

UNIT 4

TYPES OF ENGINES

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| <p>STEP 1. Text A: Types of Engines
<i>Grammar Revision: The Present Indefinite Tense</i>
Text B: Internal Combustion Engines</p> <p>STEP 2. Text A: Diesel Engines
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STEP 1

TEXT A. TYPES OF ENGINES

PRE-TEXT EXERCISES

I. Read and translate the following international words and word combinations:

mechanical energy, tractor, motor, cycle, diesel, mobile, locomotive, cylinder, isolated.

II. Read and translate the following words. Pay attention to their semantics:

a) *to operate* – 1. оперувати 2. працювати

b) *number* – 1. номер 2. кількість

III. Don't mix up the English word “a machine” (*механізм, пристрій*) with a Ukrainian word “машина” у значенні “легковий або вантажний автомобіль”.

IV. Translate words with the same root:

a) to move – movement – moving

b) heat – to heat – a heater – heating (system)

c) to produce – a producer – production – producing – produced

d) to rotate – rotation – rotary

V. Read and remember:

1. **heat** – тепло

2. **convert** – перетворювати

3. **belong** – належати

4. **internal** – внутрішній

5. **operate** – працювати

6. **burn** – горіти

7. **reciprocation** – зворотно-поступальний рух

8. **maintain** – стискати

9. **output** – вихідна (потужність)

10. velocity – швидкість

VI. Read and translate the text:

TYPES OF ENGINES

The heat engine is a machine that converts heat energy to mechanical energy. The engines of motor-cars, motor-cycles, farm tractors, motor boats, etc. are heat engines, which belong to the subgroup of internal combustion engines. Most of modern automotive engines operate on four-stroke cycle. There are also engines which operate on two-stroke and six-stroke cycle.

A diesel engine is a machine which produces power by burning oil in a body of air which has been squeezed to a high pressure by a moving piston. Diesel engines are especially suitable where an independent source of power is required, as in ships, locomotives, mobile equipment of all sorts and isolated power plants.

Steam, gas and oil engines were known and used prior to the invention of the diesel engine. The steam engine converts the heat energy of steam to the mechanical energy. A typical steam reciprocation engine consists of a cylinder fitted with a piston. A connecting rod and crankshaft change the piston to-and-fro motion. The steam pressure on the piston varies during the stroke, and it is a flywheel which maintains a constant output velocity.

TEXT – BASED ASSIGNMENTS

LEXICAL EXERCISES

I. Read the following words and find the terms:

an engine, a cycle, to consist, a crankshaft, especially, to vary, a stroke, a piston, a cylinder, to change.

II. Find synonyms:

- | A | B |
|---------------|---------------|
| 1. an engine | a) to run on |
| 2. to operate | b) up-to-date |
| 3. types | c) to change |
| 4. modern | d) a motor |
| 5. to produce | e) kinds |
| 6. to vary | f) fuel |
| 7. oil | g) to make |

III. Give English equivalents:

двигун, такт, поршень, цикл, працювати, потужність, стискати, тиск, пар, шатун, колінчатий вал, маховик.

IV. Translate the following word combinations with the key words:

– “**engine**”: a heat engine, an internal combustion engine, modern automotive engines, a diesel engine, a steam engine, a gas engine, a typical steam reciprocation engine, the engines of motor-cars;

– “**stroke**”: the number of piston strokes, a four-stroke cycle, to vary during a stroke.

V. Complete the following sentences:

1. The engine of motor-cars and motor-cycles are 2. Combustion engines may be divided into 3. Most of modern automotive engines 4. Diesel engines are especially suitable 5. A typical steam reciprocating engine consists of

VI. Choose the correct word in brackets:

1. A heat engine is a machine that converts (steam/heat) energy. 2. Combustion engines may be divided into types according to the number of (piston strokes/crankshafts). 3. Diesel engines are suitable for (mobile/stationary) equipment. 4. The steam engine converts the heat energy of steam to the (electrical/mechanical) energy. 5. The steam pressure (varies/doesn't vary).

VII. Answer the questions:

1. What energy does a heat engine convert?
2. What subgroup do heat engines belong to?
3. What cycles do the most of modern automotive engines operate on?
4. What is a diesel engine?
5. Where are diesel engines used?
6. What does a typical steam reciprocation engine consist of?
7. What types of engines were known prior to the invention of the diesel engine?

VIII. Name the types of engines mentioned in the text.

IX. Translate the following sentences into English:

1. Існують різні типи двигунів. 2. Тепловий двигун перетворює енергію тепла в механічну енергію. 3. Теплові двигуни належать до підгрупи двигунів внутрішнього згоряння та використовуються в автомобілях, мотоциклах, тракторах. 4. Двигуни внутрішнього згоряння можуть бути поділені залежно від кількості тактів поршня. 5. Більшість сучасних автомобільних двигунів працюють у 4-х тактовому циклі. 6. Дизельні двигуни використовуються на кораблях, локомотивах, пересувному устаткуванні. 7. Двигуни, що працюють, використовуючи пару та газ, були відомі до винаходу дизельного двигуна.

X. Fill in the table using the information from the text:

Engine	Appliance
<i>diesel</i>	
<i>gas</i>	
<i>heat</i>	
<i>oil</i>	
<i>steam</i>	

GRAMMAR EXERCISES
(Grammar Revision: The Present Indefinite Tense)

XI. Use the verbs below in the Present Indefinite Tense, in the third person plural. Read and translate them:

to convert, to belong, to divide, to operate, to produce, to move, to require, to know, to consist, to fit.

XII. Give the infinitives of the following verbs:

burns, uses, changes, varies, means, repeats, completes, builds, compresses, expells.

XIII. Circle the sentences in the Present Indefinite Tense:

1. The heat engine converts heat energy to mechanical energy. 2. Steam, gas and oil engines were known and used prior to the invention of the diesel engines. 3. A diesel engine produces power by burning oil in a body of ail. 4. Air has been squeezed to a high pressure by a moving piston. 5. The steam engine converts the heat energy of steam to mechanical energy.

XIV. Ask your friend and let him answer:

- 1) if the engines of motor-cars belong to the subgroup of internal combustion engines;
- 2) if a diesel engine is a machine that converts heat energy to mechanical energy;
- 3) if most of modern automotive engines operate on two-stroke cycle;
- 4) if a cycle means the succession of operations in the engine cylinder;
- 5) if diesel engines are especially suitable where an independent source of power is required.

XV. Make the following sentences negative:

1. The engines of motor-cars belong to the subgroup of internal combustion engines. 2. Most of the modern automotive engines operate on four-stroke cycle. 3. A diesel engine produces power by burning oil in a body of squeezed air. 4. The steam engine converts the heat energy of steam to mechanical energy. 5. A typical steam engine consists of a cylinder filled with a piston.

XVI. Put questions to the italicized words:

1. The great majority of modern automotive engines operate on *four-stroke cycle*. 2. *Evacuation of the products of combustion* and *admission of a new charge* take place during the latter part of the expansion and the early part of the compression stroke. 3. The engines of *practically all mechanically propelled road vehicles* belong to that class of prime movers known as heat engines. 4. There are engines which operate on *two-stroke cycle*. 5. The steam engine *converts* the heat energy to mechanical energy.

XVII. Choose the necessary form of the verb in brackets:

1. The heat engine ... heat energy to mechanical energy (convert/converts). 2. Most of modern automotive engines ... on four stroke cycle (operate/operates). 3. A diesel engine ... power by burning oil in a body of squeezed air (produce/produces). 4. A moving piston ... air to a high pressure (squeeze/squeezes). 5. A typical steam engine ... of a cylinder fitted with a piston (consist/consists).

XVIII. Replace the infinitive in brackets by the verb in the Present Indefinite Tense:

1. A connecting rod and crankshaft (to change) the piston to-and-fro motion. 2. The steam pressure (to vary) during the stroke. 3. A flywheel (to maintain) a constant output velocity. 4. Evacuation of the products of combustion (to take place) during the latter part of the expansion. 5. There are engines which (to operate) on six-stroke cycle.

CONVERSATIONAL PRACTICE

XIX. Make up a dialogue to compare a car engine and a motorcycle engine. Use the following word combinations:

a car, a motorcycle, to have the difference, to have a radiator, an air-cooled engine, a water-cooled engine.

XX. Speak about different types of engines using the table below. Work in pairs:

Adjective	Noun	Verb
heat steam diesel	an engine	to convert to operate on to produce to be suitable for to consist of

WRITTEN PRACTICE

XXI. Compare different types of engines. Write down your arguments for and against each type.

TEXT B. INTERNAL COMBUSTION ENGINES

The engines of practically all mechanically propelled road vehicles, motorcycles, airplanes, farm tractors, motor boats and mobile industrial units belong to that class of prime movers known as heat engines and belong to the subdivision of which has been generally referred to as internal combustion engines (ICEs).

Combustion engines (**Fig.18**) may be divided into types according to the duration of the cycle on which they operate, in terms of piston strokes. By a cycle is meant the succession of operations in the engine cylinder, which constantly repeats itself. The great majority of modern automotive engines operate on the four-stroke cycle, usually referred to as the Otto cycle, which is completed in four strokes of the piston, or during two revolutions of the crankshaft. Engines are also being built to operate on a cycle, which is completed in two piston strokes. In this cycle a combustible gaseous mixture is compressed in the cylinder during the outward stroke of the piston and burned and allowed to expand during the following inward stroke. Evacuation of the products of combustion and admission of a new charge take place during the latter part of the expansion and the early part of the compression stroke. Since there is no separate exhaust stroke, the burnt gases cannot be expelled from the cylinder by a pumping action of the piston therein. The burnt gases must be blown out by either fresh air or combustible mixture, a process known as scavenging. Two-stroke engines with scavenging by combustible mixture are used only in small units.

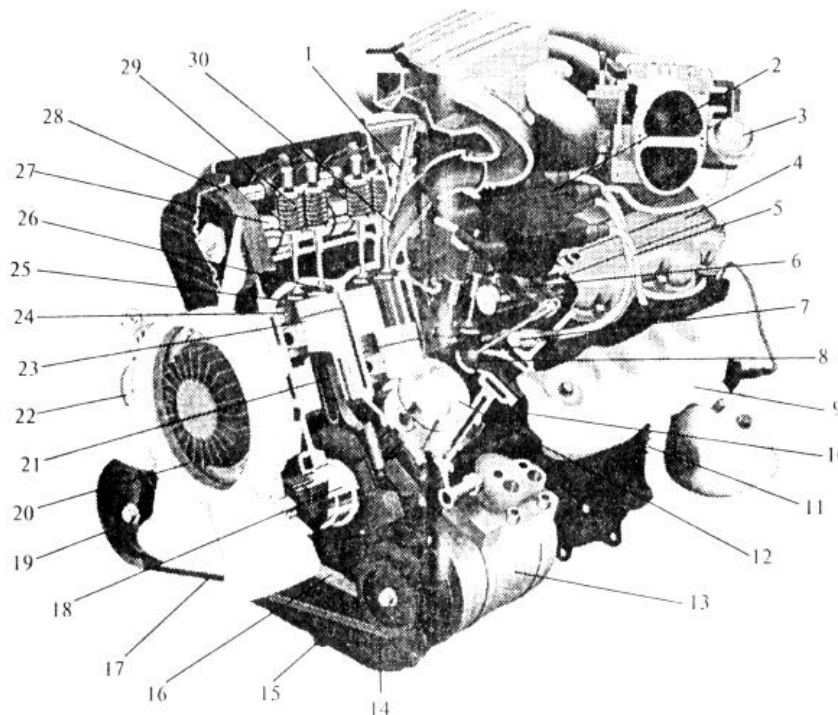


Fig.18. A gasoline engine

- | | |
|---------------------|------------------------|
| 1 – injector | 6 – inlet valve |
| 2 – intake manifold | 7 – combustion chamber |
| 3 – valve spring | 8 – ring |
| 4 – timing belt | 9 – piston skirt |
| 5 – camshaft | 10 – alternator |

11 – connecting rod	21 – flywheel
12 – cooling fan	22 – engine block
13 – pulley	23 – exhaust manifold
14 – crankshaft	24 – exhaust valve
15 – fan belt	25 – spark plug
16 – oil pan gasket	26 – rocker arm
17 – oil drain plug	27 – spark plug cable
18 – oil pan	28 – cylinder head cover
19 – air conditioner compressor	29 – vacuum diaphragm
20 – piston	30 – distributor cap

EXERCISES

I. Give your understanding of the term “The Internal Combustion Engine”.

II. Read the text and write down the main idea of the text.

III. Find out the words with several meanings.

IV. Look through the text again and put 5 questions of your own on the text.

V. Prepare to speak on the following subjects:

- fields where ICEs are used
- types of combustion engines
- evacuation of the products of combustion

VI. Render the text in Ukrainian.

VII. Write down a summary of the text using the following expressions:

Data are given about ...
 It is known that ...
 ... is dealt with ...
 ... is formulated ...
 Attention is drawn to ...
 ... is described in short ...
 It is known ...
 Attempts are made to analyze ...

STEP 2

TEXT A. DIESEL ENGINES

PRE-TEXT EXERCISES

I. Translate the following international words:

diesel, form, cylinder, carburettor, compression, energy, product, process.

II. Give the meanings of the following words:

oil, fine, charge.

III. Translate the words with the same root:

a) to inject – injection – an injector

- b) to compress – compression – a compressor
 c) to ignite – ignition – ignition (system) – ignited

IV. Read and memorize:

1. **inject** – впорскувати
2. **spray** – розбризкувати
3. **arrangement** – розташування
4. **connecting rod** – шатун
5. **crank** – кривошип
6. **valve** – клапан
7. **plug** – запальна свічка
8. **pump** – насос, помпа
9. **nozzle** – форсунка, сопло
10. **ascending** – що, піднімається

V. Read and translate the text:

DIESEL ENGINES

A diesel engine is that type of internal-combustion engine which injects fuel oil in a finely divided spray into a cylinder within which air has been compressed to a high pressure and temperature.

A diesel engine (**Fig. 19**) has the usual arrangement of the cylinder, piston, connecting rod, crank, inlet and exhaust valves as we find in a petrol engine. In place of a carburettor and a sparking plug it has an injection pump and a fuel injection valve (injector). Unlike spark-ignition engines it uses the heat of compression to fire the fuel and is, therefore, called compression-ignition engine (CI). Why do we call a compression-ignition engine by the name “diesel”? A man whose name was Rudolf Diesel originated in Germany and obtained patents in 1892 on a high-compression, self-ignition engine originally intended to burn powdered coal.

A diesel engine utilizes the fuel known as diesel oil, which is forced in the form of a fine spray through a suitable nozzle directly into the combustion space. No mixture of fuel and air is introduced into the cylinder, the compression-ignition engine draws in pure air only. This air is then compressed by the ascending piston to a high pressure. As a result of it the temperature of the air is raised considerably so that the fuel oil injected into the cylinder ignites rapidly. The temperature of the air is high enough to ignite the particles of the injected fuel; no other means are used for ignition. Because of this method of ignition, diesel engines are sometimes called compression-ignition engines, this sets them apart from other internal-combustion engines called spark-ignition engines. These later engines use gasoline or gas as fuel, and the mixture of fuel and air is ignited by an electric spark.

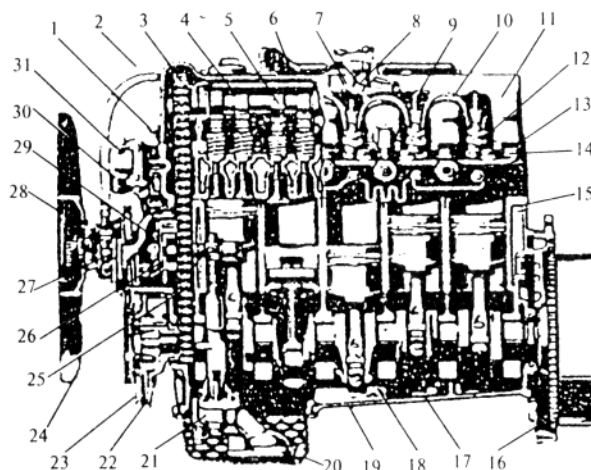


Fig. 19. Sectional view of five-cylinder in line diesel engine

1 – exhaust valve
2 – camshaft bearing
3 – double bushing chain
4 – oil filler neck
5 – camshaft, an overhead camshaft
6 – oil pipe for camshaft lubrication
7 – warm-up regulator
8 – tapered needle for idling adjustment
9 – fuel pressure pipe (fuel pressure line)
10 – fuel leak line (drip fuel line)
11 – cylinder head gasket
12 – injection nozzle (spray nozzle)
13 – cylinder head
14 – heater plug
15 – piston with piston rings and oil scraper ring
16 – flywheel

17 – crankshaft
18 – connecting rod (piston rod)
19 – crankcase
20 – oil bleeder screw (oil drain plug)
21 – oil pump
22 – thrust washer
23 – vibration damper
24 – fan
25 – intermediate gear shaft for the injection pump drive
26 – injection timer unit
27 – vacuum pump (low-pressure regulator)
28 – fan clutch for viscous drive
29 – cam for vacuum pump
30 – water pump (coolant pump)
31 – cooling water thermostat

TEXT-BASED ASSIGNMENTS

LEXICAL EXERCISES

I. Compile as many words as you can of the letters of the word “compression”.

II. Write down the noun-terms from the text.

III. Give English equivalents:

впорскувати, стискати, використовувати, піднімати, запалювати.

IV. Translate the following word combinations with the key words:

– “**engine**”: a diesel engine, an internal combustion engine, a petrol engine, a spark-ignition engine, a compression-ignition engine;

– “**air**”: no mixture of fuel and air, to drive in pure air, the temperature of the air;

– “**inject, injection**”: to inject fuel oil, an injection pump, a fuel injection valve, to inject into the cylinder, the particles of the injected fuel.

V. Make up word combinations of your own with the words from Exercises II, III.

VI. Translate the words and word combinations to describe the five-cylinder in line diesel engine (Fig. 19).

VII. Complete the following sentences:

1. A diesel engine injects
 2. A diesel engine uses
 3. Rudolf Diesel is
 4. The temperature of the air is
 5. Compression-ignition engines are sometimes called
 6. Diesel oil is injected
 7. Spark-ignition engines belong to
- a) an inventor of the diesel engine
 - b) high enough to ignite particles of the injected fuel
 - c) fuel into the cylinder
 - d) diesel engines
 - e) the fuel known as diesel oil
 - f) the internal combustion engines
 - g) in a finely divided spray

VIII. Correct the statements if necessary using the introductory phrases: *I disagree with you, I don't share your point of view, Your statement is not correct, you are wrong, you're mistaken:*

1. A diesel engine belongs to the group of internal combustion engines. 2. The fuel is not injected in a finely divided spray into a cylinder. 3. Diesel engines have neither injection pumps nor fuel injection valves. 4. Diesel oil is utilized in a diesel engine. 5. Henry Ford obtained patents on a high-compression, self-ignition engine.

IX. Translate the following sentences into English:

1. Дизельний двигун належить до групи двигунів внутрішнього згорання. 2. У дизельному двигуні паливо подається до циліндру у добре розпилюваному стані. 3. Дизельний двигун має звичайне розташування циліндру, поршня, шатуну, впускного та випускного клапанів. 4. Рудольф Дизель є автором дизельного двигуна. 5. У 1892 році він запатентував двигун з високим рівнем стискання та самозапалюванням.

X. Read the text, give it a title, write down the main components mentioned in the text and translate them.

To compress the air, put in the oil, and produce power, every diesel engine must have certain basic parts. It must have a round sleeve, or a cylinder, in the bore of which a close-fitting plug or a piston can slide in and out to make strokes. The piston must be connected to a mechanism, which controls its sliding. For this purpose ordinary engines use a crank mechanism. This consists of first, round bar or shaft, which can turn or revolve in circular guides, called bearings and which has an offset or a crank (which turns in a circle when the shaft revolves), and, second, a connecting rod which, as the name implies, connects the crank to the piston. The connecting rod is a straight rod with a bearing at each end. The crank mechanism (which is also used in many other kinds of machinery) is a device for converting the in-and-out motion of the piston to rotating motion of the crankshaft. The power produced by the engine is taken off the crankshaft.

Other basic parts are also necessary. Valves or ports are needed to let the air into the cylinder, and also to let out the burned or spent gases after they have done their work. Also a spray nozzle, or a fuel injector, is needed to deliver the oil for burning in the form of a finely divided spray (it works something like the nozzle on a garden hose). To do this the oil must be put under pressure. This is accomplished by a pump which is called a fuel-injection-pump.

GRAMMAR EXERCISES

(Grammar Revision: The Past Indefinite Tense)

XI. State what verbs are regular and irregular:

to run, to use, to make, to produce, to distinguish, to have, to evaporate, to feed, to draw, to mix.

XII. Put the following verbs in the Past Indefinite Tense:

to ignite, to limit, to get, to stop, to find, to fire, to know, to call, to set, to obtain.

XIII. Give the infinitive of the following verbs:

drew, utilized, forced, was, originated, burnt, compressed, made, needed, get.

XIV. Make the following sentences negative:

1. Rudolf Diesel obtained patents in 1892 on a high-compression, self-ignition engine. 2. The brilliant mechanic Ivan Polzunov built a steam engine in Russia in 1795. 3. Thomas Saverly made the earliest steam engine in 1698. 4. Long ago people noticed that steam had the power of moving things. 5. Engineering thought turned to the possibility of using steam for the purpose.

XV. Put questions to the italicized words:

1. Long ago people began to wonder *how steam could be made to work for them*. 2. People used *the first steam engines* in pumping mines and in raising water to supply houses and towns. 3. *The*

first steam engines had some drawbacks. 4. The Frenchman Denis Papin *improved* drawbacks of the first steam engines. 5. The growing *coalmining* industry needed a means for raising water from mines.

XVI. Replace the infinitive in brackets by the verb in the Past Indefinite Tense:

1. Rudolf Diesel (to originate) a high-compression, self-ignition engine to burn powdered coal. 2. A philosopher of Alexandria, Hero (to make) the first steam-engine. 3. The English mechanic Thomas Newcoman (to combine) the ideas Saverly and Papin. 4. Thomas Newcoman (to design) an engine not only to pump water, but to drive other machinery. 5. The Polzunov's steam engine (to have) two cylinders.

CONVERSATIONAL PRACTICE

XVII. Give the situation from the text in which the following words and word combinations are used:

fuel, diesel oil, to be forced, a fine spray, to draw in pure air, to be compressed by ascending piston, to ignite rapidly.

XVIII. Prove that a diesel engine is named after a German inventor Rudolf Diesel.

XIX. Ask your group mates questions on the text concerning

- a) the arrangement of a diesel engine
- b) the process taken place in a cylinder of a diesel engine
- c) Rudolf Diesel's achievements

WRITTEN PRACTICE

XX. Write down a short story about a diesel engine.

TEXT B. DIESEL AND GASOLINE ENGINES: PROS AND CONS

Both types of engines run on liquid fuels. In certain special cases they even use exactly the same fuel. Gasoline engines have been made to run on kerosene, and so have diesel engines. Gasoline, kerosene, and diesel oil are all produced from natural petroleum (crude oil), and are distinguished mainly by their volatility, that is, the ease with which they can be changed from a liquid to a vapour state. Gasoline is quite volatile, that is, it evaporates at a low temperature. Kerosene needs more heat to make it vaporize, while diesel oil requires still more heat. Both types of engines are internal-combustion engines, that is, they burn the fuel inside their cylinders. Most gasoline engines and many diesel engines work on the four-stroke cycle, that is, the piston makes a suction stroke (down), a compression stroke (up), a power stroke (down), and an exhaust stroke (up).

What, then, are the main differences between diesel engines and gasoline engines? A diesel engine has no ignition system – it has no spark plug fed with high-tension electricity from a distributor, a spark-coil, a timer and a battery, or from a magneto. None of this is needed on a diesel engine because the fuel is ignited simply by contact with very hot air which has been highly compressed in the cylinder. Diesel engine draws into its cylinder air alone, and it compresses this air on its compression stroke before any fuel enters the cylinder. On the other hand, a gasoline engine mixes air with fuel in a carburettor outside the cylinder before it enters the engine through the inlet valve during the suction stroke.

Diesel engines use greater compression than gasoline engines. In a gasoline engine the amount of compression or compression ratio that can be used is strictly limited, because fuel as well as air is being compressed. If the combustible fuel-air mixture is compressed too much, it gets so hot that it

will ignite by itself. In other words the mixture will pre-ignite before the piston has completed its compression stroke, and will try to stop the piston. Even a little more compression than the right amount will cause detonation or knocks because some of the mixture burns all at once before the flame from the spark gets to it. A mixture of a certain amount of fuel and air will produce more power the more it has been compressed. Therefore the efficiency of a gasoline engine, that is the amount of power produced from a certain amount of fuel, is limited by the permissible compression ratio, which is about 7 to 1 (or a little more if highly leaded premium gasoline is used).

The compression in a diesel engine is not limited by the possibility of pre-ignition because a diesel engine compresses air only. Therefore, diesel engines use compression ratios of about 16 to 1, and so achieve greater efficiency in the use of fuel.

Diesel engines use less volatile, heavier liquid fuels than gasoline engines. These heavier fuels are generally cheaper than gasoline. Gasoline engines must use this highly volatile fuel because only fuel which evaporates at low temperature will form a uniform mixture with the rapid current of air flowing through the carburettor.

EXERCISES

I. Read the text B and suggest other titles for the text. Express its main idea.

II. Divide the text into logical parts, entitle them and write down special terms.

III. Put 7 questions of your own on the text.

IV. Give arguments for

- a diesel engine
- a gasoline engine

V. Give arguments against

- a diesel engine
- a gasoline engines

VI. Compare a diesel and gasoline engine. Filling in the table:

Items	A Diesel Engine	A Gasoline Engine
<i>Fuel</i>		
<i>Cycle</i>		
<i>Ignition system</i>		
<i>Compression ratio</i>		

VIII. What type of engine do you prefer: diesel or gasoline? Give your reasons.

IX. Formulate problems to discuss.

X. Read the text, entitle it and answer the following question “Where are petrol and diesel engines used?”:

The two most common types of engines are the petrol engine and the diesel engine. Petrol engines are lighter and smaller than diesel engines. That makes them cheaper, and that is why most cars and motorbikes use petrol engines. On the other hand, diesel engines use less fuel and last longer than petrol engines. They are also safer and less dangerous. They are widely used in large vehicles such as trucks and trains.

STEP 3

TEXT A. STEAM AND AIR-COOLED ENGINES

PRE-TEXT EXERCISES

I. Translate the following international words:

philosopher, patent, industry, mechanic, idea, pump, action, radiator, method, cylinder, transmission, design.

II. While translating the text pay attention to “a false friend” of a translator:

brilliant – “видатний”, а не “діамант”.

III. While translating the text pay attention to the semantics of the following words:

a) power – 1. сила 2. потужність 3. влада

b) to operate – 1. оперувати 2. працювати

IV. Translate words with the same root:

a) to invent – invention – an inventor – inventing – invented

b) to cool – cooled – cooling (system)

c) a pump – to pump – pumping (action) – (for) pumping (water)

V. Read and remember:

1. **device** – пристрій, прилад

2. **drawback** – недолік

3. **machinery** – машини, механізми

4. **cool** – охолоджувати

5. **transmit** – передавати

6. **accomplish** – виконувати

7. **distribute** – розподіляти

8. **surface** – поверхня

9. **aircraft** – літак

10. **maintenance** – технічне обслуговування

VI. Read and translate the text:

STEAM AND AIR-COOLED ENGINES

Steam engines. Long ago people noticed that steam has the power of moving things, and they began to wonder how steam could be made to work for them. The first steam-engine was made in ancient Egypt by Hero, a philosopher of Alexandria.

The first steam-engine to do useful work was patented in England. The growing coalmining industry was in need of a means for raising water from mines, more efficient than manual or horse-drawn devices. So engineering thought turned to the possibility of using steam for the purpose.

The earliest steam-engine made by Thomas Saverly 1698 was used quite extensively in pumping mines and in raising water to supply houses and towns. But it had some drawbacks which were improved by the Frenchman Denis Papin who was also the inventor of the piston.

The next step forward was made by the English mechanic Thomas Newcoman, who combined the ideas of Saverly and Papin, designing an engine that could be used not only to pump water, but also to drive other machinery.

An ever better steam engine was built in Russia in 1795 by the brilliant mechanic Ivan Polzunov. One of the reasons why it was better was that it could be used for many purposes and not

just for pumping water. Besides, it had 2 cylinders. Hence while the piston in one was going down, the piston in the other was rising. It was therefore the first continuous-action engine.

Air-cooled engines. All vehicle engines are air-cooled to some degree. Even in water-cooled engines heat is transmitted first from a cylinder to water and afterwards, in the radiator, from water to air. This method of cooling is not difficult to accomplish, because the heat taken off the hot cylinder walls by water can be distributed without difficulty upon the large cooling surface of the radiator, and so easy transmission of heat to air is made possible.

Reciprocating engines used in aircraft are almost entirely air-cooled. Aircraft engines cooled by air are manufactured today in sizes ranging from 50 to 3500 hp and they superseded water-cooled engines. The principal advantages of air-cooled aircraft engines are low weight, and greater reliability in operation. Modern motor-cycles are also designed almost exclusively with air-cooled engines. New designs of air-cooled vehicle engines are notable for their easy maintenance, reliability and economical operation.

TEXT-BASED ASSIGNMENTS

LEXICAL EXERCISES

I. Find synonyms:

A	B
1. to begin	a) to do
2. afterwards	b) disadvantages
3. to make	c) aim
4. to use	d) to construct
5. drawbacks	e) an automobile
6. to build	f) to start
7. down	g) to apply
8. a vehicle	h) then
9. to work	i) up
10. purpose	j) to operate

II. Give English equivalents:

пара, потужність, двигун, циліндр, поршень, вага, охолоджувати, транспортний засіб, тепло, поверхня, кінська сила, надійність.

III. Translate the following word combinations with the key words:

– **“engine”**: a steam engine, an air-cooled engine, to design an engine, an ever better steam engine, the first continuous-action engine, all vehicle engines, water-cooled engines, reciprocating engines, aircraft engines, water-cooled engines;

– **“heat”**: to transmit heat, to take heat off the hot cylinder walls, easy transmission of heat to air.

IV. Choose the necessary word or word-combination:

- Polsunov built
 - a steam engine
 - an air-cooled engine
 - a gasoline engine
- Hero lived in
 - Germany
 - Russia
 - Egypt
- Denis Papin was an inventor of
 - a cylinder
 - a combustion chamber
 - a piston

4. Thomas Newcoman was
 a) a doctor
 b) a mechanic
 c) a driver
5. An ever better steam engine was built in
 a) 1698
 b) 1700
 c) 1795

V. Complete the following sentences:

1. The first steam-engine was made by 2. Hero is 3. Thomas Saverly made 4. The inventor of the piston is 5. In water-cooled engines heat is transmitted 6. The principal advantages of air-cooled engines are 7. New designs of air-cooled vehicle engines are

VI. Answer the questions:

1. Who made the first steam engine?
2. What did steam engineering thought turn to?
3. Where were steam engines used?
4. What did Denis Papin invent?
5. What engine did Thomas Newcoman invent?
6. What was Ivan Polzunov?
7. What was the first continuous-action engine?

VII. Ask your group mates questions on the text concerning:

- method of cooling in water-cooled engines
- air-craft engines
- advantages of new air-cooled engines

VIII. Fill in the table according to the text:

Name	Invention
<i>Hero</i>	
<i>Thomas Newcoman</i>	
<i>Denis Papin</i>	
<i>Ivan Polzunov</i>	
<i>Thomas Saverly</i>	

IX. Translate from Ukrainian into English:

1. Двигуни усіх транспортних засобів в певній мірі мають повітряне охолодження. 2. У двигунах з водяним охолодженням тепло передається від циліндра до води, а потім в радіаторі від води у повітря. 3. Двигуни, що використовуються в авіаційній промисловості, також мають повітряне охолодження. 4. Головні переваги авіаційних двигунів з повітряним охолодженням наступні – невелика маса та висока надійність під час роботи. 5. Перший паровий двигун був збудований в Єгипті Героном, філософом з Олександрії. 6. Перший паровий двигун, який виконував корисну роботу, був запатентований в Англії. 7. У 1795 році російський механік Іван Ползунов збудував більш удосконалений паровий двигун.

GRAMMAR EXERCISES
(Grammar Revision: The Future Indefinite Tense)

X. Put the italicized verbs into the Future Indefinite Tense:

1. Engines *run*. 2. He *originated*. 3. Mixture *gets*. 4. They *made*. 5. It *forced*. 6. She *uses*. 7. We *did*. 8. I *knew*. 9. It *has*. 10. You *set*.

XI. Make the following sentences negative:

1. Even a little more compression than the right amount will cause detonation. 2. A mixture of a certain amount of fuel and air will produce power. 3. Diesel engines will use less volatile, heavier liquid fuels than gasoline engines. 4. The mixture will pre-ignite before the piston has completed its compression stroke. 5. A magnet will attract certain metals.

XII. Put questions to the italicized words:

1. *This device* will transform thermal power into a mechanical power of rotation. 2. The use of solar power will not harm *the environment*. 3. The development of an engine *driven by solar power* will make it possible to make power generation cheaper. 4. If the rotor is heated, the other side of the rotor *will turn* towards the magnet. 5. The magneto-heat engine will drive pumps *in waterless districts*.

XIII. Choose the necessary form of the verb in brackets:

1. Long ago ancient people ... that steam has the power of moving things (notice, will notice, notices, noticed). 2. Now most of the automotive engines ... on four-stroke cycle (will operate, operated, operates, operate). 3. In the near future the magneto-heat engines... greenery in cities and settlements (waters, will water, watered, water). 4. In 1892 Diesel ... patents on a high-compression, self-ignition engine (will obtain, obtains, obtain, obtained). 5. A new magneto-heat engine ... on this principle (works, worked, work, will work).

XIV. Put the infinitives into the correct tense-form:

1. In the future air-cooled engines (to supersede) water-cooled engines. 2. Many years ago engineering thought (to turn) to the possibility of using steam for the purpose. 3. Gasoline (to vaporize) at a low temperature. 4. Soon some devices (to make) it possible to apply the idea of direct use of solar power. 5. The Russian mechanic Ivan Polzunov (to build) a steam engine in 1795.

CONVERSATIONAL PRACTICE

XV. Prove that all vehicle engines are air-cooled to some degree.

XVI. Discuss in pairs the development of the steam engine in progress.

WRITTEN PRACTICE

XVII. Write down the drawbacks of the steam engine.

TEXT B. SUN-DRIVEN ENGINES

It is common knowledge that certain metals and their alloys are attracted by a magnet. After heating, this property vanishes and it is restored after cooling down. A new magneto-heat engine works on this principle. This invention relates to device which transforms thermal power, for instance, the power of the rays, into a mechanical power of rotation.

We know that solar power is inexhaustible and its use does not harm the environment. That is why such importance is attached to the devices which make it possible to apply the idea of direct use of solar power, transforming it into mechanical forms of power. The development of an engine directly

driven by a heat source such as solar power makes it possible to simplify and make power generation considerably cheaper, in comparison with the existing thermal engines we use today. The rotor of the engine is made of an alloy that loses its magnetic properties already at 100 C. If the rotor is heated on one side, the other side of the rotor will turn towards the magnet. Since heating continues, the rotor goes on rotating too. Thus solar power can be used as a source of heat in this watering greenery in cities and settlements.

EXERCISES

I. What does the title of the text suggest?

II. Read the text and give the main idea of it.

III. Find out word combinations which describe the principle on which a sun driven-engine operates.

IV. Comprehension questions:

1. What principle does a magneto-heat engine work on?
2. What energy is solar energy transformed into?
3. Does a sun-driven engine harm the environment?

V. Speak about the advantages of using solar energy.

VI. Give examples of using a magneto-heat engine.

VII. Enlarge upon the drawbacks of the sun-driven engines.

REVISION

I. Find synonyms:

- | A | B |
|------------------|-----------------|
| 1. to operate | a) kinds |
| 2. disadvantage | b) to change |
| 3. types | c) to ignite |
| 4. fuel | d) to construct |
| 5. to vary | e) drawbacks |
| 6. to burn | f) aim |
| 7. to make | g) to vaporize |
| 8. to build | h) oil |
| 9. purpose | i) to do |
| 10. to evaporate | j) to work |

II. Give English equivalents:

двигун, поршень, циліндр, клапан, такт, паливо, шатун, тиск, цикл, потужність, колінчатий вал, маховик, запальна свічка, кривошип, насос, форсунка.

III. Translate the following verbs. Define what verbs are terms:

to convert, to transmit, to like, to run on, to squeeze, to understand, to produce, to compress, to burn, to pump, to ignite, to illustrate, to inject, to vaporize, to read, to write.

IV. Translate words with the same root:

- a) heat – to heat – a heater – heating (system)

- b) to produce – a producer – production – produced – producing
- c) to rotate – rotation – rotary
- d) to move – movement – moving
- e) to inject – an injector – injection – injected – injecting
- f) to compress – compression – a compressor
- g) to ignite – ignition – ignition (system) – ignited – igniting
- h) a pump – to pump – pumping (action) – (for) pumping (water)

V. Choose the correct word:

1. The engine, used in a standard gasoline car, is called internal combustion engine because the combustion and movement produced take place inside the (cycle, cylinder, turbine). 1. The (spark plug, crankshaft, piston) moves up and down in the combustion chamber during a 4-stroke cycle. 3. The (spark plugs, fuel pump, fuel pipe) ignite the fuel mixture producing high pressure. 4. The (exhaust, expanding, compressing) gases force the piston downward. 5. Combustion is the process by which things (burn, mix, rotate). 6. Three things are required for combustion: air, (carbon, alloy, fuel), an ignition source. 7. All internal combustion engines breathe air, burn fuel and produce mechanical (flow, power, temperature) and also exhaust gases.

VI. Supply the definitions for the following:

- 1. A heat engine is
- 2. A steam engine is
- 3. A gasoline engine is
- 4. A diesel engine is
- 5. An internal combustion engine is
- 6. An air-cooled engine is
- 7. A sun-driven engine is

VII. Fill in the table:

Engine	Appliance
<i>Air-cooled</i>	
<i>Diesel</i>	
<i>Gas</i>	
<i>Gasoline</i>	
<i>Internal Combustion</i>	
<i>Steam</i>	
<i>Sun-driven</i>	

VIII. Make up your own sentences using words of Exercises I, II, III, IV.

IX. Comment on the principle on which the following types of engines work:

- steam
- air-cooled
- diesel
- sun-driven
- gasoline

X. Speak about Skoda Octavia's crank gear (Fig. 20):

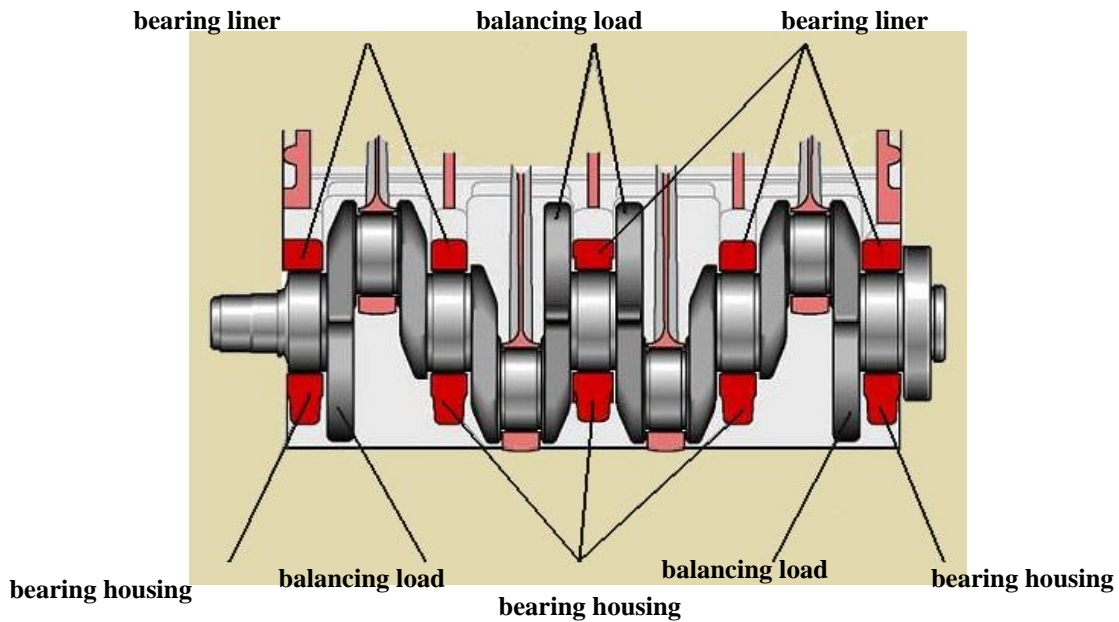


Fig. 20. Skoda Octavia's crank gear (engine 1,4 l / 55 kW and 74 kW)

XI. Imagine that you have an opportunity to buy a car. Which type of engine would you choose? Give at least 5 advantages of this type to explain your choice. You may use the following adjectives: revolutionary, reliable, durable, successful, original, famous, efficient, cheap.

XII. Read the text, entitle it and answer the following question: "What are advantages of gasoline engines?"

The automobile engine uses gasoline as a fuel. Other types of engine, for example, those used in tractors, trucks, and buses, may use kerosene, distillate alcohol, or fuel oil. Some European countries require that a certain percentage of alcohol be used in gasoline for the automobile engine.

Gasoline is a hydrocarbon, since it is made up of hydrogen and carbon compounds. Petroleum, or crude oil, is put through a refining process by which the gasoline is distilled out. Various oil fields produce petroleum that will give gasoline different characteristics. The procedures of refining are also responsible for variations in gasoline. The gasoline that is used in automobiles is a blend of various types of gasoline. As the proportions of these various types are changed, fuels of different operating characteristics are obtained. Volatility, anti-knock value and freedom from harmful chemicals and gum formations are considered to be the best characteristics of gasoline.

XIII. Name the basic fuels that vehicles use. What are their chemical elements?

XIV. Your friend is an expert on fuels. Ask him questions about various types of fuels and their composition. Which type of fuel (methanol, diesel, petrol, gas, liquid hydrogen) is suitable for the following vehicles: racing cars, passenger cars, motorcycles, lorries, buses?