

SHAPING MATERIALS

UNIT 1 • THE INTERNAL COMBUSTION ENGINE

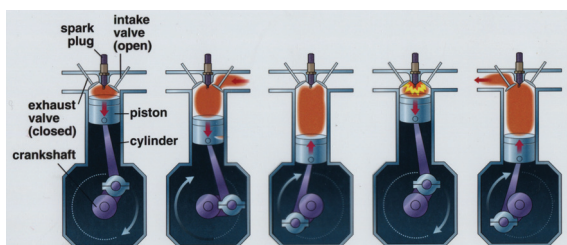


1

Read the following summary on the four-stroke internal combustion engine and fill in the blanks with the words in the box.

any • compression • continuously • crankshaft • cylinders • differs
 • does • in • injected • internal • Power • reciprocating • require • revolutions
 • rotating • spark • temperature

The four strokes of the (1) combustion engine are: Intake, Compression, (2) and Exhaust. These four strokes (3) two revolutions of the crankshaft. The process (4) repeats itself during the operation of the engine. A four-cylinder engine requires two complete (5) of the crankshaft to ignite all of its (6), exactly as an eight-cylinder piston does: it only takes two revolutions of the (7) to fire all of the cylinders of any four-stroke engine. The connecting rod converts the (8) motion (up and down) of the piston to the (9) motion of the crankshaft. The Diesel engine (10) from the gasoline engine in that the intake stroke only pulls (11) air, not air and fuel. The fuel is (12) into the cylinder at the end of the (13) stroke. The fuel burns immediately without the use of a (14) plug because of the high (15) of air in the cylinder.





2

Revise the main differences between diesel and gasoline engines; put a tick (✓) in the right column.

DISTINGUISHING FEATURES	DIESEL	GASOLINE
4-stroke cycle		
2-stroke cycle		
during intake stroke, gasoline and air are drawn into the cylinder		
during intake stroke, only air is drawn into the cylinder		
compression ratio is from 8:1 to 12:1		
compression ratio is from 14:1 to 25:1		
external ignition device		
combustion-ignition process		
fuel is mixed with air before entering the cylinder		
fuel is injected directly into the cylinder near top dead centre		



3

Listen to the passage and take notes of the advantages and disadvantages of diesel engines compared to gasoline engines.

Diesel engines are more efficient than gasoline ones, have better fuel economy and a longer life but they haven't played a significant role in the automotive marketplace for a long time, because of some "historical" problems.

Detractors, in fact, say that the higher compression ratio makes diesel engines much heavier than gasoline engines. Besides, higher weight and compression ratio cause lower maximum RPM ranges: diesel engines have high torque rather than high horsepower and they tend to give slow acceleration.

They can be harder to start in cold weather and are much noisier, with higher levels of vibrations and smoke emissions. Finally, diesel engines tend to be more expensive than gasoline ones: their good fuel economy and long life outweigh the initial cost only a long time after purchase. As a matter of fact, most of these disadvantages are now being eliminated in new diesel models, with improved performance and reduced cost thanks to continuous research and advanced computer control systems.

ADVANTAGES	DISADVANTAGES
<ul style="list-style-type: none"> 	<ul style="list-style-type: none">

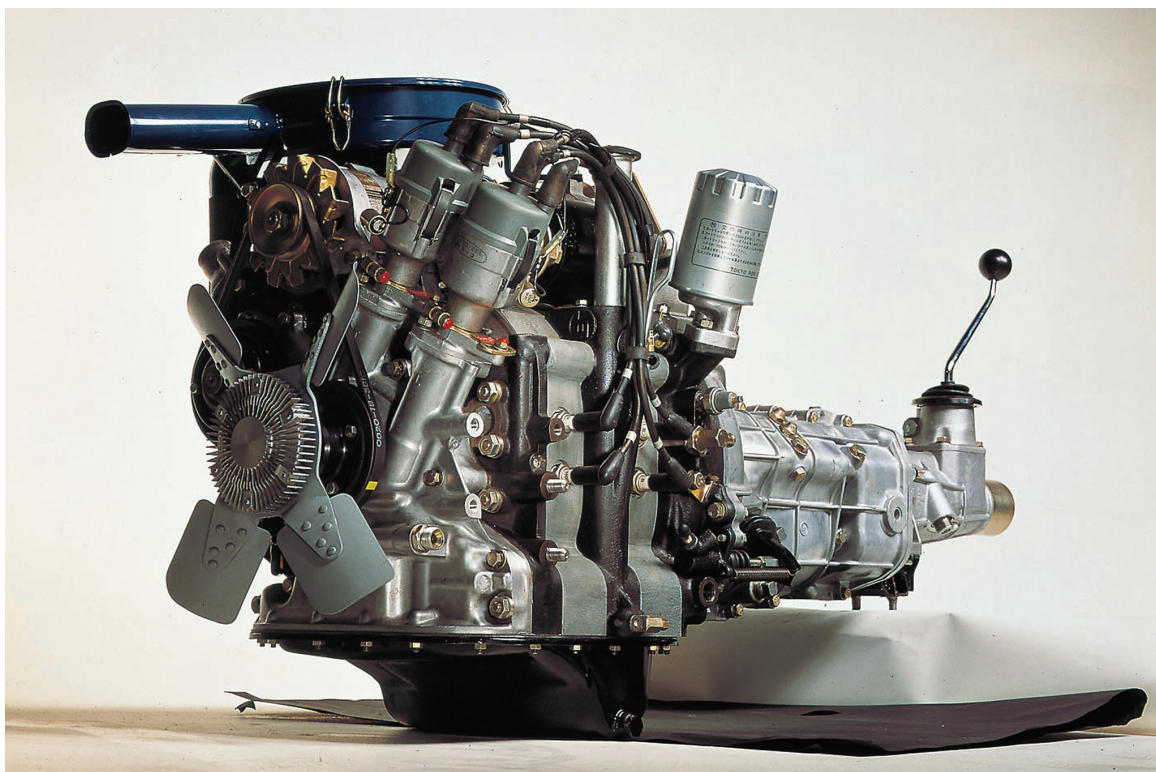


4

Read the text and decide if the following statements are true (T) or false (F). Correct the false statements.

The rotary engine is a type of internal combustion engine that uses a rotary design to convert pressure into a rotating motion instead of using reciprocating pistons. It was developed by the German engineer Felix Wankel; in 1929 he received his first patent for its innovative engine, then he began development in the early 1950s and finally he completed a prototype in 1957. Later, the concept was licensed to several companies around the world and the engine's design was continuously improved. This engine runs on a four-stroke cycle and offers various advantages: it is much smaller and less bulky than a reciprocating engine and it can be installed in a variety of vehicles and devices such as automobiles, aircraft, go-karts, chain-saws or auxiliary power units. Besides, advanced pollution control devices tend to be designed more easily for rotary engines than for conventional piston engines; finally, rotating engines ensure higher engine speeds but, unfortunately, this advantage is negatively influenced by the lack of torque at low speeds, leading to greater fuel consumption.

- | | T | F |
|--|--------------------------|--------------------------|
| a. The Wankel engine relies on reciprocating motion. | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Felix Wankel completed his prototype in 1929. | <input type="checkbox"/> | <input type="checkbox"/> |
| c. A lot of companies around the world were given the licence to send the Wankel engine into production. | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Changes to the prototype were never allowed. | <input type="checkbox"/> | <input type="checkbox"/> |
| e. The rotary engine is a four-stroke internal combustion engine. | <input type="checkbox"/> | <input type="checkbox"/> |
| f. Rotary engines are usually equipped with advanced pollution control devices. | <input type="checkbox"/> | <input type="checkbox"/> |
| g. Higher engine speeds result in greater fuel consumption. | <input type="checkbox"/> | <input type="checkbox"/> |



UNIT 2 • PRESENT TRENDS



1 Find the questions for the following answers.

- a. ?
It is a fuel-delivery system for internal combustion engines.
- b. ?
The exact quantity of fuel needed is sprayed into cylinders through electronically-controlled fuel injectors. Fuel is sent to injectors by a pump, connected to a storage tank.
- c. ?
Injectors usually consist of a nozzle, a needle valve blocking the opening in the nozzle and a compression spring.
- d. ?
It means atomizing it, that is, changing it into a cloud of tiny droplets.
- e. ?
Fuel delivery is regulated through a computer system which handles data on the engine's performance and determines the proper air/fuel mixture.
- f. ?
They monitor the engine's operating conditions and transmit information to the E.C.U.
- g. ?
Because fuel injection systems provide better engine efficiency, higher power and fuel economy; fewer undesirable emissions.



2 Read this text and find the English words for the Italian equivalents below.

As the automobile evolved, carburetors became more and more complicated, trying to handle all of the operating requirements. They typically included five different circuits: **main circuit**, **idle circuit**, **accelerator pump**, **power enrichment circuit** and **choke**. The main circuit was aimed at providing just enough fuel for fuel-efficient cruising while the idle circuit was used to provide just enough fuel to keep the engine idling. The accelerator pump supplied extra fuel during acceleration, whereas the **power enrichment circuit** provided extra fuel when driving up a hill or towing a trailer. Also the choke was used to provide extra fuel but with cold engine only. Later, in order to meet stricter emission requirements, carburetors were joined to new catalytic converters and consequently oxygen sensors and the **engine control unit** (ECU) were also introduced to monitor and adjust the air-to-fuel ratio in real-time and make the catalytic converters really effective. This system was called **closed-loop control**. A brief period of electrically-controlled carburetors then followed but they were extremely complicated and finally fuel injection systems took over. Carburetors were definitely replaced with **throttle body fuel injection systems** that incorporated electrically-controlled fuel-injector valves into the throttle body. Gradually, throttle body fuel injection was replaced by **multi-port fuel injection**. These systems have a fuel injector for each cylinder, usually located so that they spray right at the intake valve. These systems provide more accurate fuel metering and quicker response. ►

- a. *controllare*
- b. *corpo farfallato*
- c. *efficace, potente*
- d. *gestire*
- e. *girare al minimo*
- f. *iniezione multipla*
- g. *mentre*
- h. *misurare con un contatore*
- i. *più severo*
- j. *requisiti*
- k. *subentrarono*
- l. *trainare*
- m. *valvola a strozzamento*



3

Match these terms taken from the text with the correct definitions.

- | | | |
|----------------------------|--------------------------|--|
| a. acceleration | <input type="checkbox"/> | 1. The act of making something fuller, more meaningful or beautiful. |
| b. adjust | <input type="checkbox"/> | 2. A large transport vehicle designed to be drawn by a truck or a car. |
| c. catalytic converter | <input type="checkbox"/> | 3. A reaction to a specific stimulus. |
| d. circuit | <input type="checkbox"/> | 4. A change in the rate of motion, speed or action. |
| e. complicated | <input type="checkbox"/> | 5. To adapt or conform to new conditions. |
| f. enrichment | <input type="checkbox"/> | 6. A device attached to the exhaust system of a vehicle to reduce polluting emissions. |
| g. fuel-efficient cruising | <input type="checkbox"/> | 7. A closed path or a line forming a boundary. |
| h. pump | <input type="checkbox"/> | 8. Not easy to understand or analyze. |
| i. response | <input type="checkbox"/> | 9. A machine or device for raising, compressing or transferring fluids. |
| j. trailer | <input type="checkbox"/> | 10. Fuel-saving driving. |



4

Find the English words in the following text for the Italian terms below.

Turbochargers can be defined as forced induction systems which compress the air flowing into the engine. They are one of the most effective devices to get more power out of an engine: the advantage of compressing the air is that it lets the engine compress more air into a cylinder, so more fuel can be added and the explosion in each cylinder is much more powerful. A turbocharged engine produces more power overall than the same engine without the charging and this can significantly improve the power-to-weight ratio for the engine. To achieve this boost, the turbocharger uses the exhaust flow from the engine to spin a turbine, which in turn spins an air pump. The turbine in the turbocharger spins at speeds of up to 150,000 rotations per minute (rpm) – that's about 30 times faster than most car engines can go.

- a. *circa*
- b. *spinta, impulso*
- c. *efficace, potente*
- d. *che sbocca, fluisce*
- e. *induzione forzata*
- f. *carburante*
- g. *permette*
- h. *potente*
- i. *rapporto*
- j. *stesso, medesimo*
- k. *in modo significativo*
- l. *girare, far girare*



5

Refer to the passage on page 270 of New Mechways and match the terms with the suitable definitions.

- | | | |
|------------------|--------------------------|---|
| a. to aim at | <input type="checkbox"/> | 1. To make full use of something and derive great benefit. |
| b. to allow | <input type="checkbox"/> | 2. A class, a classificatory division. |
| c. almost | <input type="checkbox"/> | 3. Neither very large nor very small. |
| d. category | <input type="checkbox"/> | 4. The metal piece connecting a car's engine to the wheels. |
| e. to consist of | <input type="checkbox"/> | 5. To direct one's effort towards. |
| f. consumption | <input type="checkbox"/> | 6. With certainty, absolutely. |
| g. crankshaft | <input type="checkbox"/> | 7. To make something available to be used. |
| h. to exploit | <input type="checkbox"/> | 8. Nearly. |
| i. to improve | <input type="checkbox"/> | 9. To be made up of. |
| j. medium-sized | <input type="checkbox"/> | 10. To permit. |
| k. positively | <input type="checkbox"/> | 11. The use of something. |
| l. to supply | <input type="checkbox"/> | 12. To make something better. |



6

Find the opposite of the following terms in the text on page 270 of New Mechways.

- a. decreasing
- b. implosion
- c. inefficiency
- d. minor
- e. outer
- f. rare
- g. relieved
- h. specifically



7

Go through the five paragraphs of the following text and label them choosing from the list below.

- | | | |
|--------|--------------------------|--|
| Par. 1 | <input type="checkbox"/> | a. Differences in refuelling |
| Par. 2 | <input type="checkbox"/> | b. Other modifications |
| Par. 3 | <input type="checkbox"/> | c. Natural Gas Vehicles: main features |
| Par. 4 | <input type="checkbox"/> | d. Fuel storage modifications |
| Par. 5 | <input type="checkbox"/> | e. How natural gas engines work |

Par. 1 – Although there are some differences between natural gas and gasoline in terms of flammability and ignition temperatures, Natural-Gas Vehicles use the same basic principles as gasoline-powered vehicles: natural gas is mixed with air in the cylinder of a four-stroke engine and then ignited by a spark plug to move a piston up and down. Modifications concern mainly the fuel storage tank, the engine and the chassis but there are also some differences in refueling.

Par. 2 – Natural Gas Vehicles operate using compressed natural gas which is pumped into high-pressure, tube-shaped cylinders that are attached to the rear, top or undercarriage of the vehicle. The storage tanks of early NGVs were bulky and took up much of the vehicle's cargo space, but now new and lighter cylinders have been developed with a much smaller diameter and a shape that remarkably resembles that of a conventional gasoline tank. These cylinders are contained within a fiberglass shell and impact-absorbing foam to protect them in the event of a crash.

Par. 3 – As regards the engine, when it is started, natural gas flows from the storage cylinders into a fuel line and then the natural gas enters a regulator to reduce the pressure. After that, the gas feeds through a multipoint gaseous fuel-injection system aimed at introducing the fuel into the cylinders. Sensors and computers are employed to adjust the fuel-air mixture so that the gas burns efficiently after ignition. Natural-gas engines also rely on forged aluminum, high-compression pistons, hardened nickel-tungsten exhaust valve seats and a methane-specific catalytic converter.

Par. 4 – Besides, also some chassis modifications in the suspension are required to create space for the fuel-storage containers. Natural Gas Vehicles often replace the standard lateral-link suspension of gasoline-powered cars with a semi-trailing arm suspension in order to create more open space in the rear undercarriage. They also remove the spare tire and jack and employ "run flat" tires to compensate for the fact that the spare tire and jack are missing.

Par. 5 – The fueling point of Natural Gas Vehicles is typically at the front of the vehicle: they can be fueled either at a "fast-fill" pump (in about the same time it takes to fuel gasoline or diesel vehicles) or following a "slow-fill" method (in about five/eight hours), requiring car owners to refuel their vehicles overnight.



8

In the text above find the synonyms for the following words or expressions.

- adaptation:
- balance:
- noticeably:
- notwithstanding:
- possessor:
- properly:
- substitute:
- with reference to:



9

Refer to the text on page 274 of New Mechways and match the correct definition to the following words.

- | | | |
|------------------------|--------------------------|---|
| a. alternating current | <input type="checkbox"/> | 1. Located directly across from something else. |
| b. axle | <input type="checkbox"/> | 2. Differently, in another way. |
| c. commutator | <input type="checkbox"/> | 3. Turning around a centre or an axis. |
| d. magnet | <input type="checkbox"/> | 4. Keep away. |
| e. opposite | <input type="checkbox"/> | 5. A device used to reverse the direction of flow of an electric current. |
| f. otherwise | <input type="checkbox"/> | 6. The type of electricity that periodically reverses direction. |
| g. repel | <input type="checkbox"/> | 7. Material or object that produces a magnetic field. |
| h. rotational motion | <input type="checkbox"/> | 8. a bar or a shaft on which wheels rotate |



10

Complete the following text with the words given below.

behind • electric • electrochemistry • fields • foundations • influential •
invented • made • motor • movement • phenomenon • physicist

The link between electricity, magnetism and (1) was originally discovered in 1820 by the French (2) André-Marie Ampère (1775-1867), who laid the (3) of the basic science (4) an electric motor but the true inventors of the (5) motor were the Englishmen William Sturgeon (1783-1850) and Michael Faraday (1791-1867) and the American Joseph Henry (1797-1878). Sturgeon was a physicist who (6) the first electromagnets and (7) the first practical English (8) while Faraday was one of the most (9) scientists in history and remarkably contributed to the (10) of electromagnetism and (11); Joseph Henry was the American physicist who discovered the electromagnetic (12) of self-inductance.



11

Refer to Chapter D ("The electric motor in detail") and complete the sentences below.

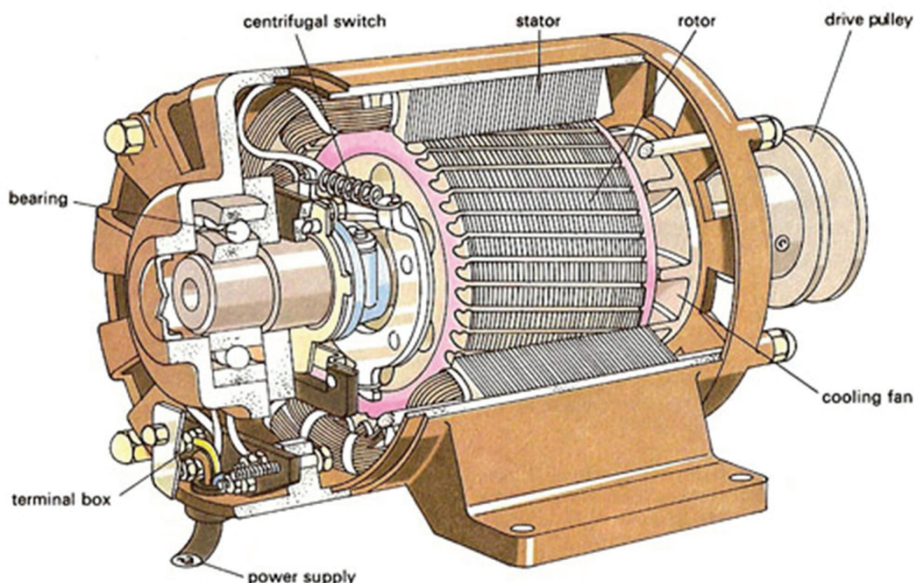
A motor or an electrical motor is nothing but an electro-mechanical device that converts electrical energy into mechanical energy. In simple words, we can say that any device that produces rotational force is a motor. The electrical motor has brought about one of the biggest advancements in the fields of engineering and technology ever since the invention of electricity. Electric motors are usually grouped into alternating current (AC) motors, direct current (DC) motors and universal motors.

An AC motor is an electric motor that is driven by alternating current: the mechanical energy is made from utilizing the force that is exerted by the rotating magnetic fields produced by the alternating current that flows through the coils. It is made up of two main components: the stationary stator, which is on the outside and has coils supplied with AC current, and the inside rotor, which is attached to the output shaft. AC motors are further divided into single-phase and three-phase motors. Single-phase AC electrical power is typically supplied in private homes while three-phase electrical current is what is commonly supplied in factories. ►

A DC motor basically is a motor that operates on a direct current electrical system and uses a magnetic field to produce torque. DC motors are the simplest type of motor and are used in household appliances, such as electric razors, and in electric windows in cars. They consist of a stator, an armature, a rotor and a commutator. They are usually grouped into brush motors, brushless motors and stepper motors. Brush motors are by far the most common ones: they are easy to build and very cost-effective. Their main defect is that they use carbon brushes to transfer electrical current to the rotating part, and these brushes wear over time and eventually result in the failure of the electric motor. The DC brushless motor does not employ brushes but is more expensive and requires much more complicated electronics to operate.

Universal motors run on both DC and AC power but produce more noise and vibration than other types of motors.

- a. An electrical motor is a device that
- b. Engineering and technology have been greatly affected by
- c. There are various types of electrical motors:
- d. is driven by alternating current.
- e. are the major components of AC motors.
- f. AC motors are also defined as
- g. employ a magnetic field to produce torque.
- h. DC motors are typically used in
- i. DC motors include
- j. The failure of an electric DC motor can be caused by the
- k. Universal motors can employ either



CLIL • DIESEL EMISSIONS



1

Refer to the text on page 284 of New Mechways and match the terms in *italics* to their Italian equivalents.

- a. *deterioramento*
- b. *difettoso*
- c. *dotato di*
- d. *evoluto*
- e. *residuo*
- f. *sufficiente*
- g. *surriscaldamento*
- h. *trasportato*



2

Refer to the text on page 284 of New Mechways and decide if the following statements are true or false. Correct the false statements.

- | | T | F |
|---|--------------------------|--------------------------|
| a. Diesel exhaust gases rarely contain CO ₂ or H ₂ O. | <input type="checkbox"/> | <input type="checkbox"/> |
| b. The greenhouse effect is caused by CO ₂ . | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Imperfect processes during combustion result in dangerous polluting emissions. | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Toxic concentrations in diesel exhaust gases cannot be reduced satisfactorily. | <input type="checkbox"/> | <input type="checkbox"/> |
| e. After-treatment devices can transform toxic emissions into non-polluting elements. | <input type="checkbox"/> | <input type="checkbox"/> |
| f. DPM consists of tiny separate particles. | <input type="checkbox"/> | <input type="checkbox"/> |
| g. Carbon monoxide is caused by overabundance of air in the combustion chamber. | <input type="checkbox"/> | <input type="checkbox"/> |

