МИНИСТЕРСТВО ОБРАЗОВАНИЯ
РЕСПУБЛИКИ БЕЛАРУСЬ

Белорусский национальный
технический университет

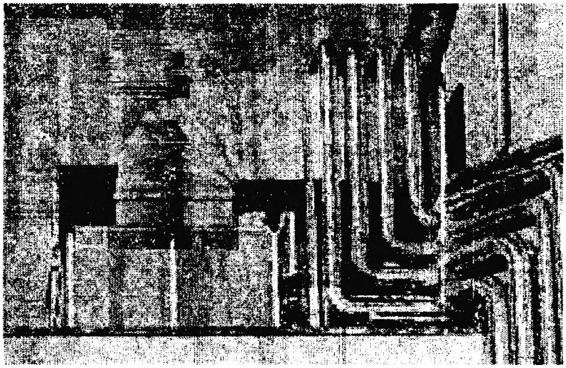
Кафедра английского языка № 2

Т.П. Фомичёва

Т.В. Кайко

HVAC Engineering

Учебно-методическое пособие



Минск
БНТУ
2015

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Учебно-методическое пособие
для студентов специальности 1-70 04 02 «Теплогазоснабжение,
вентиляция и охрана воздушного бассейна»
заочной формы обучения

*Рекомендовано учебно-методическим объединением
по образованию в области строительства и архитектуры*

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Учебно-методическое пособие написано в соответствии с типовой программой по иностранным языкам для вузов. Целью пособия является систематизация и совершенствование знаний и умений студентов, расширение их словарного запаса, формирование навыков понимания, перевода и реферирования текстов по специальности.

Состоит из четырех разделов, построенных по единому принципу. Материалом пособия послужили оригинальные, профессионально ориентированные тексты.

Предназначено для студентов-заочников строительных специальностей, а также для желающих самостоятельно повысить свой уровень владения английским языком в области гражданского строительства.

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ПРЕДИСЛОВИЕ

Учебно-методическое пособие имеет профессиональную направленность и предназначено для студентов 1 и 2 курсов заочной формы обучения специальности 1–700402 «Теплогазоснабжение, вентиляция и охрана воздушного бассейна», имеющих базовую подготовку по английскому языку. Пособие подготовлено в соответствии с требованиями типовой программы по иностранным языкам для высших учебных заведений.

Целью пособия является систематизация и совершенствование знаний и умений студентов, расширение их словарного запаса по предлагаемой тематике, формирование навыков понимания, перевода и реферирования оригинальных текстов по специальности.

Учебно-методическое пособие состоит из 4–х самостоятельных разделов, построенных по единому принципу. Основной структурной единицей является лингвометодический комплекс, который представляет собой тематически завершенный блок (Unit). Каждый блок соответствует определенному этапу обучения (Unit I – первый семестр, Unit II – второй семестр, Unit III – третий семестр, Unit IV – четвертый семестр).

Каждый раздел пособия включает профессионально ориентированные тексты для обучения различным видам чтения и упражнения к ним. Система упражнений способствует усвоению профессиональной лексики и повторению основных грамматических явлений.

В пособие включены тексты для дополнительного чтения, которые могут быть рекомендованы как для самостоятельного изучения, так и для других учебных целей, например, обучения переводу, работе со словарем, грамматическому анализу и т.п.

Работу с устными темами рекомендуется организовать по усмотрению преподавателя, как с точки зрения методики, так и форм проведения. Пособие включает тематический словарь.

Проверка изученного материала осуществляется преподавателем на практических занятиях.

Авторы выражают искреннюю благодарность всем тем, кто способствовал созданию и изданию этого пособия.

Авторы

SECTION I. READING MATERIAL

UNIT I

HVAC SYSTEMS. HEATING

Active Vocabulary

1. Read the following international words and guess their meaning. Mind the stress.

ventilation	[ventɪ'leɪʃ(ə)n]	thermodynamics	[θɜ:mədaɪ'næmɪks]
system	['sɪstəm]	operation	[ɔp(ə)'reɪʃ(ə)n]
company	['kʌmpənɪ]	aquarium	[ə'kweərɪəm]
climate	['klaɪmət]	infiltration	[ɪnfɪl'treɪʃ(ə)n]
refrigeration	[rɪfrɪʤ(ə)'reɪʃ(ə)n]	mechanics	[mɪ'kænɪks]
function	['fʌŋkʃ(ə)n]	temperature	['temp(ə)rəʧə]
control	[kən'trəul]	engineer	[enʤɪ'nɪə]
abbreviation	[əbri:vɪ'eɪʃ(ə)n]	region	['ri:ʤ(ə)n]
thermal	['θ:m(ə)l]	modernization	[mɔd(ə)naɪ'zeɪʃ(ə)n]
industrial	[ɪn'dʌstrɪəl]	term	[tɜ:m]
principle	['prɪn(t)səpl]	component	[kəm'pəunənt]
installation	[ɪnstə'leɪʃ(ə)n]	service	['sɜ:vɪs]
office	['ɔfɪs]	electrical	[ɪ'lektrɪk(ə)l]

2. Read and memorize the active vocabulary.

Nouns and noun phrases

air conditioning — кондиционирование воздуха
air infiltration — проникновение воздуха
design firms — проектно–конструкторская фирма
estimate — смета, оценка
facility — сооружение, комплекс
heating — отопление
humidity — влажность
initialism — аббревиатура
inspection — проверка

installation	установка
maintenance costs	эксплуатационные расходы
mechanical engineering	машиностроение
refrigeration	охлаждение
space	пространство
ventilating	вентилирование
worldwide enterprise	всемирное предприятие

Verbs and verbal phrases

to deliver	поставлять
to determine	определять
to ensure	обеспечивать, гарантировать
to identify	идентифицировать, распознавать; to
integrate	объединять
to interrelate	взаимодействовать
to maintain	обслуживать
to seek	стараться, прилагать усилия
to specify	устанавливать, гарантировать

Adjective

acceptable	подходящий
frequent	частый, обычный
reasonable	приемлемый
residential	жилой
thermal	тепловой

Adverbs

constantly	постоянно
correctly	верно, правильно
directly	непосредственно
normally	обычно
occasionally	периодически

3. Match English and Russian equivalents.

1. marine environments	A. механика жидкости
2. plumbing system	B. высокая эффективность
3. fluid mechanics	C. морская среда

4. heat transfer	D. обеспечить температурный комфорт
5. high efficiency	E. коммунальные услуги
6. to provide thermal comfort	F. вводить в эксплуатацию
7. contractor	G. системное проектирование
8. building service	H. инженер–эксплуатационник
9. prepare estimates	I. водопроводно-канализационная сеть здания
10. system design	J. подрядчик
11. service engineer	K. составлять сметы
12. to commission	L. теплообмен

4. Match the terms and their definitions.

1. ventilate	A. something used, accepted, or officially fixed as a measure of quality, purity, weight
2. air conditioning	B. the amount of water vapour contained in the air
3. humidity	C. to allow fresh air to enter a room, building
4. standard	D. the system that uses one or more machines to keep air in a building or room cool
5. thermodynamics	E. to set an apparatus up, ready for use
6. to install	F. science of the relations between heat and mechanical work

Reading Practice

5. Read the text thoroughly and translate it in written form.

Text A. HVAC Systems

HVAC (pronounced either "H–V–A–C" or, occasionally, *"H–vak")* is an initialism or acronym that stands for "heating, ventilating, and air conditioning". HVAC refers to as climate control. It is particularly important in the design of medium to large industrial and office buildings such as skyscrapers and in marine environments such as aquariums. Their safe and healthy building conditions are regulated with respect to temperature and humidity, using fresh air from outdoors.

HVAC system design is a major subdiscipline of mechanical engineering. HVAC is based on the principles of thermodynamics, fluid mechanics, and heat transfer and on inventions and discoveries made by Michael Faraday, Willis Carrier, Reuben Trane, James Joule, William Rankine, Sadi Carnot, and many others. The invention of the components of HVAC systems goes hand–in–hand with the Industrial Revolution, and new methods of modernization, higher efficiency, and system control are constantly introduced by companies and inventors all over the world.

The three functions of heating, ventilating, and air–conditioning are closely interrelated. All seek to provide thermal comfort, acceptable indoor air quality, and reasonable installation, operation, and maintenance costs. HVAC systems can provide ventilation, reduce air infiltration, and maintain pressure relationships between spaces.

In modern buildings the design, installation, and control systems of these functions are integrated into one or more HVAC systems. For very small buildings, contractors normally "size" and select HVAC systems and equipment. For larger buildings where required by law, "building services" designers and engineers analyze, design, and specify the HVAC systems. Mechanical contractors build and commission them. In all buildings inspections of the installations are the norm.

The HVAC industry is a worldwide enterprise, with career opportunities including operation and maintenance, system design and construction, equipment manufacturing and sales, and in education and research.

HVAC engineers can design systems for residential, industrial, institutional and commercial buildings, including schools, office buildings and health care facilities. HVAC Engineers may meet directly with clients, work with engineering colleagues like management, installers and repair technicians, design new systems and prepare estimates.

When working in this career area, individuals must have a thorough understanding of how these types of systems function. Heating systems can be powered either by gas or electricity, and HVAC engineers have to identify and determine the effectiveness of different system options.

They also need to be able to select the optimum HVAC system to go into particular homes or businesses depending on its energy–efficiency level.

This business area also involves frequent testing to ensure that products are up to par with organizational standards. HVAC engineers often have to figure out why a particular component in a system failed to operate correctly and test manufactured HVAC products to make sure that they remain high in quality for customers. Engineers usually must determine the costs of fixing HVAC system failures and the hours of work involved in these activities.

HVAC engineers can work for consulting or design firms, government agencies, facilities, offices or HVAC equipment sales offices.

Notes:
mechanical contractors – технические подрядные организации
health care facilities – учреждения здравоохранения
par – норма, стандарт
medium – среда, окружающие условия

Comprehension Check

6. Decide which statements are true and which ones are false.

1. HVAC is an initialism or acronym that stands for "heating, ventilating, air conditioning and refrigeration".
2. HVAC system design is a major subdiscipline of heating engineering.
3. Heating, ventilating, and air conditioning seek to provide thermal comfort, acceptable outdoor air quality, and high installation, operation, and maintenance costs.
4. HVAC Engineers can design systems for residential, industrial, institutional and commercial buildings.
5. HVAC engineers have to identify and determine the effectiveness of different system options.
6. Engineers usually must determine the costs of fixing HVAC system failures and the hours of work involved in these activities.

7. Complete the following sentences by adding the phrases given in part B.

Part A

1. HVAC is sometimes referred to as climate control and …
2. HVAC is based on the basic principles of thermodynamics, fluid mechanics, and heat transfer…
3. For larger buildings where required by law, "building services" designers and engineers …
4. When working in this career area, individuals must have …
5. HVAC engineers often have to figure out why a particular component in a system failed …

Part B

A. … a thorough understanding of how these types of systems function.
B. … to operate correctly and test manufactured HVAC products.
C. …and inventions and discoveries made by Faraday, Carrier, Trane, Joule, Rankine, Carnot, and many others.
D. …analyze, design, and specify the HVAC systems.
E. …is particularly important in the design of medium to large industrial and office buildings.

8. Answer the questions on the text.

1. What does an initialism HVAC stand for?
2. Is HVAC particularly important in the design of medium to large industrial and office buildings and in marine environments?
3. What is heating, ventilating, and air conditioning based on?
4. New methods of modernization, higher efficiency, and system control are constantly introduced by companies and inventors all over the world, aren`t they?
5. What can HVAC systems provide?
6. Who specifies the HVAC systems and equipment for large buildings?
7. Who builds and commissions the HVAC systems?
8. Can HVAC engineers design schools, office buildings and health care facilities?
9. What can heating systems be powered by?
10. What do HVAC engineers have to identify and determine?

11. Why does business area of HVAC engineering also involve frequent testing?
12. HVAC Engineers can't work for consulting or design firms, government agencies, facilities offices or HVAC equipment sales offices, can they?

Language Focus

9. Translate the following pairs of derivatives.

N – Adj	V – N
industry – industrial	to educate – education
architecture – architectural	to construct – construction
electric – electrical	to inspect – inspection
mechanic – mechanical	to distribute – distribution
nation – national	to organize – organization
history – historical	to invent – invention
commerce – commercial	to designate – designation
function – functional	to organize – organization

10. Transform as in the models.

Model 1 "Verb – Noun": to invent the central heating – the invention of central heating

to modernize the technology, to install the equipment, to ventilate the room, to infiltrate water, to locate the system, to condense air, to distribute a heated fluid

Model 2 «Noun – Noun»: the invention of central heating – central heating invention

11. Choose the right word or word–combination.

1. The invention of the components of HVAC systems goes hand–in–hand with the … revolution.
a) socialist b) industrial c) cultural

2. HVAC systems can provide ventilation, reduce … infiltration, and maintain pressure relationships between spaces.

a) water b) heat c) air

3. In modern buildings the design, installation, and control systems of these functions are integrated into one or … HVAC systems.

a) many b) much c) more

4. The HVAC industry is a worldwide …. , with career opportunities including operation and maintenance, system design and construction, equipment manufacturing and sales, and in education and research

a) enterprise b) company c) organization

5. HVAC engineers may meet directly with clients, work with engineering … like management, installers and repair technicians.

a) achievements b) colleagues c) systems

12. Insert the appropriate words.

a) modernization b) gas c) temperature d) contractors
e) energy efficiency f) ventilating

1. Safe and healthy building conditions of skyscrapers are regulated with respect to – 1 – and humidity, using fresh air from outdoors. **2.** New methods of – 2 –, higher efficiency, and system control are constantly introduced by companies and inventors all over the world. **3.** The three functions of heating, – 3 –, and air–conditioning are closely interrelated. **4.** For very small buildings, – 4 – normally "size" and select HVAC systems and equipment. **5.** Heating systems can be powered either by – 5 – or electricity. **6.** HVAC engineers also need to be able to select the optimum HVAC system to go into particular homes or businesses depending on its – 6 – level.

13. Fill in the words listed below.

Assignment I

a) maintaining b) compressors c) specialize d) comfort
e) thermocouples f) hazardous g) responsible

An HVAC technician job description

The HVAC technicians are the ones who – 1 – in HVAC systems. An HVAC technician job description may include many aspects of the heating, ventilation and air conditioning trade. As they are – 2 – for providing the comfortable conditions that people experience in homes, offices and various buildings, the duties are numerous. They are responsible for installing, – 3 – trouble–shooting and often sales of the HVAC units. Their job description will vary according to the season. In the summer months, the duties will include ensuring that HVAC systems are running efficiently and providing the cooling to allow maximum – 4 – levels. This will entail checking for leaks, seeing that fans are running as they should and making certain that the evaporators and – 5 – are in good working order. The winter months include testing for gas leaks as well as carbon monoxide levels to avoid – 6 – conditions. Monitoring flame levels, replacing – 7 – if needed and ensuring that the heating system is working at top efficiency are part of the job description for HVAC technicians.

Note:
HVAC technician – специалист по обслуживанию систем HVAC

Assignment II

a) refrigerant b) duties c) units d) heating e) placement
f) distributor g) air conditioning

An HVAC technician job description

Both seasons require installing new – 1 – if the ones in use are not repairable or if this is desired due to the age of the system. Additionally, when new buildings are constructed, HVAC systems will need to be installed. The HVAC technician will be responsible for the – 2 – of the ductwork and the pipes which connect the system. The testing of the system is also required to make certain there are no leaks – gas, – 3 -- or carbon monoxide – to ensure the safety of the system when the construction of the home or building is completed. Many of the – 4 -- of the HVAC technician will depend on the company or business for which they work. Some may work for plumbing, – 5 – and heating contractors. Others may work for repair shops or home improvement stores that sell and service – 6 – and air conditioning systems. Still others may work for the actual manufacturer or – 7 – of a certain type of HVAC system.

Summarizing

14. What parts of the text can you define? Name each part.

1. ________________ 4. ________________
2. ________________ 5. ________________
3. ________________ 6. ________________

15. Find key words and phrases which best express the general meaning of each part.

16. Make a short summary of the text. Do it according to the following plan.

1. The title of the text is …
2. The text is devoted to …
3. The main idea of the text is …
4. It consists of …
5. The first part is about…
6. The second (third, fourth, etc.) part deals with …
7. The conclusion is that…

17. Read the following text and answer the questions below.

Text B. Heating. Historical Development

Heating is process and system of raising the temperature of an enclosed space for the primary purpose of ensuring the comfort of the occupants. By regulating the ambient temperature, heating also serves to maintain a building's structural, mechanical, and electrical systems.

The earliest method of providing interior heating was an open fire.

Such a source, along with related methods such as fireplaces, cast–iron stoves, and modern space heaters fueled by gas or electricity, is known as ***direct heating*** because the conversion of energy into heat takes place at the site to be heated. A more common form of heating in modern times is known as central, or ***indirect, heating***. It consists of the conversion of energy to heat at a source outside of, apart from, or located within the site or sites to be heated. The resulting heat is conveyed to the site through a fluid medium such as air water, or steam.

Except for the ancient Greeks and Romans most cultures relied upon direct–heating methods. Wood was the earliest fuel used in places such as China, Japan, and the Mediterranean. Charcoal (made from wood) was used because it produced much less smoke. The flue, or chimney, which was first a simple aperture in the centre of the roof and later rose directly from the fireplace, had appeared in Europe by the 13th century. It effectively eliminated the fire's smoke and fumes from the living space. Enclosed stoves had been used by the Chinese about 600 BC and eventually spread through Russia into northern Europe and from there to the America. Benjamin Franklin invented an improved design known as the Franklin stove in 1744. Stoves are far less wasteful of heat than fireplaces because the heat of the fire is absorbed by the stove walls, which heat the air in the room, rather than passing up the chimney in the form of hot combustion gases.

Central heating has been invented in ancient Greece, but it was the Romans who became the supreme heating engineers of the ancient world with their hypocaust system. In many Roman buildings, mosaic tile floors were supported by columns below, which created air spaces, or ducts. At a site central to all the rooms to be heated, charcoal, brushwood, and, in Britain, coal were burned. The hot gases traveled beneath the floors, warming them in the process. The hypocaust system disappeared with the decline of the Roman Empire, however, and central heating was not reintroduced until some 1,500 years later.

Central heating was adopted for use again in the early 19th century when the industrial revolution caused an increase in the size of buildings for industry, residential use, and services. The use of steam as a source of power offered a new way to heat factories and mills, with the steam conveyed in pipes. Coal–fired boilers delivered hot steam to rooms by means of standing radiators. The advantages of hot water, which has a lower surface temperature and milder general effect than steam, began to be recognized about 1830.

Twentieth–century central–heating systems generally use warm air or hot water for heat conveyance. Ducted warm air has supplanted steam in most newly built American homes and offices. But in Great Britain and much of the European continent, hot water succeeded steam as the favoured method of heating; ducted warm air has never been popular there. Most other countries have adopted either the American or European preference in heating methods.

Notes:
hypocaust – подземная печь для отопления бань, комнат (в античную эпоху)

1. What is the primary purpose of heating?
2. What is direct heating?
3. Does indirect heating consist of conversion of energy into heat at the site to be heated?
4. Did the ancient Greeks and Romans rely upon direct–heating methods?
5. When did the chimney appear in Europe?
6. Where had enclosed stoves been used?
7. When was the Franklin stove invented?
8. What are the advantages of stoves?
9. Who became the supreme heating engineers of the ancient world with their hypocaust system?
10. What is the principle of hypocaust system work?
11. Why was central heating adopted for use again in the early 19th century?
12. Twentieth–century central–heating systems generally use warm air or hot water for heat conveyance, don`t they?

18. Read the following text and speak on the main energy sources for heating systems. Render the text in Russian.

Text C. Energy Sources for Heating Systems.

Most home heating systems obtain their heat by burning coal, gas, or oil. When any of these fuels is burned with a deficiency of combustion air or with an improperly adjusted burner, it can produce carbon monoxide. It is a deadly gas that is unsafe to breathe in any concentrations greater than 1 part in 10,000 parts of air. For this reason, one should recognize the importance of properly venting the gaseous products of combustion to the outside of the house, particularly in the case of a small, tightly constructed house.

Coal. The use of coal as a home heating fuel has diminished steadily in recent years because of its cost, its fuel and ash handling difficulties, and its limitation on designing for completely automatic operation. Where still in use, coal is fed to a furnace or boiler by hand or by a mechanical stoker. The stoker fire must be started by hand, but the rate of coal feed can be regulated by a thermostat in the heated space.

Gas. Natural gas (methane) is the most widely used home heating fuel. This gas is collected from large gas pockets in the earth and piped underground at high pressure to cities where it is used. In the home the gas is reduced to low pressure and burned in gas burners. Gas burners should be equipped with adequate safety controls because natural gas is a highly flammable fuel.

Liquefied petroleum gas (propane or butane) is often used where the home is not near a gas main. This gas is liquefied under moderate pressure, delivered to the home in special tank trucks, and stored in a large pressure container. When released from the pressure container for home use, the fluid returns to its gaseous state. A liquefied petroleum gas (LPG) heating system operates with the same convenience and cleanliness as a natural gas system.

Oil. Fuel oil, which is available in various grades, is delivered to home storage tanks by tank truck. Oil burners are available in many designs, with each burner designed to use a particular grade of fuel oil. Generally, oil burners are more complex than gas burners since they must vaporize the oil before it can be burned. As a general rule, fuel oil does not burn as cleanly or as efficiently as gas, and it requires somewhat more service attention. However, its flammable characteristics are somewhat less dangerous than those of gas because it is a low–volatile fuel.

Electricity. Electricity is a high–grade energy source that can be used for heating by sending current through resistance elements located, for instance, in conventional warm–air furnaces or hot–water boilers, or directly in baseboard units. In areas where economic factors justify its use, the electricity is supplied to homes under special all–electric rate schedules. Electricity has the advantages of convenience, cleanliness, low maintenance, and easy control, and it does not have the dangers associated with fuel burning.

Notes:

deficiency – отсутствие чего–л., нехватка, дефицит
diminish – сокращать, уменьшать
equip – снабжать; оборудовать
LPG – сжиженный нефтяной газ
low–volatile – с малым выходом летучих компонентов
baseboard unit – плинтусные устройства, приборы
rate schedule – таблица тарифов на электроэнергию

19. Read the text and name the main alternative heating systems for homes.

Text D. Alternative Heating

Environmental concerns and rising energy costs have many homeowners considering alternative heating sources.

Solar heating, geothermal heating, alternative stoves can provide either a primary heat source, or a supplemental one to ease the cost of running a gas, oil or electric system.

Solar heating system can be either passive or active. Passive solar heating relies in building design to collect and hold sunlight. Passive solar homes large, south-facing windows and thermal mass surfaces. Thermal mass is an absorptive material such as tile, concrete, or even water, which collects and stores heat for later use. The thermal mass can be incorporated into flooring or walls. Active solar heating systems consist of solar collectors, heat pumps, exchangers, storage tanks, and controls to gather, transfer, and disburse heat throughout a home, like in a parabolic solar steam boiler, for instance. Active systems rely on electricity to move the gathered heat from the solar collector through the home. Both alternative heating methods use a completely renewable source (the sun) to provide warm air and hot water to homes.

Geothermal residential heating systems use the Earth's heat as a source of warmth for homes. Because the temperature of the Earth remains constant just below the surface, underground piping can be installed with a fluid to absorb the heat. The fluid is then pumped into the home where a heat exchanger extracts the warmth, and a fan then distributes the heat throughout the home. This alternative heating method is extremely quiet, safe, and very efficient. Existing ductwork can be used, making this an ideal system to retrofit into any home.

Alternative stoves using corn, wood, and wood pellets have recently seen a huge rise in popularity as people seek alternative heating methods that can support local industry and that aren't imported from abroad. Although many people install these stoves to supplement existing conventional heaters, often the alternative stove provides enough heat for the entire home. Many of these stoves are direct vent systems, meaning that no additional venting system or chimney is needed. One major advantage that alternative stoves offer is convenience. Because they range in size and capacity, a stove can be found to fit in most rooms of any home. The fuel is easily stored, and the stoves are effortlessly controlled with thermostats.

Notes:
active solar heating system – система отопления на солнечных батареях
passive solar heating system – пассивная отопительная солнечная система
geothermal residential heating system – геотермальная система отопления жилых зданий

Follow up activities

20. Read the text A and make notes under the following headings. Then use your notes and talk on the topics

1. What HVAC is.
2. HVAC Engineers' Job.

UNIT II

HEATING SYSTEMS

Active Vocabulary

1. Read the following international words and guess their meaning. Mind the stress.

public	['pʌblɪk]	combination	[kɔmbɪ'neɪʃ(ə)n]
commercial	[kə'mɜ:ʃ(ə)l]	electric	[ɪ'lektrɪk]
comfortable	['kʌmf(ə)təbl]	transport	[træn'spɔ:t]
individual	[ɪndɪ'vɪdʒuəl]	correct	[kə'rekt]
type	[taɪp]	convector	[kən'vɜ:tə]
central	['sentr(ə)l]	panel	['pænəl]
energy	['enədʒɪ]	plan	[plæn]
normally	['nɔ:m(ə)l]	calculation	[kælkju'leɪʃ(ə)n]
operation	[ɔp(ə)'reɪʃ(ə)n]	filter	['fɪltə]
automatic	[ɔ:tə'mætɪk]	specification	[spesəfɪ'keɪʃ(ə)n]
design	[dɪ'zaɪn]	standard	['stændəd]
principal	['prɪn(t)səp(ə)l]	association	[əsəusɪ'eɪʃ(ə)n]
architect	['ɑ:kɪtekt]	function	['fʌŋkʃ(ə)n]

2. Read and memorize the active vocabulary.

Nouns and noun phrases

air handling system	система кондиционирования воздуха
convector	конвектор
duct	воздушный канал, воздуховод
energy converter	преобразователь, трансформатор энергии
heat exchanger	теплообменник
heat loss	тепловая потеря
heat release	выброс, выпуск тепла
heat–emitting device	тепловыделяющее устройство
heating panel	отопительная панель

hot water system	водяная система отопления
hydronics	жидкостное отопление или охлаждение
source	источник
transport medium	среда, способ передачи
warm air system	воздушная система отопления

Verbs and verbal phrases

to apply	применять
to constitute	составлять
to convert	преобразовывать
to convey	перемещать, передавать
to emit	излучать, испускать
to erect	возводить, устанавливать

Adjective

auxiliary	вспомогательный
complete	полный, завершенный
even	ровный; гладкий;
exact	верный, безошибочный, точный
principal	основной, главный
proper	присущий, свойственный

Adverbs

probably	вероятно, возможно
properly	должным образом, надлежаще

3. Match English and Russian equivalents.

1. central heating system	A. основы проектирования
2. to convert a source of energy	B. бессквозняковая вентиляция
3. to offset heat loss	C.система центрального отопления
4. to convey the heat energy	D. оборудование для увлажнения
5. draft–free ventilation	E. преобразовывать источник энергии
6. reasonable cost	F. система принудительного нагревания воздухом

7. air cooling	H. компенсировать тепловые потери
8. design principles	I. передавать тепловую энергию
9. design day	J. кондиционирование воздуха
10. forced warm–air system	K. приемлемая стоимость
11. air register	L. расчётные сутки, соответствующие максимальной теоретической нагрузке энергосистемы
12. humidifying equipment	M. воздушный регистр

4. Match the terms and their definitions.

1. heat	A. a device for transferring the heat of one substance to another
2. convector	B. apparatus for radiating heat from steam or hot water supplied through pipes
3. boiler	C. enclosed fireplace for heating building with hot water or steam
4. radiator	D. apparatus (for heating a room) by which air is warmed as it passes over hot surfaces
5. heat exchanger	E. a form of energy arising from the random motion of the molecules of bodies, which may be transferred by conduction, convection, or radiation
6. furnace	F. metal container in which water is heated

Reading Practice

5. Read the text thoroughly and translate it in written form.

Text A. Central Heating Systems. Principles and Design.

In order to provide a comfortable temperature environment for occupants in an enclosure, a central heating system must convert a source of energy into heat energy at one location and transport this energy to other locations in the structure for the purpose of off–setting the heat losses of the building.

The principal types of central heating systems are identified by the type of transport medium used to convey the heat energy.Water, steam, and air constitute the most common transport mediums. Thus, hot water, steam, and warm air are the three general types of heating systems.

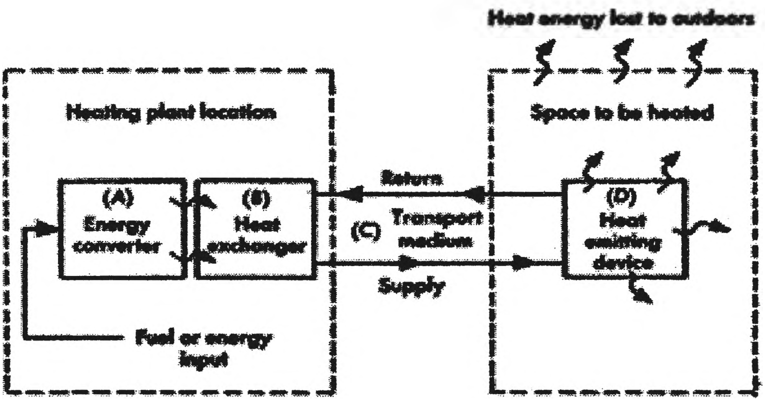


Fig. 1. Schematic diagram showing the components of a central heating system

While the exact method of providing a comfortable environment varies with the type of system, each may be considered to consist of the components illustrated schematically in Fig.1.

A source of energy (usually coal, oil, gas, or electricity) is applied to an energy converter (A), which changes the form of energy to heat energy. This heat energy is then transferred through a heat exchanger (B) to the transport medium (C), which conveys the heat energy to the heat–emitting device(D), where the heat is released to the space to be heated. After the heat release has occurred, the transport medium is returned to the heat exchanger to be reheated.

In Table 1, the basic components for the three general types of heating systems are identified in terms of the usual trade terminology.

Function	Hydronic systems		Warm air systems
	Steam	***Hot water***	
(A) Energy converter	Combustion process – most common. Electric apparatus – possible	Combustion process – most common. Electric apparatus – possible	Combustion process – most common. Electric apparatus – frequently
(B) Heat exchanger	Boiler	Boiler	Furnace or coil
(C) Transport medium	***Steam*** through copper or black iron pipes	***Water*** through copper or black iron pipes	***Air*** through ducts of sheet metal or other thin–walled conduits
(D) Heat–emitting device	Radiators, convectors, or baseboard units	Radiators, convectors, baseboard units or embedded coils of pipe	Registers, grilles,or diffusers

Table 1. Basic components of central heating systems

This is an elementary tabulation, since many designs for large installation include many special, complex components that cut across the three general types. For example, in large industrial installations, the transport medium in the ducts may be air, but the heat exchanger may contain hot water, which is provided by a boiler.

Modern heating systems, whether installed in the largest skyscraper or the smallest house, normally provide draft–free and even–temperature heat, quiet and clean operation, and automatic performance at a reasonable cost with a minimum of service. These systems are often combined with summer air cooling and other air conditioning functions.

Certain design principles are common to all types of heating systems and buildings. First, the heat loss of the building and its rooms must be determined for a design day. This is the typical winter day at the building location for which the heating system must produce comfortable room temperatures under normal operation. For commercial and public buildings or houses designed by architects, the heat loss is calculated from data taken from the architectural plans.

Second, the type of heating system must be selected to match the calculated heat loss. For larger buildings, either a hydronic (hot–water or steam) system or a combination hydronic and air–handling system probably would be selected. For homes a forced warm–air or a forced hot–water system probably would be chosen, but in some cases the choice might be some form of electric heating system.

Next, the correct location of air registers, convectors, heating panels, and other equipment must be determined to ensure even temperature distribution and air movement throughout the rooms of the building. Then the proper size of any connecting ducts or pipes is calculated, and the duct or pipe runs are properly located on the building plans. The automatic control system is then worked out, and auxiliary components, such as filtering and humidifying equipment, are determined.

Complete heating plans and specifications usually are prepared for all buildings erected from architectural plans.

Notes:
enclosure – огороженное пространство
input – подача; подвод
reheat – повторно нагревать; подогревать

Comprehension Check

6. Decide which statements are true and which ones are false.

1. A central heating system must convert a source of energy into heat energy at one location and transport this energy to other locations in the structure.

2. Hot water, steam, electric heat and warm air are the general types of heating systems.
3. An energy converter changes the form of energy to heat energy.
4. Transport medium conveys the heat energy to the heat exchanger.
5. Modern heating systems are often combined with summer air cooling and other air conditioning functions.
6. For commercial and public buildings or houses designed by architects, the heat loss must be determined for a design day.
7. For homes a forced warm–air or a forced hot–water system probably would be chosen, but in most cases the choice might be some form of electric heating system.

7. Complete the following sentences by adding the phrases given in part B.

Part A

1. A central heating system must convert a source of energy into heat energy at one location …
2. The principal types of central heating systems are identified …
3. A source of energy is applied to an energy converter …
4. In large industrial installations, the transport medium in the ducts may be air …
5. The type of heating system must be selected …
6. The correct location of air registers, convectors, heating panels, and other equipment must be determined …
7. Complete heating plans and specifications usually are prepared …

Part B

A. …to match the calculated heat loss.
B. …for all buildings erected from architectural plans.
C. …to ensure even temperature distribution and air movement throughout the rooms of the building.
D. ... and transport this energy to other locations in the structure.
E. ...by the type of transport medium used to convey the heat energy.
F. …which changes the form of energy to heat energy.
G. …but the heat exchanger may contain hot water, which is provided by a boiler.

8. Answer the questions on the text.

1. How does a central heating system function?
2. What are the principal types of central heating systems identified by?
3. What are the three general types of heating systems?
4. What are the main components of a central heating system?
5. What do modern heating systems normally provide?
6. What is the first design principle common to all types of heating systems and buildings?
7. What is the second design principle of heating systems?
8. What heating systems would be selected for larger buildings?
9. What heating systems would be chosen for homes?
10. What equipment must be installed to ensure even temperature distribution and air movement throughout the rooms of the building?
11. The pipe runs are properly located on the architectural plans, aren`t they?

Language Focus

9. Translate the following pairs of derivatives.

V – Adj	V – N
to comfort–comfortable	to require – requirement
to object – objectionable	to environ – environment
to reason – reasonable	to equip – equipment
to break – breakable	to move – movement
to profit – profitable	to replace – replacement

10. Transform as in the models.

Model 1 «Verb – Noun»: to transport the energy – the transportation of energy

to provide the environment, to convert the source of energy, to constitute the transport medium, to combine with summer air–cooling, to locate on the plans, to calculate from data

Model 2 «Noun – Noun»: the transportation of energy – energy transportation

11. Choose the right word or word–combination.

1. A central heating system must convert a source of energy into …energy.

   a) clean   b) heat   c) atomic

2. The principal types of central heating systems are identified by the type of … medium used to convey the heat energy.

   a) fluid   b) emitting   c) transport

3. Certain … principles are common to all types of heating systems and buildings.

   a) design   b) basic   c) local

4. A design day is the typical … day at the building location for which the heating system must produce comfortable room temperatures under normal operation.

   a) summer   b) winter   c) spring

5. The duct or pipe runs are properly located on the … plans.

   a) manufacturing   b) building   c) general

12. Insert the appropriate words.

a) specifications b) steam c) air–handling system d) a design day e) draft–free f) heating panels

1. Water, … and air constitute the most common transport mediums.
2. Modern heating systems normally provide … and even–temperature heat, quiet and clean operation, and automatic performance.
3. The heat loss of the building and its rooms must be determined for ….
4. For larger buildings, either a hydronic (hot–water or steam) system or a combination hydronic and … probably would be selected.
5. The correct location of air registers, convectors … and other equipment must be determined to ensure even temperature distribution and air movement throughout the rooms of the building.
6. Complete heating plans and … usually are prepared for all buildings erected from architectural plans.

Summarizing

13. What parts of the text can you define? Name each part.

1. ________________ 4. ________________
2. ________________ 5. ________________
3. ________________ 6. ________________

14. Find key words and phrases which best express the general meaning of each part.

15. Make a short summary of the text. Do it according to the following plan.

1. The title of the text is …
2. The text is devoted to …
3. The main idea of the text is …
4. It consists of …
5. The first part is about…
6. The second (third, fourth, etc.) part deals with …
7. The conclusion is that…

16. Read the following text and answer the questions below.

Text B. Warm–air Heating Systems. Part I.

Because of its low density, air carries less heat for shorter distances than do hot water or steam. The basic principle of the warm–air furnace is illustrated in Fig. 1. The heat of the furnace is transferred to the air in ducts, which rise to rooms above where the hot air is emitted through registers. The warm air from a furnace, being lighter than the cooler air around it, can be carried by gravity in ducts to the rooms. But a gravity system requires ducts of rather large diameter (20–36 cm) in order to reduce air friction, and this resulted in the basement's being filled with ductwork. Moreover, rooms distant from the furnace tended to be under heated, owing to the small pressure difference between the heated supply air and cooler air returning to the furnace.

These difficulties were solved by the use of motor–driven fans, which can force the heated air through small, compact, rectangular ducts to the most distant rooms in a building. The heated air is introduced into individual rooms through registers, grilles, or diffusers of various types, including arrangements resembling baseboards along walls. Air currents through open doors and return air vents help distribute the heat evenly.

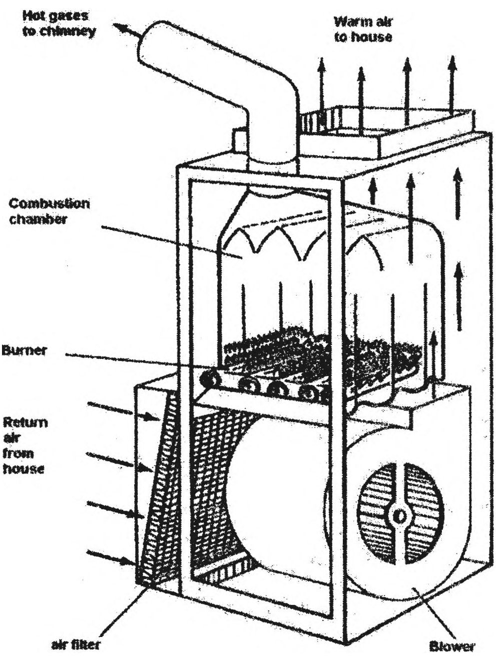


Fig. 1. Forced warm-air furnace

The warm air, after giving up its heat to the room, is returned to the furnace, as shown in Fig. 2. The entire system is controlled by thermostats that sample temperatures and then activate the gas burner and the blowers that circulate the warm air

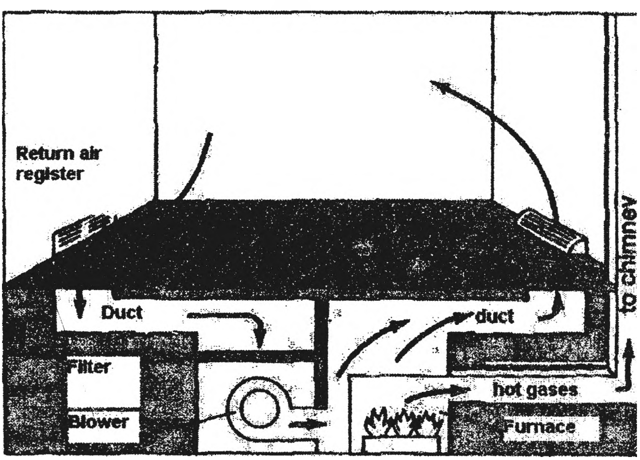


Fig. 2: Warm-air system, in which a blower circulates warm air from the furnace through ducts to room registers

through ducts. An advantage of forced warm–air heating is that the air can be passed through filters and cleaned as it circulates through the system. And if the ductwork is properly sized, the addition of a cooling coil connected to suitable refrigeration machinery easily converts the system to a year–round air–conditioning system.

Air also works in conjunction with other systems. When the primary heated medium is steam or hot water, forced air propelled by fans distributes heat by convection (air movement). Even the common steam radiator depends more on convection than on radiation for heat emission.

Notes:
duct – канал, воздуховод
grill – вентиляционная решетка
thermostat – термостат
cooling coil – охлаждающий змеевик
baseboard – плинтус

Hydronic Systems. Part II.

Hot–water heating. Water is especially favoured for central–heating systems because its high density allows it to hold more heat and because its temperature can be regulated more easily. A hot–water heating system consists of the boiler and a system of pipes connected to radiators, piping, or other heat emitters located in rooms to be

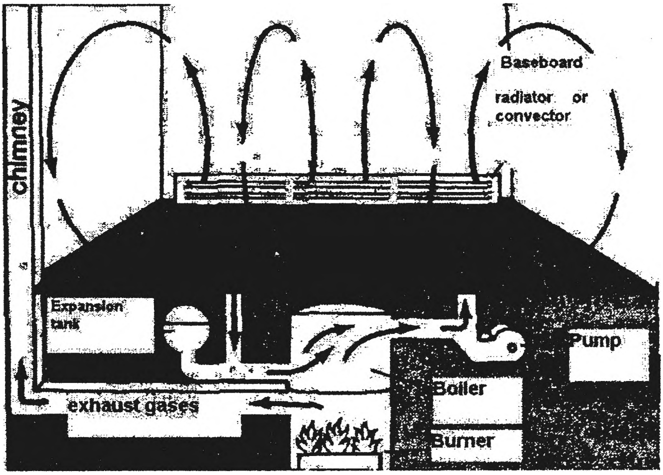


Fig. 3: Hot-water system, in which hot water is pumped from a furnace to convectors; the heat circulates and the cold water returns to the furnace

heated, the principle being shown in Fig. 3.

The pipes, usually of steel or copper, feed hot water to radiators or convectors, which give up their heat to the room. The water, now cooled, is then returned to the boiler for reheating. Two important requirements of a hot–water system are (1) provision to allow for the expansion of the water in the system, which fills the boiler, heat emitters, and piping, and (2) means for allowing air to escape by a manually or automatically operated valve. Early hot–water systems, like warm–air systems, operated by gravity, the cool water, being more dense, dropping back to the boiler, and forcing the heated lighter water to rise to the radiators. Neither the gravity warm–air nor gravity hot–water system could be used to heat rooms below the furnace or boiler. Consequently, motor–driven pumps are now used to drive not water through the pipes, making it possible to locate the boiler at any elevation in relation to the heat emitters. As with warm air, smaller pipes can be used when the fluid is pumped than with gravity operation.

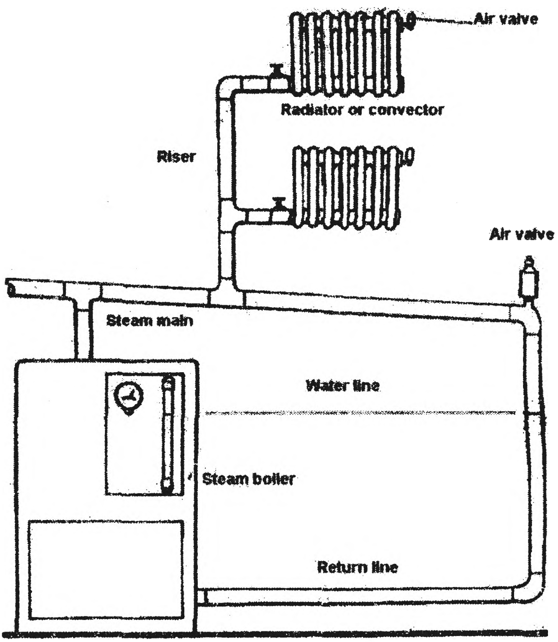


Fig. 4. One-pipe steam heating system, in which steam flows upward to the radiators, while condensate is returning downward through the same pipe to the boiler

Steam heating. Steam systems are those in which steam is generated, usually at less than 35 kilopascals (5 pounds per square inch) in the boiler, and the steam is led to the radiators through steel or copper pipes. The steam gives up its heat to the radiator and the radiator to the room, and the cooling of the steam condenses it to water. The condensate is returned to the boiler either by gravity or by a pump. The air valve on each radiator is necessary to allow air to escape; otherwise it would prevent steam from entering the radiator. The arrangement of a simple one–pipe system is shown in Fig. 4. In this system, both the steam supply and the condensate return are conveyed by the same pipe. More sophisticated systems use a two–pipe distribution system, keeping the steam supply and the condensate return as two separate streams. Steam's chief advantage, its high heat–carrying capacity, is also the source of its disadvantages. The high temperature (about 102° C) of the steam inside the system makes it hard to control and requires frequent adjustments in its rate of input to the rooms. To perform most efficiently, steam systems require more apparatus than do hot–water or warm–air systems, and the radiators used are bulky and unattractive.

Notes:
boiler – (паровой) котел, бойлер
heat emitter – нагревательный прибор
piping – трубопровод; система труб
gravity warm - air system– система гравитационного воздушного отопления
gravity hot - water system – система водяного отопления
motor - driven pump – насос с приводом двигателя
air valve – воздушный клапан
rate of input – норма запуска

1. Why does air carries less heat for shorter distances than do hot water or steam?
2. What was the basic principle of the warm–air heating?
3. How were the difficulties of the gravity system use in warm–air heating solved?
4. What is the forced warm–air system controlled by?
5. What is the advantage of forced warm–air heating?
6. Why is water especially favored for central heating system?
7. What does hot–water heating system consist of?
8. What are two important requirements of a hot water system?
9. Why is high heat–carrying capacity of steam also the source of its disadvantages?

17. Read the text and say why making an electric heating system economically acceptable in comparison with fuel–fired systems is considered to be a formidable problem. Render the text in Russian.

Text C. Electric Heating Systems.

Electricity is a high–grade energy source that can be used for heating by sending current through resistance elements located, for instance, in conventional warm–air furnaces or hot–water boilers, or directly in baseboard units. In areas where economic factors justify its use, the electricity is supplied to homes under special all–electric rate schedules. Electricity has the advantages of convenience, cleanliness, low maintenance, and easy control, and it does not have the dangers associated with fuel burning.

Until the 1960's, all–electric home heating was considered too expensive to be competitive. However, increased generating and distribution efficiencies have provided lower electric rates, and changing power demands have shifted peak loads from the winter to the summer months. As a result, electric utility companies promote winter season electric loads, such as electric resistance elements for home heating.

Electric heat can be provided in many different ways in systems for the home. For example, one electric heating system uses independent baseboard convectors, with each zone controlled by its own thermostat. The operation and control of this system are very simple. As a room thermostat calls for heat, an electric circuit is closed, sending current through the baseboard resistance elements. Since a resistance element produces its full heating effect when it is turned on, it is desirable to have a highly sensitive thermostat to prevent objectionable temperature fluctuations in a room. As in other electric wiring systems in a building, fuses and circuit breakers are used to guard against overloaded circuits. Making an electric heating system economically acceptable in comparison with fuel–fired systems is a formidable problem. For example, the calorific heating value of one gallon of fuel oil is equivalent to 41 kilowatt–hours of electric energy.

Accordingly, great care must be taken to insulate and weather–strip a house in which electric heat is to be installed. Some electric utility companies guarantee estimated heating costs for houses they serve, but they require that the house insulation meet their minimum standards. In the United States, the Federal Housing Authority standards limit the allowable heat loss for electrically heated houses to 40 Btu per hour (11.7 watts) per square foot of occupied floor area.

In spite of these economic realities and the fact that separate systems have to be supplied for summer air conditioning, air filtration, and humidification, electric heat is finding increasing acceptance in home heating.

Notes:

rate schedule – таблица тарифов
resistance elements –резистивные нагревательные элементы
electric utility – электростанция (энергосистема) общего пользования
fuse – плавкий предохранитель
circuit breaker – автоматический выключатель
acceptance – принятие, одобрение

18. Read the text and speak on the main types of emitters.

Text D. Types of Emitters.

There are many variations in the method of transferring the heat from hot water, steam, or electric resistors to the space to be heated. The most familiar heat emitter in older buildings is the common radiator. Steam or hot water circulates through its hollow sections, which can be connected to each other to produce varying lengths. Radiators are usually placed along the external walls of a room. Ambient air enters from below and in front of the radiator, and as it becomes heated it rises vertically between the radiator sections and discharges at the top. The warmed air, being less dense than the cooler air further away in the room, rises and displaces the cooler air, which falls, setting up a current of air.

Convectors differ from radiators in their smaller heat–transfer surface and their placement at the bottom of a cabinet whose inlets and outlets are designed to properly direct a stream of warmed air through the room using the same "chimney" effect. The typical convector is an arrangement of finned pipes or coils through which the heated air or water circulates at the base of an enclosure open at the top and bottom. Air flows upward over the heating surface and is discharged at the top of the enclosure; cooled air drops to the floor and reenters the convector. Such convectors are often installed along windows or along an external wall to counteract drafts and the loss of heat through those cold surfaces.

Many industrial buildings are heated using a special form of emitter called a unit heater, which consists of (1) an arrangement of finned tubes through which hot water or steam circulates and (2) an electric fan that forces air over the tubes. The forced convection results in a rapid rate of heat transfer. Unit heaters can be mounted in units either above the floor or on it.

Radiant heating systems usually employ either hot–water pipes embedded in the floor or ceiling, warm–air ducts embedded in the floor, or some form of electrical resistance panels applied to ceiling or walls.

Panel heating is a form of radiant heating characterized by very large radiant surfaces (an entire ceiling or floor is typically employed) at modestly warm temperatures. With many such systems there is no visible heating equipment in the room, which is an advantage in decorating. A disadvantage is the extent to which a ceiling or floor might be ruined in case of corroded or faulty hot–water piping where this method is employed.

Notes:
electric resistor – электрический резистор
hollow – пустой, полый
displace – вытеснять, заменять, замещать
mount – монтировать, устанавливать

Follow up activities

19. Read the texts A and B. Make notes under the following headings. Then use your notes and the illustrations to talk on the topics.

1. Central Heating Systems. Principles and Design.
2. Warm-air and Hot -water Heating Systems.

UNIT III

AIR CONDITIONING AND VENTILATING

Active Vocabulary

1. Read the following international words and guess their meaning. Mind the stress.

condensation	[kɔnden'seɪʃ(ə)n]	massive	['mæsɪv]
method	['meθəd]	circulate	['sɜ:kjəleɪt]
gas	[gæs]	absorbent	[əb'zɔ:bənt]
form	[fɔ:m]	reverse	[rɪ'vɜ:s]
conditioner	[kən'dɪʃ(ə)nə]	complex	['kɔmpleks]
process	['prəuses]	individual	[ɪndɪ'vɪʤuəl]
absorb	[əb'zɔ:b]	alternate	[ɔ:l'tɜ:nət]
contact	['kɔntækt]	industry	['ɪndəstrɪ]
version	['vɜ:ʃ(ə)n]	regulate	['regjəleɪt]
compressor	[kəm'presə]	commercial	[kə'mɜ:ʃ(ə)l]

2. Read and memorize the active vocabulary.

Nouns and noun phrases

blower	нагнетатель, вентилятор
circumstance	обстоятельство; случай; условие
coil	катушка, спираль, змеевик
cooling	охлаждение
dehydration	дегидратация
evaporation	испарение
fin	ребро, пластина
humidification	увлажнение
purity	чистота
saturation	насыщение

Verbs and verbal phrases

to adjust	регулировать, налаживать
to absorb	поглощать, впитывать
to blow	дуть, обдувать
to condense	конденсировать
to convey	подавать. перемещать
to deliver	поставлять, доставлять
to devise	изобретать, разрабатывать
to drain	осушать
to evaporate	испарять
to exhaust	удалять, извлекать, вытягивать
to expel	удалять, вытеснять
to feed	подавать, питать, снабжать
to pass	проходить, пропускать
to pressurize	повышать давление
to spray	разбрызгивать, распылять

Adjective

complex	комбинированный
reverse	обратный
variable	переменный, изменчивый
volatile	летучий

Adverbs

directly	непосредственно
otherwise	иначе, иным способом

3. Match English and Russian equivalents.

1. air conditioning	A. змеевик конденсатора
2. dew point	B. тепловой насос
3. refrigerant gas	C. 2–х канальная система
4. evaporator coil	D. система водяных фильтров для воздуха
5. saturation point	E. переменный расход воздуха
6. moisture content	F. кондиционирование воздуха
7. dehumidified air	G. точка насыщения
8. condenser coil	H. точка росы, температура конденсации

9. heat pump	I. сухой воздух
10. chilled water	J. змеевик испарителя
11. air washer system	K. пар холодильного агента
12. self–contained unit	L. охлаждённая вода
13. induction system	M. содержание влаги
14. dual–duct system	N. система забора воздуха
15. variable air volume	O. автономный устройство

4. Match the terms and their definitions.

1. to evaporate	A. liquid in the form of vapour
2. moisture	B. to take or suck in liquid, heat, light
3. condensation	C. to remove liquid from a substance
4. refrigerant	D. apparatus for forcing air into or through something
5. blower	E. substance serving to make cool or cold
6. to absorb	F. drops of liquid formed when steam or hot air becomes cool

Reading Practice

5. Read the text thoroughly and translate it in written form.

Text A. Air Conditioning

Air conditioning is the control of temperature, humidity, purity, and motion of air in an enclosed space, independent of outside conditions.

An early method of cooling air as practiced in India was to hang wet grass mats over windows where they cooled incoming air by evaporation. Modern air conditioning had its beginnings in the 19th–century textile industry, in which atomized sprays of water were used for simultaneous humidification and cooling.

In the early 20th century, Willis Carrier of Buffalo, **N.Y.**, U.S., devised the "dew point control", an air conditioning unit based on the principle that cooled air reaches saturation and loses moisture through condensation. Carrier also devised a system wherein conditioned air was fed from the ceiling and exhausted at floor level. The development of highly–efficient refrigerant gases of low toxicity known as Freons (carbon compounds containing fluorine and chlorine or bromine) in the early 1930s was an important step.

In a simple air conditioner, the refrigerant, in a volatile liquid form, is passed through a set of evaporator coils across which air inside the room is passed. The refrigerant evaporates and, in the process, absorbs the heat contained in the air. When the cooled air reaches its saturation point, its moisture content condenses on fins placed over the coils. The water runs down the fins and drains. The cooled and dehumidified air is returned into the room by means of a blower.

In the meantime the vaporized refrigerant passes into a compressor where it is pressurized and forced through condenser coils, which are in contact with outside air. Under these conditions the refrigerant condenses back into a liquid form and gives off the heat it absorbed inside. This heated air is expelled to the outside, and the liquid recirculates to the evaporator coils to continue the cooling process. In some units the two sets of coils can reverse functions so that in winter, the inside coils condense the refrigerant and heat rather than cool the room. Such a unit is known as a heat pump.

Alternate systems of cooling include the use of chilled water. Water may be cooled by refrigerant at a central location and run through coils at other places. In some large factories a version of the earlier air–washer systems is still used to avoid the massive amount of coils needed otherwise. Water may be sprayed over glass fibres and air blown through it. Dehumidification is achieved in some systems by passing the air through silica gel which absorbs the moisture, and in others, liquid absorbents cause dehydration.

The design of air conditioning systems takes many circumstances into consideration. A self–contained unit, described above, serves a space directly. More complex systems, as in tall buildings, use ducts to deliver cooled air. In the induction system, air is cooled once at a central plant and then conveyed to individual units, where water is used to adjust the air temperature according to such variables as sunlight exposure and shade. In the dual–duct system, warm air and cool air travel through separate ducts and are mixed to reach a desired temperature.

A simpler way to control temperature is to regulate the amount of cold air supplied, cutting it off once a desired temperature is reached. This method, known as variable air volume, is widely used in both high–rise and low–rise commercial or institutional buildings.

Notes:
meantime – тем временем, между тем, пока
glass fiber – стекловолокно
silica gel – силикагель, гель кремниевой кислоты

Comprehension Check

6. Decide which statements are true and which ones are false.

1. An early method of cooling air as practiced in India was to hang cotton mats over windows where they cooled incoming air by evaporation.
2. The development of highly–efficient refrigerant gases of high toxicity known as Freons was an important step.
3. The refrigerant evaporates and, in the process, dissipate the heat contained in the air.
4. The cold and dehumidified air is returned into the room by means of a blower.
5. In some units the two sets of coils can reverse functions so that in winter, the inside coils condense the refrigerant and cool rather than heat the room.
6. In some large factories a version of the earlier air–washer systems is still used to avoid a great number of coils needed otherwise.

7. Complete the following sentences by adding the phrases given in part B.

Part A

1. Carrier also devised a system…
2. When the cooled air reaches its saturation point…

3. Under these conditions the refrigerant condenses back into a liquid form…
4. Dehumidification is achieved in some systems by passing the air through silica gel …
5. In the dual–duct system, warm air and cool air travel through separate ducts and …

Part B

A. …and gives off the heat it absorbed inside.
B. …which absorbs the moisture, and in others, liquid absorbents cause dehydration.
C. …wherein conditioned air was fed from the ceiling and exhausted at floor level.
D. …are mixed to reach a desired temperature.
E. …its moisture content condenses on fins placed over the coils.

8. Answer the questions on the text.

1. What does the term "air–conditioning" mean?
2. When did modern air–conditioning have its beginning?
3. Who devised the "dew point control"?
4. What gases are known as Freons?
5. What is the main principle of air conditioner operation?
6 Alternate systems of cooling include the use of chilled water, don`t they?
7. What is dehumidification achieved by?
8. What systems are still in use in some large factories to avoid the massive amount of coils?
9. What does the design of air conditioning systems depend on?

Language Focus

9. Memorize the following pairs of derivatives, paying attention to the meaning of the prefixes.

purity – impurity	regular – irregular

efficient – inefficient dependent – independent directly – indirectly variable – invariable known – unknown important – unimportant purified – unpurified	turn – return circulate – recirculate use – reuse include – exclude hydration – dehydration humidification – dehumidification inside – outside

10. Transform as in the models.

Model 1 «Verb – Noun»: to evaporate water – evaporation of water

to use chilled water, to move air, to control temperature, to develop refrigerant gases, to absorb heat, to condense the refrigerant, to recirculate liquid

Model 2 «Noun – Noun»: evaporation of water – water evaporation

11. Choose the right word or word–combination.

1. An air conditioning unit is based on the principle that cooled air reaches saturation and loses moisture through ...
   a) condensation b) absorbtion c) humidification
2. In a simple …, the refrigerant, in a volatile liquid form, is passed through a set of evaporator coils.
   a) boiler b) heater c) air conditioner
3. In the meantime the vaporized refrigerant passes into … where it is pressurized and forced through condenser coils.
   a) generator b) compressor c) evaporator coils
4. Alternate systems of cooling include the use of …
   a) warm water b) distilled water c) chilled water
5. In the induction system, … is cooled once at a central plant and then conveyed to individual units
   a) air b) water c) steam

12. Insert the appropriate words.

a) fins b) heat pump c) purity d) coils e) ducts f) refrigerant

1. Air conditioning is the control of temperature, humidity, …, and motion of air in an enclosed space, independent of outside conditions.
2. The … evaporates and, in the process, absorbs the heat contained in the air.
3. The water runs down the … and drains.
4. Such a unit is known as a ….
5. Water may be cooled by refrigerant at a central location and run through … at other places.
6. More complex systems, as in tall buildings, use … to deliver cooled air.

13. Fill in the words listed below.

Assignment I

a) properties b) odors c) regulating d) circulation e) products f) particles g) humidity

Air conditioning

Air conditioning is the technique of – 1 – the condition of air in order to provide a comfortable environment for people or a favorable environment for making industrial – 2 –.

Air conditioning usually involves control of four physical properties of air: its temperature, its relative – 3 – its motion or – 4 – and the dust – 5 – in it. Some control of these four properties is important in air conditioning for human comfort. In certain industrial environments these – 6 – are even more precisely controlled, and there may be control of other properties, such as – 7 – and air pressure.

Assignment II

a) humid b) transportation c) conditioning d) product e) operation f) temperature g) control

Applications of air conditioning

Air conditioning has many applications. Air – 1 –for the home is useful in regions where outdoor air – 2 –and moisture content vary widely or suddenly. Stores, restaurants, and theaters have found it necessary to have air conditioned premises to attract customers on hot or – 3 –days. Air conditioned buses, trains, aircraft, and passenger cars are a feature of modern – 4 –.

Many industrial plants need close – 5 – of temperature and humidity conditions during manufacturing operations to provide a high–quality – 6 –. In addition, industrial air conditioning for the comfort of workers can thus provide more efficient – 7 –of the plant.

Summarizing

14. What parts of the text can you define? Name each part.

1. ________________ 4. ________________
2. ________________ 5. ________________
3. ________________ 6. ________________

15. Find key words and phrases which best express the general meaning of each part.

16. Make a short summary of the text. Do it according to the following plan.

1. The title of the text is …
2. The text is devoted to …
3. The main idea of the text is …
4. It consists of …
5. The first part is about …
6. The second (third, fourth, etc.) part deals with …
7. The conclusion is that …

17. Read the following text and answer the questions below.

Text B. Ventilation

Ventilation is natural or mechanically induced movement of fresh air into or through an enclosed space. Ventilation reduces indoor moisture, odors, and other pollutants. Contaminants such as formaldehyde, volatile organic compounds (VOCs), and radon that may cause health problems can accumulate in poorly ventilated homes. Inadequate ventilation allows unpleasant odors to linger. Excess moisture generated within the home needs to be removed before high humidity levels lead to physical damage to the home or mold growth.

Natural ventilation is uncontrolled air movement into a building through cracks and small holes (infiltration) and through vents such as windows and doors. Natural ventilation is the traditional method of allowing fresh outdoor air to replace indoor air. Nowadays, because of central heating and cooling, as well as the desire for privacy, people tend to make little use of widows for ventilation, so infiltration has become the principal mode of natural ventilation in homes. Unfortunately, a home's natural infiltration rate is unpredictable and uncontrollable because it depends on the home's airtightness, outdoor temperatures, wind, and other factors. During mild weather, some homes may lack sufficient ventilation for pollutant removal. Tightly built homes may have insufficient ventilation at most times. Homes with high infiltration rates may experience high energy costs.

Whole–house ventilation is the use of one or more fans and duct systems to exhaust stale air and/or supply fresh air to the house. Whole–house ventilation can better control the exchange of indoor air with outdoor air. Energy experts often quote the axiom, "seal tight, ventilation right" as their recommended approach to house ventilation. This axiom implies that houses should be tightly sealed to reduce infiltration, and a whole–house ventilation system installed to provide fresh air and remove pollutants when and where needed, in a controlled manner that does not negatively impact indoor air quality, building components, or heating and cooling bills.

Spot ventilation is the use of localized exhaust fans (e.g. kitchen range and bath fans) to quickly remove pollutants at their source. It is an important tool to improve air quality whether natural or whole–house ventilation strategies are used. Spot ventilation improves the effectiveness of ventilation systems by removing pollutants at their source as they are generated and should be integral part of any whole–house ventilation design.

Notes:
volatile organic compounds (VOCs) – летучие органические соединения
vent – вентиляционный канал; вентиляционная труба; вентиляционный проём
airtightness – воздухонепроницаемость, герметичность
exhaust fans – вытяжные вентиляторы
ventilation strategy – стратегия; концепция; принцип вентиляции

1. What is the purpose of ventilation?
2. What is natural ventilation?
3. Why is home's natural infiltration rate unpredictable and uncontrollable?
4. Why do homes with high infiltration rates experience high energy costs?
5. What can whole–house ventilation better control?
6. What does axiom "seal tight, ventilation right" mean?
7. Where is spot ventilation used?

18. Read the following text and speak on the types of air conditioning systems. Render the text in Russian.

Text C. Air Conditioning Systems

A complete air conditioning system is capable of adding and removing heat and moisture and of filtering airborne substitutes, such as dust and odorants, from the space or spaces it serves. Systems that heat, humidify, and filter only, for control of comfort in winter, are called **winter air conditioning systems**; those that cool, dehumidify, and filter only are called **summer air conditioning systems**. They are fitted with proper controls to maintain design levels of temperature, relative humidity, and air purity.

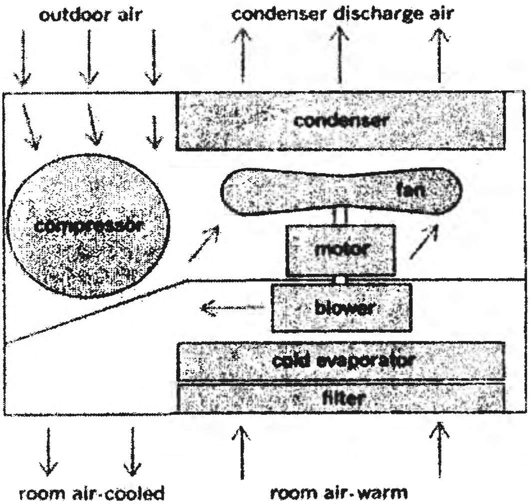


Fig.1. Schematic of room air conditioner

Design conditions may be maintained by multiple independent subsystems tied together by a single control system. Such arrangements, called **split systems**, might consist, for example, of hot–water baseboard heating convectors around a perimeter wall to offset window and wall heat losses when required, plus a central cold–air distribution system to pick up heat and moisture gains as required and to provide filtration for dust and odor.

Air conditioning systems are either **unitary or built–up**. The window or through–the–wall air conditioner is an example of a unitary summer air conditioning system (Fig.1). The entire system is housed in a single package which contains heat removal, dehumidification, and filtration capabilities.

When an electric heater is built into it with suitable controls, it functions as **a year–round air conditioning system**. Unitary air conditioners are manufactured in capacities as high as 100 tons (1 ton of air conditioning equals 12,000 Btu/h or 76,000 W/m^2) and are designed to be mounted conveniently on roofs, on the ground, or other convenient location, where they can be connected by ductwork to the conditioned space.

Built–up or field–erected systems are composed of factory–built subassemblies interconnected by means such as piping, wiring, and ducting during final assembly on the building site. Their capacities range up to thousands of tons of refrigeration and millions of Btu per hour of heating. Most large buildings are so conditioned.

Another important and somewhat parallel distinction can be made between **incremental and central systems**. An incremental system serves a single space; each space to be conditioned has its own, self–contained heating–cooling–dehumidifying–filtering unit. Central systems serve many or all of the conditioned spaces in a building. They range from small, unitary packaged systems, to serve single–family residences, to large, built–up or field–erected systems serving large buildings.

When many buildings, each with its own air conditioning system which is complete except for a refrigeration and a heating source, are tied to a central plan that distributes chilled water and hot water or steam, the interconnection is referred to as a **district heating and cooling system**. This system is especially useful for campuses, medical complexes, and office complexes under a single management.

Notes:

split system – раздельная система отопления и вентиляции
unitary – единичный
built up system – собранная на месте монтажа система
incremental – дифференциальный
packaged systems – комплектная система.
district heating and cooling system – система централизованного теплоснабжения и охлаждения района

19. Scan the following text and speak on what the main ventilation systems provide. Render this text in Russian.

Text D. Whole-house Ventilation System Designs.

Whole-house ventilation systems are usually classified as **exhaust ventilation** if mechanical system forces inside air out of the home, **supply ventilation** if the mechanical system forces outside air into the home, or **balanced ventilation** if the mechanical system forces equal quantities of air into and out of the home.

Exhaust ventilation systems (Fig.1) work by depressurizing the building. By reducing the inside air pressure below the outdoor air pressure, they extract indoor air from a house while make–up air infiltrates through leaks in the building shell and through intentional, passive vents. Typically, an exhaust ventilation system is composed of a single fan connected to a centrally located, single exhaust point in the house. Spot ventilation exhaust fans installed in the bathroom but operated continuously can represent an exhaust ventilation system in its simplest form.

Supply ventilation systems (Fig.2) work by pressurizing the building. A typical supply ventilation system has a fan and duct system that introduces fresh air into usually one, but preferably several rooms of the home that residents occupy most often (e.g., bedrooms, living room), perhaps with adjustable window or wall vents in other rooms. Supply ventilation systems allow better control of the air that enters the house than do exhaust ventilation systems. By pressurizing the house, supply ventilation systems discourage the entry of pollutants from outside the living space and avoid backdrafting of combustion gases from fireplaces and appliances. Supply ventilation also allows outdoor air introduced into the house to be filtered to remove pollen and dust or dehumidified to provide humidity control.

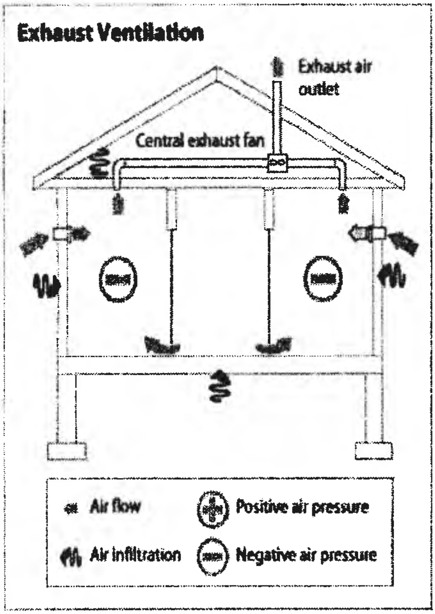


Fig. 1. Exhaust ventilation systems

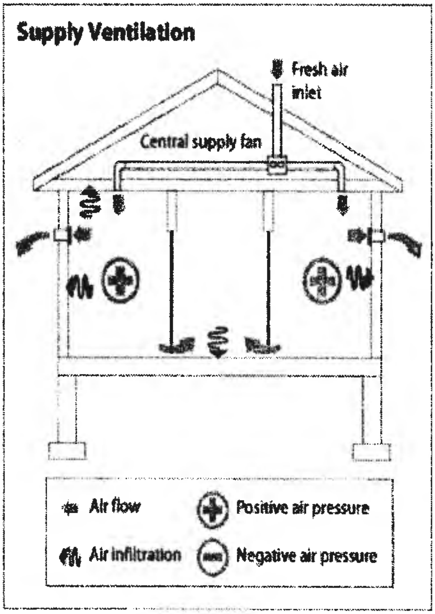


Fig. 2. Supply ventilation systems

Balanced ventilation systems (Fig.3) neither pressurize nor depressurize a house if properly designed and installed. Rather, they introduce and exhaust approximately equal quantities of fresh outside air and polluted inside air, respectively. A balanced ventilation system usually has two fans and two duct systems and facilitates good distribution of fresh air by placing supply and exhaust vents in appropriate places. A typical balanced ventilation system is designed to supply fresh air to bedrooms and living rooms, and exhaust air from rooms where moisture and pollutants are most often generated (kitchen, bathrooms, laundry room).Because they directly supply outside air, balanced systems allow the use of filters to remove dust and pollen from outside air before introducing it into the house.

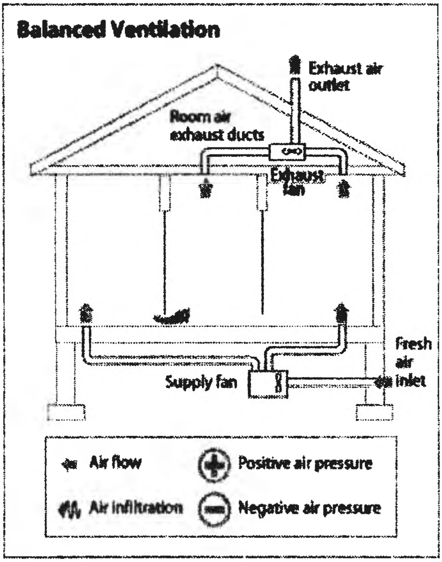


Fig. 3. Balanced ventilantion

Notes:
supply ventilation – приточная вентиляция
balanced ventilation – приточно–вытяжная вентиляция
exhaust ventilation – вытяжная вентиляция

Follow up activities

20. Read the texts A and B. Make notes under the following headings. Then use your notes and the illustrations to talk on the topics.

1. Air Conditioning and its Application.
2. Ventilation.

UNIT IV

HVAC EQUIPMENT

Active Vocabulary

1. Read the following international words and guess their meaning. Mind the stress.

boiler	['bɔɪlə]	special	['speʃ(ə)l]
metal	['met(ə)l]	manufacture	[mænju'fæktʃə]
generator	['ʤen(ə)reɪtə]	radiation	[reɪdɪ'eɪʃ(ə)n]
turbine	['tɜ:baɪn]	radioactivity	[reɪdɪəuæk'tɪvətɪ]
production	[prə'dʌkʃ(ə)n]	convection	[kən'vekʃ(ə)n]
circulation	[sɜ:kjə'leɪʃ(ə)n]	cylindrical	[sə'lɪndrɪk(ə)l]
limit	['lɪmɪt]	electricity	[elek'trɪsətɪ]

2. Read and memorize the active vocabulary

Nouns and noun phrases

pressure vessel	резервуар под давлением
application	применение
circuit	цепь, контур циркуляции
combustion chamber	камера сгорания
combustion	сжигание, горение
fossil fuel	ископаемое топливо
conduction	проводимость
pressure	давление
vaporizing	испарение
demand	требование, потребление
safety valve	предохранительный клапан
gauge	измерительный прибор

Verbs and verbal phrases

to supply	снабжать

to equip	оборудовать, оснащать
to range	колебаться в пределах
to immerse	опускать ,погружать
to drive turbine	приводить в движение турбину
to withstand	противостоять, выдерживать
to utilize	использовать, расходовать
to supplant	вытеснять

Adjectives

giant	гигантский
convertible	обратимый, изменяемый
marine	морской
widespread	широко распространенный

Adverbs

relatively	относительно, сравнительно
chiefly	в основном, преимущественно
readily	быстро, легко
enough	довольно, достаточно

3. Match English and Russian equivalents.

1. associated fuel	A. водотрубный котлы
2. exhaust systems	B. низкое рабочее давление
3. steam generator	C. ископаемое топливо
4.domestic heating systems	D. отработавшие газы
5.intermediate–size boilers	E. поверхность теплопередачи
6.heat–circulation medium	F. огнетрубные котлы
7. fossil fuels	G. паровой генератор
8. waste gases	H. системы домашнего отопления
9. heat–transfer surface	I. котлы среднего размера
10. water–tube boilers	J. соответствующее топливо
11.fire–tube boilers	K. среда циркулирования тепла
12.low operating pressure	L. выдерживать высокое давление
13. to with stand the high pressure	M. система выпуска отработавших газов

4. Match the terms and their definitions.

1. combustion chamber	A. the transfer of heat between two parts of a stationary system, caused by a temperature difference between the parts.
2. pressure	B. a gaslike form of a liquid (such as mist or steam)
3. conduction	C. any combustible organic material, as oil, coal, or natural gas, derived from the remains of former life.
4. vapor	D. an enclosure in which combustion, especially of a fuel or propellant, is initiated and controlled
5. fossil fuel	E. the transfer of heat by the circulation or movement of the heated parts of a liquid or gas.
6. convection	F. the exertion of force upon a surface by an object, fluid, etc., in contact with it.

Reading Practice

5. Read the text thoroughly and translate it in written form.

Text A. Boiler

Boiler is a pressure vessel in which water is converted to steam by the application of heat. A modern boiler generally consists of a circuit of metal tubes supplied with water. The tubes are placed and arranged to present a maximum surface to a heat source, usually a combustion chamber where fuel is burned. The boiler tubes, combustion chamber, and associated fuel, air, water, and exhaust systems are designed and controlled as an integrated complex, which may be called a boiler, a steam plant, or a steam generator.

Boilers range in size and function from the compact units in domestic heating systems to 20–story complexes that drive giant steam turbines for electrical power production. A wide range of intermediate–size boilers are designed to match the demands of steam engines and steam turbines in stationary, marine, and locomotive applications. Boilers are also required to produce steam for industrial use as a process–energy source. Many space–heating systems utilize steam as a heat–circulation medium, but some systems, such as those serving several widespread buildings, are designed to use hot water as a medium. Such systems are equipped with special boilers that heat water to high temperatures but maintain sufficient pressure to keep it from vaporizing.

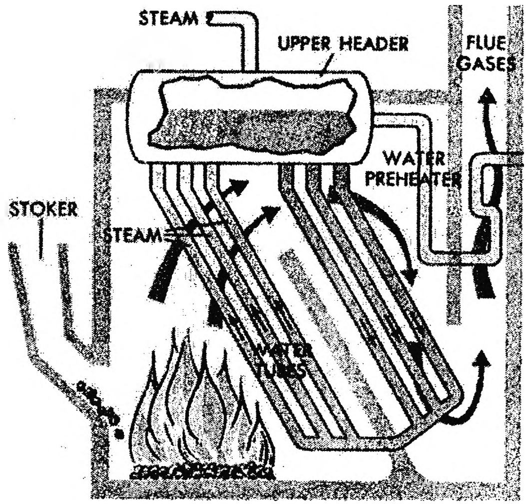


Fig. 1. Water–tube boiler

The energy for most boilers is provided by the combustion of the fossil fuels–coal, oil, and gas. Coal is the major fuel, but most boilers are readily convertible from one fuel to another. Other fuels such as wood, waste gases from industrial processes, and solid wastes such as bagasse (from sugarcane), sawdust, and even trash and garbage serve as energy sources to a limited extent. An increasing number of large steam plants built since 1960 for generating electricity are designed to use nuclear fuel, which provides heat from radioactivity.

The most important part of any boiler is the heat–transfer surface, the area where water absorbs enough energy to become steam. Most modern boilers are ***water–tube*** boilers (Fig. 1). In this type of boiler the water is passed through metal tubes, which are heated either by convection and conduction from the hot combustion gases that surround them or by direct radiation from the fire. In early designs, and in some small modern plants, the combustion gases are passed through tubes that are immersed in the water.

Such boilers, called ***fire–tube*** boilers (Fig. 2), consist of a cylindrical shell with flat ends in which the water is contained and through which the tubes pass. Fire–tube boilers are limited to relatively low operating

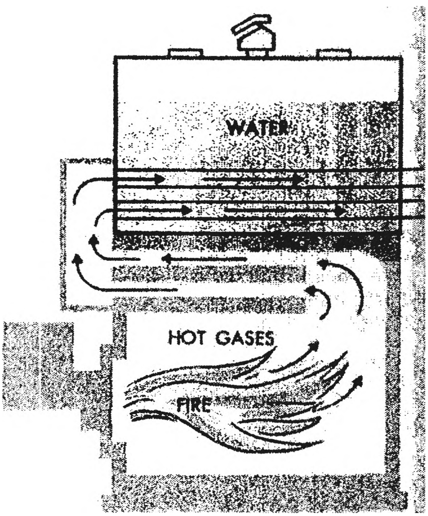


Fig. 2. Fire–tube boiler

pressures because of the difficulty of constructing a shell strong enough to with stand the high pressure required for efficient operation. As the pressure demands of steam engines and turbines increased, the fire–tube, boiler was supplanted by the water–tube boiler in major installations. Small fire–tube units are still manufactured, chiefly for domestic and small industrial heating systems.

Most modern boilers are under complete automatic control. All boilers must be provided with equipment such as safety valves, water level controls, indicating gauges, and provision for rapid cutoff of fuel combustion and accessory equipment.

The efficiency of modern boilers is extremely high, approaching 90% for large boilers with heat conservation devices. In small–capacity boilers, where the heat–absorption surface is often inadequate, efficiency is lower. In modern domestic boilers fired by gas or oil, efficiencies are about 75%.

Notes:
bagasse – выжимки, жом, жмых

Comprehension Check

6. Decide which statements are true and which ones are false.
1. A modern boiler generally consists of a circuit of metal tubes which is placed and arranged to present a maximum surface to a heat source, usually a combustion chamber.

2. Intermediate–size boilers are designed to match the demands of domestic heating systems.
3. Compact units are also required to produce steam for industrial use as a process–energy source.
4. Many space–heating systems utilize steam as a heat–circulation medium, but some systems are designed to use hot water as a medium.
5. The energy for most boilers is provided by the combustion of wood, oil, and gas.
6. The most important part of a boiler is the area where water absorbs energy to become steam.
7. In water–tube boilers the water is passed through metal tubes, which are heated either by convection and conduction from the hot combustion gases or by direct radiation from the fire.
8. All modern boilers are under complete automatic control.

7. Complete the following sentences by adding the phrases given in part B.

Part A.

1. Boilers range in size and function from the compact units in domestic heating systems to 20–story complexes…
2. A wide range of intermediate–size boilers are designed to match the demands of steam engines…
3. Other fuels such as wood, waste gases from industrial processes, and solid wastes such as…
4. Fire–tube boilers are limited to relatively low operating…
5. All boilers must be provided with equipment such as…

Part B

A. … bagasse (from sugarcane), sawdust, and even trash and garbage serve as energy sources to a limited extent.
B. ... pressures because of the difficulty of constructing a shell strong enough to with stand the high pressure required for efficient operation.
C. ... that drive giant steam turbines for electrical power production.
D. ... safety valves, water level controls, indicating gauges, and provision for rapid cutoff of fuel combustion and accessory equipment.

E.... and steam turbines in stationary, marine, and locomotive applications.

8. Answer the questions on the text.

1. What is a boiler?
2. Where is fuel burned?
3. What integrated complex may be called a boiler, a steam plant, or a steam generator?
4. What do boilers range in?
5. What are boilers designed and required to?
6. What is utilized as a heat–circulation medium in space–heating systems?
8. The energy for most boilers is provided by the combustion of wood, waste gases and solid wastes such as bagasse , sawdust, and even trash, isn't it?
9. What is the most important part of any boiler?
10. How do water–tube boilers function?
11. Why are fire–tube boilers limited to relatively low operating pressures?
12. What kind of boilers are preferable for domestic and small industrial heating systems?
13. What equipment all boilers must be provided with?

Language Focus

9. Translate the following pairs of derivatives.

V – N	present – to present
to apply – application	air – to air
to combust – combustion	water – to water
to produce – production	place – to place
to circulate – circulation	design – to design
to convect – convection	control – to control
to conduct – conduction	function – to function
to radiate – radiation	power – to power
to operate – operation	size – to size

to install – installation to provide – provision to absorb – absorbtion **N – V** heat – to heat demand – to demand use – to use convert – to convert	process – to process waste – to waste part – to part transfer – to transfer end – to end pass – to pass limit – to limit manufacture – to manufacture

10. Transform as in the models.

Model 1 «Verb – Noun»: to transport the energy – the transportation of energy

to apply force, to combust fossil fuels, to produce power, to circulate air, to convert water, to conduct light, to convect heat, to operate a boiler, to construct a shell, to install a unit, to absorb moisture

Model 2 «Noun – Noun»: the transportation of energy – energy transportation

11. Choose the right word or word–combination.

1. The boiler tubes, combustion chamber, and associated fuel, …, water, and exhaust systems are designed and controlled as an integrated complex.
a) air b)gas c) steam
2. Hot–water heating systems are equipped with special boilers that heat water to high temperatures but maintain sufficient … to keep it from vaporizing.
a) tension b) compression c) pressure
3.…is the major fuel, but most boilers are readily convertible from one fuel to another.
a) oil b) coal c) gas
4. The most important part of any boiler is the…, the area where water absorbs enough energy to become steam
a) exhaust system b) heat–transfer surface c) heat–circulation medium

5. … consist of a cylindrical shell with flat ends in which the water is contained and through which the tubes pass.

a) bent–tube boilers b) water–tube boilers c) fire–tube boilers

6. The efficiency of modern boilers is extremely high, approaching … for large boilers with heat conservation devices.

a) 90% b) 40% c) 70%

12. Insert the appropriate words.

a) *water–tube boilers* ***b)*** *a combustion chamber* ***c)*** *tubes*
d) *a pressure vessel* ***e)*** *efficiency* ***f)*** *heating systems*

1. Boiler is ... in which water is converted to steam by the application of heat.
2. Fuel is usually burned in ....
3. Most modern boilers are ...boilers.
4. In some small modern plants, the combustion gases are passed through ... that are immersed in the water.
5. Small fire–tube units are still manufactured, chiefly for domestic and small industrial ....
6. In small–capacity boilers, where the heat–absorption surface is often inadequate, ... is lower.

13. Fill in the words listed below.

Assignment I

a) *to install* ***b)*** *space* ***c)*** *heating* ***d)****speed* ***e)*** *separate* ***f)*** *heater*

Types of Boilers for Home Heating

Combi boilers provide – 1 – and hot water directly from the boiler. A combi boiler is both a high–efficiency water – 2 – and a central heating boiler, combined (hence the name) in one. You do not need a – 3 – hot water cylinder. You don't have to wait for the hot water to heat up in the cylinder. A combi boiler is also very suited if you have limited – 4 – in the property. Hot water also comes through your hot water tap at the same – 5 – as your cold water. It also takes less time – 6 – ! The water is heated on demand instead of storing hot water which can sometimes be wasted.

Assignment II

a) expansion cistern b) cold water c) a boiler d) radiators
e) system f) pump

Types of Boilers for Home Heating

Regular boilers heat your central heating – 1 – directly and produce hot water for your cylinder. The system includes – 2 – , controls and a hot water cylinder which is normally supplied by a cold water storage cistern located in your loft space. The system also has a feed and– 3 – in the loft. The water from the tanks in the loft sends – 4 – down to the cylinder which is normally located in the airing cupboard. The condensing boiler will heat the water in the cylinder and your – 5 – will circulate the hot water around the pipes and in turn heat the – 6 – The system will also have an electric immersion for backup.

Notes:
cistern – цистерна, бак; ёмкость, резервуар
loft – чердак
airing cupboard – сушилка, сушильный шкаф
backup – резервное оборудование
immersion – погружение

Summarizing

14. What parts of the text can you define? Name each part.

1. ________________ 3. ________________
2. ________________ 4. ________________

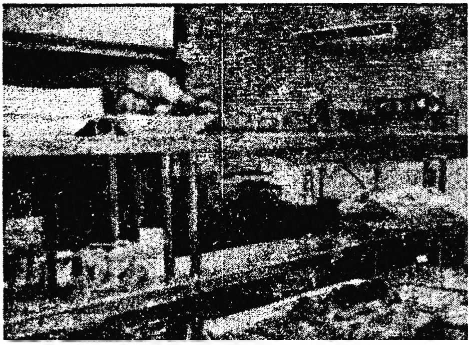
15. Find key words and phrases which best express the general meaning of each part.

16. Make a short summary of the text. Do it according to the following plan.

1. The title of the text is ...
2. The text is devoted to ...
3. The main idea of the text is ...
4. It consists of ...
5. The first part is about...
6. The second (third, fourth, etc.) part deals with ...
7. The conclusion is that...

17. Read the following text and answer the questions below.

Text B. Split Air Conditioning



A ductless, split air conditioner system or mini splits have numerous potential applications in residential, commercial, and institutional buildings. The most common applications are in multifamily housing or as retrofit add–ons to houses with "non–ducted" cooling or heating systems. Split air conditioners can also be a good choice for room additions and small apartments, where extending or installing distribution ductwork for a central air conditioner or heating systems is not feasible.

The main advantages of split AC installations are their small size and flexibility for zoning individual rooms. A split air conditioner can have many indoor air handling units or zones connected to one outdoor unit. The number depends on how much heating or cooling is required for the building or each zone. Since each of the zones will have it's own thermostat, you only need to condition that area when someone is there. This will save energy and money.

Since they are ductless, split air conditioners are also often easier to install than other types of space conditioning systems. For example, the hook–up between the outdoor and indoor units generally requires only a three inch hole through a wall for the conduit. Also, if necessary, you can locate the outdoor unit as far away as 50 feet from the indoor evaporator. This makes it possible to cool rooms on the front side of a building with the compressor in a more advantageous or inconspicuous place in the back of the building.

Since split air conditioners have no ducts, they avoid the energy losses associated with ductwork of central forced air systems. Duct losses can account for more than 30% of energy consumption for space conditioning, especially if the ducts are in an unconditioned space such as an attic.

In comparison to other add–on systems, split AC systems offer more flexibility in interior design options. The indoor air handlers can be suspended from a ceiling, mounted flush into a drop ceiling, or hung on a wall. Floor–standing models are also available. Most indoor split AC units have profiles of about seven inches deep and usually come with sleek, high–tech–looking jackets.

The primary disadvantage of split air conditioners is a bit higher initial cost per ton of cooling capacity. However this small extra investment will be offset many times over by utility bills that can be 30% to 40% less, year after year, due to much lower transmission loses. It will also be offset by the savings generated by eliminating all duct work, and by the health advantages of the higher quality air you breath.

Notes:
retrofit – модифицированная, модернизированная
add–on – добавление, дополнение
hook-up – соединение, сцепление
sleek – ровный, гладкий; глянцевый, блестящий (о поверхности)

1. What application do split air conditioner systems have?
2. What are the main advantages of split AC installations?
3. Why are split air conditioners often easier to install?
4. How much of energy consumption can duct losses account for space conditioning?

5. What do split AC systems offer in interior design options in comparison to other add–on systems?
6. What is the primary disadvantage of split air conditioners?

18. Read the following text and speak on heat pump and where it is used. Render the text in Russian.

Text C. Heat Pump

Heat pump is a term for a type of air conditioner in which the refrigeration cycle is able to be reversed, producing heat instead of cold in the indoor environment. They are also commonly referred to, and marketed as, a reverse cycle air conditioner. Using an air conditioner in this way to produce heat is significantly more efficient than electric resistance heating. Some homeowners elect to have a heat pump system installed, which is actually simply a central air conditioner with heat pump functionality (the refrigeration cycle is reversed in the winter). When the heat pump is enabled, the indoor evaporator coil switches roles and becomes the condensor coil, producing heat. The outdoor condensor unit also switches roles to serve as the evaporator, and produces cold air (colder than the ambient outdoor air).

Heat pumps are more popular in milder winter climates where the temperature is frequently in the range of 40–55°F (4–13°C), because heat pumps become inefficient in more extreme cold. This is due to the problem of the outdoor unit's coil forming ice, which blocks air flow over the coil. To compensate for this, the heat pump system must temporarily switch back into the regular air conditioning mode to switch the outdoor evaporator coil back to being the condensor coil so that it can heat up and de–ice. A heat pump system therefore will have a form of electric resistance heating in the indoor air path that is activated only in this mode in order to compensate for the temporary air conditioning, which would otherwise generate undesirable cold air in the winter. The icing problem becomes much more prevalent with lower outdoor temperatures, so heat pumps are commonly installed in tandem with a more conventional form of heating, such as a natural gas or oil furnace, which is used instead of the heat pump during harsher winter temperatures. In this case, the heat pump is used efficiently during the milder temperatures, and the system is switched to the conventional heat source when the outdoor temperature is lower.

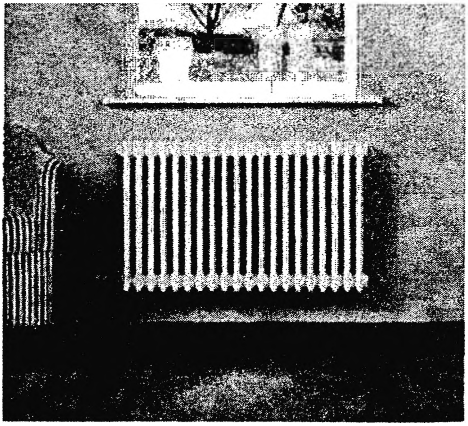
Some more expensive window air conditioning units have the heat pump function. However, a window unit that has a "heat" selection is not necessarily a heat pump because some units use electric resistance heat when heating is desired. A unit that has true heat pump functionality will be indicated in its literature by the term "heat pump".

19. Skim over the following text and name the main types of home radiators.

Text D. Types of Home Radiators

There are several types of home radiators on the market today giving home owners different options when it comes to heating the home. Radiators come in various sizes, shapes and are made from different materials. Home radiators have been around for many years and have evolved from the big ugly radiators of the past into a more elegant, efficient and cost effective way of heating your home.

Traditional Radiators



Traditional home radiators are often found in older homes and are somewhat big and bulky and are made from cast iron. The traditional radiator served homes for many generations the best thing about them is they do maintain a even heating surface and don't have hot or cold spots that is associated with forced air heated radiators. Most of the older traditional home radiators can be painted with a heat resistant paint to make them fit into the homes decor.

Towel Radiators

Towel radiators are smaller radiators that are electric operated and operate at a lower temperature than other models of home radiators. Having a towel radiator installed in a bathroom or a small room or hallway is the perfect way to add warmth to a small room without taking up all the space as other radiator units. Some of the advantages of towel radiators is the low heat and decorative look of the towel radiator. With the low heat emitted from the towel radiator you can dry wet towels or more delicate clothing without damaging them by the heat. Imagine having a warmed towel or bathrobe to use after getting out of the bath or shower. Towel radiators are smaller, decorative and cost efficient making them a great option for home heating.

Designer Home Radiators

Designer home radiators are becoming more popular today. This type of radiator is usually made from aluminum because of its ability to heat faster and the ability to make it in a limitless amount of designs. Designer home radiators can be found in styles like coat and hat racks, towel racks, benches and can even be made to resemble natural looking stone. Designer home radiators are more costly but the possibilities are endless.

There are a total of six different types of home heating radiators. The six types are: steam, cast iron, hot water, heat convectors, electric convectors, and baseboard heaters.

Follow up activities

20. Read the texts A and B and make notes under the following headings. Then use your notes and the illustrations to talk on the topics

1. Types of Boilers.
2. Split Air Conditioning.

SECTION II. SUPPLEMENTARY READING MATERIAL

UNIT I
HVAC SYSTEMS. HEATING

Text 1.

Heating

The desire for warmth and comfort may well have motivated man's first use of a fire. The earliest evidence shows that man used wood and charcoal in open fires to produce warmth, as well as to prepare food, in his cave or shelter. Such simple open fires were used as late as the 19th century by American Indians, who built fires in their huts and tepees, which had openings to allow the smoke to escape. A different method was devised by 300 b. c. by Europeans who built crude fireplaces with connecting chimneys; with this arrangement, combustion efficiency and room ventilation were much improved. By the first century b. c, the Romans had developed the hypocaust, which provided a better way to heat a room. The hypocaust was a basement with a low arched–vault furnace made of brick or stone. The hot air from the furnace passed through tile flues in the walls of the room above the furnace, heating the room. After the fall of Rome, the hypocaust went into disuse.

In America during colonial days the fireplace was the heart of the house. The chimney often was a massive structure built of field stones, adobe, or bricks. Some chimneys had several fireplace openings at different levels for the various rooms in the house.

In many regions the fireplace and chimney arrangement for heating rooms remained in use for thousands of years. It still is used in some areas.

Stoves. Records and artifacts show that clay stoves were used in Europe during Roman times. The early Chinese used stoves to heat bricks, which were then used to heat beds in other rooms of the house. In the American colonies, Benjamin Franklin invented the iron Franklin stove in 1743; it gained a reputation of high efficiency.

The use of stoves provided a new way to heat rooms. The fire was contained in a combustion chamber usually made of ceramic or iron sections. It heated the stove wall, which in turn heated the room, mainly by convection of the room air over the hot surface. Previously, the fireplace provided only the radiant heat of the fire, and most of the heating value of the fuel was lost in the hot combustion gases passing up the chimney. Space–heating stoves were first designed to burn wood or charcoal but were later adapted to burn coal or oil as these fuels became available.

Central Heating. As technology advanced, individual room stoves were superseded by central heating for the entire building. In this arrangement a furnace or a boiler is located in a basement or some other isolated area, and steam, hot water, or hot air is transported to the rooms of the buildings by pipes or ducts. As a result of the heating unit being in an isolated location, there was a great improvement in comfort, convenience, and cleanliness in the home.

The steam boiler was developed for the steam engine in England during the 18th century, but engineers soon learned to adapt it for central steam heating systems. For instance, central steam heating was installed in the Parliament building in England during that period. Steam heating systems are particularly suitable for l% 3TA serving large public buildings because large quantities of heat can be carried long distances by small pipes.

In the 20th century the adaptation of circulating fans and pumps to heating systems made possible the forced air and hot–water systems now in widespread use in central–heating systems for homes and other buildings Fuels. Improvements in systems for handling and burning fuels also were important developments. Coal was the predominant fuel for many years, but its use drastically declined in favor of gas and oil. Modern heating systems, whether installed in the largest skyscraper or the smallest house, normally provide draft–free and even–temperature heat, quiet and clean operation, and automatic performance at a reasonable cost with a minimum of service. These systems are often combined with summer air cooling and other air conditioning functions.

Text 2.

Heat as a Form of Energy

Because all of the many forms of energy, including heat, can be converted into work, amounts of energy are expressed in units of work, such as joules, foot–ponds, kilowatt–hours, or calories. Exact relationships exist between the amounts of heat added to or removed from a body and the magnitude of the effects on the state of the body. The two units of heat most commonly used are the calorie and the British thermal unit (BTU). The calorie (or gram–calorie) is the amount of energy required to raise the temperature of one gram of water from 14.5 to 15.5 C; the BTU is the amount of energy required to raise the temperature of one pound of water from 63 to 64 F. One BTU is approximately 252 calories. Both definitions specify that the temperature changes are to be measured at a constant pressure of one atmosphere, because the amounts of energy involved depend in part on pressure. The calorie used in measuring the energy content of foods is the large calorie, or kilogram–calorie, equal to 1,000 gram–calories.

In general, the amount of energy required to raise a unit mass of a substance through a specified temperature interval is called the heat capacity, or the **specific heat**, of that substance. The quantity of energy necessary to raise the temperature of a body one degree varies depending upon the restraints imposed. If heat is added to a gas confined at constant volume, the amount of heat needed to cause a one–degree temperature rise is less than if the heat is added to the same gas free to expand (as in a cylinder fitted with a movable piston) and so do work. In the first case, all the energy goes into raising the temperature of the gas, but in the second case, the energy not only contributes to the temperature increase of the gas but also provides the energy the piston. Consequently, the specific heat of a substance depends on these conditions.

The **latent heat**, also called the heat of vaporization, is the amount of energy necessary to change a liquid to a vapour at constant temperature and pressure. The energy required to melt a solid to a liquid is called the **heat of fusion**, and the heat of sublimation is the energy necessary to change a solid directly to a vapour, these changes also taking place under conditions of constant temperature and pressure.

Air is a mixture of gases and water vapour, and it is possible for the water present in the air to change phase; i.e. it may become liquid (rain) or solid (snow) .To distinguish between the energy associated with the phase change (the latent heat) and the energy required for a temperature change, the concept of **sensible heat** was introduced. In a mixture of water, vapour and air, the sensible heat is the energy necessary to produce a particular temperature change excluding any energy required for a phase change.

Text 3.

Heat Transfer

Heat, a form of kinetic energy, is transferred in three ways: conduction, convection, and radiation.

Conduction. Heat conduction involves the transfer of heat from one molecule to an adjacent one as an inelastic impact in the case of fluids, as oscillations in solid nonconductors of electricity, and as motions of electrons in conducting solids such as metals. Heat flows by conduction through the brick wall of a furnace, through the wall of a house, or through the wall of a cooking utensil.

The conductivities of materials vary widely. Any material which has a low conductivity may be considered to be an insulator. Solids which have a large conductivity may be used as insulators if they are distributed in the form of granules or powder, as fibers, or as a foam. Mineral wool, glass fiber, diatomaceous earth, glass foam, corkboard and magnesia are all examples of such materials.

Convection. Heat convection involves the transfer of heat by the mixing of molecules of a fluid with the body of the fluid after they have either gained or lost heat by intimate contact with a hot or cold surface.

Most of the heat supplied to a room from a steam or hot–water radiator is transferred by convection. In fact, the heat from the fire in the furnace heating the hot water or steam is transferred to the boiler wall by convection, and the hot water or steam transfers heat from the boiler to the radiator by convection.

Radiation. Solid material, regardless of temperature, emits radiations in all directions. These radiations may be, to varying degrees, absorbed, reflected, or transmitted.

The radiations from solids form a continuous spectrum of considerable width, increasing in intensity from a minimum at a short wavelength through a maximum and then decreasing to a minimum at a long wavelength. This process is quite apparent in the filament of a light bulb. When the bulb is operated at less than normal voltage, the light appears quite red. As the voltage is increased, the filament temperature increases and the light progressively appears more blue.

Liquids and gases only partially absorb or emit these radiations. Many liquids, especially organic liquids, have selective absorption bands in the infrared and ultraviolet regions.

Transfer of energy by radiation is unique in that no conducting substance is necessary, as with conduction and convection. It is this unique property that makes possible the transfer of large amounts of energy from the Sun to the Earth, or the transfer of heat from a radiant heater in the home.

Text 4.

Alternative Heating

The sharp rise in interest for alternative heating methods would suggest that we have reached that point. With systems such as solar heating, geothermal heating and alternative stoves becoming more affordable and available, many are turning away from fossil fuels, and toward healthier, more dependable energy sources.

Solar heating system can be either passive or active. Passive solar heating relies in building design to collect and hold sunlight. Passive solar homes large, south–facing windows and thermal mass surfaces.(где сказуемое?) Thermal mass is an absorptive material such as tile, concrete, or even water, which collects and stores heat for later use. The thermal mass can be incorporated into flooring or walls. Active solar heating systems consist of solar collectors, heat pumps, exchangers, storage tanks, and controls to gather, transfer, and disburse heat throughout a home, like in a parabolic solar steam boiler, for instance. Active systems rely on electricity to move the gathered heat from the solar collector through the home. Both alternative heating methods use a completely renewable source (the sun) to provide warm air and hot water to homes.

Geothermal residential heating systems use the Earth's heat as a source of warmth for homes. Because the temperature of the Earth remains constant just below the surface, underground piping can be installed with a fluid to absorb the heat. The fluid is then pumped into the home where a heat exchanger extracts the warmth, and a fan then distributes the heat throughout the home. This alternative heating method is extremely quiet, safe, and very efficient. Existing ductwork can be used, making this an ideal system to retrofit into any home.

Alternative stoves using corn, wood, and wood pellets have recently seen a huge rise in popularity as people seek alternative heating methods that can support local industry and that aren't imported from abroad. Although many people install these stoves to supplement existing conventional heaters, often the alternative stove provides enough heat for the entire home. Many of these stoves are direct vent systems, meaning that no additional venting system or chimney is needed. One major advantage that alternative stoves offer is convenience. Because they range in size and capacity, a stove can be found to fit in most rooms of any home. The fuel is easily stored, and the stoves are effortlessly controlled with thermostats.

Text 5.

Passive Solar Heating

With appropriate calculations, passive solar heating can be a cost effective way of heating a home or other building. In most locations, the amount of solar energy that the roof of a home receives is greater than the amount of energy needed to keep it warm.

In passive solar heating, the heating and cooling system is integrated into the building materials and elements. Windows, floors, and even the walls and roof are used to collect, store, release, and distribute heat. These same elements also work in passive solar cooling. It's important to understand that passive solar design doesn't necessarily mean that standard mechanical systems have to be eliminated. Recent designs that couple passive solar heating with high efficiency back up heating systems have been able to reduce greatly the size of the traditional heating systems required. This means that the amount of nonrenewable fuel required to maintain a comfortable temperature indoors can be reduced significantly.

To use passive solar heating in a home, two elements have to be present. These are: a transparent southern exposure that allows energy from the sun to enter the home, and a material that allows heat to be stored and released later. These two basic elements allow a number of different approaches to passive solar design to be used.

Direct gain is the simplest of approaches to passive solar heating. Sunlight comes in through south facing glass, and is almost entirely converted to thermal energy. Usually, the walls and floors are used for thermal storage and solar collection by directly encountering sunlight, and by absorbing reflected energy. As long as the temperature in the room stays high, heat will be conducted into the centre of the thermal mass. As soon as the temperatures drop, the heat flow is reversed.

Indirect gain uses basic elements of heat storage and collection in combination with convection. This approach places storage materials between the sun and the interior habitable space. This means that there is no direct heating. The heat is transferred between one side of the thermal storage wall to the other.

Isolated gain uses a fluid, such as liquid or air, to collect heat in what is referred to as a flat plate solar collector, which is attached to the structure. Heat is then transferred by natural convection through pipes or ducts, and collected in a storage area, such as a bin or tank. The cooler air or water is then displaced, and forced back to the collector to become warm again.

UNIT II
HEATING SYSTEMS

Text 1.

Heating Systems

Atmosphere–control systems in low–rise residential buildings use natural gas, fuel oil, or electric resistance coils as central heat sources; usually the heat generated is distributed to the occupied spaces by a fluid medium, either air or water. Electric resistance coils are also used to heat living spaces directly with radiant energy. Forced–air distribution moves the heat–bearing air through a treelike system of galvanized sheet–metal ducts of round or rectangular cross section; electric–powered fans provide a pressure differential to push the air from the heat source (or furnace) to the living spaces, where it is expelled from grills located in the walls or floors. The negative pressure side of the fan is connected to another treelike system of return air ducts that extract air from living spaces through grills and bring it back to the furnace for reheating. Fresh outside air can be introduced into the system airstream from an exterior intake, and odour–laden interior air can be expelled through a vent, providing ventilation, usually at the rate of about one complete air change per hour. To conserve energy, air–to–air heat exchangers can be used in the exhaust–intake process. The heated air is usually supplied in constant volume, and the ambient temperature is varied in response to a thermostat located in one room. Central humidity control is rarely provided in this building type.

Another common heating system is the radiant hot–water type. The heat source is applied to a small boiler, in which water is heated and from which it is circulated by an electric pump in insulated copper pipes similar to a domestic hot–water system. The pipes can be connected to cast–iron or finned tube steel radiators within the living spaces. The radiators are placed near the areas of greatest heat loss (such as windows or outside walls) where their radiant energy heats the surrounding air and creates a convection cycle within the room, producing a roughly uniform temperature within it. The hot water can also be conducted through narrow pipes placed in a continuous looping pattern to create a large radiant surface; this pattern of pipes may be cast in a concrete floor slab or placed above a ceiling to heat the adjoining living space. Temperature control in hot–water systems uses a thermostat in the living space to adjust the pumped flow rate of the water to vary the heat supplied.

Radiant electric resistance heating systems use coils in baseboard units in the rooms, which create convection cycles similar to hot–water radiators, or resistance cables in continuous looped patterns embedded in plaster ceilings. Local temperature control can be much more precise with electric heating, because it is possible to install a thermostatically controlled rheostat to vary the energy output of relatively small sections of baseboard units or cable.

A type of space heating that is increasing in use in residential buildings is passive solar radiation. On sunny winter days, south–facing windows let in substantial amounts of energy, often enough to heat the entire building. Wood–burning fireplaces with chimneys are still widely provided in residential buildings, but their use is mostly for aesthetic effect.

Text 2.

Warm–Air Systems

Warm–air systems are direct descendants of the primitive space heating stoves, differing from them only in the much more effective way that heat is transferred from the hot surface and transported throughout a building.

Early warm-air systems delivered air to and from rooms by gravity circulation in large ducts connected to the furnace in the basement. Since the only force producing circulation was that due to the small difference in density between the hot supply air and the cold return air, a satisfactory volume of air could be moved only by providing very large air ducts and registers and heating the air to a high temperature. The result was a very bulky system that produced hot air at the ceilings and cold air on the floor.

Forced Warm-Air System. In the 1940's the forced-circulation, warm–air system was developed. It uses a quiet centrifugal blower to force large quantities of air through long runs of small–diameter ducts.

Many forced warm-air systems are now designed to provide year–around air conditioning simply by including a cooling coil in the supply air plenum chamber. This versatility largely accounts for the great popularity of the forced warm–air system.

The operation and control of the forced warm–air system are simple and reliable. A room thermostat in a representative spot in the house calls for heat by actuating a relay that in turn opens a gas valve or starts an oil burner. After the air in the plenum "chamber warms up, a thermostat in the furnace starts the blower. The air continues to heat up until it reaches its operating temperature, at which time the furnace thermostat shuts off the fuel burner while the blower continues to circulate warm air. When the air has cooled, the furnace thermostat restarts the fuel burner. This shutoff and restart cycle continues until the room thermostat is satisfied. The room thermostat then opens the relay, and the fuel burner is inactivated beyond the control of the furnace thermostat. The blower continues to run until the air becomes so cool that it may produce uncomfortable drafts in the rooms. At this point (called the low limit shutoff) the furnace thermostat shuts off the blower. The furnace thermostat also has a high limit shutoff, set at from 200° to 250°F (93° to 121 °C), that inactivates the burner when there is an operating control failure or some other emergency. With these automatic controls the forced warm–air system can be adjusted to operate with no objectionable temperature fluctuations in the home.

A deluxe warm–air system provides heating control for different zones, or areas, of a house. In this system there is a thermostat for each zone. Each thermostat controls a motor–driven valve that regulates the warm–air delivery to each zone, thereby providing independent temperature control in each zone.

Text 3

Hot-Water Heating Systems

The early hot-water heating systems depended on gravity action for the circulation of the water, and hence were referred to as gravity hot-water systems. The heated supply water in the boiler was less dense than the cooler water in the radiators; the resulting small difference in density was sufficient to cause a flow of water through relatively large pipes. In normal operation a continuous circulation of water was maintained, and the temperature of the hot water leaving the boiler was increased as the outdoor temperature decreased. This increase in water temperature caused a larger flow of hot water to take place. In essence, therefore, a well-designed gravity hot-water system provided a continuous transfer of heat through the radiators, and modulated the heat input to the room to meet the varying demands of the weather.

In spite of good performance features, the gravity-circulation system has become largely outmoded and replaced by the force-circulation system, which utilizes a pump to move the water through the pipes. The addition of a pump provided more efficient circulation of water at higher velocities so that smaller pipes could be used. Changes in radiator styles also occurred; the large, ornate, and conspicuous radiators that protruded into the room were replaced by radiators that were less conspicuous but just as effective as heat–transfer surfaces. During the 1930's, large column-type radiators were replaced by small-tube radiators, which were low in height (19 to 25 inches) and were often recessed into a wall to conserve space. Still later, convectors were developed which provided a metal shield in front of the radiator to increase the flow of room air over the heat-transfer surfaces. About 1940 the baseboard radiator was developed which greatly increased the comfort produced by the hot–water system, as well as the aesthetics of the system. The baseboard units (of cast iron or copper) provided a complete curtain of rising air currents along the entire exposed walls of a room, and these rising currents tended to counteract the descending currents of chilled air from cold wall and window surfaces. In general, whether the heat–transfer medium consisted of baseboard radiators, convectors, or tubular radiators, the location of the unit was practically always along the outside wall and preferably below the windows.

Text 4.

Steam Heating Systems

Among the first central heating systems to be developed were steam heating systems. The early systems consisted of a single large pipe leading from the boiler to a number of metal radiators in the space to be heated. These radiators were heat–transfer devices in which the entering steam condensed inside the radiator into liquid water, and while doing so transmitted heat to the room air. The single pipe not only supplied steam to the radiator, but also returned the condensate (condensed steam) to the boiler. Steam flow took place in one direction and condensate flow took place in the reverse direction. Installation of these one–pipe systems was complicated by the necessity to slope the pipes toward the boiler to assure the flow of condensate back to the boiler. A smoothly operating system was required, however, to prevent the steam flowing over the returning condensate picking up the water and slamming it against elbows to produce "hammering" or "knocking." In later developments, the two–pipe system came into use, in which one pipe supplied steam to the radiators, and a second pipe collected the condensate from the radiators and returned it to the boiler.

The simple one–pipe steam system was not successful in regulating the heat output of the radiators to match changing outdoor weather conditions, so that wide fluctuations in room temperatures occurred. This was caused by the inability to throttle the radiator valve and permit varying amounts of steam to enter the radiator. The valve could only be maintained fully open or fully closed; any intermediate opening of the valve prevented the condensate from leaving the radiator, so that the radiator became filled with cool water.

The two–pipe system, with separate supply and return piping, alleviated this problem of lack of modulated heat output. In this system the amount of steam could be controlled by adjusting the radiator valve so that more or less steam entered the radiator. Each radiator was equipped with a steam trap that permitted the condensate, but not the steam, to flow out of the radiator. Other refinements to the basic two–pipe system, such as the addition of a vacuum pump to return the condensate to the boiler, allowed more economical operation as well as more continuous heat input to the radiators. Steam systems are still widely used in large buildings. Steam can be readily carried over long distances, usually in insulated pipes located in tunnels or mains, without undergoing a change in temperature. In this respect steam has advantages over hot water or warm air, since the latter two mediums undergo decreases in temperature as they are transmitted over long distances. In the case of steam, the temperature remains unchanged, but a portion of the steam condenses as it is carried through a long main and must be drained to a return line and returned to the boiler. Steam systems are not as commonly used in small buildings as in years past, primarily because of developments in hot–water and warm–air systems.

Text 5.

Electric Floor Heating Systems

Electric floor heating systems have very low installation cost for smaller spaces (1–5 rooms) because they are easy to install and have a very low start–up cost (a thermostat is all that is required and costs only about $100–$200). Although electric floor heating systems work well as a primary heat source, most systems are installed in the bathroom to add comfort and warmth to cold tile.

Electric floor heating systems are also typically installed in kitchens, bathrooms or in rooms that require additional heat (such as a cold basement, an addition or a kids' playroom). Rooms can be zoned with their own thermostat and programmed around the schedule of the inhabitant, this can add efficiency to an entire homes energy consumption.

Another advantage of electric underfloor heating over a warm–water system is the floor build up/height. Floor build up can be as little as 1 mm. The electric cables are usually installed onto an insulation board or directly onto the subfloor or padding (under carpet or laminate); then the floor covering is placed directly over the heating system or thinset.

Electric underfloor heating also benefits from faster installation times, with a typical installation only taking half day to a day depending on size to install. Also warm up times are generally a lot quicker than "wet" systems because the cables are installed directly below the finished flooring making it a direct acting heat source rather than a storage heater.

Electric systems are supplied in several different forms. They can be one long continuous length of cable with the consumer having to weave the cable up and down the floor at a pre–determined spacing and making a return loop to complete the circuit, or they can be provided in mat form, where the heating element is pre–formed in a mat that rolls out onto the floor. Most high voltage cables have a built in return, meaning that you have one end to connect. Most technologies consist of a loop with a start and end. With the introduction of the built in return came the "cable mat". Cable mats have added to the ease of installing a floor heating system by having the heating cable already pre–spaced on to a nylon mesh. Cable mats however can cause issues for odd shaped spaces where a free rolled cable may be able to cover in a more custom pattern.

One technique is to lay the heating cable directly onto an insulated concrete floor and then apply tile on top of it. Where time–of–use electricity metering is available, this type of system can be turned on at night when electricity rates are low, and then allowed to warm the house during the day by relying on the heat energy held within the thermal mass of the concrete.

Sometimes, in order to minimize floor buildup, a bronze screen or a carbon film heating element is used. Carbon film systems are normally installed onto a thin insulation underlay (approx 6mm) to reduce thermal loss to the sub–floor. Carbon film is used under various floor finishes, traditionally laminate flooring or engineered wood. Vinyls, carpets and other "soft" floor finishes can be heated using carbon film elements or bronze screen elements, provided a suitable overboarding system is used.

In comparison to combustion/hydronic systems, electric systems can be more efficient, if only the efficiency of the equipment in the building is considered. However, the efficiency of generating electricity from fossil fuels is low. Electric systems however are either on or off and do not require idling times. Electric systems also have the advantage of needing no maintenance and can more easily be controlled to run when and where they are needed. However, electric underfloor heating systems cannot provide cooling in summer.

Text 6.

Selection of a Home Heating System

Many factors should be considered before one selects the type of heating system and fuel for the home. There are considerable variances in fuel availability, comparative costs, and the competence of contractors in installing the equipment. These factors may dictate a decision independent of any theoretical comparisons.

In most regions a warm-air system has the lowest purchase and installation cost, an electric heating system ranks second, and a hydronic system has the highest purchase and installation cost. The efficiency in using an energy source is about 80% for gas, slightly lower for oil, and close to 100% for electricity.

Comparative fuel and electric costs are important, but these are not always conclusive factors. Quantity discounts for use of fuel and electricity must be determined. Also, concurrent energy uses, such as domestic water heating, cooking, clothes drying, and electric lighting, affect overall rates and total costs. In general, the seasonal operating cost for warm-air and hydronic systems using gas as the fuel is about the same as the cost of systems using oil as the fuel. The seasonal operating cost of electric systems is higher than that for systems using gas or oil.

All types of modern heating systems warm-air, hydronic, and electric are capable of supplying highly satisfactory heating performance when properly designed and installed. Conversely, any system can be disappointing when it is improperly designed or installed.

Future Trends. The future development of home heating systems will be affected by the continuing availability of gas and oil, the future cost of electric energy, and the development of new heating techniques.

Public awareness of the evils of air pollution will certainly have an effect on the future design and use of heating systems using coal, gas, or oil as the fuel. There may be a more widespread use of high-intensity radiant heaters because of their instant response and their ability to heat objects directly. The heat pump seems to have an assured place for the future because of its ability to provide both heating and summer air conditioning and to use electricity effectively. A more spectacular development might come from the thermoelectric heat pump, which is an all-electric device that works on the same principle as the thermocouple.

Solar heating is technically possible but economically unacceptable in most regions. Solar energy collectors are too large, too expensive, and possibly too displeasing as' a part of house architecture. With regard to the use of atomic energy for space heating, it appears likely that atomic energy applications will be limited to large central stations for the production of electric power, which in turn could be used for home heating.

UNIT III
AIR CONDITIONING AND VENTILATING

Text 1.

Cooling Systems

The cooling of atmospheres in low–rise residential buildings is often done locally with unit air conditioners, which penetrate the exterior wall of the space to be cooled; this permits the intake of fresh air when desired and the ejection of heat pumped from the space to the exterior air. Less often, forced–air heating systems have cooling coils introduced into the airstream to provide a centrally cooled interior. A compressive cooling process is used, similar to that in a domestic refrigerator. A refrigerant, which is a liquid at room temperature, is pumped through a closed system of coiled copper tubes. An electric pump maintains a low pressure in the cooling coils, and the liquid refrigerant passes through an expansion valve from a region of high pressure to the low–pressure coils. This change in pressure results in a phase change of the refrigerant; it turns from a liquid into a gas and absorbs heat in the process, just as water absorbs heat when it is boiled and converted into steam. The heat absorption of the liquid–to–gas transition cools air passing over the cooling coils. The cooled air is circulated through the building by the forced–air system. When the low–pressure gaseous refrigerant leaves the cooling coils, it goes through the pump and is pressurized. The refrigerant travels through condensing coils, which are located outside the building; there the phase change is reversed as the gas turns to a high–pressure liquid and liberates heat to the exterior air passing over the condensing coils. The liquid refrigerant returns to the expansion valve to repeat the cooling cycle. The refrigeration machine is thus a "heat pump" that moves heat out of the building to the exterior atmosphere. Heat pumps can also be run in reverse in the winter months to pump heat from the outside air into the building interior; they work best in mild climates with fairly warm winter temperatures. The use of heat pumps in cold climates poses many difficult technological problems.

Interior atmospheres are also ventilated by operating windows, as well as by unintended leakage at all types of exterior openings. Bathrooms, kitchens, and laundries generate odours and heat and often have separate exhaust systems powered by electric fans that are operated intermittently as required. Residential atmosphere quality is also protected by the smoke detector, which sounds an alarm to warn of possible danger when smoke reaches even a very low level in living spaces.

Text 2.

Ventilation

Ventilation is the process of supplying or removing air, by natural or mechanical means, to or from any space.

The ventilation of buildings was originally advocated for the purpose of removing from the air such impurities as the products of human respiration and perspiration and the gaseous products of combustion.

Before 1920, the carbon dioxide ($C0_2$) content of air was considered as the most reliable index for determining its purity, and a maximum limit was set at 10 parts of $C0_2$ per 10,000 parts of air on a volume basis. In fact, ventilation rates for public buildings were established in which the maximum permissible CO_2 content was limited to 7 parts per 10,000.

A distinction must be clearly made between the ventilation requirements for carbon monoxide (CO) and those for CO_2. Carbon monoxide is deadly to animal life, and where continuous exposure to the gas is necessary, as in garages, vehicular tunnels, and mines, the concentration must not exceed 1 part in 10,000.

Methods for ventilating a building may be divided into ***mechanical/forced*** and ***natural*** types.

Natural Ventilation.—Natural ventilation is the ventilation of a building with outside air without the use of a fan or other mechanical system. The simplest form of ventilation results from the action of wind, which builds a positive pressure on the windward side of a building and reduces the pressure on the leeward side. Wind action is variable, both in magnitude and direction, so that the resulting ventilation is not controllable. A second cause of natural ventilation is referred to as "chimney action. A building is similar to a chimney, since cool air will flow in at openings near the lower level and out through openings near the roof. Ventilation by chimney action may be accomplished on calm days, but the effect again, is variable.

Mechanical Ventilation.—Ventilation by wind or chimney action is not only capricious but frequently insufficient. For this reason, mechanical ventilation by means of a fan is often introduced.

Centrifugal and Propeller Fans.—The two most common types of fans are the propeller type and the centrifugal type. Desk and window fans are common examples of propeller fans, which are capable of moving large airflow rates against relatively low resistance. The centrifugal fan can move air against a high resistance, such as that imposed by ductwork and filters. Exhaust fans are commonly of the propeller type, since air is discharged directly to the outdoors against small resistance. Supply and exhaust fans connected to a duct system are usually of the centrifugal type.

Text 3.

Air Conditioning

Air conditioning is the technique of regulating the condition of air in order to provide a comfortable environment for man or a favorable environment for making industrial products. Air conditioning usually involves control of four physical properties of air; its temperature; its relative humidity; its motion, or circulation; and the dust particles in it.

The central cooling system commonly is¯ divided into two units; one unit is inside the home, and the other unit is located outdoors. The internal unit consists of a filter, a fan, and a cooling coil. The filter and fan are part of the heating system. Only the cooling coil has to be added. It usually is placed in the bonnet above the furnace. A drain pan to collect condensation and a drain line also need to be installed.

The external unit consists of a motor–driven compressor, a fan for the condenser, and a condenser. These components are in a cabinet that is mounted outdoors. Originally, water–cooled condensers were common, but many communities have restricted water use for condensers.

Most home cooling systems provide humidity reduction but only rather limited humidity control. The reduction in moisture content depends on the length of compressor operation. For example, on a hot day when the compressor operates continuously for several hours, the indoor humidity can reach a low value of about 40 percent. However, as soon as the compressor stops operating, the water drops on the cooling coil tend to evaporate. The jump in indoor humidity during the off period of the compressor may be much faster than the decrease of humidity during the on period, and large fluctuations in humidity can occur during the day. This limited humidity control has been acceptable to homeowners.

In some industrial operations, humidity control may be as important as temperature control. By the addition of equipment, the circulating air is cooled below the desired temperature until the moisture content of the air is reduced to the desired value. Then the dry air is heated to the desired temperature. However, it costs more to obtain full humidity control. If humidity acceptance standards of homeowners reach higher levels, they may provide their homes with equipment for full humidity control.

Text 4.

Future Needs for Air Conditioning

Changes are taking place in the living habits of people, in the air environments of the cities, in the requirements for industrial production, and in many other facets of modern society. These changes make it necessary to give more attention to air conditioning requirements.

The outdoor air in cities will continue to contain large amounts of undesirable foreign matter, such as dust, pollen, smoke, automobile exhaust gases, chemical fumes, and odors. Extensive use of air conditioning equipment will be one factor in providing a desirable air environment for urban dwellers. With the trend toward urban living, there will be greater concentrations of people in smaller areas and more apartments. Air conditioning will help to provide a. comfortable environment in apartments.

By using air conditioning, industries can move to regions that have desirable raw materials, labor supplies, or transportation.

The demand for manufactured goods of consistent quality can be met by close control of the environment. For example, a high-speed printing press must position overlapping colors precisely on a moving sheet of paper. This operation requires close control of the humidity to avoid expansion and contraction of the paper.

Modern architecture tends to use large amounts of exposed glass and large, flat roof surfaces. These practices accentuate the building heat gains from the sun and make air conditioning more necessary. Also, as air pollution becomes more widespread, the air introduced into buildings must be treated to obtain pure air.

If year-round school operation becomes necessary to handle a larger school population, the first provision that has to be made is to cool the classrooms. If public transportation is to compete with the individual's automobile, adequate heating and cooling of public vehicles is a necessity. In spite of high costs, hospitals and nursing homes will require complete air conditioning.

Text 5.

Exhaust ventilation systems

Exhaust ventilation is required to remove odors, fumes, dust, and heat from an enclosed occupied space. Such exhaust may be of the natural variety previously described or may be mechanical by means of roof or wall exhaust fans or mechanical exhaust systems. The mechanical systems may have minimal ductwork or none at all, or may be provided with extensive ductwork which is used to collect localized hot air, gases, fumes, or dust from process operations. Where it is possible to do so, the process operations are enclosed or hooded to provide maximum collection efficiency with the minimum requirement of exhaust air.

Because of the possibilities of re-circulated or external air pollution, it is customary to remove dust and fumes where practical or where required by means of ordinary ventilation filters, more efficient washers or centrifugal collectors, or chemical scrubbers.

Where dust is conveyed in the exhaust ducts, the velocities must be adequate to lift and move the dust particles. Velocities of 3000-6000 ft/min (914-1828 m/min) are required for this purpose. Lower velocities are tenable for fume removal, but corrosion protection must be provided by selection of duct and equipment materials. The round duct is used in most dust and fume systems because of its lower friction and because of its better dust-handling characteristics.

Fans for ordinary ventilation exhaust or heat removal may be similar to supply fans. Fume and dust exhaust fans must be more rugged and are frequently of the radial-blade (paddle-wheel) type for this reason. Axial flow and conventional centrifugal fans are also used in these applications.

Text 6.

Room Air Conditioner

The lowest–cost cooling device is the room air conditioner. The indoor portion of the unit consists of an air filter, a fan, and a cooling coil. The warm, humid indoor air is drawn through the filter and into the fan. The fan blows the warm, humid air over the cooling coil, which cools and dehumidifies the air before it is blown into the room.

The cooling coil contains a refrigerant fluid. The refrigerant fluid changes from a liquid state to a gas state because heat from the warm air passing over the coil causes evaporation of the refrigerant fluid. This process takes heat from the warm, humid room air.

The outdoor portion of the unit consists of a compressor, a fan, and a condenser. The compressor receives low–temperature, low–pressure, refrigerant gas from the cooling coil. The compressor delivers high–temperature, high–pressure refrigerant gas to the condenser. The fan blows outdoor air over the condenser. Inside the condenser the high–temperature, high–pressure refrigerant gas is converted to refrigerant liquid. The cooler outdoor air passing over the condenser takes heat from the hotter refrigerant gas. This process causes the refrigerant gas to change to the liquid state. The refrigerant liquid is delivered to the cooling coil.

The refrigerant fluid constantly circulates in a closed path through the cooling coil, the compressor, and the condenser. The fan for cooling the condenser sucks in relatively cool outdoor air, passes the air over the condenser, and blows the hotter air back outdoors.

In the room air conditioner the compressor and the two fans are driven by electric motors. Smaller units use 110–volt–line supplies, and larger units use 220–volt–line supplies. Some room air conditioners have sufficient capacity to cool an entire small residence.

Text 7.

Heat-Recovery Ventilator

A heat-recovery ventilator (HRV) is similar to a balanced ventilation system, except it uses the heat in the outgoing stale air to warm up the fresh air. A typical unit features two fans—one to take out household air and the other to bring in fresh air. What makes an HRV unique is the heat–exchange core. The core transfers heat from the outgoing stream to the incoming stream in the same way that the radiator in your car transfers heat from the engine's coolant to the outside air. It's composed of a series of narrow alternating passages through which incoming and outgoing airstreams flow. As the streams move through, heat is transferred from the warm side of each passage to the cold, while the airstreams never mix.

Depending on the model, HRVs can recover up to 85 percent of the heat in the outgoing airstream, making these ventilators a lot easier on your budget than opening a few windows. And, an HRV contains filters that keep particulates such as pollen or dust from entering the house.

Although an HRV can be effective in the summer months, when it will take heat from incoming fresh air and transfer it to stale air–conditioned exhaust air, it's most popular in colder climates during the winter.

If the temperature falls below about 20Â° F, however, frost can build up inside the exchange core. To handle this, a damper closes off the cold airstream and routes warm air through the core. After several minutes, a timer opens the fresh–air port and ventilation continues.

A typical HRV for residential use might move as much as 200 cfm of air, but the fan speed can be set to suit the air quality in the home. For example, a slow to medium fan speed may be adequate for normal living, while a house full of guests might require the highest setting. Controls are available for intermittent and remote operation.

HRVs are ideal for tight, moisture–prone homes because they replace the humid air with dry, fresh air. In climates with excessive outdoor humidity, an energy–recovery ventilator is more suitable. This device is similar to an HRV, but dehumidifies the incoming fresh air stream.

UNIT IV
HVAC EQUIPMENT

Text 1.

Types of Boilers

Non-condensing Gas Boilers. Residential gas boilers today are required to have an annual fuel utilization efficiency (AFUE) rating of at least 80 percent. Manufacturers have improved efficiency levels in a variety of ways, including the following:

Elimination of continuous pilot lights. Most boilers on the market today use some form of intermittent ignition device, usually electronic ignition.

Improved insulation levels. Because boilers store more heat internally than warm air furnaces do, they are subject to greater heat losses, both through their casing (sides) and up the chimney when they are not in use. New boilers have much better insulation to keep the water hot.

Better draft control methods to reduce flue losses. Many boilers use draft hoods, located downstream of the boiler. These draw household air into the gas vent along with the flue gases and stabilize the airflow through the appliance, isolating the burner from outside pressure fluctuations. But they also continuously draw heat from the boiler and warm household air up the chimney. A vent damper is usually installed downstream of the draft hood to close off the exhaust when the burner is not operating. When the gas burner turns off, the damper is closed automatically after a short period; it opens again before the burner lights again.

Boilers that use aspirating gas burners have eliminated the need for a draft hood entirely by using a powered exhaust system, usually incorporating an induced draft fan. These units have no dilution air ;high resistance to spillage during the on cycle ;minimal flow up the stack during the off cycle.

Many of today's gas boilers have replaced the naturally aspirating gas burner with a power burner. These use a fan on the burner to improve the combustion process, which helps develop and maintain an adequate draft. Like the burners used in advanced oil-fired equipment, they tend to have a high-pressure restriction or even close off the combustion air passage when the burner is not operating. This minimizes off-cycle heat losses without requiring a flue damper. Such units minimize dilution air or have sealed combustion, and have performance characteristics similar to or better than aspirating burners with a powered exhaust system.

Condensing Gas Boilers. Condensing gas boilers use either an aspirating burner with an induced draft fan or a power burner. They also have an additional heat exchanger made of corrosion-resistant materials (usually stainless steel). It extracts latent heat remaining in the combustion products by condensing before the products are exhausted. Because a chimney is not needed, installation costs are reduced. The flue gas temperature is low enough for the gases to be vented through a PVC or ABS plastic pipe out the side wall of the house.

A condensing boiler can have an AFUE rating of 90 percent or higher. But in practice, condensing boilers in hydronic (hot water) heating systems can have difficulty achieving this efficiency. For the condensing boiler's heat exchanger to extract all the heat effectively, the system has to run with the lowest possible return water temperatures, preferably not exceeding 45°C – 50°C (113°F– 122°F). Unfortunately, most radiator systems are designed to operate at significantly higher return water temperatures. This makes it difficult for the flue gas to condense. If the return water temperature is too high, actual operating efficiency may be only slightly higher than that of the better models of non-condensing boilers.

For a condensing boiler to achieve its potential, the heating system must be designed to return water to the boiler below the temperature of the condensing flue gas. Residential applications that operate at low return water temperatures include radiant floor heating or pool water heating.

Text 2.

Heat Pump

A heat pump is a machine or device that effectively "moves" thermal energy from one location called the "source," which is at a lower temperature, to another location called the "sink" or "heat sink", which is at a higher temperature. An air conditioner is a particular type of heat pump, but the class includes many other types of devices. During the operation, some of the thermal energy must be transformed to another type of energy in the process, before reappearing as thermal energy in the sink.

The heat pump uses mechanical work, or some source of thermodynamic work (such as much higher–temperature heat source dissipating heat to lower temperatures) to accomplish the desired transfer of thermal energy from source to sink. In the classical thermodynamic sense, a heat pump does not actually move heat, which by definition cannot flow from cold to hot temperatures. However, since the effect of the device in moving thermal energy is the same as if heat were flowing (albeit in the incorrect direction with regard to temperature difference), the "heat pump" is named by analogy.

A heat pump always moves thermal energy in the opposite direction from temperature, but a heat pump that maintains a thermally conditioned–space can be used to provide either heating or cooling, depending upon whether the environment is cooler or warmer than the conditioned–space. When pumps are used to provide heating, they are used because less input from a commercial–energy source is required than is required for newly–creating thermal energy by transforming heat–free sources of energy (for example, electricity) or low–entropy sources of energy (for example, a gas flame) directly into the required heating. This is because the heat pump utilizes some thermal energy from the environment for part of the delivered–heating, increasing the "efficiency" of the process. In cooler climates, it is common for heat pumps to be designed only to provide heating.

Even when a heat pump is used for heating, it still uses the same basic refrigeration cycle to do the job (merely changing operation so that the warm end of the device is inside). Rather than physically turn the device around, a reversible–cycle heat pump simply operates in a way that changes which coil is the condenser, and which the evaporator. This is normally achieved by a "reversing valve." Common examples of non–reversible (unidirectional) heat pumps are air conditioners, food refrigerators, and freezers. Reversible–cycle heat pumps are often seen in providing building–space heating in high latitude climates that are much warmer than comfortable in one season, but colder in another season. In heating, ventilation, and air conditioning (HVAC) applications, the term heat pump normally refers to a vapor–compression refrigeration device that includes a reversing valve and optimized heat exchangers so that the direction of thermal energy flow may be changed without loss of efficiency. Most commonly, when used in heating, heat pumps draw heat from the air or from the ground

Text 3.

Geothermal Heat Pump

A geothermal heat pump, ground source heat pump (GSHP), or ground heat pump is a central heating and/or cooling system that pumps heat to or from the ground.

It uses the earth as a heat source (in the winter) or a heat sink (in the summer). This design takes advantage of the moderate temperatures in the ground to boost efficiency and reduce the operational costs of heating and cooling systems, and may be combined with solar heating to form a geosolar system with even greater efficiency. Ground source heat pumps are also known as "geothermal heat pumps" although, strictly, the heat does not come from the centre of the Earth, but from the Sun. They are also known by other names, including geoexchange, earth-coupled, earth energy systems. The engineering and scientific communities prefer the terms "geoexchange" or "ground source heat pumps" to avoid confusion with traditional geothermal power, which uses a high temperature heat source to generate electricity. Ground source heat pumps harvest heat absorbed at the Earth's surface from solar temperature at that latitude at the surface.

Depending on latitude, the temperature beneath the upper 6 metres (20 ft) of Earth's surface maintains a nearly constant temperature between 10 and 16 °C (50 and 60 °F), if the temperature is undisturbed by the presence of a heat pump. Like a refrigerator or air conditioner, these systems use a heat pump to force the transfer of heat from the ground. Heat pumps can transfer heat from a cool space to a warm space, against the natural direction of flow, or they can enhance the natural flow of heat from a warm area to a cool one. The core of the heat pump is a loop of refrigerant pumped through a vapor-compression refrigeration cycle that moves heat. Air-source heat pumps are typically more efficient at heating than pure electric heaters, even when extracting heat from cold winter air, although efficiencies begin dropping significantly as outside air temperatures drop below 5 °C (41 °F). A ground source heat pump exchanges heat with the ground. This is much more energy-efficient because underground temperatures are more stable than air temperatures through the year. Seasonal variations drop off with depth and disappear below 7 metres (23 ft) due to thermal inertia . Like a cave , the shallow ground temperature is warmer than the air above during the winter and cooler than the air in the summer. A ground source heat pump extracts ground heat in the winter (for heating) and transfers heat back into the ground in the summer (for cooling). Some systems are designed to operate in one mode only, heating or cooling, depending on climate.

The geothermal pump systems reach fairly high Coefficient of performance (CoP), 3-6, on the coldest of winter nights, compared to 1.75-2.5 for air-source heat pumps on cool days. Ground source heat pumps (GSHPs) are among the most energy efficient technologies for providing HVAC and water heating . Actual CoP of a geothermal system which includes the power required to circulate the fluid through the underground tubes can be lower than 2.5. The setup costs are higher than for conventional systems, but the difference is usually returned in energy savings in 3 to 10 years. System life is estimated at 25 years for inside components and 50+ years for the ground loop. As of 2004, there are over a million units installed worldwide providing 12 GW of thermal capacity, with an annual growth rate of 10%.energy. The temperature in the ground below 6 metres (20 ft) is roughly equal to the mean annual air.

Text 4.

Types of Water Heaters

A water heater uses a heating source to raise the temperature of incoming cold water from a municipal main or well. The heated water is stored in a tank and distributed on demand to showers, bathtubs, sinks and other water–using equipment in the home. Several types of water heaters are available: storage tank water heaters; tankless water heaters; integrated space/water heating systems; solar water heaters; heat pump water heaters.

Storage tank water heaters are by far the most common type. These systems heat and store water in a tank so that hot water is available to the home at any time. As hot water is drawn from the top of the tank, cold water enters the bottom of the tank and is heated. The heating source can be electricity, gas or oil. More efficient storage tank water heaters can perform as much as 40 percent better than conventional models. An energy–efficient model will typically have one or more of the following features: extra tank insulation for better heat retention and less standby loss; a better heat exchanger to transfer more heat from the energy source to the water; factory–installed heat traps, which allow water to flow into the tank but prevent unwanted flow of hot water out of the tank.

Tankless Water Heater. These systems do not have a storage tank. They heat water only when it is needed, thus avoiding standby heat loss through tank walls and water pipes. The most basic units consist of either an electric element or a gas burner surrounded by flowing water. Tankless water heaters are usually installed to serve a specific need near the point of use, such as under a kitchen sink. Depending on overall water usage, they may not have the capacity to supply an entire home with hot water. For this reason, they are often used as booster heaters to supplement another water heating system. A relatively new tankless technology – the low–mass water heater – is capable of supplying much more hot water to the home. These systems are typically gas–fired with electronic ignition and power exhaust. This makes them more efficient than conventional tankless heaters. They can be connected to an external storage tank if necessary.

Integrated space/water heating systems combine the household heating requirement with the household hot water needs, saving money on total system installation. A single boiler is used, requiring only one combustion burner and one vent. Often these systems employ an insulated external storage tank with a high–efficiency low–mass boiler to heat the water, which then passes through a fan coil (as in a car radiator). The system then blows the heat around the house in a warm air distribution system, like a conventional furnace. For integrated systems that do not use high efficiency boilers, the initial cost saving is soon eliminated by very low seasonal efficiency. The heater is sized to produce enough heat to warm a house on the coldest winter day. However, in the spring, summer and fall, when no heating is required, the same heater heats domestic hot water only. The effect is an oversized water heater that operates for several months of the year with a low heating demand – and low efficiency, as a result. One type of integrated system that has been around for many years, particularly in the Maritime provinces, is a fuel–fired hot water boiler with a tankless coil water heater that uses a heat exchanger in the boiler to heat tap water but without a separate storage tank. The water flows through a coil inside the boiler whenever a hot water faucet is turned on. The drawback is that this system is dramatically less efficient in warmer months, when space heating is not required, as the boiler water must be kept hot all the time.

Solar water heaters use the sun's energy to heat water. Active solar systems, on the other hand, use pumps and controls to move the heated water from the collector to the storage tank. In areas where the temperature drops below freezing, the fluid in the collectors is usually antifreeze, which is then run through a heat exchanger to heat the household water. Solar systems can supply up to 50 percent of the energy needed to heat water for an average household. Since energy from the sun is free, solar water heaters can significantly reduce a household's water heating costs – savings that in turn can offset the higher purchase and installation costs of a solar system.

Text 5.

Types of Electric Heaters

An **electric heater** is an electrical appliance that converts electrical energy into heat. The heating element inside every electric heater is simply an electrical resistor, and works on the principle of Joule heating : an electric current through a resistor converts electrical energy into heat energy. Most modern electric heating devices use Nichrome wire as the active element. The heating element depicted on the right uses Nichrome wire supported by heat resistant, refractory, electrically insulating ceramic.

Radiative heaters contain a heating element that reaches a high temperature. The element is usually packaged inside a glass envelope resembling a light bulb and with a reflector to direct the energy output away from the body of the heater. The element emits infrared radiation that travels through air or space until it hits an absorbing surface, where it is partially converted to heat and partially reflected. This heat directly warms people and objects in the room, rather than warming the air. This style of heater is particularly useful in areas which unheated air flows through. They are also ideal for basements and garages where spot heating is desired. More generally, they are an excellent choice for task-specific heating.

Radiative heaters operate silently and present the greatest potential danger to ignite nearby furnishings due to the focused intensity of their output and lack of overheat protection. In the United Kingdom, these appliances are sometimes called electric fires, because they were originally used to replace open fires.

The active medium of the heater depicted at the right is a coil of Nichrome resistance wire inside a fused silica tube, open to the atmosphere at the ends, although models exist where the fused silica is sealed at the ends and the resistance alloy is not Nichrome.

In a **convection heater**, the heating element heats the air in contact with it by thermal conduction . Hot air is less dense than cool air, so it rises due to buoyancy , allowing more cool air to flow in to take its place. This sets up a convection current of hot air that rises from the heater, heats up the surrounding space, cools and then repeats the cycle. These heaters are sometimes filled with oil, which functions as an effective heat reservoir . They are ideally suited for heating a closed space. They operate silently and have a lower risk of ignition hazard in the event that they make unintended contact with furnishings compared to radiant electric heaters. This is a good choice for long periods of time or if left unattended.

Text 6.

Refrigeration Air Conditioning Equipment

Refrigeration air conditioning equipment usually reduces the humidity of the air processed by the system. The relatively cold (**below the dewpoint**) evaporator coil condenses water vapor from the processed air, (much like an ice–cold drink will condense water on the outside of a glass), sending the water to a drain and removing water vapor from the cooled space and lowering the relative humidity.

A specific type of air conditioner that is used only for dehumidifying is called a dehumidifier. A dehumidifier is different from a regular air **conditioner** that both the evaporator and condensor coils are placed in the same air path, and the entire unit is placed in the environment that is intended to be conditioned (in this ease dehumidified), rather than requiring the condensor coil to be outdoors, Having the condensor coil in the same air path as the evaporator coil produces warm, dehumidified air. The evaporator (cold) coil is placed first in the air path, dehumidifying the air exactly as a regular air conditioner does. The air next passes over the condensor coil re–warming the now dehumidified air. Note that the terms "condensor coil" and "evaporator coil" do not refer to the behavior of water in the air as it passes over each coil; instead they refer to the phases of the refrigeration cycle. Having the condensor coil in the main air path rather than in a separate, outdoor air path (as in a regular air conditioner) results in two consequences—the output air is warm rather than cold, and the unit is able to be placed anywhere in the environment to be conditioned, without a need to have the condensor outdoors.

Unlike a regular air conditioner, a dehumidifier will actually heat a room just as an electric heater that draws the same amount of power (watts) as the dehumidifier. A regular air conditioner transfers energy out of the room by means of the condensor coil, which is outside the room (outdoors). This is a thermodynamic system where the room serves as the system and energy is transferred out of the system.

Conversely with a dehumidifier, no energy is transferred out of the thermodynamic system (room) because the air conditioning unit (dehumidifier) is entirely inside the room. Therefore all of the power consumed by the dehumidifier is energy that is input into the thermodynamic system (the room), and remains in the room (as heat). In addition, if the condensed water has been removed from the room, the amount of heat needed to boil that water has been added to the room. This is the inverse of adding water to the room with an evaporative cooler.

Dehumidifiers are commonly used in cold, damp climates to prevent mold growth indoors, especially in basements. They are also sometimes used in hot, humid climates for comfort because they reduce the humidity which causes discomfort (just as a regular air conditioner, but without cooling the room).

Text 7.

Portable Air Conditioners

A portable air conditioner is one on wheels that can be easily transported inside a home or office. They are currently available with capacities of about 6,000 to 60,000 BTU/h (1,800 to 18,000 watts output) and with and without electric resistance heaters. Portable true air conditioners come in two forms, split and hose. Evaporative coolers, sometimes called conditioners, are also portable.

Air-cooled portable air conditioners are compressor-based refrigerant system that use air to exchange heat, in the same way as a car or typical household air conditioner. With this type of system the air is dehumidified as it is cooled. They collect water condensed from the cooled air, and produce hot air which must be vented outside of the cooled area (they transfer heat from the air in the cooled area to air which must be vented).

A split system has an indoor unit on wheels connected to an outdoor unit via flexible pipes, similar to a permanently fixed installed unit.

Hose systems, which can be **Air-to-Air** and **Monoblock,** are vented to the outside via air ducts. The "monoblock" version collects the water in a bucket or tray and stops when full. The Air-to-Air version re-evaporates the water and discharges it through the ducted hose, and can run continuously.

A single-duct unit draws air out of the room to cool its condenser, and then vents it outside. This air is replaced by hot air from outside or other rooms, thus reducing efficiency. Modern units run on approximately 1 to 3 ratio i.e., to produce 3 kW of cooling this will use 1 kW of electricity. A dual-duct unit draws air from outside to cool its condenser instead of from inside the room, and thus is more efficient than most single-duct units.

Evaporative air coolers, sometimes called swamp air conditioners, do not have a compressor or condenser. Liquid water is evaporated on the cooling fins, releasing the vapour into the cooled area. Evaporating water absorbs a significant amount of heat, the latent heat of vaporisation, cooling the air, humans and other animals use the same mechanism to cool themselves by sweating. Disadvantages are that unless ambient humidity is low (dry climate) cooling is limited and the cooled air is very humid and can feel clammy. They have the advantage of needing no hoses to vent heat outside the cooled area, making them truly portable; and they are very cheap to install and use less energy than refrigerative air conditioners.

Text 8.

Oil and Gas Burners

Oil Burners. For the purpose of burning fuel oil and converting chemical energy to heat energy, three types of oil burners have been developed for small installations. These are (1) a pressure–type oil burner consisting of an oil pump and a nozzle which sprays the oil into a vapor like mist; (2) a rotary–type burner containing a spinning cup which distributes the oil in a fine stream which is broken up into a vapor like mist by mechanical means; and (3) a vaporizing–oil burner which contains a shallow pool of oil which is vaporized by the heat of the burning process. In all cases, the liquid fuel is transformed into a mist or vapor so that the droplets of oil are brought into more intimate contact with the air necessary for combustion. Both pressure and rotary burners make use of a fan to supply a fixed amount of combustion air, and an electric spark for the purpose of igniting the oil mist at the start of each demand for burner operation. Both types do not operate continuously, but are turned on and off by automatic control devices. The vaporizing burner is usually operated continuously, but with varying rates of oil input to the burner depending on the demand for heat. The vaporizing burner usually requires a lighter grade of fuel oil with the consistency of kerosene, whereas the pressure burner and rotary burner handle a slightly heavier and usually less expensive grade of fuel oil. In all cases, trouble–free operation requires oil that is free from dirt and sludge, both of which can easily clog the small orifices of the nozzle or cause a sooty flame which rapidly causes soot accumulation inside the furnace or boiler.

Gas Burners. Gaseous fuels are readily burned since they are already in the gas state; as a result, gas burners are usually simple in construction and trouble–free in operation. A common form of gas burner for small installations is the atmospheric type, which has no moving parts other than a gas valve which is opened and closed by automatic controls to regulate the flow of gas to the burner. Part of the air for combustion is drawn into the burner through a slotted opening by the suction action of the flowing gas, the remaining air entering the flame above the burner. Ignition of the gas is provided by means of a small pilot light which burns continuously. Larger gas burners are provided with positive air delivery to the burner through the action of a fan. Prior to World War II, manufactured gas was commonly burned, but in the United States and Canada this has been almost entirely replaced by either natural gas or bottled gas (propane and butane).

Text 9.

Dehumidifier

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TOPICAL VOCABULARY

UNIT I
HVAC Systems. Heating

acceptable *adj* подходящий, допустимый
air conditioning *n* кондиционирование воздуха
air infiltration проникновение воздуха
ambient *adj* окружающий, внешний
aperture *n* отверстие, скважина, щель
avoid *v* избегать
building permit разрешение на строительство
building service коммунальные услуги
carbon monoxide окись углерода
check *n* контроль, проверка; *v* контролировать, проверять; adj контрольный, проверочный
chimney *n* дымоход, вытяжная труба
code-compliance соответствие правилам, инструкции
condition *n* условие
constantly *adv* непрерывно, постоянно
conversion *n* преобразование
convey *v* передавать
comfort *n* комфорт
commission *v* вводить в эксплуатацию, запускать
compressor *n* компрессор
correctly *adv* верно, правильно
deliver *v* вырабатывать, производить, снабжать, поставлять, доставлять
description *n* описание, характеристика
design *n* конструирование; *v* конструировать
determine *v* определять, устанавливать
directly *adv* непосредственно
direct heating прямой нагрев
distributor *n* распределитель, распределительное устройство
ductwork *n* система труб(воздуховодов), трубопровод
duty *n* служебные обязанности
eliminate *v* освобождать, устранять
enclosed *adj* закрытый, защищённый

encourage *v* поощрять, поддерживать
ensure *v* обеспечивать, гарантировать
enterprise *n* предприятие
estimate *n* оценка, смета; *v* оценивать
evaporator *n* испаритель
experience *n* опыт; *v* испытывать
facility *n* средство, устройство, приспособление, оборудование, сооружение, комплекс
fan *n* вентилятор; *v* вентилировать
fireplace *n* камин
flue *n* вытяжная труба, воздуховод
fluid medium *n* текучая среда
frequent *adj* частый, часто встречающийся, повторяющийся, обычный
hazardous *adj* опасный, рискованный
heating *n* отопление
high efficiency высокая эффективность, высокий коэффициент полезного действия, высокая производительность
HVAC system система нагревания, вентиляции и кондиционирования воздуха
heating contractor подрядчик по отоплению
humidity *n* влажность
identify *v* идентифицировать, распознавать, опознавать
indirect heating косвенный нагрев
initialism *n* аббревиатура
inspection *n* осмотр, проверка
install *v* устанавливать, монтировать, собирать, размещать, располагать
installation *n* установка
integrate *v* составлять целое, объединять
interrelate *v* взаимодействовать
iron stove железная печь
leak *n* просачивание; *v* просачиваться
living space жилая площадь
maintain *v* эксплуатировать, обслуживать
maintenance costs эксплуатационные расходы
manufacturer *n* изготовитель, производитель
mechanical engineering машиностроение

normally *adv* нормально, обычно
occasionally *adv* периодически
occupant *n* житель, обитатель, жилец
pipe *n* труба, трубопровод
placement *n* установка, расположение, помещение, размещение
plumbing *n* водопровод, водопроводно-канализационная сеть
reasonable *adj* приемлемый
refrigerant *n* хладагент, охлаждающее средство
refrigeration *n* охлаждение
repair *n* ремонт; *v* ремонтировать
residential *adj* жилой
responsible *adj* ответственный, надежный
run *n* работа, ход, эксплуатация; *v* работать, эксплуатировать
seek *v* пытаться, стараться,стремиться, прилагать усилия
service *n* обслуживание; *v* обслуживать
site *n* место; *v* помещать, размещать
space heater комнатный электрообогреватель, электрический камин
space *n* пространство
specialize *v* специализировать(ся), ограничивать, сужать
specify *v* устанавливать, определять
standard *n* стандарт; *adj* стандартный
thermal *adj* тепловой, термический
thermocouple *n* термоэлемент, термопара
thermodynamics *n* термодинамика
transfer *n* перемещение; *v* перемещать
trouble-shooting устранение неисправностей, неполадок
unit *n* сборочная единица, узел, блок, установка,агрегат, единица, единица измерения ; *adj* единичный,удельный секционный
ventilating *n* вентилирование
worldwide enterprise всемирное предприятие
working order рабочее состояние

UNIT II
Heating Systems

air current воздушный поток
air friction воздушное трение

air handling system система кондиционирования воздуха
arrangement *n* расположение, размещение, устройство
auxiliary *adj* вспомогательный, дополнительный, подсобный; вспомогательные устройства; вспомогательное оборудование
basement *n* подвальное помещение
baseboard unit плинтусный узел, блок, установка, агрегат
blower *n* нагнетатель, вентилятор
bulky *adj* крупногабаритный
calculate *v* вычислять
coil *n* катушка, спираль, змеевик
combustion *n* горение
condensate *n* конденсат; *v* конденсировать
conjunction *n* соединение
consist *v* состоять из
convection *n* конвекция; *adj* конвективный
convector *n* конвектор
convert *v* преобразовывать
convey *v* перемещать, транспортировать, передавать, проводить
density *n* плотность
design day расчетные сутки
diffuser *n* диффузор, распылитель
direct vent system прямая вентиляционная система
draft тяга, *v* вытягивать
draft-free бессквозняковый
ductwork *n* система каналов, система труб; трубопровод; воздуховод
electric circuit электрическая цепь
electric resistance element электрический элемент сопротивления
electric rate schedule электрическая тарифная сетка
electric wiring system электрическая проводка системы
embedded *adj* встроенный
emission *n* эмиссия
emit *v* излучать, испускать
employ *v* применять, использовать
enclosure *n* оболочка, корпус, ограждение, загороженное место; вентиляционное укрытие полностью закрытого типа; герметизированное помещение
ensure *v* обеспечивать

erect *v* устанавливать
escape *n* утечка, улетучивание
expansion *n* расширение
exposure *n* ориентация здания, помещения; ветровая, инсоляционная, шумовая экспозиция здания; длительное неблагоприятное воздействие на человека; воздействие окружающей среды
extract *n* извлечение; *v* извлекать
fan *n* вентилятор
fit *v* соответствовать
gas burner газовая горелка
gravity *n* сила тяжести, тяготение, притяжение
gravity water гравитационная вода; вода, подаваемая самотёком
heat-carrying capacity тепловая пропускная способность
heat-emitting device тепловыделяющее устройство
heat exchanger теплообменное устройство, теплообменник
heat loss тепловые потери
heating panel отопительная панель
hot-water heating водяное отопление
humidification *n* увлажнение
inlet *n* впускное отверстие
offset *v* сдвигать, смещать, ответвляться, отходить от чего-л.
outlet *n* выпускное отверстие
panel heating панельное отопление
passive solar heating пассивное солнечное отопление
peak loads пиковые нагрузки
radiator *n* радиатор; батарея
refrigeration machinery холодильное оборудование
register *n* задвижка, заслонка, регулирующий клапан
release *n* освобождение, выброс, выпуск; *v* освобождать, отпускать, выбрасывать, выпускать
retrofit *v* модифицировать, настраивать
solar collector солнечный коллектор
solar steam boiler солнечный паровой котел
source *n* источник
south-facing windows обращенные к югу окна

specification *n* спецификация, технические условия, технические требования; характеристика, техническая характеристика, техническое описание
steam *n* пар
store *n* запас, резервный склад, накопитель; *v* складировать, хранить, запасать; *adj* запасной
storage tank резервуар, расширительный бак
supplement *n* дополнение; *v* добавлять
temperature fluctuation колебания температуры
thermal mass surface тепловая поверхность массы
transparent *adj* светопроницаемый, прозрачный
transport medium среда, способ передачи
unit heater конвектор, отопительный прибор
upward *adj* направленный вверх, восходящий
warm air system воздушная система отопления

UNIT III
Air Conditioning and Ventilating

absorb *v* поглощать; впитывать
adjust *v* налаживать, регулировать
air volume объем воздуха
air washer *n* воздухоочиститель
airborne *adj* воздушно-капельный
appliance *n* приспособление, устройство
back drafting обратная тяга
blow *n* продувка; обдувка; *v* дуть, обдувать
built-up system сборная система
chilled *adj* охлаждённый
circulation *n* циркуляция, круговорот
circumstance *n* обстоятельство, положение дел
complex *n* система; *adj* комбинированный
condense *v* конденсировать
condenser *n* конденсатор
convey *v* транспортировать, подавать, перемещать
cooling охлаждение; охлаждающий
core *n* остов, каркас, ядро, сердцевина, сердечник, стержень
damper *n* задвижка; воздушный клапан, увлажнитель

dehydration *n* дегидратация
deliver *v* вырабатывать, производить, снабжать, питать, поставлять, доставлять
depressurize *v* вызывать падение давления
devise *n* изобретение ; *v* изобретать
dew point *n* температура таяния, температура конденсации
dissipate *v* рассеивать, разгонять, сбрасывать давление
drain *n* водоотвод; *v* осушать
draw *n* тяга; *v* вытягивать
dual-duct (system) двойной канал (система)
electric motor *n* электродвигатель
evaporate *v* испарять
evaporation *n* испарение, парообразование
evaporator *n* испаритель
excessive *adj* чрезмерный, избыточный
exhaust *n* выхлопная труба, вытяжка; *adj* вытяжной
expel *v* удалять, вытеснять
facilitate *v* содействовать, способствовать
feed *n* питание, загрузка, подача материала, подпитка; питающее вещество (топливо, смазка); подаваемый, загрузочный материал; сырьё
field-erected system участок установки системы
fin *n* ребро, пластина
handle *v* управлять (чем-л.), справляться (с чем-л.)
heat loss тепловые потери
heat pump тепловой насос
humidification *n* увлажнение
incoming *adj* входящий, поступающий
induction *n* индукция, впуск, всасывание
infiltration *n* инфильтрация, проникновение
intentional *adj* намеренный; умышленный
intermittent *adj* перемежающийся; периодический, временный; прерывистый (поток), неустойчивый
mat *n* циновка
moisture *n* влага, влажность, увлажнённость
odor *n* запах
otherwise *adv* иначе, иным способом; иным образом; по-другому
particle *n* частица

pass *n* проход; *v* проходить
passage *n* проход, канал, отверстие
premise *n* предположение, исходное условие; предпосылка, помещение; *v* предпосылать
pressurize *v* повышать давление; герметизировать
property *n* свойство, характеристика
purity *n* чистота, степень чистоты; беспримесность
regulate *v* выверять, регулировать
remote *adj* выносной; удалённый
residence *n* жильё; дом, квартира; офис; резиденция
resident *n* постоянный житель
reverse *n* обратное движение
saturation *n* насыщение
self-contained *adj* автономный, замкнутый
space *n* полость, пространство; *adj* пространственный
spot ventilation локальная вентиляция
spray *n* аэрозоль, распылитель; *v* разбрызгивать
substitute *n* заменитель; *v* заменять
variable *adj* переменный, изменчивый
volatile *adj* кратковременный, легкий, летучий
whole-house ventilation полная вентиляция дома

UNIT IV
HVAC Equipment

accessory equipment вспомогательное оборудование
air handler устройство подачи воздуха
air handling unit аппарат для кондиционирования воздуха
apartment *n* квартира, помещение
application *n* применение, употребление
attic *n* чердак, мансарда
chiefly *adv* преимущественно, в основном, особенно
circuit *n* трубопроводное кольцо, кольцо циркуляции, цепь, контур циркуляции (в водопроводных сетях); электрическая цепь
combi boiler комбинированный котел
combustion chamber *n* камера сгорания, топочная камера
combustion *n* сжигание, горение ; *adj* горючий
conduction *n* проводимость

conduit *n* труба; трубопровод
consumption *n* потребление, расход
convert *n* преобразовывание ; *v* преобразовывать
convertible *adj* обратимый, изменяемый
cooling capacity охлаждающая способность
cut off выключение; положение "выключено"
dehumidifying осушение
demand *n* потребление, расход, требование; *v* требовать
drive turbine приводить в действие, в движение турбину
drop ceiling *n* подвесной потолок
ductless *adj* беспроточный, не имеющий выводного протока
enough *adv* довольно, достаточно
electric resistance heating отопление методом электрического сопротивления
equip *v* оборудовать, оснащать
expansion cistern расширительный бак
feasible *adj* допустимый; подходящий
fire-tube boiler огнетрубный котел
floor-standing напольный
flush *n* намыв, подъём воды; внезапный приток воды
fossil fuel *n* ископаемое топливо
functionality функциональное назначение
garbage *n* мусор, бытовые отходы
gauge *n* мера, масштаб, размер, калибр; измерительный прибор
giant *adj* гигантский
heat-absorption surface теплопоглощающая поверхность
hole *n* отверстие
hung подвешенный
immerse *v* опускать, погружать,
inconspicuous *adj* незаметный, неприметный
installation *n* монтаж; установка
intermediate-size boiler котел среднего размера
jacket *n* кожух, чехол, оболочка; *v* обшивать, обтягивать; облицовывать
low operating pressure низкое рабочее давление
maintain *v* обслуживать, содержать в исправности, эксплуатировать
marine *adj* морской

medium *n* среда, вещество, материя, материал; носитель информации; посредствующее звено; способ, средство
multifamily housing строительство многоквартирных домов
offset *n* смещение, сдвиг, отклонение, коррекция; *v* сдвигать, выносить отклонение, компенсировать, корректировать
pressure *n* давление; напор, нажим
pressure vessel сосуд высокого давления
radioactivity *n* радиоактивность
range *n* ряд, серия, линия, шкала, зона; диапазон действия, радиус действия, дальность, интервал, пределы, расстояние;
readily *adv* быстро, легко, без труда
regular boiler систематизированный котел
relatively *adv* относительно, сравнительно
reverse *n* обратное движение; *v* давать обратный ход
safety valve предохранительный клапан
sawdust *n* опилки
separate *v* отделять(ся), выделять(ся), разделять(ся); сортировать, классифицировать
shell *n* оболочка, корпус
small-capacity boiler котел небольшой мощности
solid waste *n* твердые бытовые отходы
speed *n* скорость, быстрота ; число оборотов
split air conditioner кондиционер с раздельной системой
supplant *v* вытеснить
supply *n* снабжение; *v* снабжать, подводить
trash *n* мусор
utility bill счет за коммунальные услуги
utilize *v* использовать, расходовать
vapour *n* пар
vaporizing испарение ; испарительный
waste gases *n* отработанные газы
water-tube boiler водотрубный котёл
widespread *adj* широко распространённый
withstand *v* противостоять, выдерживать
zoning зональность, зонирование

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