

# Internal combustion engine

History of creation. Principle of operation. Coefficient of performance.

# History of creation.

ICE development stages:



Etienne Lenoir

1860 Etienne Lenoir invented the first gas-fired engine

1862 Alfons Bo De Rocha proposed the idea of a four-stroke engine. However, he failed to realize his idea.

1876 Nicolaus August Otto creates a four-stroke engine on Roche

1883 Daimler proposed the design of an engine that could operate both on gas and gasoline

Karl Benz invented a self-propelled tricycle based on Daimler's technology.

By 1920, ICEs became leading. steam and electric carriages were a rarity.



August Otto

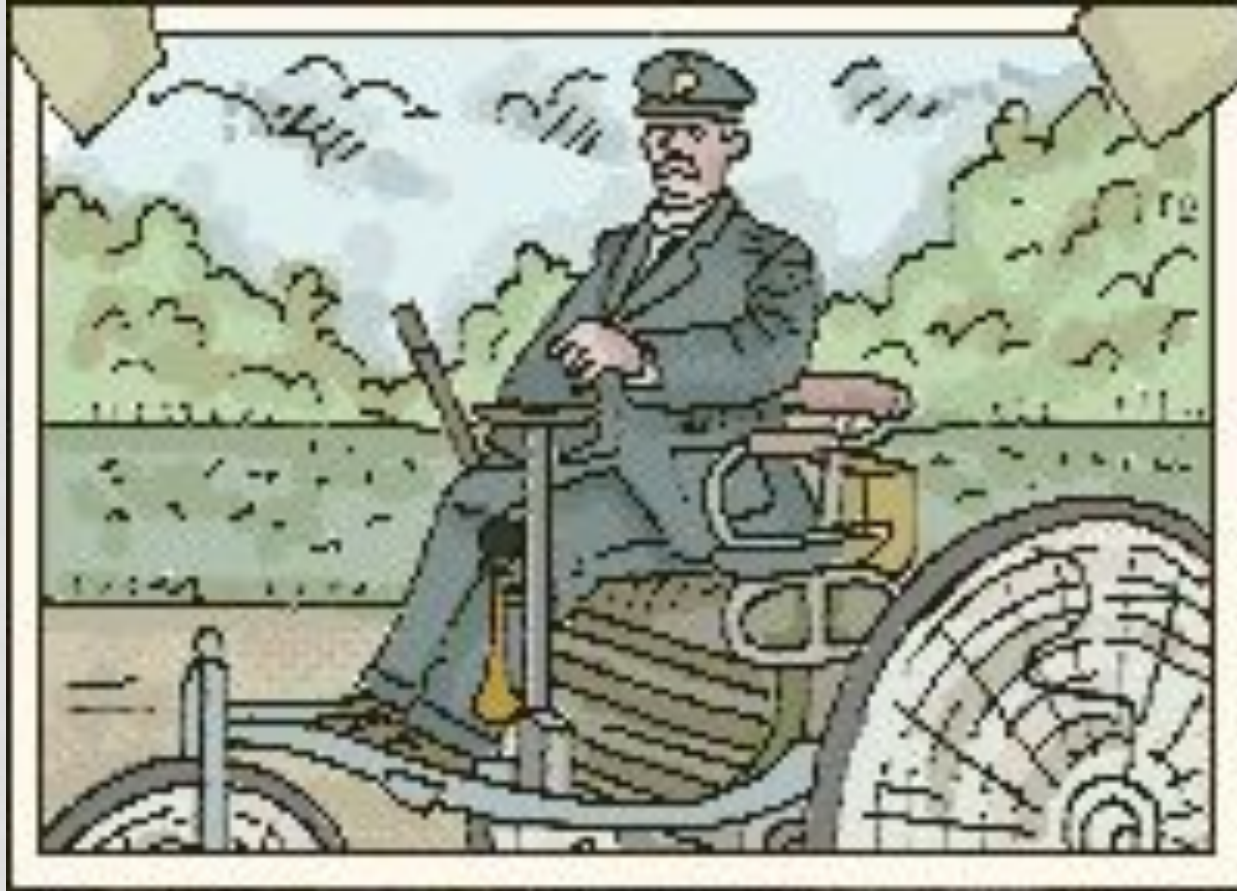


Daimler



Karl Benz

# History of creation.

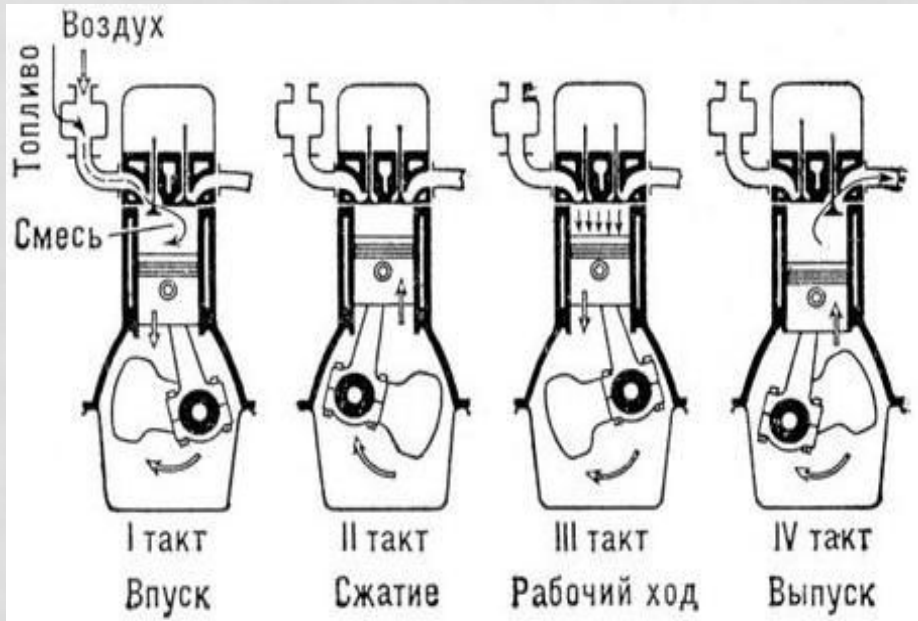


Tricycle invented by Karl Benz

# Operating principle

## Four stroke engine

The duty cycle of a four-stroke carburetor internal combustion engine takes place in 4 piston strokes (cycle), i.e., in 2 revolutions of the crankshaft.



Distinguish 4 measures:

1 cycle - inlet (fuel mixture from the carburetor enters the cylinder)

2 cycle - compression (valves are closed and the mixture is compressed, at the end of compression the mixture is ignited by an electric spark and fuel is burned)

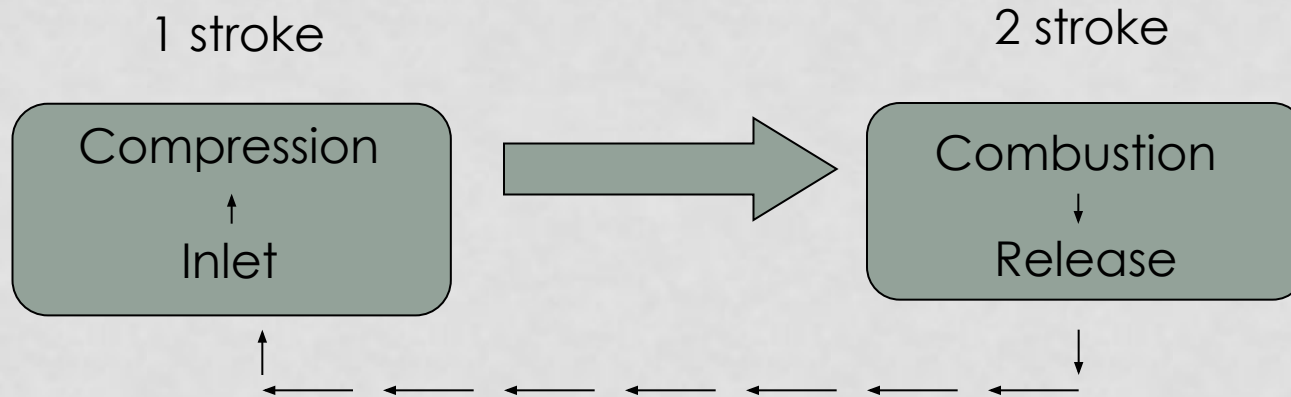
3 step - working stroke (the conversion of heat received from the combustion of fuel into mechanical work occurs)

4 cycle - release (exhaust gases are displaced by the piston)

# Operating principle

## Two stroke engine

There is also a two-stroke internal combustion engine. The duty cycle of a two-stroke carburetor internal combustion engine is carried out in two piston strokes or in one crankshaft revolution.



In practice, the power of a two-stroke carburetor internal combustion engine often not only does not exceed the power of a four-stroke, but it is even lower. This is due to the fact that a significant part of the stroke (20-35%) is made by the piston with the valves open

# Engine efficiency

The efficiency of the internal combustion engine is small and approximately amounts to 25% - 40%. The maximum effective efficiency of the most advanced ICEs is about 44%. Therefore, many scientists are trying to increase the efficiency, as well as the engine power itself.

Ways to increase engine power:

The use of multi-cylinder engines

Use of special fuel (correct mix to mixture ratio)

Replacement of engine parts (correct component sizes, depending on engine type)

Elimination of part of the heat loss by transferring the place of fuel combustion and heating the working fluid inside the cylinder

# Engine efficiency

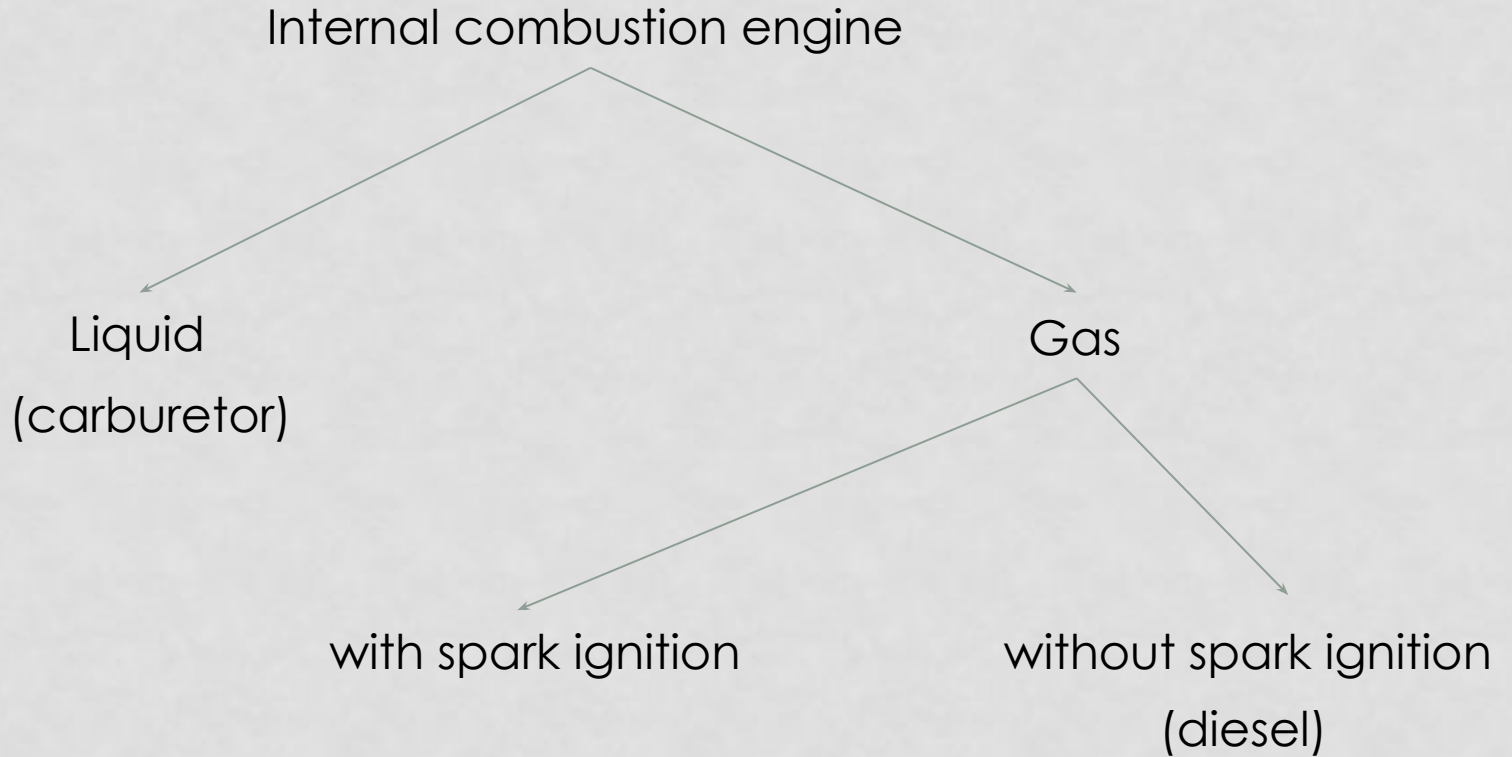
## Compression ratio

One of the most important characteristics of an engine is its compression ratio, which is determined by the following:

$$e = \frac{V_2}{V_1}$$

where  $V_2$  and  $V_1$  are volumes at the beginning and at the end of compression. With an increase in the compression ratio, the initial temperature of the combustible mixture at the end of the compression stroke increases, which contributes to its more complete combustion.

# Varieties of ICE





# Main engine components

The structure of a bright representative of the internal combustion engine - carburetor engine

**Engine skeleton** (crankcase, cylinder heads, crankshaft bearing caps, oil sump)

**Movement mechanism** (pistons, connecting rods, crankshaft, flywheel)

**Gas distribution mechanism** (cam shaft, pushers, rods, rocker arms)

**Lubrication system** (oil, coarse filter, sump)

**liquid** (radiator, liquid, etc.)

**Cooling system**

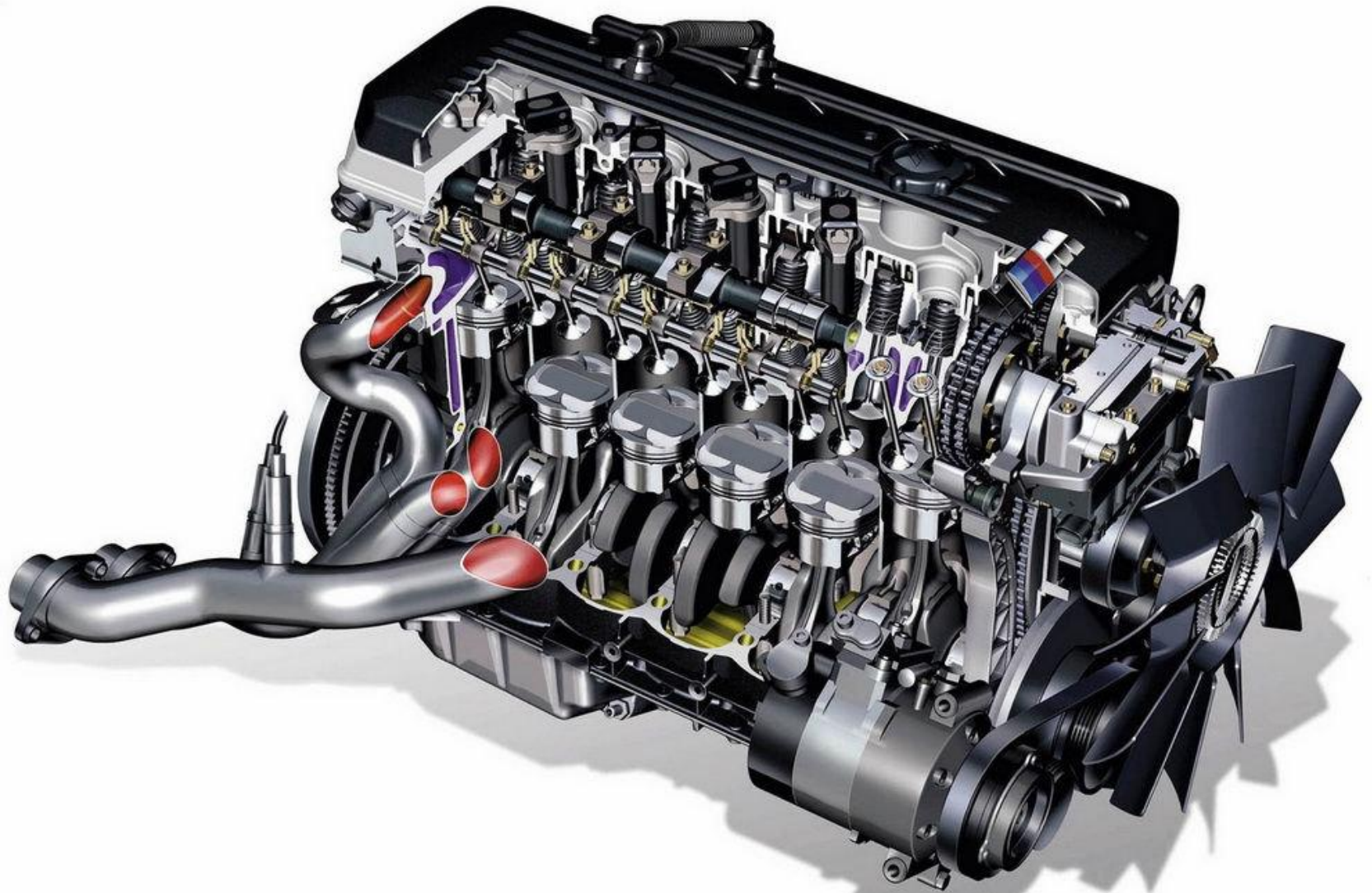
**air** (blowing with air currents)

**Power system** (fuel tank, fuel filter, carburetor, pumps)

**Ignition system** (current source - generator and battery, chopper + capacitor)

**Starting system** (electric starter, current source - battery, remote control elements)

**Intake and exhaust system** (piping, air filter, silencer)



# Conclusion

The discovery of the Internal Combustion Engine had a great influence on the development of many industries, agriculture and science. And let the era of the internal combustion engine go through, let them have many shortcomings,



let new engines appear that do not pollute the internal environment and do not use the thermal expansion function, but the first will benefit people for a long time, and after many hundreds of years, people will kindly respond to them, because they brought mankind to a new level of development, and, having passed him, humanity has risen even higher.

Thank you for the attention!