

The Otto cycle engine



Nikolaus Otto was a German engineer and inventor who revolutionised engine technology by developing the first practical four-stroke internal combustion engine. His invention,

known as the Otto cycle, set the foundation for modern petrol engines and transformed transportation and industry worldwide. Otto's work came at a time when most engines were large, inefficient, and powered by steam, and he sought a more compact and powerful alternative.

■ Early experiments and collaboration

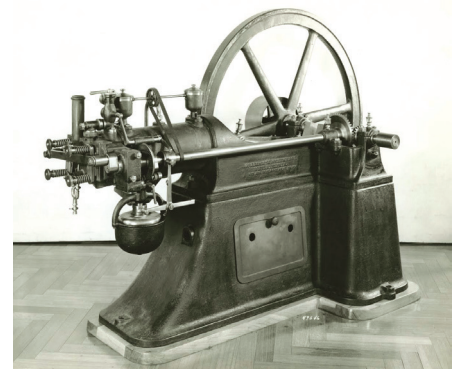
In 1864, Otto partnered with Eugen Langen to establish a company focused on developing gas engines. Their initial design, completed in 1867, was an atmospheric gas engine that ran more efficiently than existing models but still had limited power. This early success encouraged Otto to explore ways to improve performance further. He realised that the key to efficiency was in compressing the fuel-air mixture before ignition. However, early attempts at compression engines failed because materials of the time could not **withstand** the high pressure, and controlling the combustion process proved difficult.

■ The concept of compression

Otto believed that compressing the air-fuel mixture before ignition would produce a more powerful and efficient explosion. Compression, in fact, increases the temperature and density of the mixture, allowing for more energy to be released during combustion. Through repeated experimentation and careful design adjustments, Otto worked to **overcome** the technical challenges that had hindered earlier inventors. His persistence paid off when he developed a method to safely compress the mixture without damaging the engine, a crucial step towards creating a practical and reliable internal combustion engine.

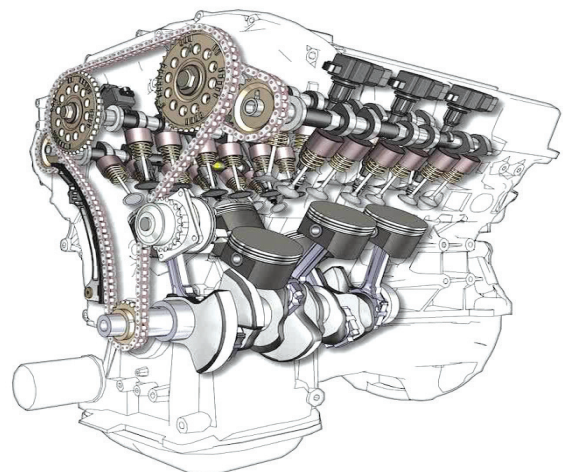
■ The 1876 breakthrough

Otto's breakthrough came in 1876 with the invention of the four-stroke engine, which became known as the Otto cycle. The engine operates in four strokes: intake, compression, power, and exhaust. During the intake stroke, the piston draws in a mixture of air and fuel. The compression stroke squeezes this mixture, increasing its potential energy. The spark plug ignites the mixture during the power stroke, forcing the piston downward and turning the crankshaft. Finally, the exhaust stroke expels the burned gases, preparing the cylinder for the next cycle. This process is repeated continuously while the engine runs.



■ Legacy and influence

The Otto cycle engine was more efficient and practical than earlier designs, making it suitable for widespread industrial and automotive use. It inspired engineers like Gottlieb Daimler and Karl Benz, who adapted it for early automobiles. Otto's innovation not only improved machine performance but also enabled the development of modern manufacturing techniques, mass production, and the automotive industry, leaving a lasting legacy that continues to influence engine design today.




breakthrough: *svolta*
to overcome: *superare*

to withstand: *sopportare*

1   Say if the sentences are true, false or not given. Correct the false ones.

- | | T | F | NG | | T | F | NG |
|--|--------------------------|--------------------------|--------------------------|---|--------------------------|--------------------------|--------------------------|
| 1. Otto was born in Berlin. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 5. Compression increases the temperature and density of the fuel-air mixture. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Otto studied engineering at university before building engines. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 6. The four-stroke engine works in three stages. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Otto's first engine was powered by steam. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 7. Otto's engine was useful only for small laboratory experiments. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. Early compression engines were successful because materials were very strong. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 8. Otto's invention influenced engineers like Gottlieb Daimler and Karl Benz. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

2  Match each term with its definitions.

- | | | |
|-------------------------------|--------------------------|--|
| 1. Four-stroke engine | <input type="checkbox"/> | a. A device that moves up and down inside a cylinder to transfer force. |
| 2. Otto cycle | <input type="checkbox"/> | b. The process of reducing the volume of a gas to increase its pressure and temperature. |
| 3. Internal combustion engine | <input type="checkbox"/> | c. A machine that produces power by burning fuel inside the engine itself. |
| 4. Compression | <input type="checkbox"/> | d. A component that produces an electric spark to ignite the fuel mixture. |
| 5. Fuel-air mixture | <input type="checkbox"/> | e. An early type of engine developed by Otto that was more efficient than previous gas engines but still limited in power. |
| 6. Spark plug | <input type="checkbox"/> | f. An engine that operates through four stages: intake, compression, power, and exhaust. |
| 7. Piston | <input type="checkbox"/> | g. A rotating shaft that converts the up-and-down motion of the piston into circular motion. |
| 8. Crankshaft | <input type="checkbox"/> | h. The sequence of intake, compression, power, and exhaust in an engine. |
| 9. Four-stroke cycle | <input type="checkbox"/> | i. A mixture of air and fuel that is burned to produce energy. |
| 10. Atmospheric gas engine | <input type="checkbox"/> | j. The operating principle of a four-stroke petrol engine developed by Otto. |

3   Read the text and fill in the gaps with the missing words.

contemporaries • journey • petrol • pioneer • vehicle • nation • speed • factory • motorboat • plugs

Otto, Benz and Daimler

Germany is a true automotive

1. – and not just because of its extensive road network and lack of a general highway speed limit. The “Otto engine”, developed in Cologne in 1876 by self-taught inventor Nicolaus August Otto (1832-1891), was a 2. of the modern combustion engine. Karl Benz (1844-1929), one of his 3., invented the automobile, as well as carburetors, spark 4., and gearshifts. Back in 1885, in Mannheim, he built the world's first petrol-powered 5., a three-wheeled vehicle with a top 6. of 18 kilometers per hour. It was mocked as a “carriage without horses”. Benz, on the other hand, sought a patent

for his work. His wife, Cäcilie Bertha Benz, another automotive pioneer, drove the vehicle on its first long-distance 7. She drove 104 kilometers, refuelling at a pharmacy along the way! By 1900, Benz's engine 8. had grown to become the world's largest automobile factory. Gottlieb Daimler (1834-1900), an engineer, also made history when he improved the 9. engine and registered the patent for this quicker, smaller engine in Cannstatt, close to Stuttgart. He created the first motorbike in 1885 and then took the risk of fitting his engine to a boat, giving rise to the 10. A year later, Benz transformed his engine into a carriage, giving birth to the modern automobile as we know it.

Adapted from: <https://learngerman.dw.com/en/otto-benz-and-daimler/l-61037474>