МИНИСТЕРСТВО СЕЛЬСКОГО ХОЗЯЙСТВА
И ПРОДОВОЛЬСТВИЯ РЕСПУБЛИКИ БЕЛАРУСЬ

ГЛАВНОЕ УПРАВЛЕНИЕ ОБРАЗОВАНИЯ, НАУКИ И КАДРОВ

Учреждение образования
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АНГЛИЙСКИЙ ЯЗЫК

ENGINES

Сборник текстов и упражнений
для студентов факультета механизации сельского хозяйства,
обучающихся по специальности 1-74 06 01 Техническое обеспечение
процессов сельскохозяйственного производства

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В сборнике приведены тексты для чтения по специальности с упражнениями, а также газетные статьи с серией предтекстовых и послетекстовых заданий. Сборник состоит из восьми уроков и содержит лексический минимум по теме «Двигатели». Приведены примерные варианты текстов для экзаменационного перевода.

Для студентов факультета механизации сельского хозяйства, обучающихся по специальности 1-74 06 01 Техническое обеспечение процессов сельскохозяйственного производства.

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ВВЕДЕНИЕ

Сборник текстов и упражнений предназначен для студентов дневного и заочного отделений факультета механизации сельского хозяйства, обучающихся по специальности 1-74 06 01 Техническое обеспечение процессов сельскохозяйственного производства.

Цель сборника – познакомить студентов с английской терминологией по специальности и подготовить их к чтению оригинальной научно-технической литературы, совершенствовать и систематизировать их знания и умения, обогатить словарный запас.

Сборник состоит из восьми уроков. Каждый урок содержит два текста.

Текст 1 – текст по специальности, насыщенный терминологической лексикой. Перед текстом приводится список незнакомых студенту терминов, которые предлагается выучить. Также имеются предтекстовые задания, направленные на снятие лексических трудностей. Послетекстовые задания служат для проверки понимания прочитанного (определение верных(неверных) предложений, вопросно-ответные формы работы) и закрепления лексики текста (подбор синонимов (антонимов)), перевод терминологических единиц с русского языка на английский и наоборот, заполнение пропусков в предложениях нужными словами и т. д.).

Текст 2 меньше по объему и содержит информацию познавательного характера (биографии известных изобретателей). Текст также снабжен предтекстовыми и послетекстовыми заданиями, после выполнения которых студент должен его пересказать.

В разделе «Check yourself» приведены примерные варианты текстов для экзаменационного перевода.

Сборник содержит лексический минимум по теме «Двигатели».

Сборник текстов и упражнений рекомендован как для аудиторной работы студентов в сотрудничестве с преподавателем, так и для самостоятельной работы.

UNIT 1

Task 1

Ex. 1. Learn the words.

Source of power – источник силы;

energy conversion [kən'vəʃən] – преобразование энергии;

heat engine – тепловой двигатель;

internal combustion [kəm'bʌstʃən] engine – двигатель внутреннего сгорания;

combustion engine – двигатель внешнего сгорания;

rotary engine – роторный двигатель;

reciprocating [rɪ'sɪpræкeɪtɪŋ] engine – возвратно-поступательный двигатель;

Wankel ['wænkəl] engine – роторно-поршневой двигатель, двигатель Ванкеля;

open cycle gas turbine – газовая турбина с разомкнутым циклом;

gasoline engine – бензиновый двигатель;

diesel ['di:zəl] engine – дизельный двигатель;

steam engine – паровой двигатель;

Stirling engine – экологически чистый, нетоксичный двигатель Стирлинга;

steam turbine – паровая турбина;

closed cycle gas turbine – газовая турбина с замкнутым циклом;

heat exchanger – теплообменник;

working fluid – рабочая жидкость;

pressure – давление.

Ex. 2. Translate the following sentences into Russian paying attention to the italicized words.

1. The word "*engine*" comes from the old French word "engine" and Latin "ingenium".

2. *Energy conversion* – is the process of changing one form of energy into another, such as nuclear energy into heat or solar energy into electrical energy.

3. The engine that converts *heat energy* into mechanical energy is called heat engine.

4. *Rotary engine* is an engine such as *turbine* or *Wankel engine* in which power is transmitted directly to *rotary components.*

5. *Reciprocating engine* is an engine in which one or more *pistons* move backwards and forwards inside a cylinder.

6. *Wankel engine* is named after Felix Wankel, a German engineer who invented it.

7. *Stirling engine* is named after Robert Stirling, Scottish minister who invented it.

8. *Gasoline engines* vary significantly in size, weight per unit of power generated, and arrangement of components. The principal type is the *reciprocating-piston engine.*

9. *An open cycle gas turbine* is a combustion turbine plant fired by liquid fuel to turn a generator rotor that produces electricity. The residual heat is exhausted to atmosphere at about 550 degrees of Celsius. This technology is similar in design to the *combustion turbines*, or *jet engines*, used in the aviation industry.

10. *The diesel cycle* was invented by German engineer Rudolf Diesel and it has the highest thermal efficiency of any regular internal or external combustion engine due to its very high compression ratio.

11. *A steam engine* is a heat engine that performs mechanical work using steam as its *working fluid*.

12. A *steam turbine* is a *mechanical device* that extracts thermal energy from pressurized steam, and converts it into *rotary motion*. Its modern manifestation was invented by Sir Charles Parsons in 1884.

13. A *heat exchanger* is a device built for efficient heat transfer from one medium to another.

Ex. 3. Translate the following international words.

Civilization, mechanical energy, machine, to transform, thermal, chemical, category, type, classification, components, temperature, maximum, vibration, specification, automobile, motorcycle, scooter, locomotive, cylinder.

Ex. 4. Can you name any types of engines? What fuel do they need? Do you know who invented different types of engines?

Read and translate the text to find the answers to these questions.

Classification and Some Basic Details of Heat Engines

The distinctive feature of our civilization today is the wide use of mechanical power.

An engine is a device which transforms one form of energy into another form. However, while transforming energy from one form to another, the

efficiency of conversion plays an important role. Normally, most of the engines convert thermal energy into mechanical work and therefore they are called “heat engines”.

Heat engine is a device which transforms the chemical energy of a fuel into thermal energy and uses this thermal energy to perform useful work.

Heat engines can be broadly classified into two categories: internal combustion engines and external combustion engines. Engines whether internal combustion or external combustion are of two types: rotary engines and reciprocating engines.

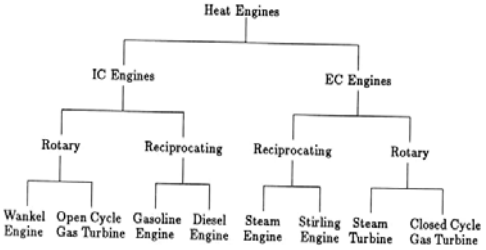


Fig.1.1 Classification of Heat Engines

Of the various types of heat engines, the most widely used ones are the reciprocating internal combustion engine, the gas turbine and the steam turbine. The steam engine is rarely used nowadays.

The reciprocating internal combustion engine enjoys some advantages over the steam turbine due to the absence of heat exchangers in the passage of the working fluid (boilers and condensers in steam turbine plant). This results in a considerable mechanical simplicity and improved efficiency of the internal combustion engine.

Another advantage of the reciprocating internal combustion engine over the other two types is that all its components work at an average temperature which is much below the maximum temperature of the working fluid in the cycle.

Further, in internal combustion engines, higher thermal efficiency can be obtained with moderate maximum working pressure of the fluid in the cycle, and therefore, the weight to power ratio is less than that of the steam turbine plant.

The main disadvantage of this type of engine is the problem of vibration caused by the reciprocating components. Also, it is not possible to use a variety of fuels in these engines. Only liquid or gaseous fuels of given specification can be efficiently used. These fuels are relatively more expensive.

Considering all the above factors the reciprocating internal combustion

engines have been found suitable for use in automobiles, motor-cycles and scooters, power boats, ships, slow speed aircraft, locomotives and power units of relatively small output.

External combustion engines are those in which combustion takes place outside the engine whereas in internal combustion engines combustion takes place within the engine. For example, in a steam engine or a steam turbine, the heat generated due to the combustion of fuel is employed to generate high pressure steam which is used as the working fluid in a reciprocating engine or a turbine.

In case of gasoline or diesel engines, the products of combustion generated by the combustion of fuel and air within the cylinder form the working fluid.

Ex. 5. Match the synonyms.

1) to use	a) to convert
2) fluid	b) moderate
3) to transform	c) different
4) average	d) to utilize
5) various	e) maximum
6) high	f) liquid
7) broadly	g) today
8) nowadays	h) widely

Ex. 6. Match the antonyms.

1) internal	a) minimum
2) small	b) disadvantage
3) maximum	c) impossible
4) advantage	d) external
5) more	e) gaseous
6) possible	f) outside
7) liquid	g) less
8) within	h) great

Ex. 7. Translate the following word chains.

Energy conversion, heat engine, heat exchanger, steam turbine plant, fluid temperature, power output, steam turbine, power ratio, high pressure steam, fuel combustion.

Ex. 8. Name the types of engines mentioned in the text.

Ex. 9. Say the same in English.

Паровая турбина; теплообменник; широкое использование механической энергии; источник силы; преобразование энергии; механизм; выполнять полезную работу; рабочая жидкость; производить пар вы-

сокого давления; использовать разнообразные виды топлива; более высокая тепловая эффективность; процесс сгорания; газообразное топливо; вырабатывать тепло; продукты сгорания.

Ex. 10. Answer the questions.

1. What is an engine?
2. Does the efficiency of energy conversion play an important role?
3. What engines are called heat engines?
4. What categories can heat engines be classified into?
5. What are the most widely used engines?
6. What advantages does the reciprocating internal combustion engine have?
7. What is the main disadvantage of this type of engine?
8. Where are the reciprocating internal combustion engines used?
9. What engines are called external combustion engines?
10. What types of external combustion engines can you name?

Task 2

Ex. 1. Translate the following sentences paying attention to the Passive Voice constructions (was, were + V3).

Model : Heat energy *was transformed* into motion.

Тепловая энергия *была преобразована* в движение.

1. Power *was provided* by water and wind.
2. The first steam engine *was invented* in the early 18th century.
3. Steam *was injected* by the piston.
4. Steam *was cooled* by water.
5. A partial vacuum *was created*.
6. The piston *was forced* down by atmospheric pressure.
7. Steam *was expanded*, *condensed* and *reheated*.
8. Much effort *was required* before engine could exploit electricity.
9. The gas *was ignited* at atmospheric pressure.
10. Benz *was considered* the inventor of the internal combustion engine.

Ex. 2. Match the words with their Russian equivalents.

1) power	a) охлаждать быстро
2) to inject steam	b) движущая сила
3) partial vacuum	c) энергия, мощность, сила
4) to cool rapidly	d) такт в минуту
5) the weight of the pump	e) источник энергии
6) driving force	f) нагнетать пар

7) stroke per minute	g) четырехтактный цикл
8) road accident	h) сжатие
9) energy source	i) вес насоса
10) four stroke cycle	J) сгорание
11) compression	k) частичный вакуум
12) combustion	l) зависимость от нефти
13) expansion	m) более надежный двигатель
14) more reliable engine	n) расширение
15) dependence on oil	o) ДТП

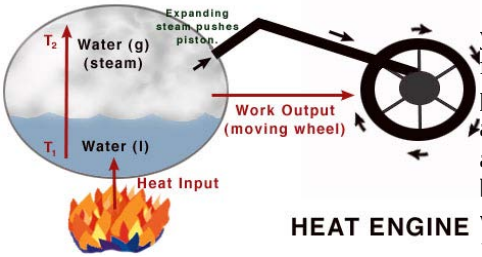
Ex. 3. Practice the pronunciation of the following proper names.

James Watt ['d eɪmz 'wɔt] – Джеймс Уатт
Cugnot ['kʌgnət] – Николя Жозеф Куньо
Lenoir [le'nɔ:] – Ленуар
Benz ['benz] – Бенц

Ex. 4. Look through the text and name the stages in the heat engine development.

Model: Stage 1. The first steam engine.
Stage 2.
Stage 3.
Stage 4.
Stage 5.
Stage 6.

The Heat Engine



For many hundreds of years motive power, mainly for mills and forges, was provided by water and wind and of course human and animal effort. The first usable heat engine, using steam, was invented in the early 18th century. It was terribly inefficient.

Steam was injected under the piston to raise it and then rapidly cooled by injecting water. A partial vacuum was thus created and the piston forced down by atmospheric pressure on the top. The steam helped by the weight of the pump, pushed it up again and the process repeated.

Some fifty years later, James Watt had the idea of doing away with this successive heating and cooling, which was obviously inefficient, by making steam the driving force, which, once expanded, was condensed and reheated. The engine could turn faster, more than twenty strokes per minute and with much more power per stroke. But it was still too heavy to be mobile. In 1770 the French inventor Cugnot built a machine which moved itself successfully. Unfortunately, by running into a wall he also invented the first mechanized road accident. His machine can still be seen in Paris.

Electricity as a source of motive power developed almost in parallel with steam during the 19th century but at a slower rate since much basic research was required before engineers could exploit it. A primitive electric motor rotated in 1831 and a generator some time later. By the 1860's battery-operated electric motors could move more than their own weight but to compete with conventional vehicles, electric motors must be combined with a heat engine to charge the battery and provide supplementary power.

The gas engine, invented by Lenoir in 1860, ushered in the principle of combustion inside the engine itself rather than in a separate boiler. However, since the gas was ignited at only atmospheric pressure, its efficiency was rather low. It was not however, mobile, being too heavy and anyway attached to its energy source.

With the formulation of the four stroke cycle (compression, combustion, expansion and exhaust) the first internal combustion engines was invented. Benz was generally considered to be the key figure. However, as usually happens at key turning points, many others were also successful. From then on it was a question of finding better ways of vaporizing fuel, mixing it with air, getting it into the engine at the right time, and finally igniting it.

Now the internal combustion engine is reliable and more and more economical. However, its dependence on oil may lead to its eventual decline in the developed countries, slowed perhaps by alternative energy sources, such as hydrogen.

Ex. 5. Match the antonyms.

1) heating	a) inefficient
2) efficient	b) slower
3) expansion	c) cooling
4) faster	d) light
5) heavy	e) low
6) inside	f) outside
7) high	g) compression

Ex. 6. Agree or disagree with the following statements.

1. The steam engine was invented in the seventeenth century.
2. The first usable heat engine was rather efficient.
3. James Watt improved the steam engine by making it more mobile.
4. In 1770 the French inventor Cugnot built the first machine which could move itself successfully.
5. A primitive electric motor rotated in 1831.
6. The gas engine was invented by Benz in 1860.
7. Benz invented the internal combustion engine.
8. Now the internal combustion engine is used all over the world as it is very economical.

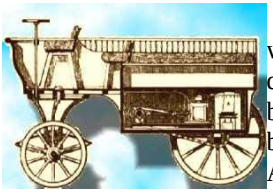
Ex. 7. Answer the questions.

1. What was the motive power for many hundreds of years?
2. When was the first heat engine invented?
3. Was it efficient? Why? Why not?
4. How did James Watt contribute to the development of the heat engine?
5. What contribution did Cugnot make to the development of the heat engine?
6. Why did the electricity as a source of motive power develop at a slow rate?
7. When was the gas engine invented?
8. Why wasn't the first gas engine efficient?
9. Who invented the internal combustion engine?
10. Why may the use of internal combustion engines decline?

Ex. 8. Look through the following passage and answer the question: "What advantages does the electric motor have over the internal combustion engine?

The first primitive electric motor was developed in 1831. Electric motors are not only non-polluting, they are quieter, smoother, and almost maintenance free, since they dispense with those costly sub-systems (transmissions, electrics, fuel pumps, injectors and emission controls, and even brakes) that come with the internal combustion engine. The electric motor has a great future.

Ex. 9. It's interesting to know. Look through the following piece of information and answer the question: "Why is it unfair to say that the automobile was invented by either Gottlieb Daimler or Karl Benz?"



The very first self-powered road vehicles were powered by steam engines and by that definition Nicolas Joseph Cugnot of France built the first automobile in 1769 – recognized by the British Royal Automobile Club and the Automobile Club de France as being the first.

So why do so many history books say that the automobile was invented by either Gottlieb Daimler or Karl Benz? It is because both Daimler and Benz invented highly successful and practical gasoline-powered vehicles that ushered in the age of modern automobiles. Daimler and Benz invented cars that looked and worked like the cars we use today. However, it is unfair to say that either man invented the automobile.

Ex. 10. Summarize all the information from the unit and get ready to speak on the topic: "Heat engines and their use in the modern world".

UNIT 2

Task 1

Ex. 1. Learn the words.

Spark ignition engine – двигатель с искровым зажиганием;
valve ['vælv] – клапан;
piston ['pɪstən] – поршень;
piston ring – поршневое кольцо;
lubricant ['lu:brɪkənt] – смазка;
output shaft ['autput 'ʃa:ft] – выходной вал;
combustion chamber – камера сгорания;
inlet manifold [mænɪ'fəuld] – впускной коллектор;
exhaust [ig'zɔ:st] manifold – выпускной коллектор;
inlet valve – впускной клапан;
exhaust valve – выпускной клапан;
spark plug ['spa:k 'plʌg] – свеча зажигания;
connecting rod – шатун;
crankshaft ['krænk ʃa:ft] – коленвал;
slot – паз;

gudgeon pin ['gʌdʒən pɪn] – поршневой палец;
camshaft ['kæm ʃa:ft] – распредвал;
timing gear ['taɪmɪŋ gɪə] – шестерня распредвала;
cam – кулачок;
flywheel – маховик;
net torque ['tɔ:k]– крутящий момент.

Ex. 2. Translate the following sentences into Russian paying attention to the italicized words.

1. The term *spark-ignition engine* normally refers to internal combustion engines, specifically *petrol engines*, where the initiation of the *combustion process* of the air-fuel mixture is ignited within the *combustion chamber* by a *spark* from a *spark plug*.

2. In automotive engineering, an engine is referred to as *multi-valve* (or multivalve) when each cylinder has more than two *valves*.

3. A *piston* is a component of *reciprocating engines*, *pumps* and gas compressors. It is located in a cylinder and is made gas-tight by *piston rings.*

4. In an engine, its purpose is to transfer force from expanding gas in the cylinder to the *crankshaft* via a *piston rod and/or connecting rod*. In a pump, the function is reversed and force is transferred from the *crankshaft* to the piston for the purpose of compressing or ejecting the fluid in the cylinder.

5. Typically *lubricants* contain 90% base oil (most often petroleum fractions, called mineral oils) and less than 10% additives.

6. Étienne Lenoir already used an *electric spark plug* in his first internal combustion engine in 1860 and he is generally credited with the invention of the spark plug.

7. In automotive engineering, an *intake manifold or inlet manifold* is the part of an engine that supplies the fuel/air mixture to the cylinders. An *exhaust manifold* collects the exhaust gases from multiple cylinders into one pipe.

Ex. 3. Read the text and do the tasks that follow.

Engine Components

A cross section of a single cylinder spark-ignition engine with side valves is shown in Fig.1.2.

***Cylinder*:** It is the space in which the piston makes a reciprocating motion. The varying volume created in the cylinder during the operation of the

engine is filled with the working fluid and subjected to different thermodynamic processes.

***Piston*:** It is a cylindrical component fitted into the cylinder forming the moving boundary of the combustion system. It fits perfectly into the cylinder providing a gas-tight space with the piston rings and the lubricant. It forms the first link in transmitting the gas forces to the output shaft.

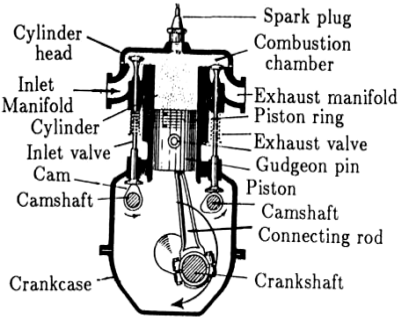


Fig.1.2 Cross-section of a Spark Ignition Engine

***Combustion Chamber*:** The space enclosed in the upper part of the cylinder, by the cylinder head and the piston top during the combustion process, is called the combustion chamber. The combustion of fuel and the consequent release of thermal energy results in the building up of pressure in this part of the cylinder.

***Inlet Manifold*:** The pipe which connects the intake system to the inlet valve of the engine and through which air or air-fuel mixture is drawn into the cylinder is called the inlet manifold

Exhaust Manifold: The pipe which connects the exhaust system to the exhaust valve of the engine and through which the products of combustion escape into the atmosphere is called the exhaust manifold.

Inlet and Exhaust Valves: They are provided either on the cylinder head or on the side of the cylinder for regulating the charge coming into the cylinder (inlet valve) and for discharging the products of combustion (exhaust valve) from the cylinder.

Spark Plug: It is a component to initiate the combustion process in spark ignition engines and is usually located on the cylinder head.

***Connecting Rod*:** It interconnects the piston and the crankshaft and transmits the gas forces from the piston to the crankshaft.

***Crankshaft*:** It converts the reciprocating motion of the piston into useful rotary motion of the output shaft. The crankshaft is enclosed in a crankcase.

Piston Rings: Piston rings, fitted into the slots around the piston, pro-

vide a tight seal between the piston and the cylinder wall thus preventing leakage of combustion gases.

Gudgeon Pin: It forms the link between the small end of the connecting rod and the piston.

Camshaft: The camshaft and its associated parts control the opening and closing of the two valves. This shaft also provides the drive to the ignition system. The camshaft is driven by the crankshaft through timing gears.

Cams: These are made as integral parts of the camshaft and are designed in such a way to open the valves at the correct timing and to keep them open for the necessary duration.

Flywheel: The net torque imparted to the crankshaft during one complete cycle of operation of the engine fluctuates causing a change in the angular velocity of the shaft. In order to achieve a uniform torque an inertia mass in the form of a wheel is attached to the output shaft and this wheel is called the flywheel. The variation of net torque decreases with increase in the number of cylinders in the engine and thereby the size of the flywheel also becomes smaller. This means that a single cylinder engine will have a larger flywheel whereas a multi-cylinder engine will have a smaller flywheel.

Ex. 4. Translate the word chains.

Cylinder block, combustion system, cylinder head, combustion process, intake system, piston top, exhaust system, ignition system, inertia mass, multi cylinder engine.

Ex. 5. Say the same in English.

Свеча зажигания; поршневое кольцо; одноцилиндровый двигатель с искровым зажиганием; боковые клапаны; поршень совершает возвратно-поступательное движение; рабочая жидкость; выходной вал; головка цилиндра; сгорание топлива; воздушно-топливная смесь; продукты сгорания; предотвращать утечку газа; открывать клапаны в нужное время; создавать изменения в угловой скорости; увеличение количества цилиндров в двигателе; камера сгорания; размер маховика; поршневой палец; многоцилиндровый двигатель.

Ex. 6. Match the antonyms.

1) single	a) exhaust
2) inlet	b) closing
3) upper	c) increase
4) static	d) to complete
5) opening	e) multi
6) decrease	f) smaller

7) larger g) dynamic
8) to initiate h) lower

Ex. 7. Complete the sentences.

1. In the cylinder space the piston _____.
2. Piston forms _____ and provides _____.
3. Combustion chamber is the space _____.
4. Inlet manifold connects _____.
5. Exhaust manifold connects _____.
6. Spark plug is component which _____.
7. Crankshaft converts _____.
8. Piston rings are fitted into _____.
9. Gudgeon pin forms the link between _____.
10. Cams are made as _____.
11. The net torque fluctuates causing _____.

Ex. 8. Answer the questions.

1. What are the main engine components?
2. What is a cylinder?
3. What is a piston?
4. What is called a combustion chamber?
5. What is called an inlet manifold?
6. What component is called an exhaust manifold?
7. What for are inlet and exhaust valves provided?
8. What is a spark plug? Where is it located?
9. What engine parts does a connecting rod interconnect?
10. What is the function of a crankshaft?
11. What does a camshaft control?
12. What for are piston rings provided?
13. In what way are cams designed?
14. What does the size of a flywheel depend on?

Task 2

Ex. 1. Translate the word chains.

Energy source, water wheels, heat engine development, evaporation and condensation properties, instrument maker, high pressure steam engine, mass production, gas air mixture, four-stroke engine, petrol engine, marine and land transport, prototype four stroke engine.

Ex. 2. Match the synonyms.

1) contrivance a) use

2) to convert	b) to build
3) utilization	c) to date back
4) significant	d) device
5) to construct	e) important
6) to have origin	f) performance
7) operation	g) to transform

Ex. 3. Practice the pronunciation of the following proper names.

Denis Papin ['denɪs 'paːpɪn] – Дени Папен
Thomas Savery ['tɔməs 'seɪvərɪ] – Томас Севери
Thomas Newcomen ['tɔməs 'njukʌmən] – Томас Ньюкомен
Richard Trevithick ['rɪtʃaːd 'trevɪtʃɪk] – Ричард Тревитик
Jean Joseph Lenoir ['dʒeɪn 'dʒɔzef 'lenɔː] – Жан Жозеф Ленуар
Gottlieb Daimler [gɔt'liːb 'daɪmlə] – Готлиб Даймлер
Robert Stirling ['rɔːbət 'stəːlɪŋ] – Роберт Стирлинг
Wilhelm Maybach ['wɪlhəlm 'maɪbək] – Вильгельм Мейбах
Rudolf Diesel ['ruːdɔlf 'diːzəl] – Рудольф Дизель

Ex. 4. Read the text to know more about the history of the heat engine.

The History of the Heat Engine

An engine is a mechanical contrivance by means of which some form of energy is converted to useful work. The first mechanical utilization of an energy source to do work dates back to the 1st century BC, when simple water wheels were used to lift water from rivers.

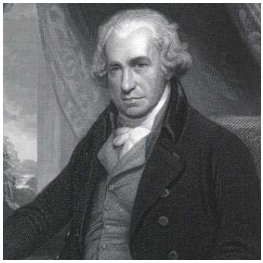
The most significant heat-engine development was that of the steam engine. The use of steam to produce a mechanical effect has its origin in the 1st century AD, when the mathematician and inventor of Alexandria described a steam-operated ‘wheel’.

It was the Frenchman Denis Papin (1647–1712) who first had the idea of constructing an atmospheric engine which made use of the evaporation and condensation properties of water. In 1689 he demonstrated what was a prototype steam engine. Although Papin’s device had limited application, it was a significant step towards the development of a practical steam engine.

In 1698 Thomas Savery (1650–1715), an English engineer, patented a steam pump which could be used to pump water out of mines. His machine was a simple arrangement with no piston and requiring the hand operation of valves. It used steam above atmospheric pressure. Since it did not have automatic safety valves, and as reliable boilers had not been perfected, the pump proved to be dangerous and it was eventually abandoned.

Whilst Thomas Savery was developing his engine, Thomas Newcomen (1663–1729) was experimenting with engines which had a piston inside a cylinder. He took his inspiration from the work of Papin, who had successfully used atmospheric pressure to act on a piston within a cylinder.

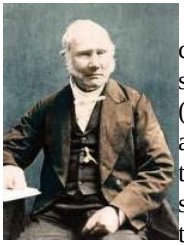
In 1712 the first practical Newcomen steam engine was constructed. It was an atmospheric engine and was thus dependent for its operation on obtaining a pressure within the cylinder below that of atmospheric pressure; this was achieved by injecting cold water into steam in the cylinder. This engine proved to be a significant breakthrough in atmospheric engine development, and Newcomen-type engines were manufactured and sold in numbers for mine pumping.



While preparing a model of a Newcomen engine for Glasgow University in the winter of 1763–64, a Scottish instrument-maker James Watt (1736–1819) realized that a considerable amount of heat was wasted by successively heating the cylinder to produce steam and subsequently cooling it to condense the steam. He proposed a major improvement to Newcomen's design, by the use of a cooling chamber (a condenser) separate from the steam cylinder.

This allowed a large increase in the overall efficiency of the engine. Watt obtained a patent for his engine in 1769.

Further developments in steam engine design did not take place until the early 1800s, when steam above atmospheric pressure was investigated. The Cornish engineer Richard Trevithick (1771–1833) perfected the first high-pressure steam engine in about 1803. In the same year he also built the first steam locomotive, thereby giving a further boost to the Industrial Revolution. From the 1830s steam locomotives dominated rail transport for over a century.



In 1816, Robert Stirling (1790–1878), a Scottish clergyman, developed another concept. His engine consisted of two cylinders. In one of them air was heated (by an external source) and cooled alternately. When the air expanded, it effected a power, or working, stroke in the other cylinder. Stirling obtained a patent for his design in 1827. Some engines were manufactured industrially in 1844, but they never attained mass production.

The next 30 years saw several designs and patents for gas engines, but most of them were never constructed; those that were had limited success.

The first internal combustion engine able to operate reliably was built by the Belgian-born inventor Jean Joseph Lenoir (1822–1900). In 1860, he patented a well-thought-out design for a gas engine. The fuel was lighting gas (derived from coal) mixed with air. This engine was a two-stroke with the fuel-air mixture fed into the cylinder alternately at either end of the piston. The Lenoir engine was slow-running, and the gas-air mixture was not compressed before ignition. It lacked power, and it had a very high fuel consumption. Despite this, it was sold in reasonable numbers.

The use of liquid fuels was not introduced until near the end of the 19th-century. In 1883, the German engineers Gottlieb Daimler (1834–1900) and Wilhelm Maybach (1846–1929) designed an engine that could operate on petrol.

In 1893, Rudolf Diesel patented a prototype four-stroke engine. This engine differed from the petrol engine in that ignition of the fuel occurred spontaneously without a spark. The high compression attained within the cylinder resulted in sufficiently high temperatures to bring about ignition of the fuel and effect a pressure stroke. The Diesel engine has found wide use for both marine and land transport.

Ex. 5. Say the same English.

Значительный прорыв в развитии; механизм; полезная работа; поршень; состоять из двух цилиндров; внешний источник энергии; большое потребление топлива; воспламенение; четырехтактный двигатель внутреннего сгорания; увеличение эффективности двигателя; значительное количество тепла; камера охлаждения; первый паровой двигатель высокого давления; использование жидкого топлива; идея создания атмосферного двигателя.

Ex. 6. Make up sentences using the table.

The mathematician of Alexandria	obtained a patent	the first steam engine in 1689.
The Frenchman Dennis Papin	perfected the first high pressure steam engine	in about 1803.
Scottish instrument maker James Watt	invented	in 1816.
The Cornish engineer Richard Trevithick	constructed	the first internal combustion engine.
A Scottish clergyman Robert Stirling	built	a prototype four stroke engine.
The Belgian-born inventor Jean Josef Lenoir	designed an engine	a steam operated "wheel" in the first century AD.
German engineers Gotlieb Daimler and Wilhelm Maybach	developed an engine consisting of two cylinders	for his improved steam engine in 1769.
Rudolf Diesel	patented	that could operate on petrol in 1883.

Ex. 7. Answer the questions.

1. When does the first use of energy to do work date back?
2. What was the most significant engine development?
3. Who first had the idea of atmospheric engine?
4. What kind of engine did Newcomen construct?
5. What improvement to Newcomen engine did Watt propose?
6. Why didn't further development in steam engine design take place until the early 1800s?
7. What invention gave a further boost to the Industrial Revolution?
8. What kind of engine did Robert Stirling develop?
9. Who built the first internal combustion engine?
10. What engine was invented by Lenoir?
11. What fuel was used in this engine?
12. Who designed an engine that could operate on petrol?
13. When was a prototype four-stroke engine invented?
14. In what way did this engine differ from the petrol engine?

Ex. 8. Fill in the table and speak on the topic" The history of the heat engine".

Inventor	Invention	Years of invention	Engine features (basic components, types of fuel used, principles of operation)

UNIT 3

Task 1

Ex. 1. Learn the words.

Motor unit – агрегат;
vacuum ['vækju:m] engine – вакуумная машина;
pump – насос, помпа;
condenser – радиатор, конденсатор;
to recirculate – циркулировать в замкнутом цикле;
latent heat – удельная теплота;
superheater – пароперегреватель, подогревательный аппарат;
draft – сила тяги;
firebox – камера сгорания;
combustible materials – горючие материалы;
reciprocating pump – насос с возвратно-поступательным движением поршня;
rotative engine – роторный двигатель;
piston rod – шток поршня;
slide ['slaɪd] valve – золотник;
valve rod – шток клапана;
cross head – ползун, крестовина.

Ex. 2. Translate the following sentences into Russian paying attention to the italicized words.

1. The *steam engine* can easily be considered the single most important *invention* of the entire industrial revolution.

2. Thomas Savery was an English military engineer and *inventor* who patented the first steam engine.

3. A *vacuum engine* derives its force from air pressure against one side of the *piston*, which has a partial vacuum on the other side of it.

4. *Reciprocating pump* is a steam engine in which the *reciprocating motion* of the piston is transformed into a continuous *rotary motion*, as by means of a *connecting rod and a crank*.

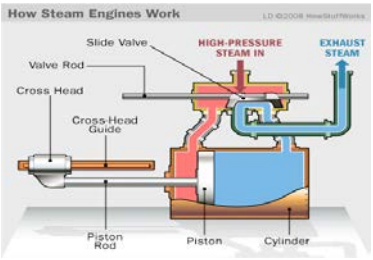
5. For *internal combustion engines* applications the *flywheel* is a heavy wheel mounted on the *crankshaft.*

Ex. 3. Read and translate the text.

Steam Engine

A steam engine is a heat engine that performs mechanical work using steam as its working fluid.

Steam engines are external combustion engines where the working fluid is separate from the combustion products. Non-combustion heat sources such as solar power, nuclear power or geothermal energy may be used. Water is heated into steam in a boiler until it reaches a high pressure. When expanded through pistons or turbines, mechanical work is done. The reduced-pressure steam is then released into the atmosphere or condensed and pumped back into the boiler.



The idea of using boiling water to produce mechanical motion has a very long history, going back about 2,000 years. Early devices were not practical power producers, but more advanced designs producing usable power have become a major source of mechanical power over the last 300 years, beginning with applications for removing water from mines using vacuum engines.

There are two fundamental components of a steam plant: the boiler or steam generator, and the "motor unit", referred to itself as a "steam engine".

Other components are often present; pumps (such as an injector) to supply water to the boiler during operation, condensers to recirculate the water and recover the latent heat of vaporization, and superheaters to raise the temperature of the steam above its saturated vapor point, and various mechanisms to increase the draft for fireboxes.

Heat source: The heat required for boiling the water and supplying the steam can be derived from various sources, most commonly from burning combustible materials with an appropriate supply of air in a closed space (called variously combustion chamber, firebox). In some cases the heat source is a nuclear reactor or geothermal energy.

Boilers: Boilers are pressure vessels that contain water to be boiled, and some kind of mechanism for transferring the heat to the water so as to boil it.

Motor units: A motor unit takes a supply of steam at high pressure and temperature and gives out a supply of steam at lower pressure and temperature, using as much of the difference in steam energy as possible to do mechanical work.

The strength of the steam engine for modern purposes is in its ability to convert heat from almost any source into mechanical work, unlike the internal combustion engine.

Applications: Since the early 18th century, steam power has been applied to a variety of practical uses. At first it was applied to reciprocating pumps, but from the 1780s rotative engines began to appear. At the turn of the 19th century, steam-powered transport on both sea and land began to make its appearance becoming ever more dominant as the century progressed.

Steam engines can be said to have been the moving force behind the Industrial Revolution and saw widespread commercial use driving machinery in factories, mills and mines; powering pumping stations; and propelling transport appliances such as railway locomotives, ships and road vehicles. Their use in agriculture led to an increase in the land available for cultivation.

Ex. 4. Say the same in English.

Вакуумная машина; насос; циркулировать в замкнутом пространстве; выполнять механическую работу; используя пар как рабочую жидкость; внешние источники тепла; удельная теплота; сила тяги; камера сгорания; горючие материалы; преобразовывать тепло в механическую работу; роторный двигатель; поршень; шатун; коленчатый вал; маховик; агрегат; применение; сила паровой машины.

Ex. 5. Make up word combinations and translate them.

1) to perform	a) combustible materials
2) to produce	b) heat
3) to integrate	c) to temperature of the steam
4) to burn	d) mechanical work
5) to convert	e) the water
6) to remove	f) into a single unit
7) to recirculate	g) water from mines
8) to recover	h) the draft
9) to raise	i) mechanical motion
10) to increase	j) the latent heat of vaporization

Ex. 6. Find the odd words in the sentences.

1. A steam engine performs mechanical work using gas as its working fluid.
2. Steam engines are typically internal combustion engines.
3. There are three fundamental components of steam engines.
4. A motor unit takes a supply of steam at low pressure and temperature gives out a supply of steam at higher pressure and temperature.
5. The strength of a steam engine for modern purposes is in its ability to convert heat from almost any source into mechanical work, like the internal combustion engine.
6. Since the early 19^{th} century, steam power has been applied to a variety of practical uses.
7. Steam engines can be said to have been the moving force behind the Green Revolution and led to an increase in the land available for cultivation.

Ex. 7. Answer the questions.

1. What is a steam engine?
2. What are the two fundamental components of a steam engine?
3. What are the other components of a steam engine?
4. What sources can the heat be derived from?
5. What are the boilers for?
6. What is a motor unit?
7. What is the strength of the steam engine for modern purposes?
8. Where are steam engines applied?

Task 2

Ex. 1. Translate the following word chains.

Steam-powered engines, power source, French military engineer, self-propelled road vehicles, three-wheeled steam tractor, four-wheeled steam-propelled road vehicles, railroad and stagecoach companies, steam-operated dredge, present-day automobile, steam vehicle.

Ex. 2. Match the synonyms.

1) racket	a) quickly
2) to dirty	b) to construct
3) rapidly	c) noise
4) to build	d) not to have
5) hauling	e) very big
6) to lack	f) to pollute
7) to blow up	g) effort

8) gigantic
9) present-day
10) attempt

h) modern
i) to explode
j) pulling

Ex. 3. Look through the text to find the answers to the questions.

1. What did inventors dream of?
2. Who was a self-propelled vehicle constructed by?
3. Did early steam cars damage the road?
4. Did Evans build a dredge or a boat?

The steam car

During the late 1700's, the development of steam-powered engines progressed rapidly in Europe. Inventors dreamt of a "horseless carriage" – and steam seemed the obvious power source.

Nicolas-Joseph Cugnot, a French military engineer, built the first self-propelled road vehicles in 1769 and 1770. One was designed to carry passengers, while the other was a three-wheeled steam tractor for hauling artillery. In 1801 and 1803 Richard Trevithick of England demonstrated four-wheeled steam-propelled road vehicles to carry passengers. But he lacked the money to continue his work.

Numerous attempts in England to promote the use and development of steam cars failed because of competition from railroad and stagecoach companies. Early steam cars damaged roads and sometimes blew up. They also made a terrible racket, dirtied the air with smoke, and frightened horses.

In1865, the "Red Flag Law" ended further development of automobiles in England for about 30 years. Under the law, a steam car could go no faster than 4 miles (6 kilometers) per hour in the country and 2 miles (3 kilometers) per hour in town. To warn of its approach, a signalman had to walk ahead of the vehicle, swinging a red flag by day and a red lantern by night.

In 1805 in the United States, an inventor named Oliver Evans demonstrated a steam-operated dredge mounted on a boat. He built the dredge to deepen and clean the Philadelphia waterfront. Evans put wheels on the boat and drove the gigantic machine, which weighed about 18 metric tons, through the streets to the harbor and into the water. During the 1860's, an-

other American inventor, Roper, developed a much smaller steam vehicle. It looked more like a present-day automobile. Roper's vehicle received much public attention and was even exhibited in a circus.

Ex. 4. Fill in the gaps with the words from the box.

Frightened, ended, developed, built (2), blew, damaged, looked, progressed, demonstrated, weighed.

1. During the late 1700's, the development of steam-powered engines _____ rapidly in Europe.
2. Cugnot, a French military engineer, _____ the first self-propelled road vehicles in 1769 and 1770.
3. In 1801 and 1803 Richard Trevithick of England _____ four-wheeled steam-propelled road vehicles to carry passengers.
4. Early steam cars _____ roads, sometimes _____ up and _____ horses.
5. In1865, the "Red Flag Law" _____ further development of automobiles in England for about 30 years.
6. In 1805 in the United States, an inventor named Oliver Evans _____ a steam-operated dredge to clean the Philadelphia waterfront.
7. The dredge _____ about 18 metric tons.
8. During the 1860's, another American inventor, Roper, _____ a much smaller steam vehicle which _____ like a present-day automobile.

Ex. 5. Choose the right answer.

1. During the late 1700 the obvious power source to drive vehicles was
a) petrol; b) horse; c) steam.
2. Nicolas Gugnot built
a) the first self-propelled vehicle to haul artillery;
b) a three wheeled steam tractor for carrying passengers;
c) the steam road vehicle to carry passengers.
3. Richard Trevithick didn't continue his work on four wheeled steam propelled road vehicles because
a) his vehicle damaged roads and sometimes blew up;
b) he lacked money;
c) his vehicles frightened horses.
4. Steam car development failed in England because
a) of competition from railroad and stage companies;
b) of the lack of money;
c) the "Red Flag Law".
5. Under the "Red Flag Law"
a) only a signalman should drive a steam car.

b) a steam car could go no faster than 4 miles per hour in town;

c) a signalman had to walk ahead of the vehicle to warn of its approach.

6. The text is mainly about

a) steam-powered engines development in Europe;

b) the first steam vehicles;

c) automobile development in England.

Ex. 6. Answer the questions.

1. When did the development of steam power engines progress in Europe?

2. What seemed the obvious source of power?

3. What for were the first road vehicles designed?

4. When was the first vehicle to carry passengers demonstrated?

5. Why didn't Richard Trevitchik continue his work on the steam vehicle?

6. Why did numerous attempts in England to promote the use of steam cars fail?

7. What drawbacks did early steam cars have?

8. When and why was "The Red Flag Law" introduced?

9. Why did "The Red Flag Law" get such a name?

10. What did Oliver Evans demonstrate in 1805?

11. What for did he build the dredge?

12. How many tons did it weigh?

13. What vehicle did Roper develop in 1860?

14. Did his vehicle receive much public attention?

Ex. 7. Write out the key sentences about the main stages of the steam car development.

Ex. 8. Speak on the main stages of the steam car development using your notes.

UNIT 4

Task 1

Ex. 1. Learn the words.

Fossil fuel – ископаемое топливо;

oxidizer [oksɪ'daɪzə] – окислитель;

intermittent [ɪntə'mɪtənt] – прерывистый, с перебоями, перемежающийся;

pressurize [preʃə'raɪz] – создавать избыточное давление, нагнетать;

re-charging – подзарядка;

intake – впуск, всасывание;

bottom dead center – нижняя мертвая точка;

stroke – такт;

propulsion [prə'pʌlʃən] – тяговое усилие, тяга, движение;

portable – портативный, переносной, съемный;

power-to-weight ratio ['reɪʃɪəu] – коэффициент отношения мощности к весу;

crankcase ['krænkeɪs] – картер двигателя.

Ex. 2. Translate the following sentences into Russian paying attention to the italicized words.

1. *Fossil fuels* such as coal, petroleum and natural gas are non-renewable resources because they take millions of years to form, and reserves are being depleted much faster than new ones are being formed.

2. Since the Industrial Revolution, mechanical *propulsion* has been possible, initially using steam engines.

3. More recently, most vehicles use some form of internal-combustion engine, with various *power-to-weight ratio*.

4. *Power-to-mass ratio* is a calculation commonly applied to engines. *Power-to-weight ratio* is a measurement of actual performance of any engine or power sources.

5. The article How Two-stroke Engines Work describes the small *two-stroke* engines found in things like chain saws, mopeds and jet skis.

6. Trying to spread adoption of electric cars, five major Japanese firms have agreed to set a unified standard for electric vehicle *recharging* stations.

7. *Crankcase* is the housing for the crankshaft.

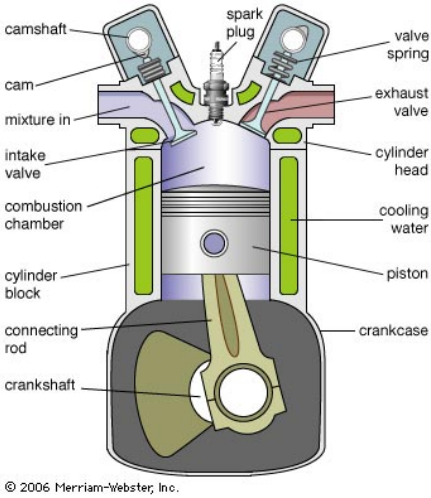
Ex. 3. Translate the word chains.

Combustion chamber, pressure gases, two-stroke piston engines, Wankel rotary engine, gas turbines, jet engines, rocket engines, external combustion engine, Stirling engine, combustion products, power stroke, compression stroke, fuel-air mix, power stroke, intake stroke, fuel vapor, exhaust stroke, power-to weigh ratio, fuel energy density.

Ex. 4. Read and translate the text to know about the principle of internal combustion engine operation.

The internal combustion engine

The internal combustion engine is an engine in which the combustion of a fuel (generally, fossil fuel) occurs with an oxidizer (usually air) in a combustion chamber.



In an internal combustion engine the expansion of the high temperature and pressure gases, which are produced by the combustion, directly applies force to a movable component of the engine, such as the pistons or turbine blades and by moving it over a distance, generate useful mechanical energy.

The term internal combustion engine usually refers to an engine in which combustion is intermittent, such as four-stroke and two-stroke piston engines, along with variants, such as the Wankel rotary engine.

A second class of internal combustion engines use continuous combustion: gas turbines, jet engines and most rocket engines. The internal combustion engine is quite different from external combustion engines, such as steam or Stirling engines, in which the energy is delivered to a working fluid not consisting of, mixed with or contaminated by combustion products

Working fluids can be air, hot water, pressurized water or even liquid sodium, heated in some kind of boiler by fossil fuel, wood-burning, nuclear, solar etc.

Two-stroke

This system manages to pack one power stroke into every two strokes of the piston (up-down). This is achieved by exhausting and re-charging the cylinder simultaneously.

The steps involved here are:

1. Intake and exhaust occur at bottom dead center. Some form of pressure is needed, either crankcase compression or super-charging.
2. Compression stroke: Fuel-air mix compressed and ignited.
3. Power stroke: piston is pushed downwards by the hot exhaust gases.

Four-stroke

1. Intake stroke: Air and vaporized fuel are drawn in.
2. Compression stroke: Fuel vapor and air are compressed and ignited.
3. Combustion stroke: Fuel combusts and piston is pushed downwards.

4. Exhaust stroke: Exhaust is driven out.

Engines based on the four-stroke cycle have one power stroke for every four strokes (up-down-up-down) and employ spark plug ignition, Combustion occurs rapidly, and during the combustion the volume varies little. They are used in cars, larger boats, some motorcycles, and many light aircraft. They are generally quieter, more efficient, and larger than their two-stroke counterparts.

Internal combustion engines are most commonly used for mobile propulsion in vehicles and portable machinery. In mobile equipment, internal combustion is advantageous since it can provide high power-to-weight ratios together with excellent fuel energy density. Generally using fossil fuel (mainly petroleum), these engines have appeared in transport in almost all vehicles (automobiles, trucks, motorcycles, boats, and in a wide variety of aircraft and locomotives).

Ex. 5. Match the words with their Russian equivalents.

1) combustion of a fuel	a) тяговое усилие, тяга
2) propulsion	b) бензин
3) petroleum	c) более эффективный двигатель
4) spark plug ignition	d) вырабатывать энергию
5) more efficient engine	e) самовоспламеняющийся
6) generate energy	f) искровое зажигание
7) mixed with combustion products	g) движущийся компонент двигателя
8) self-ignited	h) сгорание происходит быстро
9) moveable component of the engine	i) сгорание топлива
10) combustion occurs rapidly	j) нагреваемый в бойлере
11) heated in a boiler	k) поршень двигается вниз
12) piston moves downward	l) смешанный с продуктами сгорания
13) in almost all vehicles	m) нижняя мертвая точка
14) pressurized water	n) вода под давлением
15) bottom dead center	o) почти во всех транспортных средствах

Ex. 6. Form the nouns out of the given verbs and translate them.

To combust, to ignite, to oxidize, to expand, to force, to contaminate, to charge.

Ex. 7. Fill in the gaps with the best suited words. See the prompts.

1. _____ are produced by combustion.

2. Piston is a _____.

3. In steam engines the energy is delivered to a _____ mixed with combustion products.

4. Working fluids can be air, hot water or _____.

5. Intake or exhaust occur at _____.

6. Engines based on the _____ have one power stroke for every four strokes and employ _____.

7. Internal combustion engines are used for _____ in vehicles and _____.

Prompts: mobile propulsion, pressurized water, moveable component of the engine, pressure gases, working fluid, bottom dead center, four stroke cycle, spark plug ignition, portable machinery.

Ex. 8. Answer the questions.

1. What engine is called the internal combustion engine?
2. What engines does the term “internal combustion engine” usually refer to?
3. What engines use continuous combustion?
4. In what way does the internal combustion engine differ from the external combustion engine?
5. What strokes are there in a two-stroke engine?
6. What happens during the compression stroke?
7. What happens during the power stroke?
8. What strokes are there in a four-stroke engine?
9. Where are internal combustion engines commonly used?
10. Why is an internal combustion engine advantageous in mobile equipment?
11. What fuel is mainly used in internal combustion engines?

Ex. 9. The following sentences have been removed from the text. Decide in which numbered gap each sentence should go and write in the appropriate letter.

A. Daimler first built a two-wheeled vehicle the "Reitwagen" (Riding Carriage) with this engine and a year later built the world's first four-wheeled motor vehicle.

B. However, it was considered the first safe and practical oil engine.

C. In 1863, Lenoir attached an improved engine (using petroleum and a primitive carburetor) to a three-wheeled wagon that managed to complete an historic fifty-mile road trip.

D. He used it to briefly power a vehicle up Shooter's Hill in London.

E. Rivaz designed a car for his engine – the first internal combustion powered automobile.

F. Several years later, Marcus designed a vehicle that briefly ran at 10 mph that a few historians have considered as the forerunner of the modern automobile by being the world's first gasoline-powered vehicle.

G. 1876 – Nikolaus August Otto invented and later patented a successful four-stroke engine, known as the "Otto cycle".

History of the internal combustion engine

A brief outline of the history of the internal combustion engine includes the following highlights:

1680 – Dutch physicist, Christian Huygens designed (but never built) an internal combustion engine that was to be fueled with gunpowder.

1807 – Francois Isaac de Rivaz of Switzerland invented an internal combustion engine that used a mixture of hydrogen and oxygen for fuel. (1_____). However, his design was very unsuccessful.

1824 – English engineer, Samuel Brown adapted an old Newcomen steam engine to burn gas. (2_____).

1858 – Belgian-born engineer, Jean Joseph Étienne Lenoir invented and patented (1860) a double-acting, electric spark-ignition internal combustion engine fueled by coal gas. (3_____).

1862 – Alphonse Beau de Rochas, a French civil engineer, patented but did not build a four-stroke engine.

1864 – Austrian engineer, Siegfried Marcus, built a one-cylinder engine with a crude carburetor, and attached his engine to a cart for a rocky 500-foot drive. (4_____)

1873 – George Brayton, an American engineer, developed an unsuccessful two-stroke kerosene engine (it used two external pumping cylinders). (5_____).

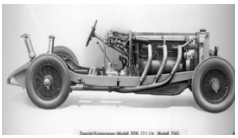
1866 − German engineers, Eugen Langen and Nikolaus August Otto improved on Lenoir's and de Rochas' designs and invented a more efficient gas engine. (6_____).

1876 – The first successful two-stroke engine was invented by Sir Dougald Clerk.

1883 – French engineer, Edouard Delamare-Debouteville, built a single-cylinder four-stroke engine that ran on stove gas.

1885 – Gottlieb Daimler invented the prototype of the modern gas engine – with a vertical cylinder, and with gasoline injected through a carburetor (patented in 1887). (7_____).

1886 – On January 29, Karl Benz received the first patent for a gas-fueled car.



1889 – Daimler built an improved four-stroke engine with mushroom-shaped valves and two V-slant cylinders.

1890 – Wilhelm Maybach built the first four-cylinder, four-stroke engine.

Task 2

Ex. 1. Translate the word chains.

Engine design, gas motor engine, two-stroke gas driven internal combustion engine, engine manufacturing company, atmospheric gas engine.

Ex. 2. Practice the pronunciation of the following proper names.

Nicolaus Otto [nɪkə'laus 'ɔ:tə] – Николя Отто

Holzhausen ['ɔlθauðən] – Хольцхаузен

Eugen Langen [eu'hən 'la:nhən] – Ойген Ланген

Ex. 3. Match the synonyms.

1) to complete	a) to give up
2) occupation	b) to go on
3) to quit	c) to begin
4) to continue	d) to finish
5) to start	e) to inspirit
6) to inspire	f) trade, profession

Ex. 4. What contribution did Nicolaus Otto make to the development of the internal combustion engine? Read the article to know about it.

Nicolaus Otto

One of the most important landmarks in engine design comes from Nicolaus Otto who in 1876 invented an effective gas motor engine.

Nicolaus Otto was born on June 14, 1832 in Holzhausen, Germany. Otto's first occupation was as a travelling salesman selling tea, coffee, and sugar. He soon developed an interest in the new technologies of the day and began experimenting with building four-stroke engines**.**

After meeting Eugen Langen, a technician and owner of a sugar factory, Otto quit his job, and in 1864, they started the world's first engine manufacturing company. In 1867, the pair was awarded a Gold Medal at the Paris World Exhibition for their atmospheric gas engine built a year earlier.

In May 1876, Otto built the first four-stroke piston cycle internal combustion engine. This was the first practical alternative to the steam engine. In the next ten years, over 30,000 of the engine were sold. This engine was the prototype of the combustion engines that have since been built. The engine was named the “Otto cycle” in his honor. The engine's design consists of four strokes of a piston which draws in and compresses a gas-air mixture within a cylinder. This process results in an internal explosion.

Gottlieb Daimler constructed a very light engine, using Otto's model and attached one of them to a bicycle. This became the world's first motorcycle. Karl Benz built his first three-wheel automobile employing Otto's engine. Daimler also constructed an automobile, using Otto's engine.

Otto's practical internal combustion engine is used to power automobiles, motorcycles and motorboats.

Ex. 5. Answer the questions.

1. When and where was Nicolaus Otto born?
2. What was Otto’s first occupation?
3. Why did Otto quit his job?
4. What company did Otto and Langen start?
5. For what were they awarded a Gold Medal at the Paris World Exhibition?
6. When did Otto build the first practical internal combustion engine?

7. How did he call it?

8. What was Otto’s contribution to the engine development?

9. Where is Otto’s engine used?

Ex. 6. Read the passage translating the words in brackets.

Nicolaus Otto was born 1832 in Germany. Otto's (первая профессия) was as a travelling salesman selling tea, coffee, and sugar. He soon (проявил интерес) in the new technologies of the day and began experimenting with (четырехтактным двигателем). In 1864 together with Eugen Langen he started (первую в мире компанию по производству двигателей). In 1876, Nicolaus Otto built (первый четырехтактный двигатель внутреннего сгорания). This was the first practical alternative to the (паровому двигателю). (Двигатель был назван) the “Otto cycle” in his honor. The engine's design consists of (четырех тактов поршня) which draws in and compresses a (смесь из газа и воздуха внутри цилиндра). This process results in an (внутреннему взрыву).

Gottlieb Daimler (сконструировал очень легкий двигатель), using Otto's model and attached one of them to a bicycle. This became the world's first motorcycle. Karl Benz (построил первый трехколесный автомобиль) employing Otto's engine. Daimler also constructed an automobile, (используя двигатель Отто).

Otto's practical (двигатель внутреннего сгорания) is used to power automobiles, motorcycles and motorboats.

Ex. 7. Make a list of key words necessary to retell the article.

Ex. 8. Retell the article making use of your list of key words.

UNIT 5

Task 1

Ex. 1. Learn the words.

Volatile fuel ['vɔlətaıl 'fjuəl] – летучее топливо;

to self-ignite [self ıg'naıt] – самовоспламеняться;

cylinder-direct petrol injection ['sılındə 'daırəkt 'petrɔl in'dʒekʃən] – подача топлива непосредственно через цилиндр;

fuel injection – подача топлива;

conrod – шатун;

compression ratio – коэффициент сжатия (уплотнения);

V-formation – V-образной формы;

intake port – впускное отверстие;

exhaust port – выпускное отверстие;

reed valve – пластинчатый клапан

fin – лопасть;

water jacket – водяная рубашка двигателя;

coolant – охлаждающая жидкость;

magneto [mæg'nɪtəu] – магнето;

ignition coil ['kоɪl] – катушка зажигания;

ignition timing – установка угла опережения зажигания или впрыска топлива;

Engine Control Unit – блок управления двигателем.

Ex. 2. Translate the following sentences into Russian paying attention to the italicized words.

1. *Gasoline engines* take in a *mixture of air and gasoline* and compress it to not more than 12.8 bar (1.28 MPa), then use a *spark plug* to ignite the mixture when it is compressed by the *piston head* in each cylinder.

2. *Vapour pressure* is an indicator of *volatility*: the higher the vapour pressure, the more *volatile* the fuel. Vapour pressure increases with temperature, so the *volatility* of a fuel can be increased by raising the temperature.

3. A highly *volatile* fuel is more likely to form a *flammable or explosive mixture* with air than a *non-volatile* fuel. By definition, gases are volatile.

4. In modern automotive internal combustion engines, the *connecting rods* are most usually made of steel for production engines. They are not rigidly fixed at either end, so that the angle between the connecting rod and the piston can change as the rod moves up and down and *rotates* around the *crankshaft*.

5. The *compression ratio* of an *internal-combustion engine* or *external combustion engine* is a value that represents the ratio of the volume of its *combustion chamber* from its largest capacity to its smallest capacity.

6. There are many engines arranged in a v- formation.

7. *Reed valves* are commonly used in two-stroke engines.

8. *Water jackets* are often used in *water cooling*.

9. An *ignition coil* (also called a spark coil) is an induction coil in an automobile's ignition system needed *to spark the spark plugs*.

10. An *engine control unit* (ECU) is a type of electronic control unit that determines the *amount of fuel*, ignition timing and other parameters an internal combustion engine needs to keep running.

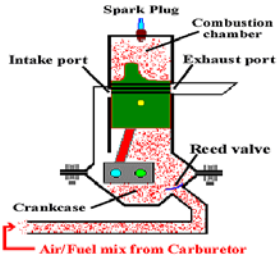
Ex. 3. Read and translate the text.

Gasoline engine

A petrol engine (known as a gasoline engine in North America) is an internal combustion engine with spark-ignition, designed to run on petrol (gasoline) and similar volatile fuels.

It differs from a diesel engine in the method of mixing the fuel and air, and in the fact that it uses spark plugs to initiate the combustion process. In a diesel engine, only air is compressed (and therefore heated), and the fuel is injected into the now very hot air at the end of the compression stroke, and self-ignites. In a petrol engine, the fuel and air are usually pre-mixed before compression (although some modern petrol engines now use cylinder-direct petrol injection).

The pre-mixing was formerly done in a carburetor, but now (except in the smallest engines) it is done by electronically controlled fuel injection. Petrol engines run at higher speeds than Diesels partially due to their lighter pistons, conrods and crankshaft (as a result of lower compression ratios) and due to petrol burning faster than diesel.



Petrol engines have many applications, including: motor cars, motorcycles, aircraft, motorboats, small machines, such as lawn mowers, chainsaws and portable engine-generators.

Petrol engines may run on the four-stroke cycle or the two-stroke cycle.

Cylinder arrangement. Common cylinder arrangements are from 1 to 6 cylinders in-line or from 2 to 16 cylinders in V-formation.

Cooling. Petrol engines may be air-cooled, with fins (to increase the surface area on the cylinders and cylinder head); or liquid-cooled, by a water jacket and radiator.

Compression ratio. The compression ratio is the ratio between the total volumes of the cylinder and the combustion chambers – at the beginning, and end of the compression stroke.

Petrol engines use spark ignition and high voltage current for the spark may be provided by a magneto or an ignition coil. In modern car engines the ignition timing is managed by an electronic Engine Control Unit.

Ex. 4. Say the same in English.

Бензиновый двигатель; двигатель внутреннего сгорания с искровым зажиганием; работать на бензине; летучее топливо; использовать свечи зажигания, чтобы начать процесс сгорания; воздух сжимается и воспламеняется; в конце такта сжатия; более легкий поршень; шатун и коленвал; расположение цилиндров; охлаждение; камера сгорания; эффективность двигателя; повреждение двигателя; катушка зажигания; блок управления двигателем.

Ex. 5. Fill in the gaps with the necessary words: *crankshaft, electronically controlled fuel injection, carburetor, liquid-cooled, magneto, cylinder-direct petrol injection, air-cooled, compression ratio, ignition timing, voltage current.*

1. In a petrol engine, the fuel and air are usually pre-mixed before compression (although some modern petrol engines now use _____).
2. The pre-mixing was formerly done in a _____, but now it is done by _____.
3. Petrol engines run at higher speeds than Diesels partially due to their lighter pistons, conrods & _____.
4. Petrol engines may be _____, with fins or _____, by a water jacket and radiator.
5. The _____ is the ratio between the total volumes of the cylinder and the combustion chambers.
6. Petrol engines use spark ignition and high _____ for the spark may be provided by a _____or an ignition coil.
7. In modern car engines the _____ is managed by an electronic Engine Control Unit.

Ex. 6. Answer the questions.

1. What fuel does a petrol engine use?
2. In what way does it differ from a diesel engine?
3. What applications do petrol engines have?
4. What cycles do petrol engines run on?
5. What are common cylinder arrangements in petrol engines?
6. How may petrol engines be cooled?
7. What is the compression ratio?
8. What provides high voltage current for the spark in petrol engines?
9. What is the ignition timing managed by in modern car engines?

Ex. 7. Fill in the following table and speak about the differences between a petrol and diesel engine.

	Petrol engine	Diesel engine
The type of fuel used		
The way of mixing fuel and air		
Cylinder arrangement		
Application		

Task 2

Ex. 1. Translate the word combinations.

A gas-fueled car, a four wheeled car, to design a motor carriage, the body of the vehicle, water-cooling, mass-produced car, to grant a patent for an automobile, mechanical engineer, the world's first practical automobile to be powered by an internal-combustion engine.

Ex. 2. Say the same in English.

Четырехколесный автомобиль; самый крупный производитель автомобилей в мире; производить промышленные двигатели; двухтактный двигатель, приводимый в движение двигателем внутреннего сгорания.

Ex. 3. Read the article paying attention to the pronunciation of the following proper names:

Karl Friedrich Benz ['ka:l 'frɪdrɪʧ 'benz] – Карл Фридрих Бенц
Karlsruhe [ka:ls'ruə] – Карлсруэ
August Ritter ['augəst 'rɪtə] – Август Риттер
Gottlieb Daimler [gɔt'li:b 'daɪmlə] – Готлиб Даймлер
Bertha Ringer ['bə:rtə 'rɪnhə] – Берта Рингер

Karl Benz (Carl Benz)

In 1885, German mechanical engineer, Karl Benz designed and built the world's first practical automobile to be powered by an internal-combustion engine. On January 29, 1886 Benz received the first patent for a gas-fueled car. It was a three-wheeler; Benz built his first four-wheeled car in 1891. Benz & Company, the company started by the inventor, became the world's largest manufacturer of automobiles by 1900.

Karl Friedrich Benz was born in 1844 in a town near Karlsruhe, Germany. He was the son of an engine driver. Benz attended the Karlsruhe grammar school and later the Karlsruhe Polytechnic University. In 1871 he founded his first company with partner August Ritter, a supplier of building materials. Benz began his work on a two-stroke engine in hopes of finding a new income.

He received his first patent in 1879. In 1883 he founded Benz & Company to produce industrial engines. He then began designing a “motor carriage” with a four-stroke engine (based on Nicolaus Otto's patent). Benz designed his engine and the body for the three-wheel vehicle with an electric ignition and water-cooling. The car was first driven in 1885. On January 29, 1886 he was granted a patent for his gas-fueled automobile and in July he began selling his automobile to the public.

In 1893 the Benz Velo became the world's first inexpensive mass-produced car.

In 1903 Karl Benz retired from Benz & Company; his designs were already outdated by Gottlieb Daimler. He served as a member of the supervisory board of Daimler-Benz AG from 1926, when the company was formed, until his death.

He married Bertha Ringer in 1872, who played an active role in his business, they had five children. Karl Benz passed away in 1929.

Ex. 4. Give the missing forms.

Present Indefinite	Past Indefinite
design	
build	
	was
become	
attend	
	founded
	began
	retired
grant	
marry	

Ex. 5. Answer the questions.

1. When did Karl Benz build the world’s first practical automobile?
2. How many wheels did the first gas-fueled car have?

3. When was the first four-wheeled car built?
4. When and where was Karl Benz born?
5. What education did he get?
6. What company did he form in 1871?
7. What did his company produce?
8. Why did Benz begin his work on a two-stroke engine?
9. When did he receive his first patent?
10. When did he found Benz & Company?
11. What did his company produce?
12. What vehicle did he design?
13. For what was he granted a patent in 1886?
14.When did Benz retire from the company?
15. When did he die?
16. What is his contribution to the car industry?

Ex. 6. Translate the sentences into English.

1. Немецкий инженер-механик Карл Бенц родился в 1844 году.
2. Он окончил грамматическую школу, а затем Политехнический университет.
3. В 1871 году он основал свою первую компанию.
4. В надежде найти новый источник дохода Бенц начал работу над двухтактным двигателем.
5. Свой первый патент он получил в 1879 году.
6. В 1883 году он основал компанию по производству промышленных двигателей.
7. В 1885 году Бенц построил первый в мире автомобиль с двигателем внутреннего сгорания.
8. В 1886 году Карл Бенц начал продажу автомобилей.
9. В 1893 году марка Velo стала первой в мире недорогой машиной массового производства.
10. Карл Бенц был членом совета директоров компании Daimler Benz с 1926 года до своей смерти в 1926 году.

Ex. 7. Make up sentences using the prompts and retell the article.

1844	to be born
1871	to found the company
1872	to marry
1879	to receive first patent
1883	to found Benz & company
1885	to be driven (a three-wheel vehicle)
1886	to be granted a patent for a gas fuel automobile

1891	to build the first four wheeled car
1893	to become the world's first inexpensive mass produced car
1903	to retire from Benz & Company
1926	to form Daimler Benz company
1929	to pass away

UNIT 6

Task 1

Ex. 1. Learn the words.

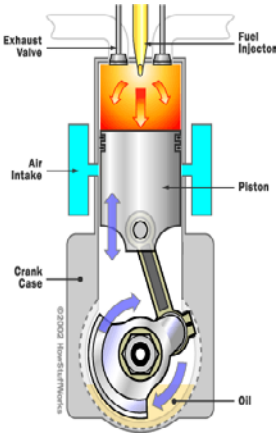
Gaseous fuel ['gæsɪəs] – газообразное топливо;
Diesel cycle – цикл с воспламенением от сжатия;
thermal efficiency – термический к. п. д.;
fuel injector – инжектор, топливная форсунка;
combustion gases – газы, выделяющиеся при горении;
lubrication properties – смазочные свойства;
flammable – легковоспламеняющийся;
carbon monoxide content – содержание окиси углерода;
underground mine – рудник, шахта.

Ex. 2. Translate the following sentences into Russian paying attention to the italicized words.

1. *Gaseous fuels* may be divided into four classes: naturel gas, producer gas (энергетический газ), water gas and coal gas.
2. The Diesel engine has the lowest *fuel consumption* of any large internal combustion engines.
3. In North America, diesel engines are primarily used in large trucks, where *high-efficiency cycle* leads to much longer *engine life* and lower *operational costs*.
4. *Thermal efficiency* is the relationship between actual heat energy stored within the fuel and power produced in the engine.
5. Diesel engines produce very little *carbon monoxide*.
6. Diesel fuel has low *flammability*, leading to a lower risk of fire.

Ex. 3. Read and translate the text.

Diesel Engine



A diesel engine (also known as a compression-ignition engine) is an internal combustion engine that uses the heat of compression to initiate ignition to burn the fuel, which is injected into the combustion chamber. This is in contrast to spark-ignition engines such as a petrol engine (gasoline engine) or gas engine (using a gaseous fuel as opposed to gasoline), which uses a spark plug to ignite an air-fuel mixture. The engine was developed by Rudolf Diesel in 1893. The diesel engine has the highest thermal efficiency of any regular internal or external combustion engine due to its very high compression ratio.

Diesel engines are manufactured in two-stroke and four-stroke versions.

In the true diesel engine, only air is initially introduced into the combustion chamber. The air is then compressed with a compression ratio typically between 15:1 and 22:1. This high compression heats the air to 550 °C (1,022 °F). At about the top of the compression stroke, fuel is injected directly into the compressed air in the combustion chamber.

The fuel injector ensures that the fuel is broken down into small droplets, and that the fuel is distributed evenly. The heat of the compressed air vaporizes fuel from the surface of the droplets.

The vapor is then ignited by the heat from the compressed air in the combustion chamber, the droplets continue to vaporize from their surfaces and burn, getting smaller, until all the fuel in the droplets has been burnt. The rapid expansion of combustion gases then drives the piston downward, supplying power to the crankshaft.

Major advantages. Diesel engines have several advantages over other internal combustion engines:

- They burn less fuel than a petrol engine performing the same work,

due to the engine's higher temperature of combustion and greater expansion ratio. Gasoline engines are typically 30 % efficient while diesel engines can convert over 45 % of the fuel energy into mechanical energy.

- They have no high voltage electrical ignition system, resulting in high reliability and easy adaptation to damp environments.
- The life of a diesel engine is generally about twice as long as that of a petrol engine due to the increased strength of parts used.
- Diesel fuel has better lubrication properties than petrol as well.
- Diesel fuel is considered safer than petrol in many applications.
- The fuel efficiency of a diesel engine remains nearly constant, as opposed to petrol and turbine engines which use proportionally more fuel.
- They generate less waste heat in cooling and exhaust. The carbon monoxide content of the exhaust is minimal, therefore diesel engines are used in underground mines.

Ex. 4. Say the same in English.

Сжигать топливо; двигатель с искровым зажиганием; воспламенять топливно-воздушную смесь; цикл с воспламенением от сжатия; высокий термический к. п. д.; двигатель внешнего сгорания; воздух поступает в камеру сгорания; нагревать воздух до температуры; в начале такта сжатия; топливо впрыскивается непосредственно в сжатый воздух в камере сгорания; инжектор; топливо распадается на маленькие капли; газы, выделяющиеся при горении; толкать поршень вниз; сжигать меньше топлива при выполнении той же работы; преобразовывать энергию топлива в механическую энергию; высокая надежность; срок службы дизельного двигателя; лучшие смазочные свойства.

Ex. 5. True or False?

1. A diesel engine is an internal combustion engine that uses the heat of compression to initiate ignition to burn the fuel.
2. Petrol and gas engine use a spark plug to ignite an air-fuel mixture.
3. Diesel engines are manufactured only in two-stroke versions.
4. Diesel engines burn less fuel than petrol engines performing the same kind of work.
5. Diesel engines can convert 30% of the fuel energy into mechanical energy.
6. Diesel engines can easily operate in damp environments.
7. The life of a diesel engine is the same as that of a petrol engine.
8. Diesel fuel is considered safer than petrol in many applications.
9. Diesel engines generate more waste heat in cooling and exhaust.
10. The carbon monoxide content of the exhaust is minimal.

Ex. 6. Answer the questions.

1. What engine can be called a diesel engine?
2. Who developed a diesel engine?
3. What thermal efficiency does the diesel engine have in comparison with other engines?
4. In what version are diesel engines manufactured?
5. What advantages do diesel engines have over other internal combustion engines?
6. Where are diesel engines applied?

Task 2

Ex. 1. Read and translate the article paying attention to the pronunciation of the following proper names.

Rudolf Diesel ['ru:dɔlf 'di:zəl] – Рудольф Дизель
Paris ['pærɪs] – Париж
Bavarian [bə'veərɪən] – баварский
Munich ['mju:nɪk] – Мюнхен

Rudolf Diesel (1858−1913)

Rudolf Diesel was born in Paris in 1858. His parents were Bavarian immigrants. Rudolf Diesel was educated at Munich Polytechnic. After graduation he was employed as a refrigerator engineer. However, his true love lay in engines design. Rudolf Diesel designed many heat engines, including a solar-powered air engine.

In 1893, he published a paper describing an engine with combustion within a cylinder, the internal combustion engine. In 1894, he filed for a patent for his new invention. Rudolf Diesel was almost killed by his engine when it exploded. However, his engine was the first that proved that fuel could be ignited without a spark. He operated his first successful engine in 1897.

In 1898, Rudolf Diesel was granted patent for an "internal combustion engine" the Diesel engine.

The diesel engines of today are refined and improved versions of Rudolf Diesel's original concept. They are often used in submarines, ships, locomotives, and large trucks and in electric generating plants.

Rudolf Diesel originally conceived the diesel engine to enable independent craftsmen to compete with large industry.

On August 10, 1893 Rudolf Diesel's prime model, a single 10-foot iron cylinder with a flywheel at its base, ran on its own power for the first time. Rudolf Diesel spent two more years making improvements and in 1896 demonstrated another model. By 1898 Rudolf Diesel was a millionaire. His engines were used to power pipelines, electric and water plants, automobiles and trucks, and marine craft, and soon after were used in mines, oil fields, factories, and shipping.

Rudolf Diesel obtained patents for his design in Germany and other countries, including the USA.

He died at sea after falling from a steamer on the night of Sept. 29/30, 1913.

Ex. 2. Translate the word chains.

Refrigerator engineer, solar-powered air engine, heat generating plants, Diesel's prime model, 10-foot iron cylinder, electric and water plants, marine craft, oil field, engine design.

Ex. 3. Find in the text the anonyms for the following words.

Secondary, multi, outside, old, with, seldom, last.

Ex. 4. Say the same in English.

Проектировать тепловые двигатели; сгорание внутри цилиндра; топливо могло воспламеняться без свечи; улучшенный вариант первоначальной модели; получить патент на изобретение; большие грузовики; маховик у основания; конкурировать с промышленностью; гидроэлектростанция.

Ex. 5. True or False?

1. Rudolf Diesel was born in Germany.
2. He was employed as a mechanical engineer.
3. Rudolf Diesel designed many steam engines.
4. His true love lay in refrigerator design.
5. Rudolf Diesel was killed by his engine when it started.
6. Diesel engine was the first that proved that fuel could be ignited without a spark.
7. Diesel engines were used to power automobiles and trucks and air craft.

Ex. 6. Open the brackets using Past Simple Passive.

1. Rudolf Diesel (to bear) in Paris in 1858.
2. Rudolf Diesel (to educate) at Munich Polytechnic.
3. After graduation he (to employ) as a refrigerator engineer.

4. In 1898 Rudolf Diesel (to grant) patent for the Diesel engine.
5. In his engine the fuel (to ignite) without a spark.
6. Diesel engines (to use) to power pipelines, electric and water plants, mines, oil fields and shipping.

Ex. 7. Answer the questions.

1. When and where was Rudolf Diesel born?
2. Where was he educated?
3. What engines did he design?
4. What paper did he publish in 1893?
5. When did Diesel operate his first successful engine?
6. What for was Rudolf Diesel granted a patent?
7. Why did Diesel originally conceive the diesel engine?
8. Where are the diesel engines used nowadays?

Ex. 8. Draw a time line and speak on Rudolf Diesel biography.

1858

was born

UNIT 7

Task 1

Ex. 1. Learn the words.

Wankel engine – роторно-поршневой двигатель, двигатель Ванкеля;
reciprocating piston – поршень возвратно-поступательного хода;
sequentially [sɪ'kwenʃəlɪ] – последовательно;
oval housing – овальный корпус;
to seal – обеспечивать герметичность;
inner periphery [pə'rɪfərɪ] – внутренняя периферия;
intake pipe – впускная труба;
exhaust gas – выхлопной газ;
stator – статор;
room – камера;
sprockets – звездочки;
crown – венец шестерни;
eccentricity [eksen'trɪsətɪ] of the crankshaft – эксцентрик коленвала.

Ex. 2. Translate the following sentences into Russian paying attention to the italicized words.

1. The Mazda *Wankel engines* are family of car engines derived from experiments in the early 1960s by Felix Wankel, a German engineer.

2. The *stator* is the *stationary part* of a *rotor system*, found in an electric generator, electric motor.

3. A *reciprocating engine*, also known as a *piston engine*, is a *heat engine* that uses one or more *reciprocating pistons* to convert pressure into a *rotating motion*.

4. The Wankel engine is a type of internal combustion engine which uses a *rotary piston* instead of *reciprocating pistons*.

5. A *hydrogen vehicle* is an alternative *fuel vehicle* that uses hydrogen as its fuel.

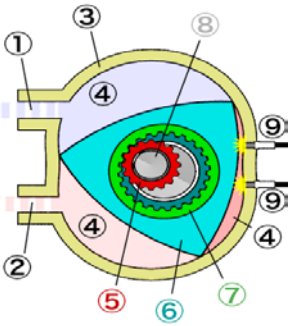
6. Machines comprise both *moving and fixed parts*.

Ex. 3. Translate the word chains.

Otto cycle engine, iron rotor, construction costs, combustion stroke, safety benefit, aircraft use, octane number, hydrogen cars, air-fuel charge, fuel economy.

Ex. 4. Read and translate the text.

Wankel engine



Wankel engine:

1: Intake Pipe
2: Exhaust gas
3: Stator
4: Rooms
5: Sprockets
6: piston (rotor)
7: Crown
8: eccentricity of the crankshaft
9: Spark

The Wankel engine is a type of internal combustion engine using a rotary design to convert pressure into a rotating motion instead of using reciprocating pistons.

The engine was invented by German engineer Felix Wankel. He received his first patent for the engine in 1929, began development in the early 1950s, completing a working prototype in 1957.

Thanks to their compact design, Wankel rotary engines have been installed in a variety of vehicles and devices including automobiles, motorcycles, racers, aircraft, go-karts, jet skis, snowmobiles and chain saws.

How it works. In the Wankel engine, the four strokes of a typical Otto cycle are arranged sequentially around an oval housing, unlike the reciprocating motion of a piston. In the basic single rotor Wankel engine, a single oval housing surrounds a three-sided rotor which turns and moves within the housing. The sides of the rotor seal against the sides of the housing, and the corners of the rotor seal against the inner periphery of the housing, dividing it into three combustion chambers.

As the rotor turns, its motion and the shape of the housing cause each side of the rotor to get closer and farther from the wall of the housing, compressing and expanding combustion chamber similarly to the strokes in a reciprocating engine.

Advantages. Wankel engines have several major advantages over reciprocating piston designs:

- Wankel engines are considerably lighter, simpler, and contain far fewer moving parts.
- The construction of the engine, with an iron rotor within a housing made of aluminum, which has a greater coefficient of thermal expansion, ensures a substantial safety benefit in aircraft use.
- The simplicity of design and smaller size of the Wankel engine al so allow for savings in construction costs.
- The shape of the Wankel combustion chamber allows the use of fuel of very low octane number without pre-ignition or detonation, a particular advantage for hydrogen cars.

Ex. 5. Match the words and translate the word combinations.

1) rotary	a) motion
2) reciprocating	b) prototype
3) working	c) housing
4) racing	d) parts
5) oval	e) expansion
6) moving	f) fuel
7) thermal	g) pistons
8) conventional	h)cars

Ex. 6. Complete the sentences.

1. Wankel engine was invented by _____.
2. Wankel rotary engines have been installed in a variety of vehicles and devices including _____.
3. In the Wankel engine, the four strokes of a typical Otto cycle are arranged sequentially around _____.
4. A single oval housing surrounds a three-sided rotor which _____.
5. As the rotor turns _____.
6. Wankel engines are considerably _____.
7. Aluminum has a greater coefficient of _____.
8. The simplicity of design and smaller size of the Wankel engine also allow for _____.
9. Wankel engine is particularly advantageous for _____.

Ex. 7. Answer the questions.

1. What type of engine is the Wankel engine?
2. Who invented the Wankel engine?
3. When did Felix Wankel receive his first patent for the engine?
4. When did he complete a working prototype of the engine?
5. What vehicles have Wankel rotary engines been installed?
6. How are the four strokes of a typical Otto cycle engine arranged in the Wankel engine?
7. How does the Wankel engine work?
8. What are the advantages of the Wankel engine?

Ex. 8. Fill in the following table and be ready to make a short report about Wankel, petrol and diesel engines.

	Wankel engine	Petrol engine	Diesel engine
Inventor (who, where, when)			
Construction (design) of the engine			
Size			
The type of fuel used			
The principles of operation			
Application			
Advantages			
Disadvantages			

Task 2

Ex. 1. Translate the word chains.

To be the only son in the family, to drop out from school, to be gifted since childhood, to become interested in the world of machines, to afford university education, to teach himself technical subjects, to conceive the engine, to win the patent, to be imprisoned, to present the rotary engine, the found the company, to have a driver's license, to be granted an honorary Doctorate of Engineering degree.

Ex. 2. Read and translate the article paying attention to the pronunciation of the following words.

Felix Wankel ['felıks 'wænkəl] – Феликс Ванкель

Lahr ['la:r] – Лар (город в Германии, районный центр)

Heidelberg ['eıdəlbə:g] – Гейдельберг (город на юго-западе Германии)

coupe ['ku:peı] – двухместный легковой автомобиль

sedan [sı'dæn] – автомобиль с кузовом седан

to chauffeur ['tʃəufə] – возить кого-либо

rotary valve ['rɔtəri 'vælv] – золотниковый клапан

Felix Wankel

Felix Wankel was born in 1902 in Lahr, Germany. He was the only son in the family. His father fell in World War II. Thereafter, the family moved to Heidelberg. He went to high school in Heidelberg but dropped out in 1921. Then he learned to be a purchaser but lost his job because of economic problems in 1926.

He was gifted since childhood and became interested in the world of machines, especially combustion engines. After his mother was widowed, Wankel could not afford university education; however, he was able to teach himself technical subjects. At the age of 17 he told friends that he had dreamt of constructing a car with "a new type of engine, half turbine, half reciprocating".

True to this prediction, he conceived the Wankel engine in 1924 and opened a shop in Heidelberg to develop the idea, winning his first patent in 1929.

During World War II, Wankel developed rotary valves for German air force aircraft and navy torpedoes, for BMW and Daimler-Benz. After the

war, in 1945, he was imprisoned by France for some months, his laboratory was closed by French occupation troops, his work was confiscated, and he was prohibited from doing more work. However, by 1951, he got funding to furnish the new Technical Development Center in his private house.

On January 19, 1960 the rotary engine was presented for the first time to specialists and the press in a meeting of the German Engineers' Union in Munich. In the same year the first practical rotary engine was presented. In 1964, the first consumer vehicle, Wankel-Spider, went into production.

In Japan, the manufacturer Mazda got interested in the Wankel engine. The engine has been successfully used by Mazda in several generations of their coupes and sedans.

By 1958 Wankel and his partners had founded the company, providing Wankel with a share of the profits for marketing the engine. Among the licensees were Daimler-Benz, General Motors, Toyota.

Wankel himself never had a driver's license, because he was extremely near-sighted. He was, however, the owner of a car with a Wankel engine, which was chauffeured for him.

In 1969, Wankel was granted an honorary Doctorate of Engineering from Munich's technical university.

Wankel died in Heidelberg, aged 86.

Ex. 3. Match the sentences.

1) Felix Wankel was born in	a) opened a shop in Heidelberg to develop the idea, winning his first patent in 1929.
2) He went to high school in Heidelberg but	b) his laboratory was closed by French occupation troops, his work was confiscated, and he was prohibited from doing more work.
3) He was gifted since childhood and	c) 1902 in Lahr, Germany.
4) He conceived the Wankel engine in 1924 and	d) became interested in the world of machines, especially combustion engines.
5) During World War II, Wankel	e) Wankel-Spider, went into production.
6) After the war, in 1945, he was imprisoned by France for some months,	f) developed rotary valves for German air force aircraft and navy torpedoes, for BMW and Daimler-Benz.

7) However, by 1951 he got funding	g) dropped out in 1921.
8) In 1964, the first consumer vehicle	h) an honorary Doctorate of Engineering from Munich's technical university.
9) By 1958 Wankel and partners	i) to furnish the new Technical Development Center in his private house.
10) In 1969, Wankel was granted	j) had founded the company, providing Wankel with a share of the profits for marketing the engine.

Ex. 4. Answer the questions.

1. When and where was Felix Wankel born?
2. Did he have university education?
3. When did he conceive the Wankel engine?
4. When did he win his first patent?
5. What did he develop during World War II?
6. What happened to Wankel after the War?
7. How did he manage to continue his work?
8. What manufacturers got interested in the Wankel engine?
9. What degree was Wankel granted in 1969?
10. When did he die?

Ex. 5. Make up sentences using the prompts and retell the article.

1902	to be born
1921	to drop out from a school
1926	to lose job
1924	to conceive the wankel engine
1929	to win the first patent
World War II	to develop rotary valves
1945	to be imprisoned
1951	to get funding
1960	to present the rotary engine
1964	to go into production
1958	to found the company
1969	to die

UNIT 8

Task 1

Ex. 1. Learn the words.

Fatigue – изнурительная работа;
lubrication – смазка;
vision – обзор;
safety – безопасность;
cab – кабина;
noise level – уровень шума;
transmission – трансмиссия;
to mount – крепить, навешивать;
pneumatic suspension – пневматическая подвеска;
air filtration – очищение воздуха;
heating – обогрев;
to install – устанавливать;
roof – крыша;
anti-burst door locks – противоугонная система;
refinement – усовершенствование.

Ex. 2. Translate the following sentences into Russian paying attention to the italicized words.

1. Tractor needn't any rest to recover from *fatigue*.
2. Agro Tractors provide excellent *vision* and *safety*.
3. Adequate *lubrication* allows smooth continuous operation of equipment.
4. Sims Cab Depot designs and manufactures tractor *cabs* and accessories for compact tractors, lawn and garden tractors, machinery, and heavy equipment for most major tractor brands.
5. A *transmission* or gearbox provides speed and torque conversions from a rotating power source to another device using gear ratios.
6. The purpose of *pneumatic suspension* is to provide a soft, comfortable, yet well-controlled ride quality.
7. Thieves often enter cars by 'bursting' the *door lock* mechanism with a foreign key.
8. As much as half of the energy used in your home goes to *heating* and cooling.
9. *Transmission controls* have been mounted on the flat floor of the tractor.

10. *Air filtration* enhances driver's comfort.

11. Preliminary noise tests which were conducted earlier this month showed that noise levels are within acceptable ranges.

Ex. 3. Translate the word chains.

Ford tractors, time-consuming tasks, 6-cylinder engines, noise level, transmission systems, driver's seat, air filtration, driver's efficiency, halogen work lights, climate control filters, cost efficiency, anti-burst door locks.

Ford Tractors

Needless to say, one of the most important industrial achievements for farmers today is the introduction of agricultural tractors in their work. Horses and men have been almost entirely replaced by tractors in many time-consuming tasks that are carried out on the land. A tractor performs the work of numerous horses and, what is of greater importance, it does not need any rest in order to recover from fatigue.

If necessary attention is paid to its lubrication and it is constantly supplied with fuel, it will work on indefinitely.

During the years since its introduction a huge progress has been made in developing a more efficient machine. Modern tractors have been constructed to meet all requirements of space, comfort, vision and safety. Many devices have been incorporated in the mechanisms of the tractor for this purpose. The 6-cylinder engines have been installed in them for improved productivity. Some tractors have been equipped with a hydraulic system, which gives the driver the choice of the right power for every operation.

Nowadays there exists a wide range of different types of tractors. Ford tractors are probably best-known among them. The Ford Company is famous as a technologically advanced manufacturer of vehicles. For many years the Ford Company has been deeply involved in the manufacture of tractors, cars and trucks. Ford tractors enable farmers to work quickly and efficiently. The cab is a comfortable and efficient workplace. Modern acoustic systems have greatly reduced noise levels inside the cab. Transmission controls have been mounted on the flat floor. The driver's seat has been equipped with pneumatic suspension and it turns easily and gives the driver

a more comfortable view. Air filtration, efficient heating and ventilation with air-conditioning further enhance comfort and the driver's efficiency. Individually adjustable halogen work lights have been installed into the cab roof.

These tractors have also been equipped with climate control filters and anti-burst door locks. Ford tractors are famous for their unique combination of outstanding performance, high reliability and cost efficiency. They have been continually improved since their introduction. Dozens of features and refinements have been added during recent years. Ford tractors have been trusted by generations of farmers due to their high quality.

Ex. 4. Match the synonyms.

1) important	a) to rest
2) to carry out	b) great
3) numerous	c) constantly
4) to recover	d) nearly
5) huge	e) operation
6) to improve	f) significant
7) a wide range of	g) to build
8) continually	h) to mount
9) almost	i) convenient
10) performance	j) to perform
11) to supply	k) famous
12) comfortable	l) a lot of
13) to construct	m) to provide
14) best-known	n) many
15) to install	o) to refine

Ex. 5. Say the same in English.

Противоугонная система; смазка; самое важное промышленное достижение; выполнять работу; снабжать топливом; работать бесконечно; пространство; удобство; обзор; удобное рабочее место; безопасность; установить 6-цилиндровый двигатель; оборудовать гидравлической системой; необходимая мощность для каждой операции; производство машин и грузовиков; сократить уровень шума; высокая надежность и эффективность; пневматическая подвеска.

Ex. 6. Find the right answers to the questions.

1. Why are tractors the most important agricultural achievement for farmers?

A. They have replaced horses.

B. They carry out time - consuming tasks.

C. They do not need any rest and can work indefinitely.

2. What progress has been made in tractor developing?

A. Necessary attention is paid to tractors lubrication.

B. Many devices have been incorporated in the mechanisms of the tractor to meet all requirements of space, comfort, vision and safety.

C. Modern tractors are supplied with high quality fuel.

3. What is the function of the hydraulic system?

A. It gives the driver the choice of the right power for every operation.

B. It gives the driver a more comfortable view.

C. It reduces noise level.

4. Where have transmission controls been mounted?

A. Into the cab roof.

B. Under the driver's seat.

C. On the flat floor.

5. What has the driver's seat been equipped with?

A. Climate control filters.

B. Pneumatic suspension.

C. Halogen work lights.

6. How does pneumatic suspension enhance driver's comfort?

A. It regulates climate control in the cab.

B. Driver's seat turns easily and gives the driver a more comfortable view.

A. It heats the cab.

7. What are Ford tractors famous for?

A. Ford tractors are famous for their outstanding performance, high reliability and cost efficiency.

B. Ford tractors are famous for their high price.

C. Ford tractors are famous for their great speed.

Ex. 7. Complete the sentences. Choose the suitable words from the box.

Mass production and the assembly line, durability, massive scale, farmers, tractor industry, agriculture, machines, mechanization.

The Ford farm tractors hold an important role in _____. The Ford tractors were not the first farm _____, but they were the first to be produced on a _____ and the first farm tractors to be affordable by average _____ and rural citizens.

The Ford Motor Company was one of the largest and most successful companies in the _____. Ford was one of the early leaders in _____, and

they took these strengths with them in their production of tractors. This allowed them to offer these machines at low prices and this made Ford one of the keys towards the _____ of agriculture. It is a testament to the quality and _____ of the machines they produced that many of them are still running and being actively used throughout the world, five decades or more past their production dates.

Ex. 8. Think and answer.

1. What famous farm machinery companies do you know?
2. Are there any famous farm machinery corporations in our country?
3. What farm machinery do they produce?

Task 2

Ex. 1. Match the words with their definitions.

1) to tinker	a) rich, wealthy
2) multitude	b) profit
3) to dip	c) to experiment, to create something new
4) well-to-do	d) easy to buy, inexpensive
5) constantly-moving	e) a famous man
6) gain	f) to change, to transform
7) to double the wage	g) a lot of, many
8) celebrity	h) moving all the time
9) affordable	i) to pay twice as much
10) to convert	j) to drop, to cut off, to decline

Ex. 2. Translate the word chains.

Automobile manufacturer, family's farm, farm work, Detroit machine shop, Ford Motor Company, luxury item, Michigan plant, production techniques, assembly line, three-shift workday, Ford's affordable Model T, Ford's mass-production techniques, American society, highway system, Ford Foundation, human welfare, research grants.

Ex. 3. These words are from the text below. Learn how to pronounce them properly.

Michigan ['mɪtʃɪgən] – Мичиган

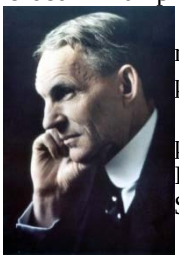
Detroit [dɪ'trɔɪt] – Детройт, город на севере США, в штате Мичиган

Highland Park [‘hailænd 'pa:k] – Хайленд Парк (*зд.* название завода)

Look through the text and answer the question:” What made Henry Ford an international celebrity?”

Henry Ford (1863−1947)

Automobile manufacturer Henry Ford was born on July 30, 1863, on his family's farm in Michigan. From the time he was a young boy, Ford enjoyed tinkering with machines. Farm work and a job in a Detroit machine shop afforded him ample opportunities to experiment.



By 1896 Ford had constructed his first horseless carriage which he sold in order to finance work on an improved model.

Ford incorporated the Ford Motor Company in 1903, proclaiming, "I will build a car for the great multitude." In October 1908, he did so, offering the Model T for $950.

In nineteen years of production, its price dipped as low as $280. Nearly 15,500,000 were sold in the United States alone. The Model T evolved from luxury item for the well-to-do to essential transportation for the ordinary man.

Ford revolutionized manufacturing. By 1914, his Highland Park, Michigan plant, using innovative production techniques, could turn out a complete chassis every 93 minutes. This was a great improvement over the earlier production time of 728 minutes. Using a constantly-moving assembly line, subdivision of labour, and careful coordination of operations, Ford realized huge gains in productivity.

In 1914, Ford began paying his employees five dollars a day, nearly doubling the wages offered by other manufacturers. He cut the workday from nine to eight hours in order to convert the factory to a three-shift workday. Ford's mass-production techniques would eventually allow for the manufacture of a Model T every 24 seconds. His innovations made him an international celebrity.

Ford's affordable Model T altered American society. The United States saw the creation of a national highway system, and the possibility of going anywhere anytime.

Henry Ford created the Ford Foundation in 1936 to promote human welfare through research grants, educational grants and development.

In 1947, at the age 83 Henry Ford died and was buried in the Ford Cemetery in Detroit.

Ex. 4. Say the same in English.

Улучшенная модель; важное средство транспорта для обычных людей; революционизировать производство; инновационные технологии производства; огромное улучшение; разделение труда; тщательная координация операций; сократить рабочий день; собрать машину за 24 секунды; возможность ездить куда угодно в любое время.

Ex. 5. What do these figures stand for?

1863, 1896, 1903, 1908, $ 950, $ 280, 15 500 000, 1914, 93, 728, 5, 8, 9, 24.

Ex. 6. Agree or disagree with the following sentences. Correct the false ones.

1. Automobile manufacturer Henry Ford was born on July 30, 1863, on his family's farm in Dearborn, near Detroit.
2. Ford set up the Ford Motor Company in 1908.
3. Ford offered Model T for $ 960.
4. Nearly 15, 500, 000, 000 Model T cars were sold in the USA.
5. The Model T was designed for ordinary people.
6. Subdivision of labor and cutting down the workers' wages Ford realized huge gains in productivity.
7. Ford's mass-production techniques allow for the manufacture of a Model T every 24 seconds.
8. Ford car altered American society.

Ex. 7. Answer the questions.

1. When and where was Henry Ford born?
2. Did he enjoy experimenting with machines?
3. Did he have any opportunities to experiment?
4. When did Ford incorporate the Ford Motor Company?
5. What did he proclaim?
6. What was the initial price for the Model T? Did the price dip later?
7. How did the Model T evolve?
8. What innovative production techniques did Ford use?
9. How did Model T alter American society?

Ex. 8. Speak on the topics:

a) Ford biography;

b) the Model T as a car for the great multitude;

c) Ford innovative mass production techniques.

CHECK YOURSELF

Translate the text into Russian using the dictionary.
You have 45 minutes at your disposal.

Variant 1

Diesel engine is a type of internal-combustion engine used chiefly for heavy-duty work. Most of the locomotives in the United States are diesel powered. Diesel engines drive huge freight trucks, large buses, tractors, and heavy road building equipment. They are also used to power submarines and ships, the generators of electric-power stations in small cities, and emergency electric-power generators. Some automobiles are powered by diesel engines.

How a Diesel Engine Works. There are two main types of internal-combustion engines – gasoline engines and diesel engines. The gasoline engine, found in most cars, is a spark-ignition engine. It uses electricity and spark plugs to ignite the fuel and air mixture in the engine's cylinders. The diesel engine is a compression-ignition engine. It compresses the air in the cylinders, causing the temperature of the air to rise. Fuel injected into the hot, compressed air immediately ignites.

During the combustion process, the stored chemical energy in the fuel is converted to thermal, or heat, energy. The temperature in each cylinder rises as high as 2480 degrees C^{o} and creates pressures of 1,500 pounds per square inch. The pressure pushes against the tops of the pistons, forcing them to the other end of their cylinders. The pistons are connected by a rod or other mechanism to a crankshaft that they turn. In this way, a diesel engine supplies rotary power to drive vehicles and other machines.

Diesel engines have a high thermal efficiency, or ability to convert the stored chemical energy in the fuel into mechanical energy, or work.

Variant 2

Gasoline engine is an engine that uses gasoline as a fuel. Inside the engine, the combustion (burning) of fuel mixed with air produces hot gases that expand against parts of the engine and cause them to move. For this reason, gasoline engines are called internal-combustion engines. The motion inside the engine is transferred outside it to turn wheels and propellers

or to operate machines. In this way, a gasoline engine turns heat energy into mechanical work.

Gasoline engines are compact and light in weight for the power they produce. This makes them one of the most important types of engines for vehicles. Nearly all automobiles, lawn mowers, motorcycles, motor scooters, snowmobiles, and small tractors have gasoline engines. So do many trucks, buses, airplanes, and small boats. Gasoline engines may also be used as portable power plants – for example, to supply the power to run pumps and other machinery on farms.

Kinds of Gasoline Engines. There are two main types of gasoline engines, reciprocating engines and rotary engines. Reciprocating engines have pistons that move up and down or back and forth. A part called a crankshaft changes this reciprocating motion into rotary motion. A rotary engine uses devices called rotors instead of pistons. The rotors produce rotary motion directly.

Reciprocating gasoline engines are classified in a number of ways. These include (1) by the number of piston strokes per cycle, (2) by the type of compression, (3) by the way they are cooled, (4) by their valve arrangement, (5) by their cylinder arrangement, and (6) by the way they are supplied with air and fuel.

GLOSSARY

Engine / Двигатель

A

air filter (air cleaner)	воздушный фильтр

B

belt	ремень привода
BDC (bottom dead center)	нижняя мертвая точка

C

cam	кулачок
CAM camshaft	распределительный вал
CFI – Central Fuel Injection	центральный впрыск
choke	воздушная заслонка ("подсос")
CI	центральный впрыск
closed cycle gas turbine	газовая турбина с замкнутым циклом

G

gasoline engine	бензиновый двигатель
gudgeon pin	поршневой палец

H

heat engine	тепловой двигатель
heat exchanger	теплообменник
hose	шланг (патрубок)

I

ignition coil	катушка зажигания
ignition timing	установка угла опережения зажигания или впрыска топлива
injection	впрыск
inlet manifold	впускной коллектор
inlet valve	впускной клапан
intake	впуск
intake pipe	впускная труба
intake port	впускное отверстие
internal combustion engine	двигатель внутреннего сгорания

L

lubricunt	смазка

M

magneto	магнето
manifold	коллектор

N

net torque	крутящий момент

O

oil	масло
oil filter	масляный фильтр
open cycle gas turbine	газовая турбина с разомкнутым циклом
output shaft	выходной вал
overlap	перекрытие (клапанов)

P

pipe	трубка
piston	поршень
piston ring	поршневое кольцо
piston rod	шток поршня
pressure	давление
pump	насос

R

radiator	радиатор
reciprocating engine	возвратно-поступательный двигатель
reciprocating piston	поршень возвратно-поступательного хода
reed valve	пластинчатый клапан
room	камера
rotary (rotative) engine	роторный двигатель

S

seal	сальник
shaft	вал
sliding valve	золотник
spark plug	свеча зажигания
spark plug wire	провод свечи зажигания
spark ignition engine	двигатель с искровым зажиганием
sprockets	звездочки
stator	статор
steam engine	паровой двигатель
Steam turbine	паровая турбина
Stirling engine	экологически чистый, нетоксичный двигатель Стирлинга
stroke	ход поршня, такт

T

TDC (top dead center)	верхняя мертвая точка – крайнее верхнее положение, достигаемое поршнем в цилиндре ДВС

throttle	дроссель
timing belt	ремень привода газораспределительного механизма
timing gear	шестерня распредвала

V

valve	клапан

W

Wankel engine	роторно-поршневой двигатель, двигатель Ванкеля
water jacket	водяная рубашка двигателя
working fluid	рабочая жидкость

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