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FROM THE HISTORY OF ENGINEERING. REFRIGERATING PLANTS

Методичні вказівки з англійської мови
для студентів I–II курсів
напряму "Енергомашинобудування"

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CONTENT

UNIT 1

Useful language:

1. withstand – витримувати
2. tremendous – величезний
3. stress – напруга
4. motion – рух
5. into account – брати до уваги
6. satisfactory – відповідний
7. try – намагатися
8. divide – розподіляти; division – розділ, галузь
9. combustion – згорання
11. transmission – передача
12. road – шлях
13. require – вимагати, наказувати
14. strength – сила, міцність
15. deal – мати справу з …
16. assure – гарантувати

1. Read the text and complete the below.

ENGINEERING

Today machines have to withstand such tremendous stresses and to be able of such complex motions that, complicated and specialized calculations taking hundreds of factors into account are needed in the design of even quite a simple machine like a motor-car engine.

So, as engineering progresses, engineers must become ever more scientific and specialized. Today the branches of engineering are so wide that it is impossible to give a satisfactory classification. But we may try to divide it into uses. The main divisions of engineering may be listed as follows:

1. Mechanical engineering.

Steam engines; internal combustion engines; turbines (steam, gas, water); pumps; compressors; machine-tools; mechanisms.

2. Electrical engineering.

a) Power: generators; motors; transformers; transmission (power lines and so on);

b) radio, radar, television.

3. Civil engineering.

Dams; tunnels; roads; and so on.

4. Structural engineering.

The structural details of all large buildings and bridges.

5. Chemical engineering.

Any of these branches of engineering may require the special services of the following specialists: the metallurgist; the strength of materials expert; the thermodynamics of heat expert; the mechanics or machines experts; the various production engineering experts such as the engineering designer or the tool designer; the mathematician specializing in engineering problems and many more.

The engineer must also deal with the economists to assure himself that he is producing what is wanted.

2. Fill in the table.

Branch of engineering	Specialist	Object of work
1. civil engineering	civil engineer	dams, tunnels, roads ...
2. mechanical engineering		
3. electrical engineering a) b)		 a) b)
4. structural engineering		
5. chemical engineering		

3. Complete the sentences from column A with the correct ending from column B.

A	B
1. At present there are...	...more scientific and specialized.
2. It is very difficult...	...the special services of specialists from various branches.
3. The main divisions of engineering are...	...numerous branches of engineering.
4. So, engineers must become...	...complicated and specialized calculations are needed.
5. In designing even a simple machine...	...to give a satisfactory classification of these branches.
6. Thus, any branch of engineering may require...	…mechanical engineering, electrical engineering, civil engineering,
	…structural engineering and chemical engineering.

UNIT 2

Useful language:

1. sensing or feedback – зворотний зв'язок
2. decision – рішення
3. determine – визначати
4. sequence – послідовність
5. step – степс, шаг
6. convey – супроводжувати
7. check – контролювати
8. carry – проводити, передавати
9. voltage – напруга струму
10. valves – електронна лампа
11. switches – електровимикач
12. break / into – розпадатися на окремі частини

1. Read the text and answer the questions below.

INDUSTRIAL ENGINEERING AND AUTOMATION

We now use the term automation for specific techniques combined to operate automatically in a complete system. These techniques are possible because of devices, most of which have come into use in the last thirty years. They include program, action, sensing or feedback, decision, and control elements as components of a complete system.

The program elements determine what the system does and the step-by-step manner in which it works to produce the desired result. A program is a step-by-step sequence that breaks a task into its individual parts. Some steps in an industrial automation program direct other parts of the system when and how to carry out their jobs.

The action elements are those which do the actual work. They may carry or convey materials to specific places at specific times or they may perform operations on the materials. The term mechanical handling device is also used for the action elements.

Perhaps the most important part of an automated system is sensing or feedback. Sensing devices automatically check on parts of the manufacturing process such as the thickness of a sheet of steel or paper. This is called feedback because the instruments return or feed back this information to the central system control.

The decision element is used to compare what is going on in the system with what should be going on; it receives information from the sensing devices and makes decisions necessary to maintain the system correctly. If some action is necessary the decision element can give instructions or commands to the system.

The control element consists of devices to carry out the commands of the decision element. They may be many kinds of devices: valves that open or close, switches that control the flow of electricity, or regulators that change the voltage in various machines. They make the necessary corrections or adjustments to keep the system in conformity with its program.

An industrial engineer working with automated systems is part of a team. Many components of the system, such as computers, are devices so engineers and technicians are also involved. Many of the industries in which automation has proved particularly suitable – chemicals, papermaking, metals processing – involve chemical processes, so there may be chemical engineers at work too. An industrial engineer with expertise in all these fields may become a systems engineer for automation projects thereby coordinating the activities of all the members of the team.

2. Answer the following questions:

1) What kinds of devices do we use in automated systems?
2) How is the sequence of actions called?
3) With the help of what devices are people able to carry or convey materials, perform operations?

4) What tasks can systems with feedback ability be used for?

5) What kind of technical system is able to analyse the state of system?

6) What kind of technical devices does the control element consist of?

7) If technical devices are able to do all work in manufacturing process, why is the presence of humans necessary ?

3. Write down seven sentences using these word combinations:

automatic valve; continuous-process manufacturing; refining steel; computer-controlled automation; quality control to move; to assemble; to perform; to increase; to produce; to work

4. Make up five questions to the text.

How Old Is the Wheel?

Nobody knows the name of the person who invented the wheel. But it is possible to date the invention. Archaeologists found the oldest wheeled carriage in the world in Mesopotamia – it is 5,500 years old. And recently, Soviet archaeologists found parts of a wooden wheel in the Crimea, which is 4,500 years old. The expedition has found several other wheels belonging to different epochs.

UNIT 3

Useful language:

1. device – прилад
2. accomplish – виконувати
3. force – сила
4. transmit – передача, передавати
5. motion – рух, хід
6. imply – означати
7. raise – піднімати
8. prime mover – первинний двигун; power – потужність
9. receive – отримувати
10. fuel – паливо
11. effort – зусилля
12. exert – впливати, напружувати сили
13. move – рухатися
14. supply – поставляти
15. current – струм

1. Read the text and choose the best title.

MACHINES AND WORK

Defined in the simplest terms a machine is a device that uses force to accomplish something. More technically, it is a device that transmits and changes force or motion into work. This definition implies that a machine must have moving parts. A machine can be very simple, like a block and tackle to raise a heavy weight, or very complex, like a railroad locomotive or the mechanical systems used for industrial processes.

A machine receives input from an energy source and transforms it into output in the form of mechanical or electrical energy. Machines whose input is a natural source of energy are called prime movers. Natural sources of energy include wind, water, steam, and petroleum. Windmills and waterwheels are prime movers; so are the great turbines driven by water or steam that turn the generators that produce electricity; and so are internal combustion engines that use petroleum products as fuel. Electric motors are not prime movers, since an alternating current of electricity which supplies most electrical energy does not exist in nature.

Terms like work, force, and power are frequently used, in mechanical engineering, so it is necessary to define them precisely. Force is an effort that results in motion or physical change. If you use your muscles to lift a box you are exerting force on that box. The water which strikes the blades of a turbine is exerting force on those blades, thereby setting them in motion. In a technical sense work is the combination of the force and the distance through which it is exerted.

To produce work, a force must act through a distance. If you stand and hold a twenty-pound weight for any length of time, you may get very tired, but you are not doing work in an engineering sense because the force you exerted to hold up the weight was not acting through a distance. However, if you raised the weight, you would be doing work.

Power is another term used in a special technical sense in speaking of machines. It is the rate at which work is performed. In the English-speaking countries, the rate of doing work is usually given in terms of horsepower, often abbreviated hp. In the metric system power is measured in terms of watts and kilowatts.

2. Choose the title:

a) Первинні двигуни
b) Машини
c) Сила і робота
d) Енергія та її одиниці виміру

3. Choose the correct definitions to the words in the left hand column.

Machine		the rate at which work is performed.
Prime mover		a device that uses force to accomplish something.
Force	is	an effort that results in motion or physical change.
Work		a machine whose input is a natural source of energy.
Power		a combination of the force and the distance through which it is exerted.

4. Find the sentences that correspond to the text.

a) 1. If a device transmits force into motion it is called a machine.
2. If a device transmitted force into motion it would be called a machine.

b) 1. If you stand and hold weight, you are not doing work in engineering sense.
2. If you stood and held weight, you would be doing work.

c) 1. If you raised the weight, you would be doing work.
2. If you raise the weight, you are not doing work.

UNIT 4

Useful language:

1. reliability – надійність
2. requirement – вимога
3. ingenious – оригінальний
4. useless – непотрібний
5. friction – тертя
6. resistance – опір
7. comprehensive research – всеохоплююче дослідження
8. assembly – монтаж

1. Read the text.

RELIABILITY

Reliability is a basic requirement of any instrument, plant or machine. The most ingenious machine is nothing but useless unless it is reliable.

At present the main defect in any machine is the different service life of its parts. The first to break down are parts with friction, the most numerous in any machine. Until quite recently scientists differed in their explanations of why parts subject to friction break. At present scientists are engaged in research into friction and wear-and-tear resistance. The results of their comprehensive research will extend the useful life of units with friction by thirty to fifty percent as compared with what we have now.

Sufficient reliability and long service life of highly complicated automatic complexes, spaceships and assembly lines can be ensured by the high quality of their components, their accurate assembly and continuous checking while in operation, as well as by detecting faults as soon as they appear. This means that instruments are necessary for checking metal billets; all kinds of test installations and multiple switching control devices by which temperature, pressure and density in any part of a system may be inspected a number of times over a period of only one second. We need diagnostic systems and many different types of flaw detectors and sensors because, as is known, reliability is the key which opens the way to large-scale automation.

2. Find the answers to the following questions:

1. What is a basic requirement of any instrument plant or machine?
2. What is the main defect in any machine?
3. Why is the service life of different machine parts different?
4. What factors do the service life and reliability of complicated systems depend on?
5. In what ways can the quality of machine parts be inspected?

3. Make up the most available word combinations.

A	B
1. basic	a) systems
2. main	b) devices
3. different	c) installations
4. sufficient	d) faults
5. automatic	e) quality
6. high	f) complexes
7. detecting	g) reliability
8. test	h) service life
9. control	i) defect
10. diagnostic	j) requirement

UNIT 5

Useful language:

1. trend – тенденція, загальне направлення
2. unmanned – автоматичний, без втручання людини
3. raise – підвищувати
4. reliability – міцність
5. extend – продовжувати
6. certainly – безумовно
7. scale – розмір
8. suit – відповідати (вимогам)

1. Read the text and answer the questions below.

TRENDS IN THE MODERN MACHINE-BUILDING INDUSTRY

The scientific and technological progress will continue in engineering along two main headlines. Firstly, it is automation, including the creation of "unmanned" industries. Secondly, raising the reliability and extending the service life of machines.

This certainly requires new technology. The machine modules which have only begun to be made on a large scale are well suited for "unmanned" industries.

Intense work is being carried out on new robots. What we need is not merely manipulators which can take up a workpiece and pass it on, but robots which can identify objects, their position in space, etc.

We also need machines that would trace the entire process of machining. Some have been designed and are manufactured. Over the past few years this country has created new automated coal-digging complexes and machine systems, installations for the continuous casting of steel, machines for spindless spinning and shuttleless weaving, machine-tools for electrophysical and electrochemical treatment of metals, unique welding equipment, automatic rotor transfer lines and machine-tool modules for flexible industries.

New technologies and equipment have been designed for most branches of engineering.

In the shortest time possible we are to start producing new generations of machines and equipment, which would allow us to increase productivity several times and to find a way for the application of advanced technologies.

Large reserves in extending service life for machines can be found in the process of designing. Automatic design systems allow for an optimizing of the solutions in design and technology when new machines are still in the blueprint stage.

2. Answer the following questions:

1. Name the main trends in modern machine-building.
2. What does automation include?
3. In what way can automation be achieved?
4. What is the role of new technologies?
5. Give some examples of advanced methods for increasing the service life of machine parts.

3. Write out the sentences that correspond to the text.

1. There are two main trends in modern machine-building: automation and raising of the reliability of machines.
2. The creation of "unmanned" industries is included into automation.
3. Machine modules and robots are not suited for "unmanned industries".
4. Automation and raising of the reliability of machines require new technologies.
5. Advanced technologies are applied in most branches of engineering.

4. Translate the following word combinations; make up your own sentences with them.

1. to raise reliability
2. to extend the service of life
3. to increase productivity
4. to trace the process
5. to take up a workpiece
6. to identify an object

UNIT 6

Useful language:

1. cryogenics – кріогеніка (наука), техніка низьких температур
2. "ice" cold – крижаний холод
3. compared to the cold realm produced routinely – у порівнянні з областю холоду, яку одержали за шаблонною методикою
4. cryogenic temperatures – низькі температури
5. the boiling point – точка кипіння
6. a bar of lead – чушка свинцю
7. ... clinks dully – ... глухо дзвенить
8. a rubber ball – гумовий (каучуковий) м'яч
9. to drive nails – забивати цвяхи (забивать гвозди)
10. brittle – крихкий, ламкий
11. superconductive – надпровідний
12. super-fluid – надтекучий, надрідкий
13. fluid-tight – герметичний, непроникний для рідини

1. Read the text and write down the key sentences from the text.

CRYOGENICS

Electronics at Ultra-low Temperatures

Cryogenics – the science of producing and using extremely low temperatures – comes from the Greek word "kryos" meaning "icy cold". While the Greeks may have had a word for it, they didn't really know what "cold" was. The temperatures which occur in nature are red hot compared to the unbelievably cold realm now produced routinely in hundreds of laboratories around the world.

Cryogenics temperatures - frequently defined as those below – 297°F, the boiling point of liquid oxygen - interest scientists because ordinary substances whose temperature is reduced to this region take on many new properties. A bar of lead which usually clinks dully when tapped rings like a piece of fine crystal at cryogenic temperatures. You can drive nails with a cryogenically cooled banana. Steel becomes five times as strong, but so brittle it will split if struck.

Near absolute zero (about – 460°F or – 273°C) some metals lose all electrical resistance and become superconductive. A current circulating in a superconductive ring will turn around forever, even though connected to no power source, as long as the temperature is kept low enough- Furthermore, superconductive metals become diamagnetic.

Remarkable new cryogenic techniques are coming into use in many different fields. Scientists, for example, have devised a system for deep-freezing whole human blood for an indefinite period. Live cells and bacteria cultures can also be frozen and stored for years.

Another promising area is in storing and shipping food.

One of the strangest cryogenic products is "Helium II", simple helium gas cooled to within about one degree of absolute zero. Helium II refuses to obey the natural laws of liquids. It becomes what scientists call "superfluid". For example, it flows easily between two sheets of flat glass pressed together, a joint which is normally completely fluid-tight.

Scientists may soon actually see atoms with a powerful new cryogenic microscope hundreds or perhaps even thousands of times more powerful than to-day's best instruments.

Literally, dozens of other jobs have been suggested for cryogenic detectors, some being already under construction. Infrared detectors, for example, are far more sensitive when operated within a few degrees of absolute zero. Cryogenics is having a profound effect on the field of electronics.

2. Find synonyms and antonyms:

a) synonyms: really, often, usual, to reduce, enough, about, for example, device, realm, to occur frequently, common, in fact, sufficiently, for instance, completely, instrument, to decrease, circa, to happen, field

b) antonyms: high, cold, seldom, strong, near, definite; liquid, boiling-point, below 0°C, ordinary

warm, solid, far, indefinite, low, freezing point, frequently, weak, above 0 C, unusual

3. Answer the following questions

1. Where does the word cryogenics come from?
2. Why do cryogenic temperatures interest scientists?
3. At what temperature do some metal become superconductive?
4. In what fields are cryogenic temperatures used?
5. What is "Helium II"?
6. What are the properties of Helium II?
7. Have many jobs been suggested for cryogenic devices?

4. Complete the sentences A with correct ending from column B

1. Cryogenics is the science of	a) brittle it will split if struck.
2. Cryogenics temperatures are	b) of great importance in many different fields.
3. A bar of lead which usually clinks dully when tapped	c) area in storing and shipping food.
4. Steel becomes five times as strong, but	d) an efficient influence on the field of electronics.
5. Remarkable new cryogenic techniques are	e) frequently defined as those below – 297°F.
6. Cryogenics is a promising	f) producing and using extremely low temperatures.
7. Cryogenics is having	g) rings like a piece of fine crystal at cryogenic temperatures.

UNIT 7

Useful language:

1. refrigeration – охолодження, заморожування
2. the process of eliminating heat – процес відведення тепла
3. space – простір
4. evaporation temperature – температура випарювання
5. liquid – 1) рідина, 2) рідкий
6. to obtain the change – щоб досягти перетворення
7. pressure – тиск
8. to increase – збільшувати, підвищувати
9. lbs.sq.in. (pounds per square inch) – фунти на квадратний дюйм
10. °F (degrees Fahrenheit) – за шкалою Фаренгейта
11. liquid refrigerant – рідкий охолоджувач
12. evaporator – випарник

1. Read the text. Pay attention to the passive constructions.

THE PRINCIPLES OF REFRIGERATION

Refrigeration may be defined as the process of eliminating heat. If heat is eliminated from the air contained in a given space, that space becomes cooler, and its temperature lower.

Heat can always be induced to pass from one body to another colder body and the rate at which it passes will depend on the difference in temperature existing.

The evaporation temperature, i.e., boiling point, is that at which a liquid forms into a gaseous state, and no matter at what temperature this occurs; in order to bring about the change, heat must be added to the liquid. Conversely, condensation temperature is that at which a gas returns to its liquid state and, similarly, heat must be removed from it to obtain the change.

Pressure also affects the boiling point. Thus, if the pressure is increased, the boiling point is raised, and if the pressure is reduced the boiling point is lowered. As an example, water boils (or condenses) under the normal atmospheric pressure of 14.7 lbs. sq.in. at 212°F. If the pressure is increased to 100 lbs. sq. in. the boiling point is raised to 338°F.

These relationships between pressure and temperature for a refrigerant constitute one of the most important physical laws on which refrigeration itself is based. Briefly then, mechanical refrigeration is based on these laws, and the necessary heat to evaporate or boil the liquid refrigerant is obtained from the substance to be cooled. This heat must, in turn, be removed from the gas to cause it to re-liquefy or condense. A compression refrigerating machine consists of four essential parts: The Compressor; The Condenser; The Regulator; The Evaporator.

2. Write down the passive constructions from the text.

3. Find the correct definition and match the words from column A and B.

liquid	the quality of being hot; high temperature
boiling point	flatten by pressure; squeeze; press
pressure	to make up; form; compose
refrigerant	to remove or take out; get rid of
heat	turn from liquid into vapour
to compress	the unlimited three-dimensional expanse in which all material objects are located
to constitute	the continuous physical force exerted on or against an object by something in contact with it
to eliminate	the boiling point of a liquid is the temperature at which it starts to change into steam or vapour
evaporation	a substance that flows freely but is of constant volume, having a consistency like that of water or oil
space	a substance used for refrigeration

UNIT 8

1. Read the text, use the words given below.

AIR CONDITIONING SYSTEM

To supply the required amount of cooled air to each room the systems on the market are many and various. The essential differences between the system are indicated in the "family tree" shown in Fig.1.

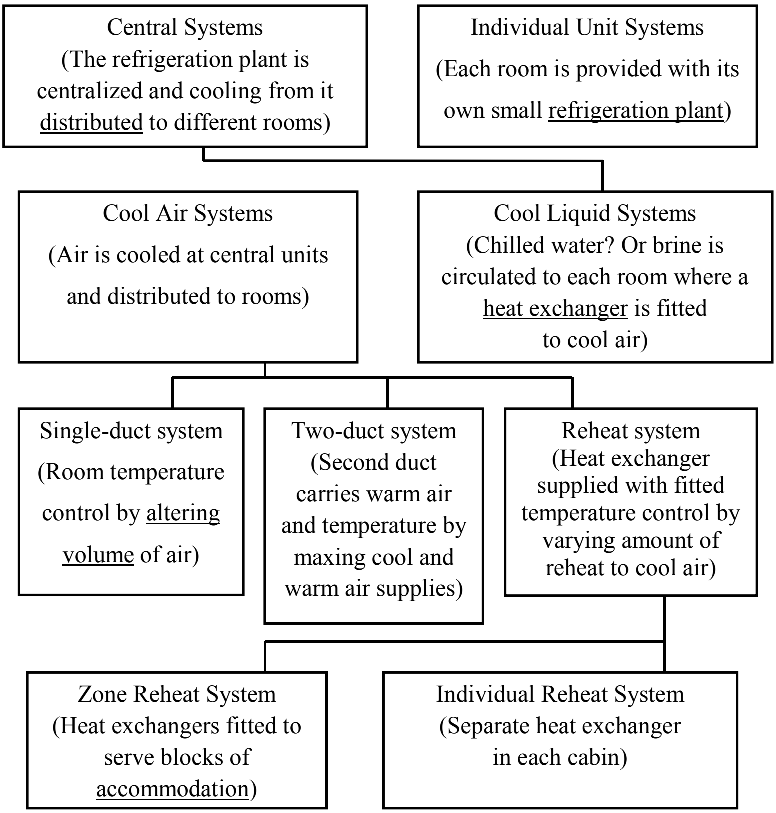


Fig.1. "Family tree" of differences between air conditioning systems

Individual unit system is the system with the lowest first cost, but with the highest maintenance costs. The units are noisy compared to other systems. The system is sometimes used for conversion of old ships to air-conditioning.

Single-duct system is the one commonly used for accommodation on cargo ships. Provided the ductwork is well designed, it can provide satisfactorily cool conditions throughout the ship. But it does not allow for the adjustment of temperature in each room.

Two-duct system is a flexible system with the merits of simplicity of equipment and absence of Plumbing, apart from at central units, but it has the obvious disadvantage of the extra ductwork in that all ducts are duplicated, cool and warm air ducts running parallel throughout the ship.

Reheat system. With this flexible system the amount of ductwork reverts to that of the single-duct system, but the refinement of temperature control obtained is paid for by having to run a not water system throughout the accommodation, and the numerous heat exchangers.

Cool liquid system. The flexibility of temperature control is the same as for reheat system. An advantage of the system is that the quantities of air hundled by the ductwork system can be less.

Useful language:

1. to supply – підводити, подавати, обладнувати (with)
2. supplies (pl) – запаси
3. essential – основний
4. to indicate – показувати
5. refrigeration plant – холодильна установка
6. unit – секція
7. to chill – охолоджувати
8. brine – соляний розчин
9. heat exchanger – теплообмінник
10. fitted control – належний контроль

11. reheat – підігрів, повторний нагрів
12. duct – труба, провід, трубопровід, канал
13. to plumb – встановлювати вертикально
14. ductwork – система труб; трубопровід

2. Find antonyms in column B to the words given in column A

A	B
1. high	a) two-duct
2. cool	b) common
3. chill	c) heat
4. advantage	d) warm
5. individual	e) quality
6. single-duct	f) block
7. unit	g) low
8. numerous	h) maintenance cost
9. quantity	i) disadvantage
10. first cost	j) not numerous

3. Give the names to the following definitions

1. Each room is provided with its own small refrigeration plant.
2. Air is cooled at central units and distributed to rooms.
3. Chilled water or brine is circulated to each room.
4. A heat exchanger is fitted to cool air.
5. The refrigeration plant is centralized and cooling from it distributed to different rooms.

4. Answer the following questions

1. Are individual unit systems noisy ones?
2. Does a single-duct systems allow for the adjustment of temperature in each room?

3. What is the disadvantage of a two-duct system?
4. What is the amount of ductwork in a reheat system?
5. What is the advantage of a cool liquid system?

UNIT 9

Useful language:

1. vapour – пара
2. gland – потовщення
3. displacement compressor – поршневий компресор
4. die cast – штампований
5. screw – гвинт
6. bush – втулка
7. twin-cylinder – двоциліндровий
8. triple-cylinder – трициліндровий
9. housing – корпус
10. hardened steel – загартована сталь
11. case – випадок
12. to lubricate – змащувати
13. spiral – спіраль
14. similar – подібний
15. splash – розбризкування
16. strainer – фільтр
17. sump – злив
18. to fit – встановлювати
19. to deposit – розміщувати
20. lo push – штовхати
21. connecting rod – шатун
22. unsuitable – невідповідний
23. stamping – штампування
24. trouble – несправність
25. to line (with) – облицьовувати
26. viscosity – в'язкість
27. crankshaft – колінчастий вал
28. flywheel – маховик

1. Read the text.

COMPRESSOR

A compressor of the refrigerating plant serves to take agent vapour from the evaporator, to compress it and deliver it to the condenser. There are different types of compressors: displacement, screw, rotary and centrifugal compressors.

The compressor may be a twin-cylinder, a triple-cylinder and multi-cylinder. In either case it is in all essential particulars, similar to the displacement type shown below.

The suction strainer is located in the square box which is cast on the rear end of the cylinder block. A magnet is fitted inside the strainer basket to assist in collecting any metallic fragments which may enter.

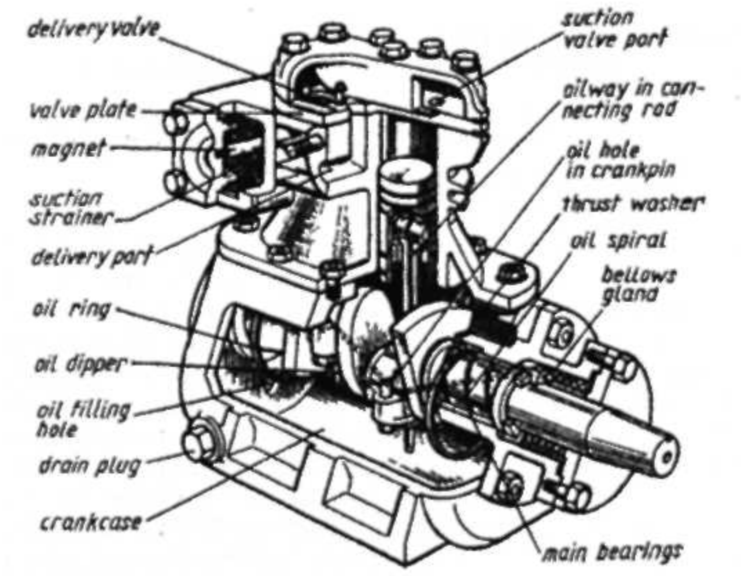
Both delivery and suction valves are mounted on the valve plate, the delivery valves on the upper side and the suction valves on the other side. The delivery port is on the side of the cylinder block.

The connecting rods are steel stampings. The bottom ends are lined with white metal. The crankshaft is carried on two main bearings housed in the crankcase at the rear end and in the gland box at the front end. These bearings are die cast white metal bushes pressed into cast iron housings.

Thrust washers are placed at the end of the crankshaft to take end thrust. They are made of special oil hardened steel.

These compressors are lubricated by means of oil supplied from the oil pump spirals on the crankshaft and by splash. The oil rings pick up the oil from the sump (crankcase) and deposit it on top of the crankshaft. As the shaft rotates this oil is pushed forward into the gland box by the front spiral and backward into the space behind the shaft by the rear spiral. From both these spaces the oil is then pushed along the passageways in the shaft shown dotted in.

On no account must ordinary engine oil be used in the crankcase. As an unsuitable oil may cause trouble, a pure mineral oil should be used.



2. Supply the proper preposition from the list: under, from, on, in, by, with, inside

1. The direction of rotation must be altered ... no circumstances. 2. These compressors are lubricated ... splash. 3. The oil rings pick up the oil ... the sump. 4. Bearings are pressed ... housings. 5. Bearings are lined ... white babbitt, 6. Ordinary engine oil must be used in the crankcase ... no account. 7. A magnet is fitted ... the strainer. 8. A magnet assists ... collecting metallic fragments. 9. The lubricating system is shown.

3. Can you answer these questions on the text?

One student asks questions, the other answers them with a short response. Test your comprehension.

Model. *What is shown in?*

The displacement compressor.

1. What is the function of the compressor? 2. Does the compressor deliver agent vapour to the condenser? 3. What types of compressors do you know? 4. Of what construction may the compressor be? 5. Where is the suction strainer located? 6. Where is the magnet fitted? And why? 7. What valves are mounted on the plate? 8. What are bottom ends of the connecting rods lined with? 9. On what bearings is the crankshaft carried? 10. For what purpose are the thrust washers placed at the end of the crankshaft? 11. By means of what are the compressors lubricated? 12. What is the function of oil rings? 13. What are the functions of front and rear spirals? 14. What is shown dotted at the diagram? 15. May an ordinary oil be used in the compressor crankcase? 16. By means of what may the compressor be driven? 17. When is a flexible coupling used? 18. What is the normal direction of rotation? 19. Will the change in direction of rotation cause serious damage? 20. Would the change of the direction of rotation stop lubrication of the working parts?

4. Speak about the compressor, its construction and principle of operation. The following plan will help you.

1. Types of compressors.
2. The main parts.
3. Lubricating system.
4. Fuel oil specification.
5. Compressor drive.

UNIT 10

Useful language:

1. whence – звідки
2. to provide – забезпечувати
3. expansion valve – розширювальний клапан
4. water heads – водяні камери
5. shell – кожух
6. to lessen – зменшувати
7. to fit – монтувати
8. cast-iron – чавун
9. to prevent – запобігати
10. cover – кришка
11. oscillations – коливання
12. danger – небезпека
13. safety valve – запобіжний клапан

1. Read the text.

CONDENSER

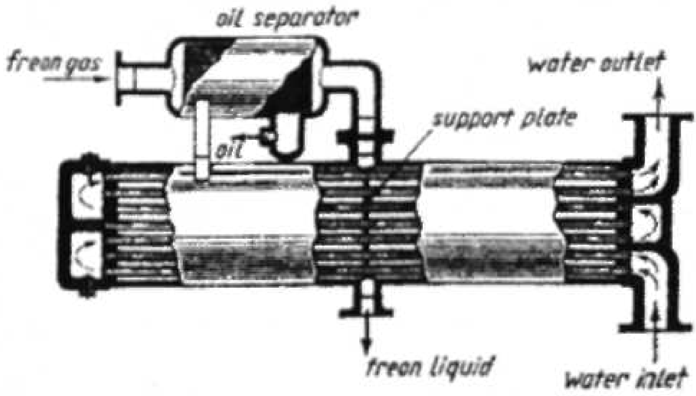
The hot, high-pressure gas from the compressor is cooled in the condenser and condenses into a liquid. The condenser is cooled by water or, in the small size, air.

Liquid refrigerant collects in the bottom of the condenser whence it flows to the receiver and the expansion valve.

Water-cooled condensers are usually of the shell and tube type, with a steel shell and tubes and tube-plates of special brass or plastic covered steel.

The tubes are expanded into the tube-plates or, in some types, soft soldered. The refrigerant condenses on the outside of the tubes. Large condensers are fitted with one or more support plates to prevent oscillations of the tubes due to vibrations in the ship. Safety valves are provided on the large condensers. The cooling water circulates inside the tubes, water heads at the ends of the condenser passing it through the desired number of tubes at a time. Anti-corrosion plates are fitted in the water heads to lessen the corrosive action of sea water on the material of which the condenser is made. These plates are made of some material, usually zinc or soft iron, which corrodes more easily than that used in the condenser. They are thus consumable items which should be kept in stock on board and changed when necessary. The inside of the cast iron covers should be protected and maintained by painting.

If there is any danger of freezing during winter when the refrigerating machinery is not in use, the water in the condenser tubes must be drained off.



2. Translate the following word combinations.

High-pressure gas, liquid refrigerant, expansion valve, water-cooled condenser, shell-and-tube type condenser, outside of the tubes, are expanded into tube-plates, are fitted with, to prevent oscillations, due to vibration, safety valves, are provided on the condenser, inside the tubes, water heads, plates are fitted, corrosive action, consumable items, to keep in stock, danger of freezing, refrigerating machinery.

3. Translate the if-sentences.

1. If the water flows through the condenser, the refrigerant will be cooled.
2. If there is any danger of freezing, the water in the condenser tubes must be drained off.
3. The tubes may be inspected and cleaned if the water is drawn off from the condenser.
4. The hot gas condenses into a liquid if it is cooled in the condenser.

4. Make up 5 questions to the text.

5. Say what you can about the condenser. Use the plan.

1. Principle of operation.
2. Types of condensers.
3. Principal parts of the condenser.
4. Their material and function.

UNIT 11

Useful language:

1. to design – проектувати
2. freezing – заморожування
3. to equalize – вирівнювати
4. drop – падіння
5. thermovalve – терморегулюючий клапан
6. distributor – розподільник
7. to intend – призначати
8. to maintain – підтримувати
9. degree – ступінь
10. superheating – перегрів
11. vapourizatlon – випаровування
12. conditions – умови
13. rated output – номінальна потужність
14. to ensure – забезпечувати
15. actuator – термочутливий механізм
16. piping – трубопровід
17. to fill – заповнювати

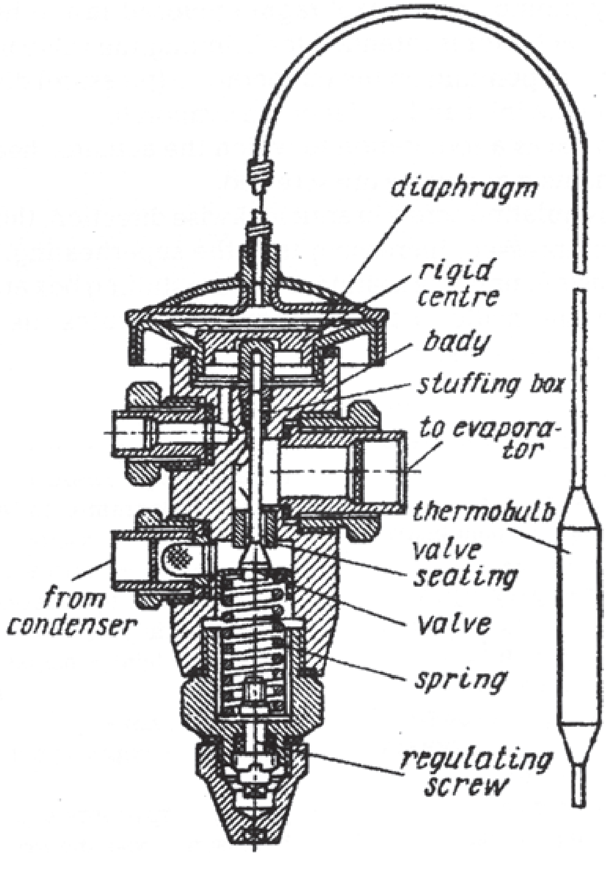
1. Read the text.

REGULATION

Thermostatic Expansion Valves are designed to be used as a regulator in all dry expansion refrigeration systems for product cooling with one or more evaporators, deep freezing units and transport refrigerator units. Internal equalized valve is for evaporators with low pressure drop. External equalized valve provides maximum heat transfer for evaporators with higher pressure drop and when using refrigerant distributors.

The external equalized thermo valve TPB-7 is intended for maintaining in the evaporator automatically a constant degree of superheating of the Freon-12 vapors, ensuring full vaporization of the liquid.

In the range of vaporization temperatures from –30° to +10°C the thermo valve maintains automatically the proper operating conditions of the machine, at a difference of the refrigerant temperatures of superheating from 2 to 8 °C on the inlet and outlet of the evaporator.



Main Technical Data.

1. Type of thermo valve ... regulating.
2. Refrigerant ... Freon-12.
3. Rated output ... 7000 kcal/h.

Note: The rated output is ensured when after the valve opening the superheating is increased by 3–5 °C.

4. The working range of vaporization temperatures ... from t –30°C to t_0 +10°C.
5. The superheating at which the valve opens, is aligned to a range of temperatures of 2 to 8 °C.
6. Working pressure on inlet ... up to 12 kg/cm^2.
7. Working pressure on outlet ... up to 3.3 kg/cm^3.
8. Length of actuator piping ... 3.0 m.

Note: The length of the capillary pipe can be lessened if necessary. The thermo valve consists of the following basic units: the actuator, the body, and the valve and regulating (adjusting) mechanism .

The actuator is filled with Freon-12 and consists of a thermo sensitive bulb, a capillary piping and a diaphragm enclosed in the head of the thermo valve. The actuator is intended for bringing the valve mechanism in a working state, depending on the temperature (pressure) difference of the refrigerant on the inlet and outlet of the evaporator.

The body serves as a foundation to which the actuator head and the regulating mechanism and valve are screwed.

Turning the regulating screw in anticlockwise direction, the adjusting spring can be compressed, increasing thus the superheating. The valve mechanism consists mainly of a seating, a valve, a stuffing box and a spring; it is fastened to the inside of the body and constitutes the operating mechanism of the thermo valve.

2. Remember the nouns corresponding to these adjectives.

long – length; deep – depth; high – height; wide – width

3. Make up 5 sentences of your own with the words from the text.

rated output, thermo valve, degree, to ensure, to fill.

4. Extend the sentences.

1. The actuator is filled with ... .
2. The regulating screw can be turned in ... .
3. The spring constitutes the operating mechanism of the ... .
4. If necessary, the length of the capillary pipe can be ... .
5. The working range of vaporization temperatures is from ... to ... .
6. The working pressure on the inlet and outlet of the thermo valve varies from ... to ... .
7. Refrigerating systems are used for ... .

SUPPLEMENTARY READING

1. INVENTION OF THE WHEEL

It's difficult to imagine our lives without any form of movement. Wheels are one of the most ancient discoveries in all of humankind. However, none of us question how the wheel was actually discovered?

Wheels have made it much easier for all of us to travel. The creation of the wheel is perhaps the most significant discovery. As soon as the wheel was invented, there was a revolt in the manufacturing industry.

The first inventor of the wheel remains unknown. What is known, is the fact that the first ever wheel was discovered approximately 3,000 years ago where weavers and potters were the first to utilise them.

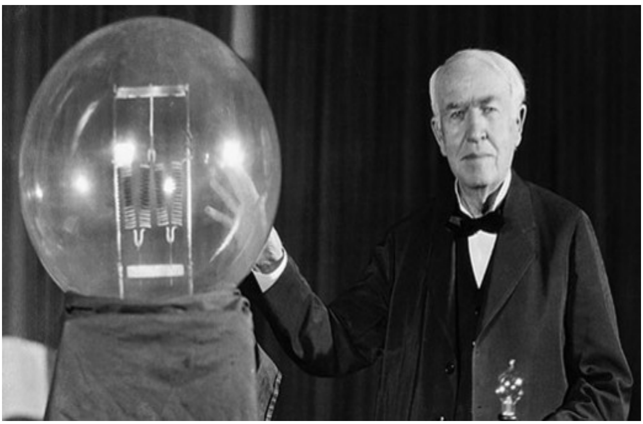
The containers that were prepared by the potters were helpful for carrying the essentials; drinking water and nutritious food. There was yet another enhancement by utilising the wheels for moving on the vehicles. The advanced version of these same wheels are now being used by the cars which we use today, for our own convenience.

There was always a regular growth in the advancement of inventing new and innovative designs the wheel. The wheels that we now see in heavy vehicles were also invented during the early centuries, but the differences are huge. The initial designs were much simpler in comparison to the designs we see today.

Unlike other inventions that took place around 5000 B.C. or even earlier, wheels are still commonplace today and are still high in demand. Many contemporary discoveries are derived from the ancient and original wheel. It's clear that if there was no invention of the wheel, there would be no vehicles. Our roads would have been empty and aeroplanes would not have been able to take to the skies.

As result of the wheel, there has been great development in the field of industrialisation. The different manufacturing factories and companies are a productive outcome of wheels. If the wheel had been a relatively new invention, the inventor would have received worldwide acclaim. Although what we determine to be a simple idea, the concept at that time was truly groundbreaking and ingenius – a concept that has withstood the ultimate test of time.

2. THE INVENTION OF THE LIGHT BULB



The very first electric light was invented as early as 1800 by English inventor, Humphry Davy. Through various experimentations with electricity, he invented a basic electric battery, soon followed by electric light once he realised that carbon glowed, producing light when connected to the battery. This reaction is called an electric arc.

In 1860, Sir Joseph Wilson Swan set about attempting to develop a practical, long-lasting form of electric light. It was he who realised that carbon paper filament worked well, however did burn up relatively quickly. In 1878, his new lamp inventions were showcased in Newcastle, England.

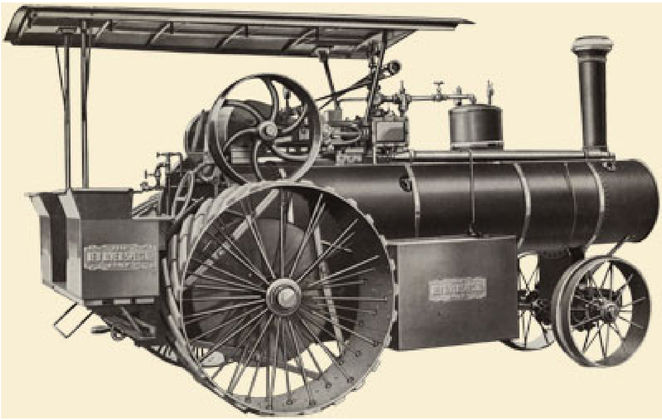
1877 saw American Charles Francis Brush develop a series of carbon arcs in order to illuminate a public square in Ohio, USA. A few streets, some large office buildings and some stores all utilised electric lights, but the extent of usage was not at all common.

Typically credited as the 'inventor of the light bulb', Thomas Alva Edison experimented with thousands upon thousands of alternative filaments to find the best material for a long-lasting, high glow solution. 1879 was the year Edison finally realised that a carbon filament within an oxygen-free bulb glowed, but would not burn up for approximately 40 hours. Later, Edison invented a bulb that would not expire for over 1500 hours.

Lewis Howard Latimer improved upon Edison's bulb with a new carbon filament which he patented in 1881. Latimer was part of Edison's research team, termed "Edison's Pioneers", and in 1882 began to manufacture and distribute his own carbon filaments. At the turn of the century, in 1903, Willis R. Whitney introduced a 'fix' to the light bulb, so that the inside of the bulb would not darken as the filament began to glow, thus producing more vivid and bright light. William David Coolidge then invented a tungsten version of the traditional filament, which lasted longer than any other filament. This incandescent light bulb revolutionised the way in which we live today.

3. THE INVENTION OF THE STEAM ENGINE

The invention of the engine has played a major role in the environment we live in today – surrounded by transport and industries all reliant on an engine of some description. The engine we see today is a progression of the steam engine, using the same principles, but applied in a more developed manner in the modern world. Every single engine works the same way – a conversion of burning fuel into kinetic energy. It's near enough impossible to imagine a world without the engine, so let's look at the history of the engine and how it has come to the forefront of our industrialized world.



The first incarnations of the steam engine were wood-powered, before coal was discovered as a superior replacement, allowing the invention of the steam engine to be one of the most pivotal developments in decades. Most valued during the Industrial Revolution, the steam engine offered an increase in transportation speeds, and an obvious positive impact across industrial industries.

It is a well known fallacy that the lead inventor of the steam engine, James Watt, was inspired by watching the power of steam lifting off a kettle lid. In all truth, Watt was truly inspired when working on a Newcomen engine at the University of Glasgow, where he attempted to repair the engine in May, 1765. It's necessary to look at the engine variations leading up to this point, to properly understand the development of the steam engine.

Thomas Savery, an English inventor/engineer, developed a water pimp which utilized steam from a boiler to create its power. The idea itself was brilliant, but Savery could not really make the most out of it, allowing Thomas Newcomen, an English blacksmith to step in and improve things, in 1712.

Newcomen's contraption was most commonly used in coal mines to pump water – where steam was condensed in cylinders creating a fractional vacuum underneath the piston. Air pressure would naturally apply to the top of the piston, forcing it downwards in a regular motion.

James Watt then took over the reins, and the development of the steam engine really began to gather pace. The Scottish engineer noticed from Newcomen's design that a vast amount of heat energy was escaping from the mechanism heating the cylinders. Watt's vision was to use a completely separate condenser, connected to the cylinder via a simple valve, wherein the cylinder would be kept hot, yet the condenser would be kept cold. Watt patented his steam engine in 1769, though it was to be a few years before the engine became available.

As the years progressed, Watt made some alterations to his initial design, including insulation, oil lubrication and a gear system for controlling the motion of the piston. His reformed engine was introduced in 1783.

The steam engine had a dramatic impact all over the world. Setting aside the obvious improvements to transportation speeds, the engine also allowed factories freedom from the reliance on water power. Countries rich in coal began to reap the financial benefits attached – the UK using its own coal reserves to expand the British Empire in both the eighteenth and nineteenth centuries. Trains powered by steam engines proved highly advantageous during the industrialization period.

The steam engine invented by James Watt may, in the current day, look rather basic in comparison to modern day technology, but it was Watt's creation which produced the fundamentals for the engine's development through time. The invention of the automobile can be traced back as far as 1769, when one Nicolas-Joseph Cugnot, devised the very first concept – a complex, three wheeled steam engine. The idea never really took off, as it could not compete with horse powered transportation which were easier to handle, faster, less expensive and more commercially viable.

Horses were at the heart of the transport industry, with every individual business relying on horses to pull their vehicles. The steam train was named the iron horse, the bicycle was named the poor man's horse and the trolley car was named the horseless carriage. Horsepower was used to define performance, and is still commonplace to this day.

James Watt adopted the term "horsepower" to express the pulling power of a steam train, which was calculated as 33,000 foot-pounds per minute based upon his experience in working with horses. The horse industry was immensely powerful and those looking to force the automobile through in its place would meet a lot of resistance from those companies turning over significant profits.

"The horse is here to stay but the automobile is only a novelty, a fad." – President of Michigan Savings Bank, 1901.

4. THE INVENTION OF THE AUTOMOBILE

Cars had to become practical, to be simple to use, offer benefits over horses and be affordable, yet profitable. In 1807, Francois Isaac de Rivaz, a Swiss inventor, invented the very first internal combustion engine using hydrogen as fuel. This prompted a whole host of engineers to develop this idea further. Karl Benz created an internal combustion engine powered by gasoline in 1879. Daimler and Mayback, two successful German engineers, began producing automobiles in 1889, manufacturing thirty cars powered by a bi-cylinder, 1.5hp gas engine with four-speed transmission. Benz produced twenty five cars all powered by a four-stroke gas engine.

Both companies soon merged to become the Daimler-Benz Company, creating both Daimler and Mercedes Benz brands. The speed of these cars were more than a match for horses, but the ignition still sputtered as a result of the fuel used within the internal combustion engines. This problem was resolved over the next few years by using a lead additive.

Those against the introduction of automobiles warned the public of the dangers of cars, including air pollution and noise, which created an air of uncertainty. This resistance forced cars to be used on a separate roadway to that of horses. Those in favour of the car responded, by expressing problems with horses such as the amount of food and water they required, and also the quantities of manure they deposited behind. In the height of Summer, the smell and flies attracted were insufferable. Cars obviously didn't get hungry, tired or produce manure like their 4 legged competitors.

Henry Ford was an intelligent man who understood the process of commercialising inventions to turn a profit. He made it his mission to develop a car which could compete against horses in terms of affordability, competitiveness and profitability. His vision was for the car to progress along an assembly line, with worked staged at specific locations with specific tasks. This concept allowed one vehicle to be manufactured in as little as 90 minutes – seven times faster than rival manufacturers. A quick drying paint was used to keep up the speed of production but was only available in one colour – black.

Car components soon became universal, allowing parts to be interchangeable, therefore driving down costs of both manufacturing and repair work. Ford led automobiles to become affordable, profitable and competitive and the progression from horses to cars escalated – quickly becoming the number one transportation method in the world.

5. THE INVENTION OF THE BAR CODE

Perhaps one of the most under rated inventions belongs to the barcode. Barcodes aren't given much thought by the majority of consumers, but these codes were fairly recently implemented, in a working fashion, in 1970.

A small food store owner decided one day that keeping records of the inventory of his stock and their associated prices was an extremely laborious process and so, in 1948, he took it upon himself to contact The Drexel Institute of Technology in a bid to work towards a feasible solution. Bernard Silver rose to the challenge and set out to investigate this problem, and began working on a solution involving an automatic way of keeping track of items which had been sold. Bernard Silver and a group of students from the institute realised their answer in the form of ultraviolet rays, ink and a scanner.

The system did work initially, but possessed two major negatives. The system was incredibly costly making implementation on a large scale much more economically draining and the system was also notorious as being unstable. If the invention was to become commonplace in grocery stores, these two problems had to be ironed out to provide a more viable solution.

The patent for the bar code system was filed by Silver and one of his students, Woodland. The patent was not granted immediately; in fact it took three years for the patent agency to grant their invention patent for the bar code, occurring on 7th October, 1952. The invention of the barcode is patent number 2,612,994, Classifying Apparatus and Method, the official title of the patent.

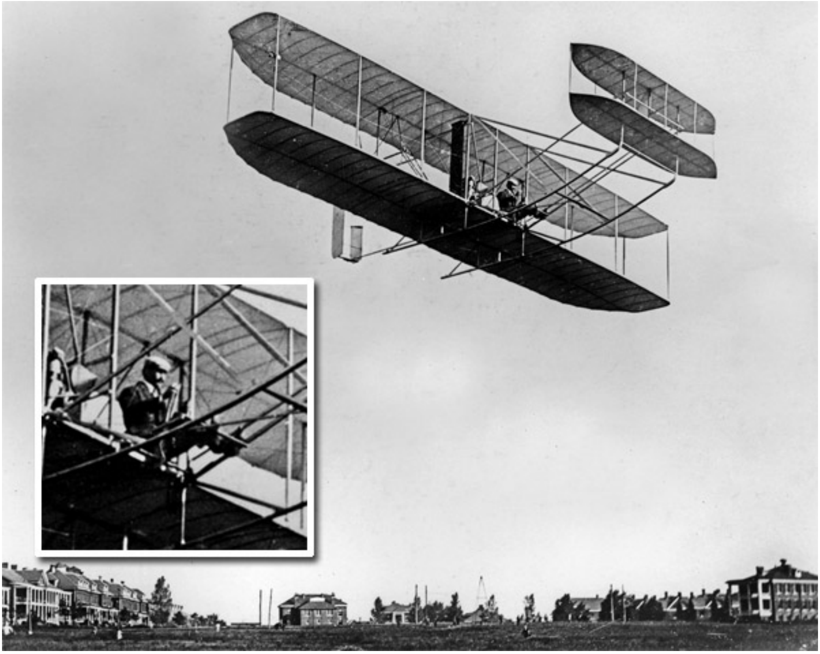
Despite this patent being issued, the system was still not welcomed by the majority of store owners. It wasn't until 1966, that the system began creeping its way into more and more grocery stores. This system was soon criticised, as there was no central mechanism for controlling uniformly coded items. In 1970, Logicorn developed Universal Grocery Products Identification code (UGPIC), soon shortened to Universal Identification Number (UPC). It was Marsh's superstore in Troy, which was the very first store to install this sophisticated barcode reading system and its popularity has soared ever since, obviously now commonplace in all types of stores worldwide.

The first product to have ever been added to the barcode system was a pack of Wrigley's chewing gum. The invention of the bar code may not appear as complex, ground breaking, or as revolutionary as many other inventions, but few have been as understated, yet so effectively time-saving, efficient and manageable.

6. THE INVENTION OF THE AIRPLANE

The discovery of the airplane accelerated development in the transport industry. The time taken to travel greater distances has been dramatically reduced, and places have become increasingly more accessible.

Despite the Wright Brothers universally credited with the invention of the airplane, the emergence of the plane can be traced back an entire century before the brothers took to the sky. Sir George Cayley, born in Scarborough, in 1773, built his first model helicopter in 1796.



In 1804, he successfully designed and manufactured a glider, before publishing three papers detailing the fundamental principles of aeronautics. It was within these papers that the ideas of thrust and lift were first explained.

The two people most commonly linked with the invention of the airplane are the Wright Brothers. Wilbur Wright was born on 16th April, 1867 while his brother, Orville, was born on 19th August, 1871. Both left education at an early stage to set up their own bicycle repair store. Otto Lilienthal, a German aviator, was a man who the Wright Brothers closely followed, keeping up to date with his research and experiments. Lilienthal died in a glider accident, which inspired the brothers to take matters into their own hands and continue their own research into aeronautics. This love of mechanics drove them to experiment with the principles of airplanes and flight, carrying out extensive tests for many years. One of these many tests focused on the wings. The brothers set about building a set of wings similar to that of a bird, albeit with a moveable rudder. This was known as "wing warping" and was the benchmark for their design. It was in 17th December, 1903, that the brothers unveiled their first airplane, the first plane that had been capable of a controlled flight with no landing damage and a constant speed.

The brothers made it part of their research to photograph each prototype they tested, also persuading an attendant from a lifesaving station to capture Orville in flight. The "flying machine", as it was referred to at that point, rose to an altitude of 10 feet, travelled 120 feet and took just 12 seconds. Two further successful flights took place later that day prompting the brothers to contact their father to tell him to get in touch with the press about their recent flights. Unfortunately, many dismissed their claims, so Wilbur ventured into Europe to spread the word. Their news was finally accepted, and the brothers received worldwide fame for their work.

7. THE INVENTION OF THE INTERNET

The Internet is something which many of us now take for granted, but the invention of the Internet, is still recent. The Internet is essentially a network connecting thousands of smaller networks into a single global network. The Internet model and the Transmission Control Protocols used to implement the idea were developed in 1973 by Vinton Cerf, an American computer scientist. His project was backed by the United States Department of Defense Advanced Research Projects Agency (ARPA), directed by Robert Khan, an American engineer.

The Internet initially was used to connect University networks and research labs within the United States. The World Wide Web, as we now know it, was developed in 1989 by Timothy Berners-Lee, an English scientist, for the European Organization for Nuclear Research (CERN).

"The design of the Internet was done in 1973 and published in 1974. There ensued about 10 years of hard work, resulting in the roll out of Internet in 1983. Prior to that, a number of demonstrations were made of the technology - such as the first three-network interconnection demonstrated in November 1977 linking SATNET, PRNET and ARPANET in a path leading from Menlo Park, CA to University College London and back to USC/ISI in Marina del Rey, CA." . – Vinton Cerf.

The Internet is better described as an interconnection of various computer networks which enable each connected machine to communicate directly. Smaller Internets exist, called Intranets, which are typically used within a single organization.

The Internet grew to phenomenal levels over a short period of time. In 1996, more than 25 million computers had been connected to the Internet across 180 different countries.

The Internet makes use of gateways to connect separate networks to a single network. Gateway interconnections are established across telephone lines, optical fibers and radio links. New networks can be added by welcoming new gateways into the network. Data sent from one machine is tagged, using a unique address which identifies that particular machine, and to ensure the information is sent to the correct destination.

Addressing is crucial to the success of the Internet and commonly uses the dotted decimal approach, for example 168.124.1.0. This address is often associated with a web address, with the numeric address and the URL paired up in an addressing table, to eradicate the need to remember number strings. Once data is sent from one machine, the data travels from gateway to gateway until it reaches the network belonging to the destination machine. The Internet has no central repository, and therefore is unique in its methodology.

The Internet Protocol is a key element to a successful Internet. The Internet Protocol determines how a gateway receives a request and what to do with that request once received. The Transmission Control Protocol then verifies that the information has been sent and received successfully, allowing the data to be re-sent if an error occurs during transmission.

The Internet has changed our world bringing a wealth of information to our fingertips. The sharing of information has accelerated with the introduction of the Internet, with new, fresh content accessible second after second. More applications are being introduced to the Internet, and with the rising popularity of Internet enabled phones, the Internet will only continue to grow at a tremendous rate opening up thousands more opportunities to all of us. The invention of the Internet is indeed, one of the most recent revolutionary inventions which have been a major success and welcome addition to our world.

GLOSSARY OF COMMON REFRIGERATION TERMS

Term	Definition
Air curtain	A steady stream of air (generated by a fan) that acts as a barrier to separate environments at different temperatures, without blocking the movement of people or objects. Air curtains are used in open-fronted refrigerated display cabinets to retain chilled air within the cabinet`s volume while still allowing ready access to the stored products.
Ambient temperature	The temperature of the outside air.
Ancillary load	Load created by secondary equipment. In the case of refrigeration, this may be the additional heat created by lighting or evaporator fan motors in refrigerated space.
Automated leak detection	System that continually monitors for the presence of airborne refrigerant gases and generates an alarm when excessive levels are detected, indicating leakage of refrigerants from the refrigeration system.
Auxiliary energy	Energy used by devices in a refrigeration system other than the main compressors; usually, this refers to pumps and fans.
CFC	Chlorofluorocarbon. This is a type of refrigerant consisting of chlorine, fluorine and carbon.
Coefficient of Performance (COP)	A way of expressing the efficiency of a refrigeration plant. Defined as cooling carried out divided by energy input. Compressor suction and discharge pressures. The pressure at the inlet and outlet of a refrigeration compressor.
Compressor	A machine which raises the pressure of a gas, such as a refrigerant vapour. This will usually raise the temperature and energy level of the gas.

Term	Definition
Condenser	A heat exchanger in which a gas, such as a refrigerant vapour, cools and then condenses to liquid form.
Cooling load	The total amount of cooling carried out by a refrigeration plant – usually made up of several individual heat loads.
Defrost-on-demand control	A control system that automatically initiates a defrost sequence when an appropriate amount of ice has built up on the evaporator surface.
Discharge	The high pressure exit from a compressor.
Evaporator	A heat exchanger in which a liquid refrigerant absorbs energy from its surroundings and vapourizes, producing a cooling effect.
Expansion valve	A valve through which liquid refrigerant passes and is reduced in pressure and temperature.
Flash	The process of liquid refrigerant being vapourized by a sudden reduction of pressure.
Halocarbons	A family of primary refrigerants based on hydrocarbon molecules in which some or all of the hydrogen has been replaced by either fluorine or chlorine. Halocarbons include CFCs, HCFCs and HFCs.
HCFC	Hydrochlorofluorocarbon. A primary refrigerant of the halocarbon family.
Heat exchanger	A device for transferring heat between two physically separate streams.
Heat of compression	The amount of heat added to the refrigerant vapour by the compressor during the process of raising the pressure of the refrigerant to condenser conditions.
Hest rejection temperatures	The temperature at which a refrigeration plant rejects heat from the condenser, usually into ambient air or cooling water.
Helical-rotary compressor	A type of compressor that uses two mated rotors to trap the refrigerant vapour and compress it by gradually shrinking the volume of the refrigerant.

Term	Definition
Hermetic compressor	A type of compressor that has the motor sealed within the compressor housing. The motor is cooled by refrigerant.
Hot gas bypass	A method used to prevent evaporator freeze-up by diverting hot, high-pressure refrigerant vapour from the discharge line to the low-pressure side of the refrigeration system.
Liquid line	A pipe that transports refrigerant vapour from the condenser to the evaporator in a mechanical refrigeration system.
Positive-displacement	A class of compressors that work on the principle of trapping the refrigerant vapour and compressing it by gradually shrinking the volume of the refrigerant.
Pressure-enthalpy chart	A graphical representation of the properties of a refrigerant, plotting refrigerant pressure versus enthalpy.
Receiver	A vessel used to store a fluid (liquid or gas) usually at pressure. In a refrigeration system, the most common are high-pressure receivers, located after the condenser. Some systems also utilize a low-pressure receiver located before the compressor suction.
Reciprocating compressor	A type of refrigeration compressor using a piston to compress vapour trapped in a cylinder.
Refrigerant	The working fluid of the refrigeration system which absorbs heat in the evaporator and rejects it in the condenser.
Refrigerant leakage	Most types of refrigeration system are prone to some degree of refrigerant leakage. This can cause a loss of cooling performance, excessive energy consumption and damage to the environment.
Screw compressor	A type of refrigeration compressor using a rotating screw to trap a volume of vapour and compress it.

Term	Definition
Suction	The entry point for vapour into a compressor.
Suction strainer	A strainer at the inlet of a compressor designed to prevent damage caused by small objects entering the compressor.
Superheat	A thermodynamic term referring to a vapour at a temperature above the boiling point at the prevailing pressure.
Vapour compression cycle	A type of refrigeration cycle using a compressor to remove low-pressure vapour from an evaporator, where it has absorbed heat, and deliver it to a condenser at a higher pressure.
Water cooled condenser	A heat exchanger used to condense refrigerant vapour using cooling water.