of a local oscillator.

Упражнение 9. ***Прочтите и переведите предложения, обращая внимание на формы и функции герундия.***

1. The usual method of changing the frequency is to include in the oscillator circuit a variable condenser. 2. At present radio can be used in orientating the aircraft and in fixing the aircraft's position. 3. There are different methods of generating high-frequency current for heating. 4. His having made this discovery interested everyone. 5. Their having obtained

the new equipment will help them greatly. 6. We know of their having obtained some interesting results. 7. Making use of these properties will help us greatly.

Text 9 B.

<u>Задание 1.</u> Прочтите следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять содержание текста.

waveband - диапазон частот, выделенный для определенной радиослужбы, provided - при условии если, to match - согласовать, giant hops - гигантские скачки, dense - густой, in terms of - в единицах, to discriminate - различать, распознавать, fidelity - точность, верность звуковоспроизведения.

<u>Задание 2.</u> Прочтите текст, стараясь понять основное содержание.

Choosing the Right Waveband

All long distance medium and short wave reception depends on the ionosphere, electrified layers of gas extending several hundreds of kilometres above the earth. Provided the engineers choose a suitable band to match the state of the ionosphere, the radio waves are reflected by the ionosphere and by the surface of the earth and travel from transmitting aerial to receiving aerial by a series of giant hops, each perhaps as much as four thousand kilometres long.

The ionosphere is produced by radiation from the sun and it is much denser during daylight than during darkness. Consequently it is able to reflect during daylight the signals in the upper bands such as 21 and 17

MHz. Although during darkness these frequencies can often pass straight through it and be lost in space. On the other hand throughout the hours of daylight the lower layers of the ionosphere are so dense that medium wave signals and signals in the lower frequency bands are heavily attenuated as they pass through them. The daylight range of these transmissions is therefore very limited.

During daylight reception is best at higher frequencies. During darkness reception is likely to be better at lower frequencies and at medium waves if there is a medium wave transmitter in the area. If the signal has to travel through a mixed path of daylight and darkness on its way from the transmitter to receiver the middle bands will be best.

Characteristics of Broadcast Receivers

The most important characteristics of a receiver for radio-telephone signals are the sensitivity, the selectivity and the fidelity. The sensitivity represents the ability of a receiver to respond to small radio-signal voltages. The sensitivity is measured in terms of the voltage induced in the antenna by the radio signal to develop a standard output from the power amplifier. The selectivity is the property that enables a radio receiver to discriminate between radio signals of different carrier frequencies. Fidelity represents the extent to which the receiver reproduces the different modulation frequencies without frequency distortion. The fidelity of a radio receiver is expressed in curves which give the variation in audio-frequency output voltage as the modulation frequency of the signal is varied.

Задание 3. Ответьте на вопросы к тексту.

1. What factors does long distance medium and short wave reception depend upon? 2. Is the ionosphere denser during daylight or darkness? 3. What signals are reflected by the ionosphere during daylight? 4. Why is

the daylight range of the transmissions limited? 5. What are the most important characteristics of a receiver? 6. What ability of a receiver does the sensitivity represent? What property of a receiver does the selectivity represent? How is the fidelity of a receiver expressed?

<u>Задание 4.</u> Закончите предложения, выбрав из предложенных вариантов один, соответствующий содержанию текста.

1. The ionosphere is much denser …

a) during daylight; *b) during darkness*

2. The ionosphere is able to reflect during daylight the signals…

a) in the middle bands; *b) in the upper bands*

3. The daylight range of the transmission is…

a) very limited; *b) unlimited*

4. During daylight reception is best …

a) at lower frequencies; *b) at higher frequencies*

5. The sensitivity represents the ability of a receiver to respond to…

a) high radio signal voltages; *b) small radio signal voltages*

6. Fidelity represents the extent to which the receiver reproduces the different modulation frequencies…

a) without frequency distortion; *b) with high frequency distortion*

UNIT X. ANTENNAS

Participle Constructions; Absolute Participle Construction

<u>Упражнение 1.</u> Прочтите и переведите следующие предложения, обращая внимание на формы и функции причастий.

1. Increasing the voltage across a resistor we increase the current flowing through the resistor. 2. The heat produced per second depends both upon resistance of the conductor and upon the amount of current flowing through

it. 3. Using a transformer you can increase or decrease the voltage of the alternating current. 4. The radio waves produced by an alternating current will vary in intensity with the frequency of the current. 5. Having determined the number of amperes and the number of volts we can find the resistance of the coil by using Ohm's law. 6. Having been carefully tested the device was put into operation. 7. The results achieved depended upon the methods used. 8. This simple and inexpensive device gives good results if properly used. 9. When reconstructed the plant increased the output of receivers. 10. When heated most bodies increase in length and expand in all directions.

<u>Упражнение 2.</u> Прочтите и переведите на русский язык следующие словосочетания, обращая внимание на причастие.

a) the device operating at an average speed, the mechanism transmitting the power, the device converting mechanical energy into electricity, the tasks facing the radio industry, the plant producing tape-recorders;
b) the experiment being made in the laboratory, the plant being built in this town, the problem being discussed at the meeting, the device being tested here;
c) making the experiment, using the new equipment, comparing these two methods, moving at high speed, increasing the output power, providing the necessary conditions;
d) having measured the distance, having tested the device, having replaced the worn components, having reduced the resistance, having finished tests, having achieved good results, having amplified the input signal, having obtained these data.

<u>Упражнение 3.</u> Прочтите и переведите предложения, обращая внимание на независимый причастный оборот.

1. The device working well, we can use it in our work. 2. The new equipment having been installed at the plant, the labour productivity increased considerably. 3. The voltage being increased, the field becomes stronger enough to cause the electrons to produce additional ions. 4. The question being too difficult, no one could answer it. 5. Transistors being very sensitive to light, engineers use this property. 6. The grid being positively charged, it attracts electrons and increases their flow from the filament to the plate. 7. There are many types of antennas in use today, the most popular being the vertical antenna. 8. An antenna being used for wave radiation, energy is fed into it by a transmission line connected to a transmitter. 9. The principle of operation being extremely simple, the device was widely used for various purposes.

Text 10 A. Antennas

Antennas are used to radiate or receive radio waves. When an antenna is used for wave radiation energy is fed into it by a transmitter. When used as a receiver the antenna is placed so as to intercept a portion of energy radiated by the transmitting antenna. This energy then is fed into a transmission line leading to a receiver.

An antenna has identical transmitting and receiving properties and in most cases may be used for transmitting and receiving simultaneously.

To be an efficient radiator an antenna must have physical dimensions comparable with the signal wavelength. Thus stations with lower frequencies and therefore longer wavelengths require longer antennas than short wave stations.

So very many types of antennas are in use. The most popular type, however, is the vertical radiator (fig.14). It consists of a single steel tower whose height is from one half to one full wavelength.

fig. 14

For low frequencies inverted L or T antennas may be used. The inverted L antenna consists of an elevated horizontal conductor connected at one end to the transmitter or receiver. Another much used antenna is the dipole, the most usual form of which is a conductor whose length is approximately equal to a half wavelength of the signal being sent or received. This length is usually divided at its electrical centre by a short gap. The transmitter or receiver is connected across this air gap. This type of an antenna both radiates to and receives signals from all directions.

Transistor portable receivers designed for short wave reception usually have a rod aerial and to get the maximum benefit from this it is necessary to vary its length and position until the best reception is obtained. Listeners should remember that on most occasions their transistor set together with its rod aerial will be used indoors and reception will be worse than that achieved with an outside aerial; some improvement can usually be achieved by placing the set and its rod aerial near a window, particularly if you live in a modern block of flats. Short-wave transistor portable receivers are sometimes equipped with an external aerial as well and in this case a short outdoor aerial will usually produce good results.

Active Vocabulary

aerial - антенна

dipole - диполь; симметричный вибратор

external	-	внешний
to intercept	-	перехватывать
identical	-	тот же самый; одинаковый, идентичный
gap	-	зазор; минимум диаграммы направленности антенны
to radiate	-	излучать
rod	-	стержень
simultaneously	-	одновременно

<u>Упражнение 4.</u> Ответьте на следующие вопросы:

1. What purposes are antennas used for? 2. May antennas be used only for transmitting signals? 3. What type of the antenna is the most popular? 4. What antennas are used for low frequencies? 5. What does the inverted L antenna consist of? 6. What aerials do transistor portable receivers usually have?

<u>Упражнение 5.</u> Закончите предложения, выбрав из предложенных вариантов один, подходящий по смыслу. Переведите предложения.

1. An antenna may be used in most cases for transmitting and receiving…

a) quickly; b) seldom; c) simultaneously

2. The inverted L antenna may be used for…

a) high frequencies; b) low frequencies; c) intermediate frequencies

3. The most popular type of the antenna is …

a) an inverted V antenna; b) a dipole; c) a vertical radiator

4. Transistor portable receivers designed for short-wave reception usually have…

a) a rhombic aerial; b) a vertical radiator; c) a telescopic rod aerial

5. The reception will be better if to place the set and its rod aerial…

a) near the window; b) far from the window

6. The stations with lower frequencies and longer wave lengths require…

a) larger antennas; b) smaller antennas

Упражнение 6. ***Дайте возможные сочетания следующих прилагательных и существительных.***

Прилагательные: exact, perfect, common, effective, certain, careful.

Существительные: alignment, device, function, operation, displacement, stability, methods.

Упражнение 7. ***Прочтите и переведите следующие слово-сочетания:***

transmitting antenna, receiving antenna, wave radiation, wave type, wave length, frequency range, transmission line, low frequencies, high frequencies, intermediate frequencies, to receive signals, short-wave reception, usual form, usual dimensions, carrier wave, portable receiver, sensitive receiver, indoor aerial, external aerial, local transmission.

Упражнение 8. ***Выразите свое согласие или несогласие со следующими утверждениями, употребляя фразы:*** *"That's right"; "That's wrong".*

1. An antenna has identical transmitting and receiving properties. 2. A dipole antenna acquires considerable directional properties when one or more reflectors of appropriate size and position are included. 3. A dipole antenna only radiates signals in all directions. 4. Stations with lower frequencies and longer wave lengths require smaller antennas than short-wave stations. 5. Very few types of antennas are in use today. 6. The most popular type of an antenna is the inverted V antenna.

Упражнение 9. ***Переведите слова, данные в скобках, употребляя причастие I.***

1. Electronic devices (использующие) transistors instead of valves can be made smaller in size. 2. A magnetometer is an instrument (измеряющий) magnetic forces or fields. 3. A current (проходящий) through a tube may be changed in various ways by the action of the tube. 4. A tube (усиливающая) weak signals is called an amplifier. 5. Quite a different sort of electronic device is the cathode ray tube (производящая) a strong narrow beam of cathode rays. 6. (Зная) the velocity of the radio waves and the exact time for the echo to come back the distance to the object can be calculated. 7. (Определив) the current in the circuit we can measure the resistance using Ohm's law.

Text 10 B

Задание 1. ***Прочтите следующие слова. Обратите внимание на их значения. Знание этих слов поможет Вам понять основное содержание***,

to expose - размещать; a fraction - частица, доля; medium - среда; to traverse - проходить через; distinct - определенный, отдельный; to restrict - ограничивать; an outdoor aerial - внешняя антенна; a complex affair - сложное дело; marconic antenna - ненаправленная вертикальная проволочная несимметричная антенна.

Задание 2. ***Прочтите текст, стараясь понять основное содержание.***

Aerial Construction and Application

The transmission and reception of electromagnetic waves for radio communication are accomplished by radiators and collectors exposed in

space and known as antennas. An antenna is a device composed of a system of one or more linear conductors, usually of large electrical dimensions, from a fraction to several wavelengths. Between the transmitting and the receiving antennas there is a combination of earth, water, air which constitute the mediums in which electromagnetic waves are propagated. The action of the waves in traversing these mediums is very complex and depends upon many factors. Among prominent factors are the transmitting frequency, the radiation characteristics of the transmitting antenna, the time of the day and the conditions of daylight and darkness along path, the season of the year, the distance between the transmitter and receiver, the characteristics of the receiving antenna.

It must be emphasized that antenna applications are dependent upon the nature of wave propagation for any frequency and transmission circuit and for that reason the antenna engineer must also be an expert in propagation physics. Practical antennas fall into one of two district classes: (1) elevated or Hertz antennas which operate some distance above the ground in either a horizontal or vertical position and (2) vertical grounded or Marconi antennas which operate with one end grounded in a vertical position. Elevated or Hertz antennas are used at frequencies higher than 2 megacycles, while vertical grounded antennas are restricted to use at frequencies below 2 megacycles. The most elementary form of the Hertz antenna is the half-wave dipole.

Simple Aerials for Short or Medium Wave Reception

For the best reception a good aerial is a necessity. No matter how sensitive the receiver, unless the aerial supplies sufficient signal the receiver is working at a disadvantage. To ensure that the signals reaching

the aerial are not affected by absorption in the walls of the building an outdoor aerial is always best and this should be mounted as high as possible and as far away from any sources of interference as is practicable. An aerial need not be a complex affair; a simple outdoor horizontal or sloping wire will usually effect a tremendous improvement over an indoor aerial.

Задание 3. ***Ответьте на вопросы к тексту.***

1. What device is called an antenna? 2. In which mediums are electromagnetic waves propagated? 3. What factors does the action of the waves depend upon? 4. What two distinct classes do practical antennas fall into? 5. What frequencies are Hertz antennas used at? 6. What are the requirements for mounting an outdoor aerial? 7. What device is it necessary to use for the best short or medium wave reception? 8. Why is an outdoor antenna rather better than an indoor aerial?

Задание 4. ***Из данных утверждений выберите те, которые соответствуют содержанию текста, и прочтите их.***

1. The transmission and reception of electromagnetic waves for radio communication are accomplished by amplifiers. 2. The antenna application depends upon the nature of wave propagation for any frequency and transmission circuit. 3. Elevated or Hertz antennas are used at frequencies lower than 2 megacycles. 4. For the best short or medium reception a good antenna is not a necessity. 5. A simple outdoor horizontal or sloping wire will effect a great improvement over an indoor aerial. 6. Between the transmitting and the receiving antennas there are mediums in which electromagnetic waves are propagated. 7. Practically there is only one class of antennas.

<u>Задание 5.</u> Закончите предложения, выбрав из предложенных вариантов один, соответствующий содержанию текста.

1. The transmission and reception of electromagnetic waves for radio communication are accomplished…

a) by antennas; b) by oscillators

2. The antenna engineer must be an export in: …

a) nuclear physics; b) propagation physics

3. An antenna is a device composed of one or more linear conductors of…

a) small electrical dimensions; b) large electrical dimensions

4. The action of the electromagnetic waves in traversing the mediums is…

a) very complex; b) very simple

5. Elevated or Hertz antennas are used at frequencies…

a) lower than 2 megacycles; b) higher than 2 megacycles

6. For the best reception a good antenna is…

a) quite necessary; b) not necessary

7. An outdoor aerial should be mounted…

a) near the sources of interference; b) far away from any sources of interference

8. An aerial need not be…

a) a simple affair; b) a complex affair

9. An outdoor antenna should be mounted…

a) as high as possible; b) as low as possible.

UNIT XI. THE INVENTION OF RADIO

<u>Упражнение I.</u> Прочтите и запомните следующие слова и группы слов. Они помогут Вам понять содержание текста.

wireless -беспроволочный; to conduct research - проводить, вести исследования; generation - поколение; to investigate - исследовать; investigation - исследование; to lay foundation - закладывать основы, основать; to establish - устанавливать; to elaborate - разрабатывать; sensitive - чувствительный, восприимчивей; sensitivity - чувствительность; arrangement -устройство; to belong to - принадлежать; as well as - также, так же как; to install - устанавливать, to equip - оборудовать; equipment - оборудование; to design - проектировать, конструировать; on a large scale - в большом масштабе; means - средство, способ.

<u>Упражнение 2.</u> Прочтите текст, постарайтесь понять основные положения и запомнить уточняющие детали.

The Invention of Radio

May 7 is the date of the invention of radio. A.S.Popov (fig. 15) - the great Russian scientist is the inventor of wireless telegraphy. His discovery was the result of extensive research. Popov conducted that research over a period of some years studying electric waves and oscillations. Popov's scientific discovery was the culmination of the efforts of some generations of scientists. Their work made up the early history of radio which began with the investigations of Faraday.

fig. 15

Faraday's discovery of electromagnetic induction laid the foundation of present-day electrical engineering. His natural-scientific ideas brought a revolution in the understanding of electrical phenomena. Faraday's theory of magnetic and electric lines of force was very important too. Maxwell developed Faraday's scientific idea. He worked in many fields of physics, mechanics. But his chief works were investigations in electromagnetism and in the kinetic theory of gases. His electromagnetic theory of light is one of the greatest achievements of science of the 19th century. Of great value to radio was Maxwell's idea of free electromagnetic waves. Heinrich Hertz proved the real existence of electromagnetic or radio waves by the experimental investigations. He established the fact that free electromagnetic waves had the same laws as light waves. By measuring the length of the electric waves and calculating the frequency of his oscillator Hertz was able to calculate the velocity of transmission of the waves through air. With his simple equipment, for which he measured the wavelength at about 66 cm (455 MHz), Heinrich Hertz conducted experiments which led to a revolution in physics and a revolution in electrical communications. His experiments were the basis of wireless telegraphy.

Popov was one of the first who began to elaborate this important scientific advancement. He pointed out that their new achievement of science is not only of theoretical value but it may find a practical application. Many scientists in different countries worked in the field of electromagnetic waves. We must speak about the works of two of them, E. Branly (1846-1940) and O. Lodge (1851-1940). The French scientist Edward Branly noticed the influence of an oscillating discharge on the

resistance of metals. Branly's device was a tube. There were two electrodes in it with a small space between them. That space was filled with metallic powder. When an electromagnetic wave passed through this device, the powder instantly became a good conductor.

The British scientist Oliver Lodge made the next step. He worked on the problems that followed from Faraday-Maxwell theory. Lodge developed a better device and succeeded in transmitting waves a certain distance beyond his laboratory. Lodge was the closest of anyone to the invention of wireless telegraphy.

A.S. Popov worked on problems of electric waves and oscillations. He wanted to find a practical application of these waves in the transmission of signals over considerable distances.

In 1894 Popov had already a reliably operating generator of electromagnetic oscillations. But the receiving part did not satisfy him. He decided to improve the device, to make it more sensitive and automatic in operation. During the experiments Popov noticed that the arrangement reacted to storm discharges and registered discharges at considerable distances. This was the birth of the first radio-receiving station in the world.

On May 7, 1895 Alexander Popov demonstrated his device at the Russian Physico-chemical Society. A.S.Popov reported "On the Relationship of Metal Powders to Electric Oscillations". He demonstrated an instrument designed to indicate rapid oscillations of atmospheric electricity.

That Instrument consisted of a glass tube which was filled with metal powder and was connected in the circuit of a sensitive relay. A.S. Popov demonstrated that device and also the main experiments in the variation of the resistance of powders caused by electric oscillations. The sensitivity of

that arrangement was good but the system was unstable. His further investigations A.S. Popov described in an article "An Instrument for Detecting and Registering Electric Oscillations". The date of the article was December 1895. Popov's discovery became known to the broadest scientific circles. Popov least of all thought how to obtain a patent for his invention. When the instrument was ready Popov did not take it to the "Department of Trade and Industry" that handled patents in Russia. The great Russian scientist did not make any secret of his discovery. He described it in the press and made reports about it at the meetings of scientific societies. He expressed the hope to use electromagnetic waves in the Naval Department in future.

But it happened so that in 1897 the whole world read in the papers about the new invention of the Italian Marconi (Fig. 16) in the field of wireless telegraphy. The name of the young inventor immediately became known in the whole world. The Russian newspapers published the articles of the real facts that showed who the actual inventor of wireless telegraphy was. "The idea of telegraphy over great distances without wire belongs to our compatriot, a well-known scientist, A.S.Popov, who discovered the new method of telegraphy as long as two years ago and who did not want to publish the results of his work because of the natural desire to bring to perfection his telegraph instrument".

fig. 16

On September 15, 1895 the Fourth Congress of Railway and other Electricians was held in Odessa. A.S. Popov was invited to the congress to speak on the new type of communication. His report and the demonstration

of experiments lasted several hours. He was listened to with great interest. A.S. Popov demonstrated the experiments in the transmission of signals. A transmitter was placed in the library of the Society. In the main hall, behind a thick stone wall was a receiver which was invented by the speaker as early as 1895. When sparks appeared in the receiver, the telegraph apparatus produced signals. The same action was produced if the transmitter was at a distance of two or more versts.

Popov was the first radio specialist to construct radio instruments as well as radio stations in Russia. He was invited to deliver some public lectures and to demonstrate his experiments in wireless telegraphy.

The year of 1897 was the year of great victory for the inventor of radio. A.S. Popov began to experiment on a large scale. The experiments began in the spring of 1897 in Kronstadt with instruments built for this purpose. The instruments were installed on the ships "Rossiya" and "Afrika". Signals were transmitted up to 700 metres and more.

However, the successful experiments at sea did not solve the problem to equip the Navy with radio. Trained radiomen and mass-produced radio equipment were needed before wireless telegraphy could be used in the Navy. A.S. Popov was a pioneer. He himself trained the first radio telegraph-men who were instructors in the training of new specialists. The production of radio equipment began according to ideas and instructions of A.S. Popov.

During experiments in wireless telegraphy the Russian scientists noticed that it was possible to receive signals by ear. A.S. Popov worked out an arrangement of an ear-phone receiver. Later Popov received a patent for it not only la Russia but also in Britain and France.

Saving fishermen from death through the use of wireless telegraphy spread throughout Russia. This showed good qualities of the new means of communication. Beginning with 1897 the name of Popov was in the headlines not only in scientific and technical journals but also in newspapers. Since 1900 wireless telegraphy and radio stations began to be used outside the Navy.

A.S.Popov is the pioneer in the construction of civil radio stations. Popov's name is also connected with the building of a wireless telegraph designed for international communications. He was asked to establish wireless communication between Russia and Bulgaria. In order to transmit signals over great distances it was necessary to increase the power of the electromagnetic waves source and to use a complex network of antennas. And Popov headed the construction work.

Everybody understood the importance of wireless telegraphy in naval affairs. But in reality the Navy in Russia remained without radio equipment. The heads of the Russian Army did not take practical steps to supply the army units and warships with radio equipment, Russia, the homeland of a number of scientific discoveries and inventions was rarely the first to apply them practically and on a large scale.

The inventor of radio A.S.Popov taught his whole life since the graduation from the St. Petersburg University until his death at the age of 46. Popov's love for work was one of his most typical features. He found rest in his favourite work. Day or night, holiday or workday made no difference to him. Popov was one of those scientists with "golden hands". In this respect he reminds us of Faraday.

Teaching was his main work and it lasted all his life. Delivering the lectures on electricity and wireless telegraphy Popov spoke as a pioneer in electrotechnical and later radiotechnical training in Russia. The radio course delivered by Popov was an entirely new field which had not existed before. The radio course was called "Lectures in Wireless Telegraphy". The success of his lectures was due to the carefully prepared and skillfully made experiments. The centre of his teaching was an experiment. A.S.Popov devoted much of his time to practical work with the students. He talked with the students not only on topics connected with the lecture or laboratory work. He always listened attentively to his pupils. In 1905 he was elected the director of the electrotechnical Institute. For nearly a quarter of a century Popov, who opened up a new page not only in the history of science and engineering, but also in human culture was working in the field of training radio specialists.

A.S.Popov died when he was only 46 years old but his name and work are known all over the world. He was a great scientist and a great patriot, "Future generations", he wrote, "will understand how great was my devotion to my country and how happy 1 am that it was in Russia and not abroad that a new means of communication was discovered".

<u>Упражнение 3.</u> Ответьте на следующие вопросы в соответствии с содержанием прочитанного.

1. What is the date of the invention of radio? 2. Who invented radio in Russia? 3. Who began the history of radio? 4. Whose discovery laid the foundation of electrical engineering? 5. Whose theory was very important for Maxwell? 6. In what fields of science did Maxwell work? 7. What

discovery was one of the greatest achievements of the 19th century? 8. What scientists worked in the field of electromagnetic waves? 9. What good results did Oliver Lodge achieve in the experiments? 10. Did Popov make any secret of his great discovery? 11. Was Marconi a real inventor of wireless telegraphy? 12. Did Popov publish the results of his work in 1895? 13. When did Popov begin to experiment on a large scale? 14. Who trained the first radiotelegraph-men in Russia? 15. What practical application of wireless telegraphy brought good results? 16. Was Russia the first country to apply all Popov's discoveries and inventions? 17. Was teaching the main work for Popov? 18. How long did Popov work in the field of training radio specialists? 19. Was an experiment the centre of Popov's teaching?

Упражнение 4. Найдите в тексте предложения, являющиеся ответом на следующие вопросы.

1. What discovery laid the foundation of present day electrical engineering? 2 What did Hertz prove by his experimental investigations? 3. Where did Alexander Popov demonstrate his device on May 7, 1895? 4. Between what two countries did Alexander Popov establish wireless communication? 5. Why were Popov's lectures successful? 6. What did Alexander Popov say himself about his invention?

Упражнение 5. Опровергните следующие утверждения, используя прочитанный текст.

1. The Italian Marconi was the first real inventor of wireless telegraphy. 2. The scientists in other countries did not work in the field of electromagnetic waves. 3. Popov's generator of electromagnetic oscillations in 1894 was a very reliable generator and fully satisfied him. 4. Popov took his device to the "Department of Trade and Industry" as soon as the

instrument was ready. 5. Russia was the first country to apply inventions practically on a large scale.

<u>Упражнение 6.</u> Закончите следующие предложения так, чтобы они верно отражали содержание текста.

1. Alexander Popov wanted to find a practical application of these waves… 2. During the experiments Popov noticed that his generator of electromagnetic oscillations ... 3. The Russian newspapers published the articles in 1897 ... 4. In order to transmit signals over great distances it was necessary ... 5. The success of Popov's lectures was due to ... 6. For nearly a quarter of a century Popov ... 7. The idea of telegraphy without wires over great distances ...

<u>Упражнение 7.</u> Из данных ответов на вопрос выберите тот, который соответствует содержанию текста.

1. What was important to the invention of radio?
   a. Of great value to radio was Maxwell's idea of free electromagnetic waves.
   b. Yoffe's research in semiconductors was important to the invention of radio.
   c. The works of academician Vvedenssky were important to the invention of radio.
2. Where did Popov want to find a practical application of electric waves and oscillations?
   a. Popov wanted to find a practical application of electric waves and oscillations in the production of transistors.
   b. Popov wanted to find a practical application of electric waves and oscillations in the transmission of signals over considerable distances.
   c. Popov wanted to find a practical application of electric waves and oscillations in chemistry.

3. What was necessary in order to transmit signals over great distances?

a. It was necessary to increase the power of the electromagnetic waves source to transmit signals over great distances.
b. It was necessary to have sparks in the receiver to transmit signals over great distances.
c. It was necessary to install a receiver to transmit signals over great distances

<u>Упражнение 8.</u> Найдите в тексте предложения, являющиеся эквивалентами русских предложений.

I. Попов проводил это исследование в течение ряда лет, изучая электрические волны и колебания. 2. Открытие электромагнитной индукции Фарадеем заложило основы современной электротехники. 3. Много ученых в различных странах работали в области электромагнитных волн. 4. В 1894 году Попов располагал надежно работающим генератором электромагнитных колебаний. 5. Доклад Попова и показ опытов продолжались несколько часов. 6. Он решил усовершенствовать свой прибор, сделать его более чувствительным и автоматическим в работе. 7 мая 1895 года Александр Попов продемонстрировал свой прибор на заседании русского физико-химического общества. 7. Чувствительность его прибора была хорошей, но система неустойчивой.

UNIT XII. FUNDAMENTALS

<u>Упражнение 1.</u> Прочтите и запомните следующие слова. Они помогут Вам понять содержание текста:

nucleus (nuclei) - ядро (ядра); in terms of – исходя из; to abbreviate - сокращать; ease - легкость, простота; available -имеющийся в распоряжении, доступный; dangerous - опасный; severe -тяжелый; bare

wires - оголенные провода; wet - сырой; to pull - тащить; to save - спасать; to wear – носить, изнашиваться.

<u>Упражнение 2.</u> Прочтите текст, постарайтесь понять основные положения и запомнить уточняющие детали.

Fundamentals

All substances are electrical in nature. The atom consists of two parts: a nucleus which contains neutrons and protons and a number of electrons which revolve around the nucleus.

The protons are positively charged and the electrons are negatively charged. The neutrons have no electrical charge. In the discussion of radio circuits electrons are of great interest.

Electrons are very small negatively charged particles. They travel in orbits around the nucleus in a manner similar to the way the earth travels around the sun.

Electrical Current and Units of Current Flow

Since current flow is the movement of electrons it is expressed in terms of the number of electrons which flow past a given point. Because electrons are small units the coulomb has been adopted as a unit of quantity of electricity. A coulomb is equal to approximately 620 million electrons. In practice we are usually interested in the rate of current flow or the number of coulombs which flow past a point each second. But to simplify matters the term "ampere" has been adopted. An ampere is equal to one coulomb per second.

Although the ampere is commonly used in electrical work, it is seldom used in radio engineenring. The more commonly used unit is the milliampere or one-thousandth of an ampere, usually abbreviated ma.

For example, a current flow of 0,250 amperes can be expressed as 250 milliamperes. Another unit of current flow used in radio circuits is the microampere, micro means millionth. Thus, a measurement of current flow may be given in three units; amperes, milliamperes or microamperes. An example: 0.00054 amperes = 0.54 milliamperes = 540 microamperes.

The amount of current that will flow through a conductor depends upon two factors. One of these is the voltage or pressure, the other is the resistance of the conductor. The opposition to a steady electron flow is called the resistance (R) of the material, and it is one of its physical properties.

The greater the resistance the lower will be the current flow for a given voltage and the lower the resistance the greater will be the current flow. The unit of measurement of resistance is the "ohm". The resistance of most conductors is very small, so that high resistance materials are used to make the known value resistors which are used throughout radio circuits.

Conductance is a measure of the ease with which a conductor will pass current. The term "mho" has been applied to the unit of measurement of conductance. But the "mho" is a very large unit and is seldom used. Conductance is usually expressed in micromhos. For example: Resistance = 1000 ohms, conductance = 1/1000=0.001 mhos = = 1000 micromhos.

Electrical Circuits

Electrons will flow from a point of negative potential to a positive point if a path is provided between two points. This path which includes the source of voltage is known as a circuit. If the path is broken there can be no current flow. There are series and parallel circuits. The circuit of figure 16 A is an example of a series circuit.

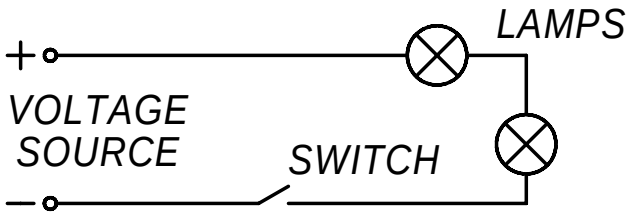

fig. 17,a

It is called a series circuit because all of the elements, the voltage source, switch and the lamps are connected so that there is only one path for the electron flow. Important facts to remember about series circuits are the same amount of current will flow through every part of the circuit; the sum of the voltage drops across each element in the circuit will equal the supply voltage. Figure 16 B illustrates a parallel circuit.

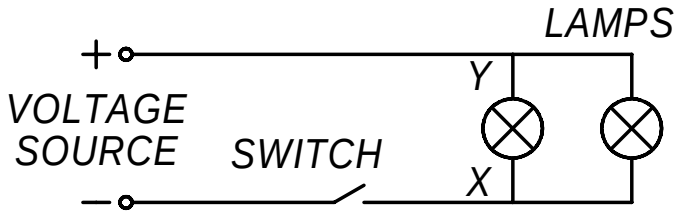

fig. 17, b

A parallel circuit has the main line and parallel branches. One side of each lamp is connected to the positive side of the voltage source and the other sides of the lamps to the negative terminal of the source. When the switch is closed electrons flow from the negative side of the source to the point "X". At this point two paths are available through which the electrons may flow so the total electron flow divides and a portion flows through each path lighting the lamps. At point "Y" only one path is available back to the positive side of the source so the currents through the branches combine and complete their paths to the positive side of the source. Each lamp is connected across the voltage source; therefore the same voltage is applied across each branch of the parallel circuits. The amount of current

flowing in each branch may not be the same since the current is also dependent upon the amount of resistance in the branch.

Inductors and Inductance

Inductors are circuit elements. An inductor is mainly a coil of wire wound around a core of air, a magnetic metal or a non-magnetic metal (fig18). Inductors are used in circuits of receivers and transmitters, radio frequency and audio-frequency filters.

Inductance is not a material thing but is a property of a circuit. It does not exist until current is passed through the circuit. The unit of measurement of inductance is the henry. A circuit has an inductance of one henry when a current change of one ampere per second will cause an induced e.m.f. of one volt.

fig 18

When a change of one ampere per second in one circuit induces one volt in another circuit the two circuits have a mutual inductance of one Henry. Inductance always opposes a change in current. The greater the rate of current changes the greater the opposition and the greater the induced voltage.

Many people have severe shocks from electric wires in a house. The wires seldom carry current at a higher voltage than 230 and a person who touches a bare wire or terminal may suffer no harm if his heart is strong and his skin is dry. But if the hand is wet he may be killed. Water is a good conductor of electricity and provides an easy path for the current from the wire to the body. One of the main wires carrying the current is connected to earth and if a person touches the other with a wet hand a heavy current will

flow through his body to earth and so to the other wire. The body forms part of an electric circuit. The current contracts the muscles and if the hand is holding the wire it may be impossible to open it so as to pull away from the wire and break the circuit.

The best thing you can do for a person is first to switch off the current at once if possible and then to pull him away from the wires quickly. Do it in dry gloves. Then give him artificial respiration at once. If this is done quickly his life may be saved.

When we are dealing with wires carrying electric current it is best to wear rubber gloves. Rubber is a good insulator and will not let the current pass to the skin. Never touch a bare wire with the hand and never touch a water pipe and an electric wire at the same time.

We all use electricity in our homes every day but sometimes forget that this is a form of power and may be dangerous. At the other end of the silent wires are great generators driven by turbines turning at high speeds. They generate enormous power. It can burn and kill; but it will serve us well if we use it properly.

<u>Упражнение 3.</u> Ответьте на следующие вопросы в соответствии с содержанием прочитанного.

1. What does the atom consist of? 2. What is the charge of protons? 3. How are electrons charged? 4. What are electrons? 5. What is the most common unit of current used in radio? 6. What two types of electric circuits do you know? 7. What are the circuit elements? 8. What is the function of a resistor in a circuit? 9. Is inductance a material thing? 10. What is it necessary to do for a person if he has an electric shock?

<u>Упражнение 4.</u> Найдите в тексте предложения, которые являются ответами на следующие вопросы.

1. How do electrons travel? 2. What is conductance? 3. What does a parallel circuit consist of? 4. What happens at the point "X" or a parallel circuit? 5. What happens to a person if he touches a bare wire?

<u>Упражнение 5.</u> Закончите следующие предложения так, чтобы они верно отражали содержание текста.

1. A circuit has an inductance of one henry when ... 2. The opposition to a steady electron flow is ... 3. The amount of current flowing in each branch may not be the same ... 4. Inductance is not a material thing but ... 5. The best thing you can do for a person who has a shock from electric wires ... 6. At the other end of the silent wires are ...

<u>Упражнение 6.</u> Найдите в тексте предложения, являющиеся эквивалентами русских предложений.

1. Протоны заряжены положительно, а электроны заряжены отрицательно. 2. Чем выше сопротивление, тем меньше ток при заданном напряжении. 3. Единица измерения сопротивления - Ом. 4. Сопротивление большинства проводников очень маленькое. 5. Существуют параллельные и последовательные цепи. 6. Катушки индуктивности используются в цепях приемников и передатчиков, фильтрах высокой и низкой частот.

UNIT XIII. VALVES. HISTORICAL DEVELOPMENT

<u>Упражнение 1.</u> Прочтите и запомните следующие слова и группы слов. Они помогут Вам понять содержание текста:

to occur - происходить, случаться; luminous - светящийся, светлый; to probe - зондировать; via - через; to file - представлять, подавать какой-

либо документ; meanwhile - тем временем; to eliminate the inconstancy - устранять непостоянство; to wear out - изнашиваться; amplification factor - коэффициент усиления; except -за исключением, исключая; mutual conductance – крутизна характеристики (электронной лампы).

<u>Упражнение 2.</u> Прочтите текст, постарайтесь понять основные положения и запомнить уточняющие детали.

Valves. Historical Development

The radio valve is one of the great achievements which has played and is playing an important part in modern life. It is important to see firstly the historical development through the main phases from the discovery of ionic conduction of electricity through gases to the definite establishment of purely electronic current conduction and the invention of various kinds of thermionic and other electronic devices. It is interesting to note that some of the early outstanding experiments that led to the emitting cathodes used today occurred as early as 1877. In that year Crookes first observed currents in a glass tube which had two electrodes connected to a high potential. He was able to control the direction of the current and to deflect the luminous beam by static as well as magnetic means.

In 1883 the great American inventor Thomas Edison probed inside the incandescent light bulb first with a wire and then with a metal plate. He found that if this electrode was connected to the positive end of the filament via a galvanometer then a current was detected. If it was connected to the negative end no current flowed.

This "Edison effect" was studied by many people over following 20 years, particularly to examine thermionic emission. Fleming studied it carefully in 1883 and again in 1896. Certainly, for 20 years it was a well-

known phenomenon before anyone thought of an important application for it. Fleming was the first to use an electron device for radio reception. This was in 1903. He constructed a two-electrode vacuum valve in which one electrode was a hot filament. This served as a rectifier of radio frequency currents when received by an aerial.

The introduction of a control grid between the emissive filament and the anode is due to Lee de Forest who used this device in 1906 for detection but he did not realize that he had produced the means for amplification.

The triode or audion as Lee de Forest called it was invented in 1907. For years the triode was simply another radio detector.

What transformed the triode into the basis of electronics were the improvements made by industrial laboratories following the discovery how to use it to amplify and oscillate. These circuit inventions were made independently by several people in 1912 ace 1913.

Captain Round produced a soft valve for Marconi in 1913. Meanwhile Langmuir and Arnold in America were working on the production of a really hard valve. In 1913 Langmuir used tungsten filamentary cathodes but in 1914 Arnold made a hard valve with an oxide-coated cathode. Arnold's triode was probably the first mass production valve.

Then came the first World far and much progress was made in tungsten-filament type triodes is Prance, Germany and Britain. The period immediately after the First World War was notable for a general advance in the technique of valve design and manufacture and the perfection of the thoriated tungsten filament.

The real introduction of the indirectly-heated cathode occurred in many firms simultaneously. The screen-grid valve was introduced in 1927.

Many fine papers were published about this time. During the 1939-1945 War a need arose for valves to operate at very high frequencies. Special valves, the klystron and the magnetron, were developed for the purpose. Quite recently valves of very small physical size have been developed.

From the above summary it can be seen that the modern valve is not the work of any one man but is the result of many years efforts by a great number of talented scientists in many countries.

Some Properties of Electron Valves

The properties of electron valves differ from those of other types of devices. We shall consider some of these properties.

Electron tubes are controlled by means of an electric field. The power required for the control is very low, their sensitivity is very high. In many devices used in automation the voltage required to control an electronic circuit has a value of the order of a few microvolts (millionth parts of volts).

High Amplification

By using several electronic amplifier stages it is possible to highly increase current, voltage or power. Amplification of power by a milliard times occurs in standard electronic devices used in automation.

Characteristics of electron valves are not constant and change during service life by 10 per cent or more. However special methods have been developed in electronics which eliminate the inconstancy of electron valve characteristics. In mechanical devices moving parts wear out and this shortens their service life. In electronic devices electrically charged particles - electrons and ions - are also in mechanical motion. But such particles do not wear out when they are moving. The service life of some

electronic devices depends upon the number of electrically charged particles in a certain volume.

Electronic devices operate noiselessly and have small overall dimensions and weight. Thus the space occupied by an electron valve is only a few cubic centimetres and its weight is some grams. The cost of such devices is also relatively low.

Tube Parameters

These are the amplification factor, the mutual conductance and the internal plate resistance. They are also called tube characteristics. The amplification factor symbolized by the Greek letter μ (pronounced "mu") is defined as the tube ratio of plate-voltage change to grid-voltage change when plate current is maintained constant. It is a measure of relative effectiveness of the grid. In triodes μ ranges in value from 2 to 1000, with most tubes it is from 10 to 40. The amplification factor is almost constant for all operating conditions except at very low plate currents.

Mutual conductance (Gm) is stated in microohms and for most of the tubes it is a value of a few thousand. It is nearly as constant as the amplification factor. Its value depends mainly on the amount of plate current.

Internal plate resistance (Rp) is the third tube parameter. It is the ratio of plate-voltage change to plate-current change but the grid voltage is constant. It is measured in ohms. For triodes the value of internal plate resistance is between 2,000 to 100,000 ohms. The following relationship exists between these three parameters:

$$\mu = Rp \cdot Gm.$$

Упражнение 3. ***Ответьте на следующие вопросы в соответствии с содержанием прочитанного.***

1. When does the history of ionic conductance of electricity begin? 2. Who was the first to observe the current flowing in a glass tube? 3. How could Crookes control the direction of the current in a glass tube? 4. What scientist was the first to use an electron device for radio reception? 5. What was Fleming's tube like? 6. Who introduced a control grid between the emissive filament and the anode? 7. Whose triode was the first mass production valve? 8. When did the need arise for valves to operate at very high frequencies? 9. What properties of electron tubes are discussed in the text? 10. What are the three tube parameters discussed in the text?

Упражнение 4. ***Найдите в тексте предложения, являвшиеся ответом на следующие вопросы.***

1. What is the purpose of the grid in a triode? 2. When was the triode invented? 3. What transformed the triode into the basis of electronics? 4. What was the period immediately after the First World War notable for? 5. What relationship exists between the three tube parameters?

Упражнение 5. ***Опровергните следующие утверждения, используя предложения из текста.***

1. The early tube produced by Lee de Forest was a tube with 4 electrodes. 2. The modern valve is the work of one scientist only. 3. The "Edison effect" was studied only by Fleming. 4. The real introduction of the indirectly heated cathode occurred in Marconi firm only. 5. Characteristics of electron devices are constant and do not change during service life.

<u>Упражнение 6.</u> Вставьте вместо пропусков слово или группу слов, выбрав из предложенных вариантов один, соответствующий содержанию прочитанного.

1. Fleming constructed a two-electrode vacuum valve in which one electrode was ...

1) a rectifier; 2) a hot filament; 3) an amplifier.

2. The early triode produced by Lee de Forest was a ... valve.

1) hard; 2) soft; 3) hot.

3. A cathode is constructed of a good electron emitting material such as ...

1) rubber; 2) paper; 3) thoriated tungsten.

4. The amplification factor is almost ... for all operating conditions except at very low plate currents.

1) high; 2) low; 3) constant.

5. The power required to control the electron tubes is ...

1) very low; 2) constant; 3) rather high.

<u>Упражнение 7.</u> Найдите в тексте предложения, являющиеся эквивалентами русских предложений.

1. Флеминг был первый, кто использовал электронное устройство для радиоприема. 2. Двухэлектродная вакуумная лампа служила выпрямителем высокочастотных токов. 3. Электрически заряженные частицы - электроны и ионы - в электронных устройствах находятся в механическом движении. 4. Величина крутизны характеристики лампы зависит в основном от величины анодного тока. 5. Коэффициент усиления лампы почти постоянный при всех рабочих условиях. 6. Электронные устройства работают бесшумно, и они имеют малые габаритные размеры и вес. 7. Стоимость таких устройств относительно низкая.

UNIT XIV. RETURN OF THE VACUUM VALVE

<u>Упражнение 1.</u> Прочтите и запомните следующие слова и группы слов. Они помогут Вам понять содержание текста:

to survive - продолжать существовать, выдержать; environment - окружающая среда; to expose - подвергать действию (лучей); failure - повреждение; immune- устойчивый; surface - поверхность; to surmount - преодолеть; triangular - треугольный; to enhance - увеличивать, усиливать; to take advantage of smth.- воспользоваться чем-либо; power consumption - потребление энергии; gate - затвор; depletion region - обедненная область; to incorporate- помещать; sharp tipped structure - структура с остроконечной вершиной; proximity - близость; electron beam – электронный луч.

Return of the Vacuum Valve

Until the 1950s, all active electronic functions were performed by the vacuum valve. They were made up of metal electrodes arranged in a vacuum glass envelope. Their sizes varied, but even one of the latest valves had a volume of more than one cubic centimetre. When solid state devices were invented, one of their main attractions was their small size. As the technology developed, individual elements became smaller and smaller, until complete circuits could be designed on a single piece of silicon. This development resulted in the replacement of vacuum valves by transistors in receivers and low-power electronic systems. In high power transmitters vacuum valves continue to survive; and thermionic emitters are still used where a free source of electrons is required as in cathode-ray tubes. But semiconductor devices proved to be poorly equipped to survive certain environments.

For example, when semiconductor devices are exposed to ionizing radiation in space and defence systems, they are bombarded by both neutral and charged particles, which cause fluctuations in current leading to failure of the device. Vacuum tubes are far more immune to such environments. Vacuum tubes work at much higher voltages than semiconductors and they have the potential to provide high frequency operation. Therefore some research centres have developed research programmes for producing micron-sized vacuum electronic devices. It is the semiconductor fabrication technology which now offers the opportunity of producing vacuum tubes as small as transistors.

The operation of any vacuum valve depends on obtaining electrons from the cathode surface and attracting them to a positively biased electrode known as the anode. The old type of valve operated with a thermionic cathode which was heated to give the electrons sufficient energy to surmount the surface barrier, escape into the vacuum and be attracted to the anode by a positive potential. An alternative means of obtaining an electron discharge in vacuum is with field emission. This relies on a very high electric field being applied to a cold cathode. At high electric fields the surface barrier is distorted to a triangular shape. This allows electrons to tunnel through the barrier and be attracted by the anode. Electric fields of the order of 10^9 V/m are necessary before an observable current may be obtained; this is equivalent to 1000V across 1 μ ($1x10^{-6}$m). Since most solid dielectrics can withstand little more than 10^8V/m, some lithographic techniques are used to construct devices which enhance the electric field around the emitting area only.

There are many potential applications of vacuum microelectronics, but they all centre on the properties of field emitting devices. For many years a great deal of effort has been directed towards finding a cold electron source to replace the thermionic cathode in such devices as cathode ray tubes, travelling were tubes and microwave power amplifiers. Most research programmes have concentrated on cold cathodes to take advantage of the small device size, low power consumption and high current densities which in turn will lead to high operating frequencies and fast switching.

Until 1988, however, there was a research programme at Los Alamos which produced miniature thermionic electronic components. This technique used thin-film deposition and photolithographic techniques to produce integrated structures consisting of a grid and an oxide-coated cathode on one substrate, with an anode on a separate substrate directly opposite.

A different approach has been reported by the Philips Research Centre in Eindhoven which has exploited the strong internal electric field in a semiconductor with a reverse-biased p-n junction. When a p-n junction is reverse-biased a very strong field is created in the depletion region. Electrons coming from a highly doped p-region are therefore accelerated and have sufficient energy to surmount the potential barrier at the surface and escape into the vacuum. The complete structure consists of the p-n junction with the gate above it separated by silicon dioxide. Such structures have already been incorporated into small cathode ray tubes to give clear and bright black and white and colour pictures.

The major area of interest in other groups is in sharp-tipped structures, which are incorporated into a diode configuration, and make use of a grid

about 1 μm away to create a very high field around the tip which will then emit electrons. A typical field-emitting device is shown in Fig. 19, and is made up of small cathodes 1-2 μm in height, with sub-micron (~50 nm) emitting tips. These are separated from a metal grid 0,5 μm thick by a layer of silicon dioxide.

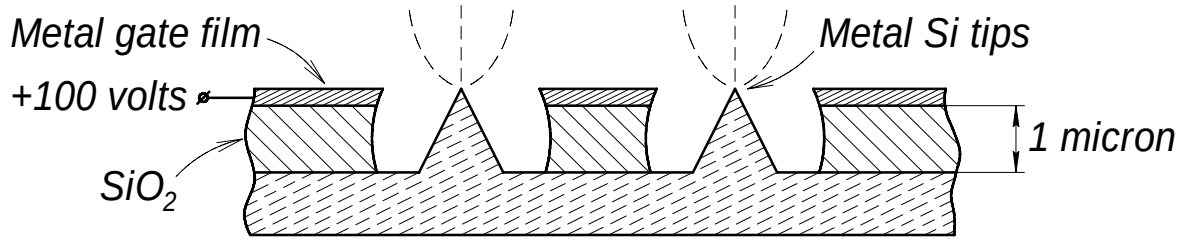

Fig. 19.

A typical field-emitting device consists of a metal or silicon substrate, with a number of small sharp tipped structures about 1-2 μm high and 10 μm apart. These have tip radii of about 50 cm and are separated from an integral grid by 1-2 μm of silicon dioxide. The structure is operated by applying a positive voltage of 100-200V to the metal grid, which creates a high electric field around each of the emitting tips from which electrons are emitted. These can be collected either on the grid itself or by an external anode held in close proximity to the tips. Such structures have given currents of 100μA/tip leading to current densities of 100A/cm^2 and lifetimes of over 60 000 hours.

A number of techniques may be used to produce such structures and these include the anisotropic etching of silicon, the use of deposition techniques, electron beam lithography, etc. At present much interest centres about vacuum microelectronics because there is a need for devices which can work at high temperatures, withstand high voltage pulses and have the potential to provide high frequency operations. Vacuum microelectronics

can offer such properties. The First International Conference on Vacuum Microelectronics was held in Williamsburg in 1988, with 200 attending from Prance, Holland, Japan, Russia, USA and UK. This Conference attracted much interest from both academic and industrial organizations worldwide.

<u>Упражнение 3.</u> Ответьте на следующие вопросы в соответствии с содержанием прочитанного.

1. How long were vacuum valves widely used in radio and electronic systems? 2. What elements was the old type of valve made up of? 3. What does the operation of any vacuum valve depend on? 4. What cathode was used in the old type of valve? 5. When did solid state devices begin to replace vacuum valves in radio and electronic systems? 6. What was one of the main attractions of solid state devices? 7. What advantage have vacuum valves over solid state devices when they operate in hostile environments? 8. Why have most research programmes concentrated on cold cathodes as the source of electrons? 9. What techniques were used for the production of electronic components according to a research programme at Los Alamos? 10. What structure has been developed by the Philips Research Centre? 11. What does a typical field-emitting device consist of? 12. How does it operate? 13. What techniques may be used to produce sharp tipped structures? 14. When was the First International Conference on Vacuum Microelectronics held?

<u>Упражнение 4.</u> Опровергните следующие утверждения, используя прочитанный текст.

1. The old type of valve operated with a cold cathode. 2. Vacuum tubes were small in size they had a volume of less than one cubic centimetre.

3. Semiconductor devices work at much higher voltages than vacuum tubes. 4. Deposition techniques and electron beam lithography were used in the production of the old type of valves. 5. Semiconductor devices are far more immune to hostile environments than vacuum tubes. 6. Sharp tipped structures were used in the production of early cathode ray tubes.

<u>Упражнение 5.</u> Заполните пропуски словами или словосочетаниями, приведенными ниже.

1. Until the 1950s, all active electronic functions were performed by ... 2. Vacuum valves operated by electrons passing from cathode to anode within a ... 3. A thermionic cathode is heated to give the electrons sufficient energy to ... the surface barrier and escape into the vacuum. 4. Vacuum tubes can ... high voltage pulses and ionizing radiation. 5. One of the main attractions of solid state devices was their small ... 6. Field emitting devices are expected to be reliable in hostile ... 7. A typical field emitting device consists of a metal or silicon substrate with a number of small ... 8. Micron-sized cathodes have been ... into a triode configuration. 3. ... is one of a number of techniques which may be used to produce sharp tipped structures. 10. Ionizing radiation causes fluctuations in current in semiconductor devices and leads to... of the device.

a) withstand, b) electron beam lithography, c) vacuum valves, d) failure, e) vacuum, f) size, g) incorporated, h) sharp tipped structures, i) surmount, j) environments.

UNIT XV. TRANSISTORS

<u>Упражнение I.</u> Прочтите и запомните следующие слова и группы слов. Они помогут Вам понять содержание текста.

improvement - усовершенствование; reliable - надежный; to resemble - иметь сходство; unique - уникальный, особенный; SCR-silicon cont-

rolled rectifier - одноопераційний триодний тиристор; breakdown voltage - пробивное напряжение,напряжение пробоя; power dissipation - мощность рассеяния, рассеиваемая мощность; junction capacitance - емкость перехода; LSI - large scale integration - высокая степень интеграции,БИС; silicon wafer - кремниевая пластинка; stringent - строгий, точный; VHSIC - very high speed integrated circuit-сверхскоростная интегральная схема, ССИС; refinement - усовершенствование; to make contribution - вносить вклад.

<u>Упражнение 2.</u> Прочтите текст, постарайтесь понять основные положения и запомнить уточняющие детали.

Transistors

The transistor was discovered by a team of Bell laboratories scientists - Shockley, Bardeen and Brattain. In 1947 on December 23 they reported about the invention of a three-electrode device. They called this solid-state device the transistor. Less than a year after the transistor was invented a few types of transistors appeared, but they were short-lived, noisy. Their characteristics varied with time. The frequency range was limited. But improvements came fast.

The junction transistor was more reliable than the point-contact type. The junction transistor was considered as an improvement of the point-contact transistor, but it also had some disadvantages. The frequency range was limited, control of impurities was not exact. Methods were found to overcome these disadvantages and new types of transistors appeared such as alloy transistors, planar transistors, bipolar and field-effect transistors, unijunction transistors, MOSFETs etc.

Let us consider some of these types of transistors. The first field-effect transistors (FET) were junction types, the earliest were invented in France. It was a cylindrical Fig.18 device of n-type semiconductor, which resembled a resistor.

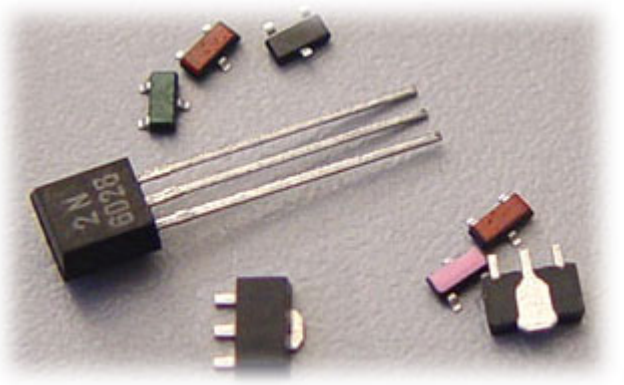

Fig. 20

The modern metal-oxide semiconductor field-effect transistors (MOSFETs) are of great importance in integrated circuits. The modern MOSFET consists of channels of either n or p material with a control element placed above the channels. This control element is insulated from the channels. This type of transistors has a high input impedance like a vacuum tube. This leads to its use in radio frequency amplifiers at high frequencies.

The unijunction transistor (UJT) is a unique semiconductor with properties unlike conventional transistors. It contains only one junction between n and p-type silicon while conventional transistors have two junctions. Though the junction transistors were developed in 1954 the electronics industry only begins to use this semiconductor device. It finds application in many different fields: multivibrators, pulse generators, SCR circuits, time-delay circuits, etc. They have low price, excellent linearity and stability. Besides they require very simple circuits which are stable over a wide range of temperature variations.

Up to about 1960 germanium transistors dominated despite the fact that there are many materials which can be classed as semiconductors. A silicon transistor was announced in the late 50s. Its gain was low and it was

expensive to manufacture but it had a breakdown voltage of 300, much higher that that of germanium devices. Within the next six years silicon transistors became more important than germanium ones. And today silicon is dominant in most of the new designs because of its processing flexibility and high temperature capability. Silicon transistors with an upper frequency limit of over 4 gigahertz at low power levels and a power dissipation of more than 300 watts are in common use. Development of new germanium devices continues to be important especially in microwave field. In selecting a transistor for a given application the important criteria are performance, reliability and cost.

Multi-purpose Semiconductors

A transistor functioning as a switch differs from other transistors. As a switch the transistor has two stable states; it is either "on"(conducting) or "off"(non-conducting). One of the most important semiconductor devices is the silicon controlled rectifier or SCR. It has many important properties. Basically it acts as a unidirectional semiconductor switch which is normally off but which can be turned on with a suitable trigger signal. The silicon controlled rectifier is like a normal rectifier but has an additional terminal known as a gate. Normally with no signal applied to the gate SCR is off and acts like an open circuit switch. When a positive pulse is fed to the gate the SCR turns on and acts like a normal silicon rectifier: it conducts in the forward direction but blocks in the reverse direction. Silicon controlled rectifier can be used in both ac and dc circuits.

The history of the semiconductor diode began in the early days of radio when "crystals" were used as signal detectors. But they were not used as active devices until the development of modern transistor physics. Diodes

whose junction capacitance is variable with voltage are known as parametric diodes or varactors. As a variable capacitor the varactor is rugged and small and is not affected by dust or moisture. The most significant parameter of a variable-capacitance diode is the capacitance ratio, "Q". The capacitance ratio is the amount of capacitance variation over the bias voltage range. It is normally expressed as the ratio of the low-voltage capacitance divided by the high-voltage capacitance. The capacitance ratio of varactors varies according to the construction. They may have ratios of 20:1 and higher.

Immediately after the introduction of a variable-capacitance diode another semiconductor diode known as the tunnel diode was developed. It was developed in 1958. The tunnel diode was a new semiconductor device at that time. It is like a varactor a two-terminal active element which can be used for a wide variety of functions such as amplifying, switching, frequency conversion, etc. It has good frequency response and low noise characteristics. The advantages of the tunnel diode are its very small size, extreme speed and stability under varying temperature conditions. The tunnel diodes may function as switches, amplifiers and capacitors.

Large scale integration (LSI) of devices has put great demands on crystal materials. The semiconductor industry now requires high purity and minimum point-defects concentration in silicon in order to improve the component yield per silicon wafer. These requirements have become increasingly stringent as the technology changes from large-scale integration (LSI) to very large-scale integration (VLSI) and very high speed integrated circuits (VHSIC).

The circuit performance of a device and the intrinsic and extrinsic materials properties of silicon are interdependent. The silicon wafer substrate must be practically defect-free when the active device density may be as high as 10^5 to 10^6 per chip.

To increase further the speed of semiconductor devices requires not only refinements in present designs and fabrication techniques but also new materials that are superior to materials presently being used like germanium and silicon. New material under consideration is gallium arsenide.

Gallium arsenide has a much higher electron mobility than germanium and silicon. It is chemically and mechanically stable, it permits operation at higher temperatures.

The new gallium arsenide hetero-junction diode has a potential for much faster switching than conventional junction diodes. Its calculated switching time is on the order of a few piroseconds (trillions of a second). However, the difficulty of producing gallium arsenide of sufficient purity has limited its application.

Yet, gallium arsenide is far from the end of the story. Any searching for an answer makes contributions. This is the way of developing better materials and devices.

<u>Упражнение 3.</u> Ответьте на следующие вопросы в соответствии с содержанием прочитанного.

1. What great discovery was made by a team of Bell Laboratories scientists in 1947? 2. What characteristics had the first types of transistors? 3. What disadvantages had the earliest junction transistor? 4. What does the modern MOSFET consist of? 5. Have the unijunction transistors one or two junctions? 6. What are the fields of application for the unijunction

transistors? 7. What semiconductor material was used for the production of transistors up to about 1960? 8. Why is silicon dominant in most of the semiconductor devices? 9. What criteria are the most important in selecting a transistor for a given application? 10. What are two stable states of the silicon controlled rectifier? 11. What additional terminal has the silicon controlled rectifier? 12. How does the silicon controlled rectifier operate? 13. What advantages has the varactor over conventional diodes? 14. What is the capacitance ratio? 15. What functions can the tunnel-diode perform? 16. What new semiconductor material gained favour over germanium and silicon? 17. What characteristics has gallium arsenide?

Упражнение 4. ***Опровергните следующие утверждения, используя прочитанный текст,***

1. The first point-contact transistor was more reliable than the junction transistor. 2. When the junction transistor was invented its frequency range was unlimited and control of impurities was exact. 3. The properties of unijunction transistors are like those of conventional transistors. 4. Silicon transistors came into being before germanium transistors. 5. There is no difference between SCRs and normal rectifiers. 6. We must be very careful while working with the varactor because it is affected by dust and moisture. 7. At present silicon begins to replace gallium arsenide in the fabrication of semiconductor devices.

Упражнение 5. ***Заполните пропуски словами или словосочетаниями, приведенными ниже.***

1. Planar transistors and field-effect transistors have some ... over point-contact transistors. 2. The junction transistor was more ... than the point-contact transistor. 3. Some methods were found ... the disadvantages of junction transistors. 4. The unijunction transistors are ... semiconductors

with properties unlike conventional transistors. 5. When a ... is fed to the gate the SCR turns on and acts like a normal silicon rectifier. 6. The most important parameter of a variable-capacitance diode is the ... 7. The tunnel diode has good ... 8. Gallium arsenide has a much higher ... than germanium and silicon. 9. Gallium arsenide is chemically and mechanically ...

a) frequency response, b) advantages, c) reliable, d) to overcome, e) positive pulse, f) electron mobility, g) unique, j) capacitance ratio, k) stable.

UNIT XVI. AMATEUR RADIO

<u>Упражнение 1.</u> Прочтите и запомните следующие слова и группы слов. Они помогут Вам понять содержание текста.

to scatter - разбрасывать, размещать; an exciting technique - захватывающая, увлекательная техника; thrill - глубокое волнение; self-expression - самовыражение; keen interest - живой интерес; to fire imagination -разжигать воображение; scarce - недостаточный, скудный; a proving ground - испытательный полигон; emergency -чрезвычайные обстоятельства; personal sacrifice - личное самопожертвование; to track - следить, прослеживать; allocation - размещение; to allocate - назначать, закреплять; congestion - перенаселенность, скопление; lack - отсутствие; profit – прибыль, доход.

<u>Упражнение 2.</u> Прочтите текст, постарайтесь понять основные положения и запомнить уточняющие детали.

Amateur Radio

To the half million radio amateurs scattered around the globe radio is an exciting technique. This technique is used to communicate with one's

fellow man, to overcome the barrier of distance and boundary and to achieve lasting friendship with other enthusiasts around the world. Perhaps only these who had the experience can truly understand the thrill of assembling a small radio station and then use that equipment to talk with another radio amateur who may be in the next town or the next continent. It is a form of self-expression and world friendship. The better way to learn about radio communication is by participating in it. Many of the young radio amateurs of today are certain to be the professional engineers and scientists of tomorrow.

How did amateur radio begin? In the latter years of the 19th century there already existed a keen interest in a new marvel - electricity. Amateur experimenters mainly in Europe and North America were making small electromagnets, motors, dry cells and static machines and building other experimental electrical devices.

It was not until the very end of 1901, however, that an event took place that fired the imagination of these experimenters still further - wireless communication appeared. It was on everyone's tongue. Large numbers of amateur electrical experimenters turned away from their electromagnets, motors and dry cells and began to explore radio communication. Amateur radio was born! During the first decade of 20th century amateur experimentation with radio was a difficult task since technical and constructional materials were scarce. A typical amateur station of those years consisted of an induction coil, a capacitor and a spark gap for transmitting and a simple coherer-decoherer and a single head telephone for receiving. It was not unusual for early radio amateurs to communicate with each other using such equipment over distances of 80 to 160 km.

International regulations did not exist at that time since there was no radio law. Everyone had an equal right to the air.

Radio Amateurs have been Pioneers

From the very beginning the radio amateur has been a pioneer. He experimented, he tried this and that, always with the purpose of extending the range of communication or with the purpose of increasing operator efficiency.

Radio amateurs were, however, the first to demonstrate the enormous usefulness of short waves and they also pioneered the use of the vhf and uhf regions of the radio spectrum. They were among the first to devise practical transmitting and receiving equipment using vacuum tubes and they contributed much to radio propagation research. Amateurs led the field of devising techniques to reduce interference so that greater use can be made of radio spectrum. The use of parametric amplifiers was pioneered in the amateur bands. Since its birth amateur radio has been a proving ground for almost every major technical and operational development in the field of radio communication.

From the early days amateur radio has earned an outstanding reputation for providing communication during emergencies when other means of communication fail or are overloaded. And in case of natural catastrophes, epidemics, etc. radio amateurs with skill and devotion and frequently at personal sacrifice had served their communities and brought speedy relief to victims of suffering and need. Many thousands of lives, millions of dollars in property have been saved by their efforts; radio amateurs consider such assistance not a duty but an opportunity to serve humanity.

The Exploration of Space

Space exploration opened a new era for amateur radio as it did for all communication services. Radio amateurs entered the space age with the successful launching of the Oskar I satellite. Built entirely by radio amateurs and containing a beacon transmitter operating in the amateur 144 MHz band the satellite was tracked by observers in 30 countries. Then there have been a number of other successful amateur satellites which provide reliable intercontinental communications for hundreds of amateurs using frequencies in the amateur allocations at 28 and 144 MHz.

It is interesting to note that in many countries the first two-way space communication was made by amateur satellite rather than via those satellites that have been established commercially - sometimes several years before the commercial satellites were available.

A recent study of the growth of the amateur service throughout the world indicates that the present population of amateurs had grown to about two million by the year 2000. Amateur radio has outgrown much of the hf spectrum.

Radio Amateurs have been Progressive

How have radio amateurs been able to survive? Only by the progressive adoption of the most modern technical and operating advances. Spark was the earliest form of radio transmission, but when continuous wave radio-telegraphy was developed radio amateurs seized upon it immediately as a way not only of obtaining greater distances but also of reducing interference.

In an attempt to maximize the use of the amateur allocations receivers were radically improved by means of quarts and mechanical filters which reduced the bandwidth, improved the signal-to-noise ratios and thus made

more effective use of the amateur frequency bands by reducing interference. It is interesting to note that the first so-called "single-signal" receiver was developed by a radio amateur and was immediately accepted as the standard in the field of communication.

Improved reception and more efficient transmission are frequently attained by the use of highly-directive aerials at one or both ends of the circuit eliminating interference and enabling more reliable communication. Since amateurs work with the bands of frequencies allocated by international treaty the use of stable but variable frequency oscillators permitted the users of a given amateur band to adjust their transmitting frequencies in order to avoid interference being caused by another amateur station.

Nevertheless, the amateur population is growing, the allocated spectrum space has remained substantially unchanged since 1927. Under these conditions the amateur service faces ever-increasing limitations resulting from three principal problems:

a) increasing congestion due to the growing amateur population;

b) impractical sharing arrangements with other services in some of the bands;

c) the lack of suitable orders of frequency bands to support communication over the most heavily used paths during the normal daily and yearly variations in ionospheric propagation.

<u>Упражнение 3.</u> Ответьте на следующие вопросы в соответствии с содержанием прочитанного.

1. What electrical devices were amateur experimenters making at the end of the 19th century? 2. What did a typical amateur station of the first decade of

the 19th century consist of? 3. Were radio amateurs the first to demonstrate the usefulness of short waves? 4. When was the first amateur satellite launched? 5. What is the importance of launching Oskar amateur satellite into space? 6. How large had the number of amateurs grown by the year 2000? 7. How were the receivers improved to maximize the use of amateur allocations? 8. What problems do radio amateurs face?

UNIT XVII. THE TV SET

Упражнение I. ***Прочтите и запомните следующие слова и группы слов. Они помогут Вам понять содержание текста.***

VCR = video cassette recorder-кассетный видеомагнитофон; cone-конус баллона (ЭЛТ); the electron gun-электронная пушка; deflection coil-отклоняющая катушка; shadow mask-теневая маска; phosphor-люминофор; to converge-сводить, сходиться; brightness-яркость; pixel-элемент изображения; interlacing-чересстрочная развертка;скачковая развертка; raster-растр; to glow-светиться; to blend-смешивать, сливаться; bandwidth-ширина полосы; compatible-совместимый; hue-цветовой тон; saturation-насыщенность цвета, насыщение; cross color-перекрестная цветовая помеха.

Упражнение 2. ***Прочтите текст, постарайтесь понять основные положения и запомнить уточняющие детали.***

THE TV SET

Introduction. The TV set is the central element of any audio/visual setup. It allows us to watch programs received by antenna, cable or satellite, and movies via our VCR. We can also use the TV as a monitor to play games on game computers and CD-i players.

The Picture Tube. The central component of a TV set is the cathode ray tube (CRT). The components of a cathode ray tube are: the cone, the screen, the electron gun, the deflection coil and the shadow mask.

The cone and the screen are welded together to form a glass envelope into which the shadow mask and the electron gun are positioned. The deflection coil is placed around the outside of the neck of the cone.

The inside of the screen is coated with light sensitive red, green and blue crystals called phosphors. These phosphors are arranged in groups of three (or triads) of one blue, one red and one green. Three electron beams are generated by the electron gun, one for each color, which directed by the deflection coil scans the screen moving left to right and up and down. The phosphors light up in the relevant color when they are illuminated by the beams.

In order to produce a correctly colored image, each electron beam must hit only the appropriate colored phosphor. To ensure such accuracy, a shadow mask is used as a filter. The shadow mask is a metal plate which is the same shape as the screen and has the same number of holes as the number of triads on the screen. Each hole has a corresponding triad of phosphors which prevents adjacent triads from being influenced.

The beams of the electron gun must converge exactly at the holes of the shadow mask, so there must be an alignment of the beams onto the mask. This is performed by an electromagnet within the gun.

The electromagnetic deflection coil surrounds the neck of the picture tube, ensuring accurate deflection of the beam. Electrical signals transmitted through the deflection coil generate precisely focused magnetic fields. These magnetic fields control the position of the electron beam vertically and horizontally.

Beam movement. The electron beam moves in lines, from left to right and from top to bottom. In most European countries the screen is made up of 625 (horizontal) lines. The number of lines on the screen determines the picture detail.

When the beam reaches the end of a line, it returns at greater speed to its original starting point. When it goes back, brightness is suppressed for a split second. Then it moves down two lines and the process repeats itself

(see 'Interlacing' for further explanation). When the beam has reached the end of the bottom line, it restarts (with a split second interruption in brightness) at the top line.

Precision in Line. In a color TV, there are three cathodes, each generating an electron beam for one of the primary colors. In the early color TVs the three electron beams were placed in a triangular orientation. This was called the delta setup. As the pixels are round, this setup caused much of the light to disappear between the dots. Nowadays, the in-line system is applied (called Precision in Line), in which the electron guns are placed in a horizontal line.

Interlacing. The picture is created by firstly all the odd lines (1, 3, 5, 7, 9 etc...625) being scanned from left to right and from top to bottom and followed by a scan of all the even lines (2, 4, 6, 8,10 etc...624). The result is that a single scan creates only half an image. In a 50 Hz TV, one scan takes 1/50 second, so to make two half images it takes 1/25 second. In other words, every second 25 complete images are formed. As the process of scanning two half images takes place in only 1/25 second, to the human eye the two halves appear to be one. This process is called interlacing. Fifty half images are formed per second, making up 25 whole images. This interlacing technique means the picture will show less flicker than if the beam were to scan all lines at once. The frequency of scans is called the raster frequency which is 50 Hz (50 scans per second), whereas the line frequency is 25 x 625 = 15,625 Hz.

Line and Image Synchronization. The image and the reproduction must be synchronized perfectly. This will ensure that each picture element picked up from the camera target is reproduced in the right place on the display.

There are two kinds of synchronization (sync) pulses: line and image. The line sync pulse ensures that a line is reproduced correctly (i.e., what is at the beginning of a line, is reproduced at the beginning), and the image sync pulse is to ensure the whole image is reproduced correctly (i.e., the transmitted top line will be the reproduced top line). These sync pulses are

transmitted with the picture signal. They do not control the electron beam of the tube in your TV set, because this could seriously damage or affect the image. The actual scanning movement of the electron beam in the TV set is directed by two deflection generators. These are continuously synchronized by the synchronization pulses generated by the camera. Even if there is no incoming signal, the electron beam in the TV set is continuously moving.

Color. In a black-and-white TV set, only one pixel type covers the entire screen. A black-and-white tube therefore only needs a single cathode gun. Variation in the brightness of the beam determines how much a pixel will light up, resulting in shades of black/white.

Fig. 21

A color tube has three beams: one for the red, one for the blue, and one for the green pixels (phosphors). The three electron beams scan the screen as if they were one. The screen is covered with three types of phosphor dots and each type lights up in one of the primary colors of red, green or blue when it is struck by an electron beam. (The primary colors of red, green and blue [RGB] form the basis of all other colors.) A complete picture on a 28" TV contains approximately 450,000 pixels.

The ratio of the illuminated phosphors determines the total color. If, for instance, the beam that strikes the blue phosphor is suppressed, allowing only the red and green phosphors to glow, to the human eye the red and green will blend together to form bright yellow. By varying the brightness of one or more electron beams, the color pattern changes accordingly, which means that every possible color in varying brightness can be generated. When the camera scans a bright image, the transmitted signal has a higher voltage than when scanning a dark image. The electron beam in the tube immediately responds and the same relative brightness also appears on the screen, pixel by pixel.

Luminance and Chrominance Signals. When color transmission became a reality, it was decided to make the color TV transmissions compatible with the existing black-and-white TV. The black-and-white sets should then be able to receive the color TV transmissions and display them as normal high-quality black-and-white signals. In order to achieve this, the color images are split up in brightness (luminance) and color (chrominance) signals before they leave the transmitter.

The brightness or luminance signal. The brightness or luminance signal (Y) is transmitted via normal, full bandwidth, enabling a black-and-white TV to show a normal black-and-white picture. The white light needed for the luminance signal is made up out of 30% red, 59% green and 11% blue.

The color or chrominance signal. Apart from luminance, two other characteristics make up a total color. First, there is the hue, which is the actual color (blue for example). Second, there is the saturation of the color, which is the depth of color, that makes the blue a light or a deep blue. The hue can vary from deep to pale, and the amount of color is its saturation. On a TV, a less saturated image has more white.

The chrominance signal (C), which contains the hue and saturation, is modulated to a special color-difference signal. Since the luminance information is already being transmitted, the color signal doesn't need its brightness information anymore. The three color-difference signals are therefore: red minus the luminance signal (R-Y), green minus the luminance signal (G-Y) and blue minus the luminance signal (B-Y).

There is no need to transmit all three color-difference signals because when two ratios of the total chrominance signal are known, the third one can be calculated. For example, when there is 50% blue and 40% red in a specific color, the green must be 10% (50% + 40% + x = 100%; x = 10%). The two color-difference signals chosen for transmission are the R-Y and B-Y. The G-Y is omitted for signal-quality reasons. Since the Y-signal is made up out of 59% green, G-Y must have the smallest difference signal. The relatively small G-Y signal would be more vulnerable to noise in the transmission

system than the larger R-Y and B-Y signals. Only using two of the three color-difference signals leads to a decrease in the amount of information to be transmitted.

Cross Color and Cross Luminance. Sometimes the luminance and chrominance signals are mistaken for what they are in the TV set. It can happen that Y signals are seen as C signals and the other way around. Cross color occurs when a luminance signal is mistaken for a chrominance signal. This becomes visible in picture patterns with regular structures of lines close together, such as checkerboard patterns.

When a chrominance signal is mistaken for a luminance signal, it is called cross luminance. It appears as a colorless "string of pearls" at edges of colored areas. Filters which improve separation of these signals are called comb filters and may be analog or digital filters. The digital comb filter is an improvement on the analog filter as it is better able to separate the Y and C signals.

Color Transmission Systems. After the color-difference signals R-Y and B-Y are modulated, the two are mixed to one signal in the transmitter. Demodulating the same signal in the receiver is a rather complex process, which has been solved in different ways in different countries. This has resulted in three major non-compatible systems worldwide, which are NTSC, PAL and SECAM.

NTSC. Around 1950, the NTSC system was developed as the first color TV standard. This basic color system works well, and after 40 years is still in use in North America and Japan. NTSC stands for: National Television System Committee, which was the organization that defined this color TV standard. NTSC is based on 525 picture lines and 60 Hz (60 scans across the screen in one second). The major problem with NTSC is that hue errors might occur. In order to correct this, all NTSC receivers are equipped with a special hue control.

PAL.PAL stands for: Phase Alternating Line and was introduced 15 years after NTSC. The system is based on 625 lines and 50 Hz. It has more

picture detail than NTSC, because it uses 100 more lines and is able to write colors with greater accuracy. If there is a color distortion on one line, it will correct this on the next line by reversing the error. If, for instance, the intended green shifts to a yellow, on the next line it will correct this with a reverse error. The result is that the next line will be cyan (blue-green), which results in an optical green; the yellow and cyan will blend to green.

The major disadvantage of the PAL system compared with NTSC, is that it makes use of 50 scans per second rather than 60. This results in flicker and a more unstable picture. However, the problem of flicker is solved when the raster frequency is adjusted to 100 Hz (100 scans per second). PAL is the most common system in most of Europe and Asia.

SECAM.SECAM or Sequence Couleur a Memoire, (which translates as color sequence in memory) was developed around the same time as PAL. Whereas with both NTSC and PAL color errors still occur, with SECAM there are no color errors. SECAM is used in France, Eastern Europe, Russia and Africa.

The systems are not compatible because of the difference in the number of lines and the raster frequency, and the way they handle color reproduction. For those who want to watch movies recorded in a different standard, TVs and VCRs have been developed which are able to handle two or three systems. Conversion of TV, satellite or cassette programs to other systems results in lower quality.

<u>Упражнение 3.</u> Ответьте на следующие вопросы в соответствии с содержанием прочитанного.

1. What is the central element of any audio/visual setup? 2. What is the central component of a TV set? 3. What basic components does a cathode ray tube consist of? 4. Where are the essential parts of the cathode ray tube positioned? 5. What is the inside of the screen coated with? 6. What does the electron gun produce? 7. What does the shadow mask look like? 8. What is the function of the deflection coil? 9. How does the electron

beam move? 10. How is the picture created? 11. What two kinds of synchronization do you know? 12. What is the difference between a black-and-white tube and a color tube? 13. What makes up a total color? 14. When does cross color occur? 15. What three color transmission systems do you know?

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