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DEPARTMENT OF AGRICULTURAL ENGINEERING

COURSE CODE & NAME: 19AGT301 & HEAT POWER ENGINEERING

III YEAR / V SEMESTER

UNIT : IV IC ENGINE PERFORMANCE AND AIR COMPRESSORS

TOPIC 5 : Working principles of Wankel rotary combustion engine

WANKEL ENGINE

Conventionally IC engines are reciprocating type. However, in the twentieth century, a rotary engine was invented.
The engine invented by German engineer Felix Wankel, is a type of internal combustion engine using a rotary design to convert pressure into a rotating motion instead of using reciprocating pistons.

Its four-stroke cycle takes place in a space between the inside of an oval-like epitrochoid-shaped housing and a rotor that is similar in shape to a Reuleaux triangle but with sides that are somewhat flatter.

This design delivers power smoothly even at very high speed. The engine is quite compact in size.

It is the only internal combustion engine invented in the twentieth century to go into production. Since its introduction the engine has been commonly considered rotary engine.

Basic Design

A typical design of the Wankel engine is shown in the Fig.There are three apexes as seen in the figure. The (8) marked in the figure is one of the three apexes of the rotor. The (4) marked is the eccentric shaft and (7) is the lobe of the eccentric shaft. The shaft turns three times for each rotation of the rotor around the housing. It rotates once for each orbital revolution around the eccentric shaft.

In the Wankel engine, the four strokes of a typical Otto cycle occur in the space between a three-sided symmetric rotor and the inside of a housing. The expansion phase of the Wankel cycle is much longer than that of the Otto cycle. In the basic single-rotor Wankel engine, the oval-like epitrochoid-shaped housing (2) surrounds a rotor. The configuration of rotor is triangular with bow-shaped flanks. It has three-pointed curve of constant width having the bulge in the middle of each side. The shape of the rotor between the fixed corners is so designed to achieve minimum volume of the geometric combustion chamber and to maximize the compression ratio.

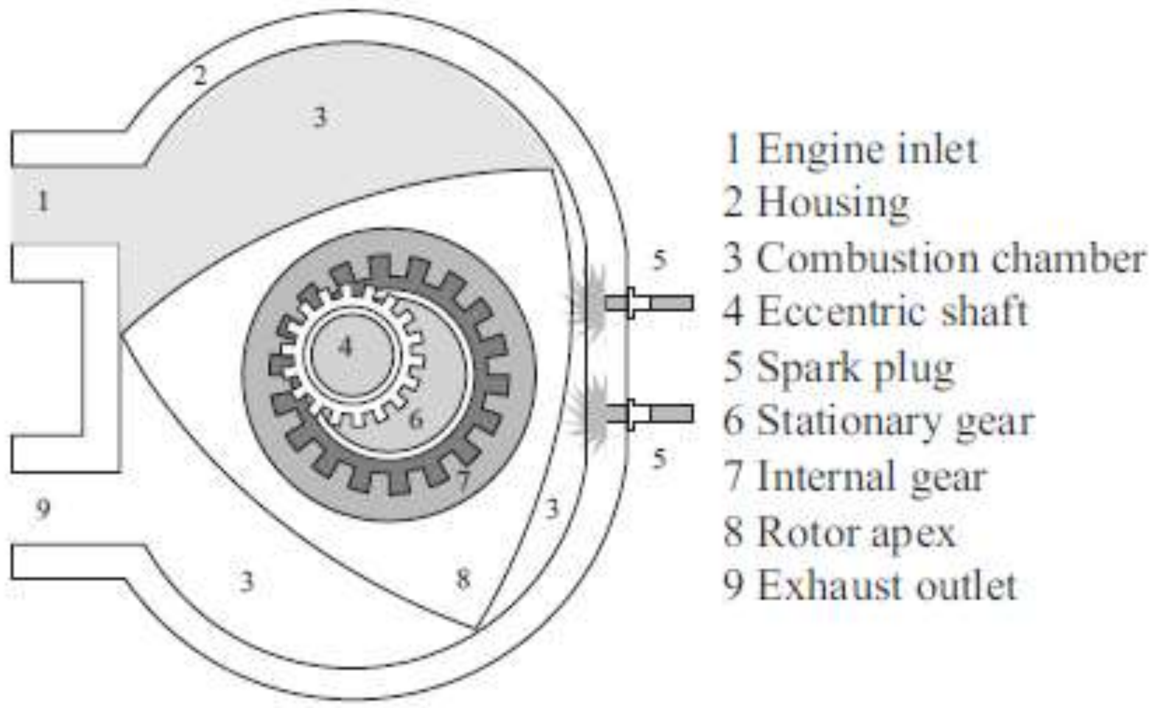

Fig. 20.34 A typical design of the Wankel engine

WORKING OF A WANKEL ENGINE

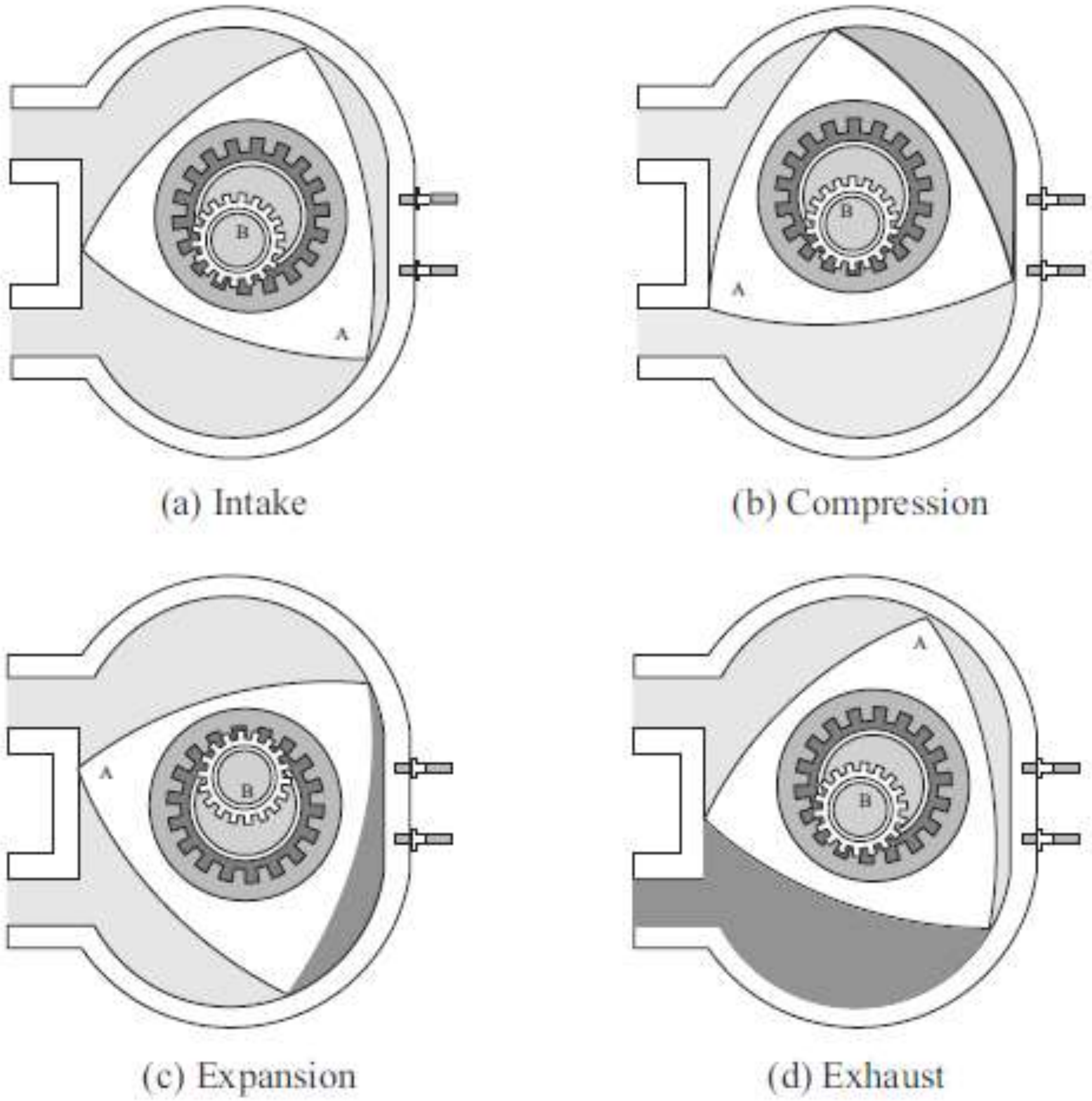

Fig. 20.35 Working of Wankel engine

WORKING OF A WANKEL ENGINE

The central drive shaft, called the eccentric shaft or e-shaft, passes through the center of the rotor. It is supported by fixed bearings. The rotors ride on eccentrics (analogous to cranks) integral to the eccentric shaft (analogous to a crankshaft).

The rotors rotate around the eccentrics and at the same time make orbital revolutions around the eccentric shaft. Seals at the corners of the rotor seal against the periphery of the housing, dividing it into three moving combustion chambers.

The rotation of each rotor on its own axis is caused and controlled by a pair of synchronizing gears. A fixed gear mounted on one side of the rotor housing engages a ring gear attached to the rotor and ensures the rotor moves exactly 1/3 turn for each turn of the eccentric shaft.

The power output of the engine is not transmitted through the synchronizing gears. The force of gas pressure on the rotor (to a first approximation) goes directly to the center of the eccentric, part of the output shaft.

The Wankel engine is actually a variable-volume progressing-cavity system. thus there are 3 cavities per housing, all repeating the same cycle. Note as well that points A and B on the rotor and e-shaft turn at different speed, point B moves 3 times faster than point A, so that one full orbit of the rotor equates to 3 turns of the e-shaft.

As the rotor rotates and orbitally revolves, each side of the rotor is brought closer to and then away from the wall of the housing, compressing and expanding the combustion chamber like the strokes of a piston in a reciprocating engine. The power vector of the combustion stage goes through the center of the offset lobe.

Advantages of Wankel Engines

(i) Wankel engines are considerably lighter, simpler, and contain far fewer moving part
(ii) There are no valves or complex valve trains
(iii) There are no connecting rods and there is no crankshaft.
(iv) The elimination of reciprocating mass and the elimination of the most highly stressed and failure prone parts of piston engines gives the Wankel engine high reliability, a smoother flow of power, and a high power-toweight ratio.
(v) It has higher volumetric efficiency and a lower pumping loss
(vi) It is very quick to react to throttle changes and is able to quickly deliver a surge of power when the demand arises, especially at higher rpm.
(vii) A further advantage of the Wankel engine for use in remotely piloted aircrafts is the fact that a Wankel engine generally has a smaller frontal area than a piston engine of equivalent power, allowing a more aerodynamic nose to be designed around it.
(viii) The simplicity of design and smaller size of the Wankel engine also allows for savings in construction costs, compared to piston engines of comparable power output.
(ix) Due to a 50% longer stroke duration compared to a four-cycle engine, there is more time to complete the combustion. This leads to greater suitability for direct injection.

Dis Advantages of Wankel Engines

(i) In two dimensions the sealing system of a Wankel looks to be simpler than that of a corresponding multi-cylinder piston engine. However, in three dimensions the opposite is true. The rotor must also seal against the chamber ends which is comparatively difficult.
(ii) The less effective sealing of the Wankel is one factor reducing its efficiency, limiting its use mainly to applications such as racing engines and sports vehicles where neither efficiency nor long engine life are major considerations.
(iii) The time available for fuel to be port-injected into a Wankel engine is significantly shorter, compared to four stroke piston engines, due to the way the three chambers rotate.
(iv) The fuel-air mixture cannot be pre-stored as there is no intake valve.

Thank You