MAK 3031- Internal Combustion Engines

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Syllabus

1	Definitions of internal combustion engines, Engine Classification,
2	Principles of engine operation, Introduction to engine thermodynamics,
3	Ideal cycles (Otto, Diesel and Seilinger Cycles, Thermal Efficiency and Mean Indicated Pressure Expressions),
4	Ideal Cycles and Comparisons,
5	Introduction to Combustion in Engines, (Minimum Oxygen and Air Intake calculation, Complete and Incomplete Combustion, excess air factor, Number of moles of Change),
6	Exercises: Examples of related application cycles (Engine Thermodynamics), Application examples on Combustion (Combustion Engines),
7	Actual Engine Cycle (the differencies between the ideal and the actual engine cycle). Definition of Organic Efficiency, the combustion event, Compression and Expansion Events, Gas Exchange Event,
8	Mid-term Exam
9	Volumetric Efficiency (Definition, Calculation, Factors Affecting Volumetric Efficiency),
10	(Compression Ignition and Combustion, Ignition Delay, definition and factors affecting) in Diesel Engines,
11	Detonation (Knock) in Engines, Otto and Diesel Engines Knocking, knocking disadvantages,
12	The factors affecting detonation, octane and cetane numbers,
13	The main principles of Mixture Formation in Otto Engines, Carburation (simple carburettor), Fuel Injection (Injection type, the general scheme of injection), The basics of Diesel Mixture Formation, General Injection System, the expected properties from Injection System,
14	Mid-term Exam
15	Engine Power Calculation,

Syllabus

1	İçten Yanmalı Motorlarla İlgili Tanımlar, Motorların Sınıflandırılması,
2	Motorların Çalışma Prensibi, Motor Termodinamiğine Giriş,
3	İdeal Çevrimler (Otto, Diesel ve Seilinger Çevrimleri, Termik Verim ve Ortalama İndike Basınç İfadeleri),
4	İdeal Çevrimler ve Karşılaştırmaları,
5	Motorlarda Yanmaya Giriş (Minimum Oksijen ve Hava Miktarı hesabı, Tam ve Eksik Yanma Yanma, Hava Fazlalık Katsayısı, Mol Sayısı Değişimi),
6	Uygulama: Çevrimlerle ilgili uygulama örnekleri (Motor Termodinamiği), Yanma ile ilgili uygulama örnekleri (Motorlarda Yanma),
7	Gerçek Motor Çevrimi (ideal ve Gerçek Motor çevrimi arasındaki farklar). Organik Verim tarifi, Yanma Olayı, Sıkıştırma ve Genişleme Olayları, Gaz Değişimi Olayı,
8	Vize
9	Volümetrik Verim (Tanımı, Hesabı, Volümetrik Verime Etki Eden Faktörler),
10	Diesel Motorlarında (Tutuşma ve Yanma, Tutuşma Gecikmesi, tanımı ve etki eden faktörler),
11	Motorlarda Vuruntu, Otto ve Diesel Motorlarında Vuruntu, Vuruntunun mahsurları,
12	Vuruntuya etki eden faktörler, Oktan ve Setan sayıları,
13	Otto Motorlarında Karışım Teşkilinin temelleri, Karbürasyon (basit Karbüratör), Benzin Püskürtme (Bölgeye göre püskürtme, püskürme sistemi genel şeması), Diesel Karışım Teşkilinin temelleri, Genel Püskürtme Sistemi, Püskürtme Sisteminden beklenen özellikler,
14	Vize
15	Motor Gücü Hesabı,
16	Final

Week-1/Introduction

- The internal combustion engine is a heat engine that converts chemical energy to mechnical energy.
- The main types are reciprocating and rotating piston applications.
- Crude petroleum products such as gasoline and diesel fuel are mainly used as fuel today.
- Other primary conventional fuels are liquified petroleum gas, ethanol, methanol, natural gas, waste gas etc.

Week-1/Introduction

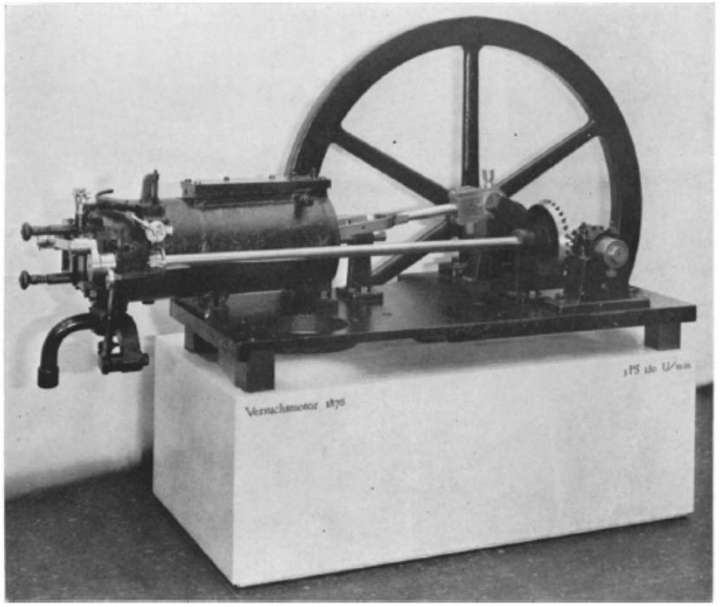
- ICEs produce power as 100 watt to thousands of kilowatts.

Week-1/Introduction

- Advantages
  - Relatively low-cost of prod.
  - Favorable power/weight ratio
  - High efficiency
  - Simple and robust operation
- Disadvantages
  - Combustion induced pollutant formation
  - Engine noise and vibration
  - Indirect environmental effects (Pollution generated by production and waste of fluids required to operate the engine)

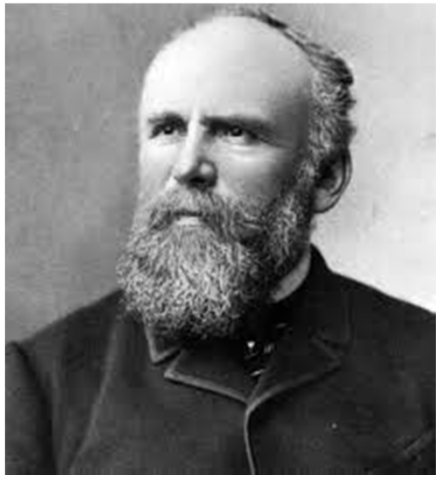
Week-1/Brief History

The first practical engine was invented by J.J.E. Lenoir (1822-1900) in 1860.
In 1867 the Otto-Langen engine was revealed with 11% improvement in efficiency.



The Otto prototype engine from Lynwood Bryant. Picture of Otto´s first 4S compression engine of 1876 taken by "Werkfoto Deutz" in the Klöckner-Humboldt-Deutz museum in Cologne. (also Fig. 9.2 plate)

Nicolaus August Otto (1832-1891)
Inventer of four stroke cycle engine

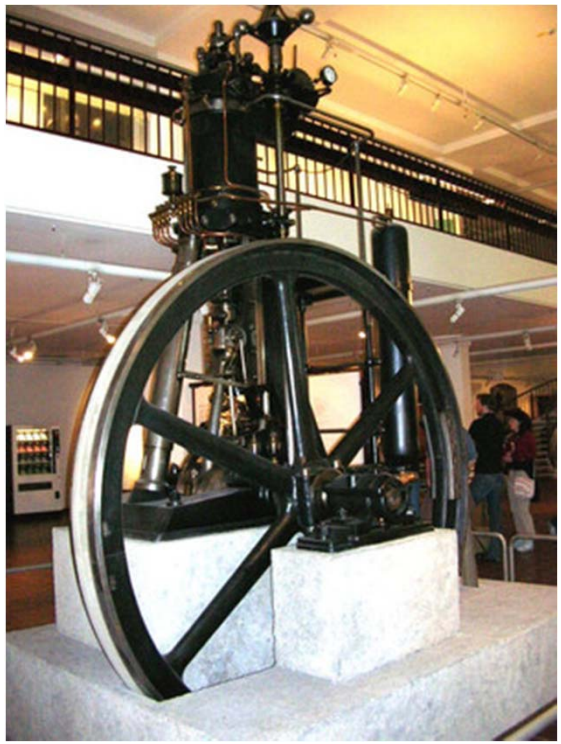


Eugen Langen (1833-1895)

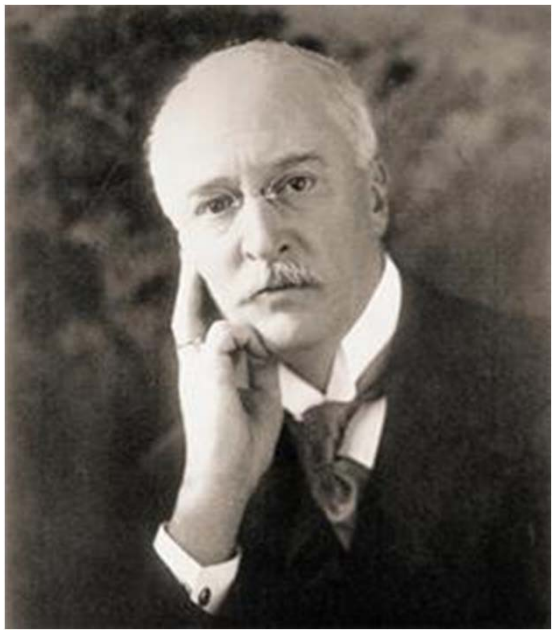
Week-1/Brief History

The first use of internal comb. Engines in automobiles was in 1880.

Rudolf Diesel was invented his compression ignition engine in 1892. It was basically same as today's modern diesel engine principal but it was very heavy and noisy prototype. First diesel principle engines were slow and single cylinder engines.



Single-cylinder,
four-stroke, water-cooled Air injection of fuel
Output: 14.7 kW (20 HP)
Number of revolutions: 172 min-1
Stroke volume: 19.6 l
Bore: 250 mm
Stroke: 40 mm



Rudolf Diesel
(1858-1913)

Week-1/Homework-1.1

- Prepare a study about below-listed inventers. Including inventions and biography.
  - Alphonse Beau de Rochas
  - Henry Ford
  - Gottlieb Wilhelm Daimler
  - Wilhelm Maybach
  - Clessie Lyle Cummins
  - Robert and James Stirling
  - Jean Joseph Etienne LENOIR

Week-1/Classifications

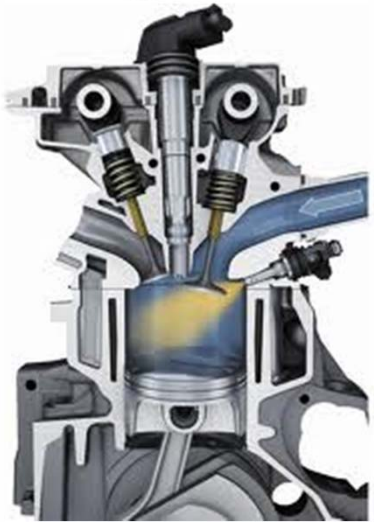
Classification based upon stroke numbers

- **Four stroke cycle engines**

- **Two stroke cycle engines**

Week-1/Classifications

- Classification based upon carburation methods
  - Carburator equipped engines
  - Fuel injected engines



Week-1/Classifications

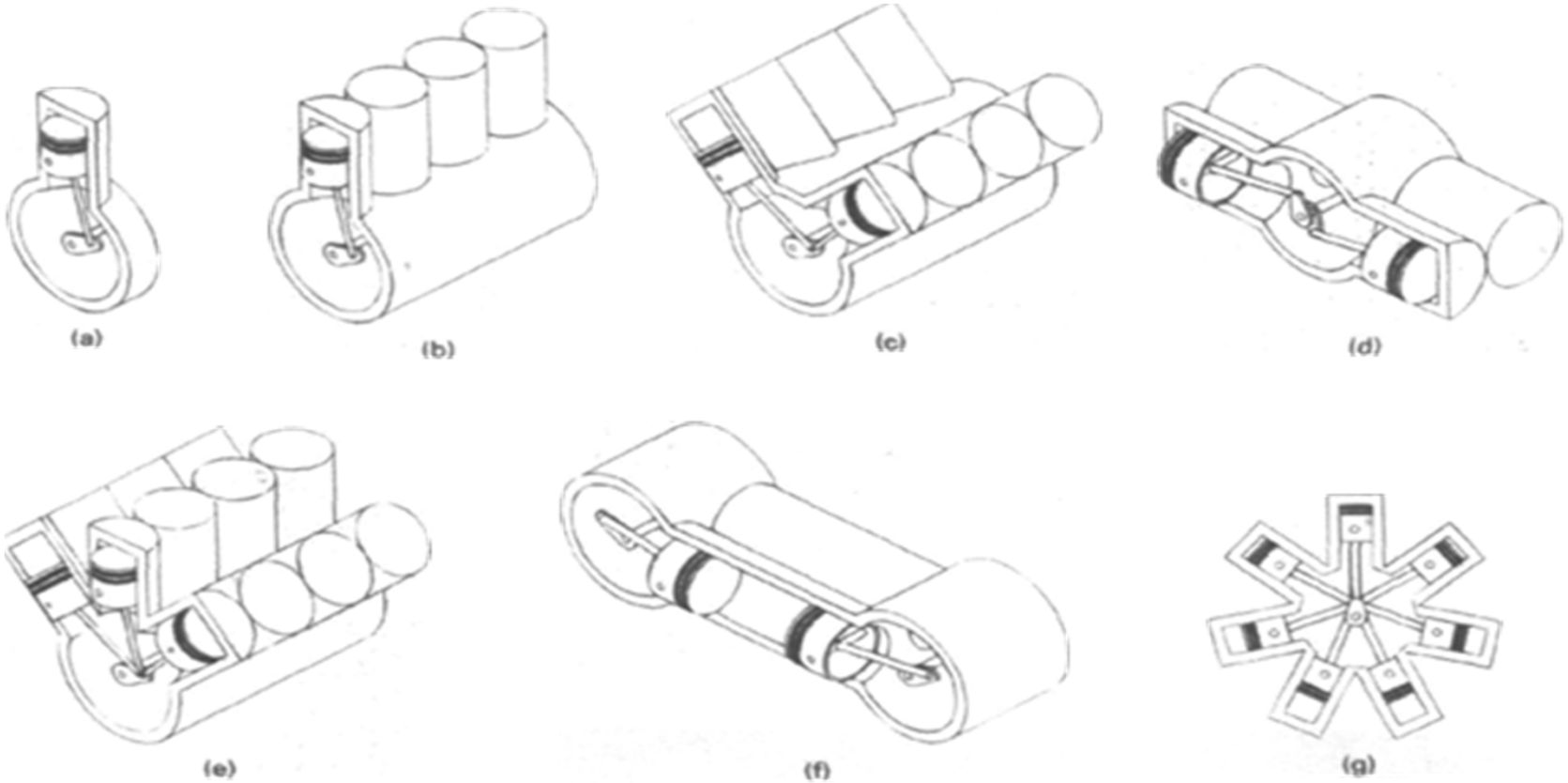
- Classification based upon cycle principle
  - Constant volume combustion engines OTTO Engine
  - Constant pressure combustion engines DIESEL Engine
  - Dual cycle, consists constant volume and pressure combustion SEILINGER Cycle engine

Week-1/Classifications

- Classification based upon fuel type
  - Liquid fuel engines
  - Solid fuel engine
  - Gaseous fuel engines
- Classification based upon charging method
  - Naturally aspirated engines
  - Supercharged engines

Week-1/Classifications

- Classification based upon cylinder arrangement



Week-1/Classifications

Single cylinder engine

Multi-cylinder engine