A PRESENTATION ON

OTTO CYCLE

Submitted to:

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Content:

- Introduction
- What is otto cycle
- Otto cycle processes
- Work
- Thermal efficiency
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Introduction

- In 1876, a German engineer, **Nikolaus August Otto** build first working four-stroke engine.
- A stationary engine using a coal gas-air mixture for fuel.
- The cycle of the Otto engine is called the Otto cycle.
- It is the one of most common **thermodynamic cycles** found in **automobile engines.**
- It is a typical spark ignition piston engine.

What is Otto Cycle?

- Because of complicated analysis some assumption are made.
- The main assumption is that the working fluid is ideal air and heat is transfer by heat reservoir so this cycle known as air standard cycle.
- Otto cycle consist four processes:

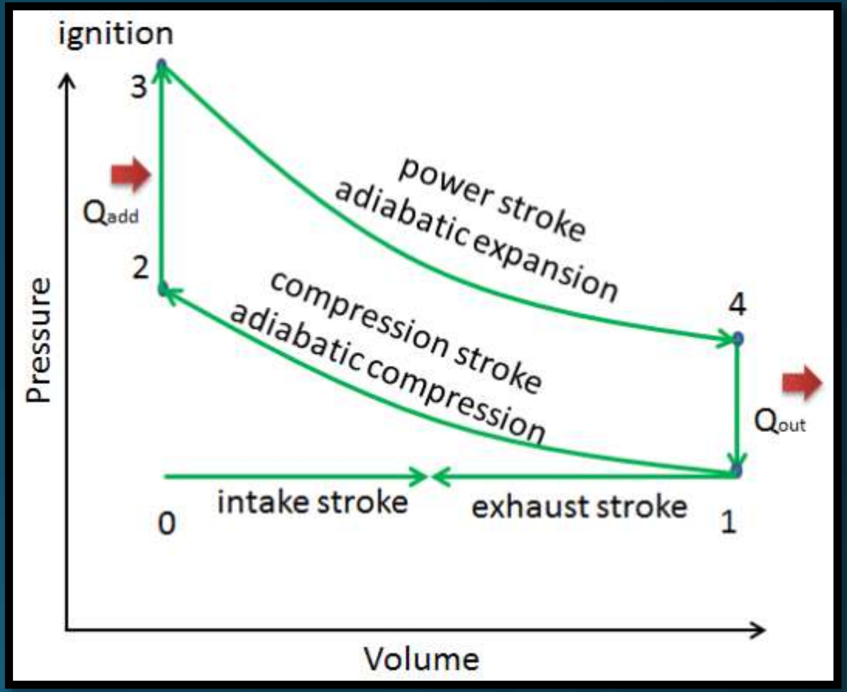
1. two are constant volume (isochoric)
2. two are isentropic processes.

- In this cycle heat addition is done at constant volume process so this cycle is also known as constant volume cycle.

Otto Cycle – Processes

- **Isentropic compression**

  (compression stroke) – The gas is compressed adiabatically from state 1 to state 2, as the piston moves from bottom dead center to top dead center.
- The changes in volumes and its the ratio (V_1 / V_2) is known as the compression ratio.



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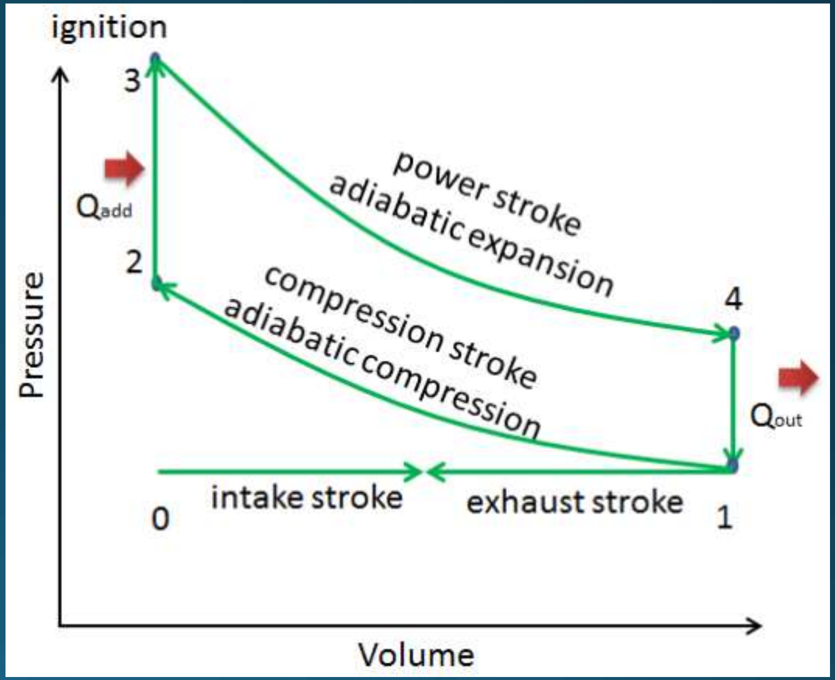
- **Isochoric compression** (ignition phase)
- In this phase heat transfer to the air from an external source while the piston is at rest at top dead center.
- This process is intended to represent the ignition of the fuel–air mixture injected.
- The pressure rises and the ratio (P_3 / P_2) is known as the “explosion ratio”.



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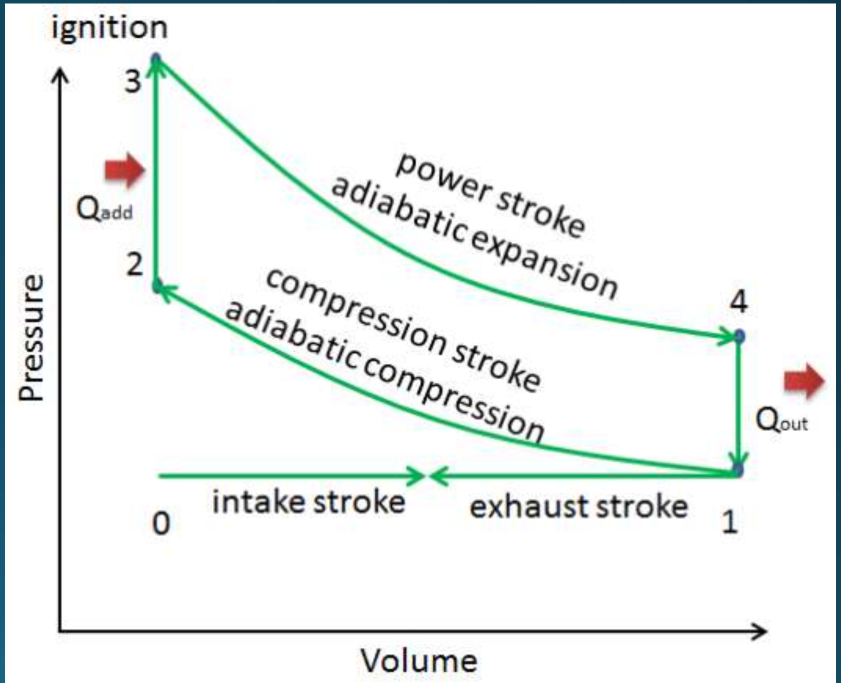
- **Isentropic expansion** (power stroke) – The gas expands adiabatically.
- The gas does work on the piston and forces it to move to the bottom dead centre.
- The volume ratio (V_4 / V_3) is known as the isentropic expansion ration, but for Otto cycle, it is equal to the compression ratio.



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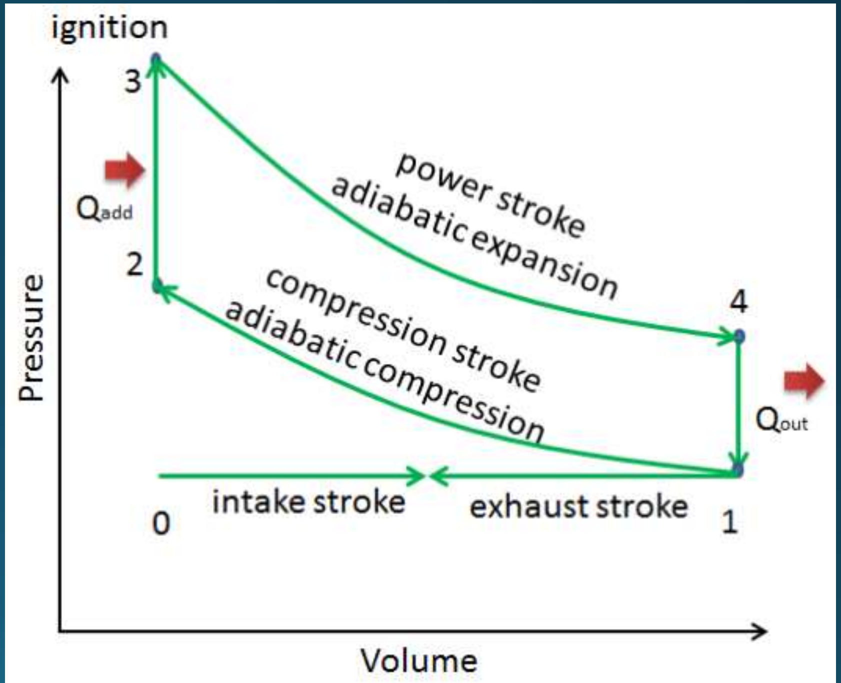
- **Isochoric decompression (exhaust stroke)** – In this phase the cycle completes by a constant-volume process in which heat is rejected from the air while the piston is at bottom dead center.
- The working gas pressure drops instantaneously from point 4 to point 1. The exhaust valve opens at point 4.
- At the end the exhaust valve opened, the gaseous mixture is vented to the atmosphere.



Work:

- During the Otto cycle, work is done on the gas by the piston between states 1 and 2 (**isentropic compression**).
- Work is done by the gas on the piston between stages 3 and 4 (**isentropic expansion**).
- The difference between the work done by the gas and the work done on the gas is the net work produced by the cycle and it corresponds to the area enclosed by the cycle curve.

Thermal Efficiency for Otto Cycle

- In general the **thermal efficiency, η_{th}**, of any heat engine is defined as the ratio of the work it does, **W**, to the heat input at the high temperature, Q_H.

$$\eta_{th} = \frac{W}{Q_H} = \frac{Q_H - Q_C}{Q_H} = 1 - \frac{Q_C}{Q_H}$$

- $Q_{add} = mc_v (T_3 - T_2)$
- $Q_{out} = mc_v (T_4 - T_1)$

$$\eta_{th} = 1 - \frac{T_4 - T_1}{T_3 - T_2} \quad \rightarrow \quad \eta_{Otto} = 1 - \left(\frac{V_2}{V_1}\right)^{\kappa - 1} = 1 - \frac{1}{CR^{\kappa - 1}}$$

Applications

- Common cycle used in internal combustion engines.
- Otto cycle (4 stroke) engines are commonly used in most cars and trucks today

THANK YOU