جامعة بيرزيت
BIRZEIT UNIVERSITY

Internal Combustion Engines
ENME 535

Department of Mechanical and Mechatronics Engineering

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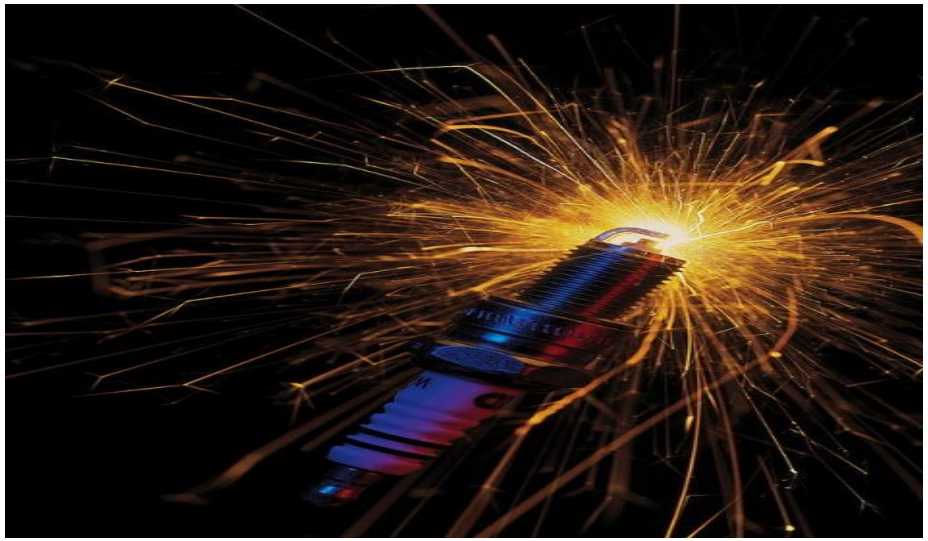
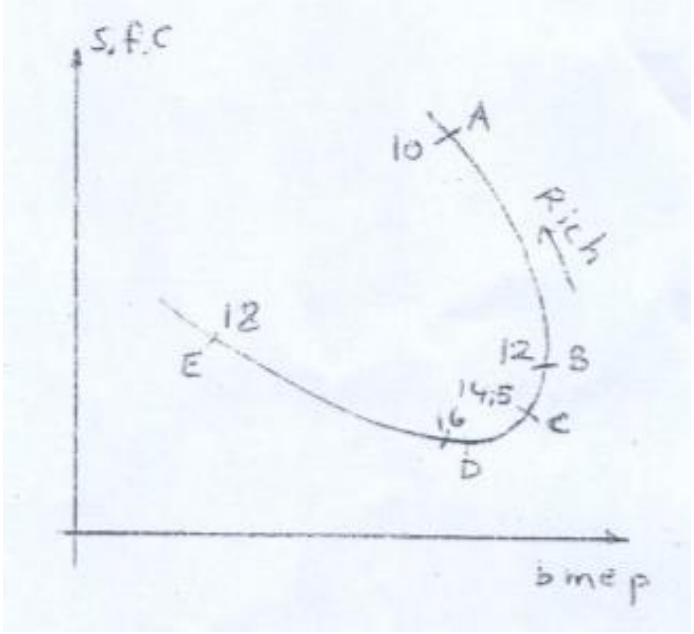
Chapter 4: SPARK IGNITION ENGINES



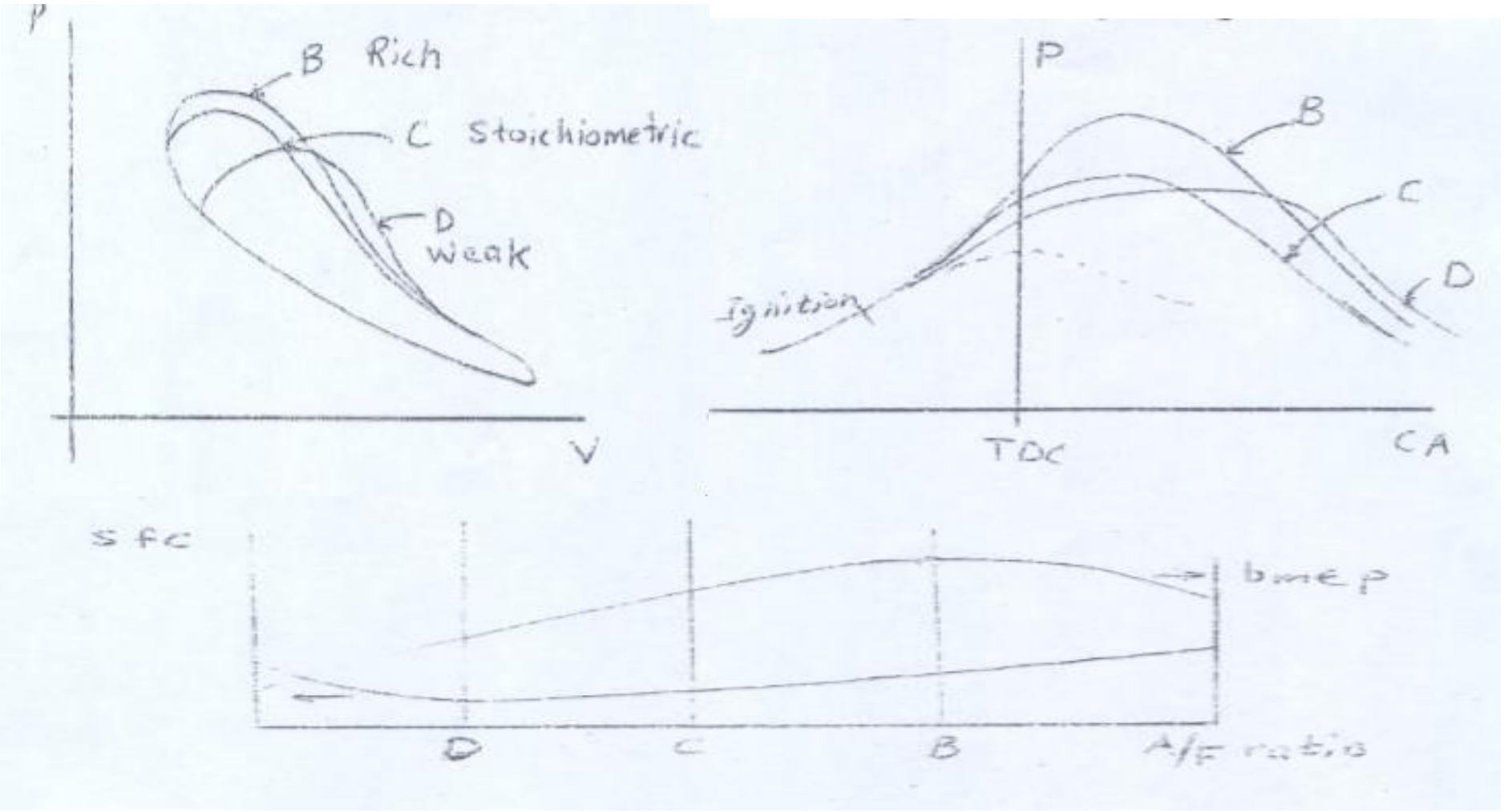
- In this chapter the main parts and the idea of SIE will be discussed.
- SIE is a quantity governed by the opening or closing of a throttle valve which regulates the mass flow of charge to the cylinders .
- The SIE operates on mixtures near to stoichiometric. the air/fuel ratio is important to the engine.

A test made at constant speed, throttle opening, and ignition setting. The sfc is plotted against bmep and the consumption loop is obtained.

The min A/F ratio is at A as the air/fuel ratio increases the bmep maximum is reached at B, sfc further increase in bmep with increasing economy until the position of max economy is reached at D, beyond D, for increasing air/fuel ratios, with bmep and consumption values are adversely affected .



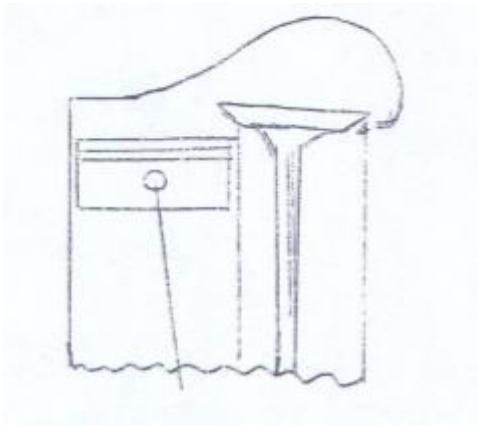
The following figures show the indicator diagram corresponding to mixtures B,C and D

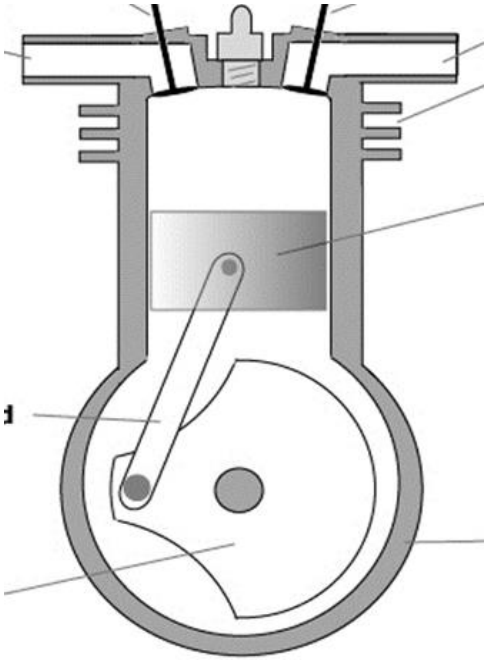


COMBUSTION CHAMBERS :

The early combustion chambers were with side inlet and exhaust valves.

Cylinder head was fitted only with the spark plug, sketch is shown for this type of heads. CR for these engines was about 6:1 the shape of the head affects the turbulence to insure rapid combustion. but excessive turbulence causes excessive heat transfer to the combustion chamber walls





CONSIDERATIONS IN COMBUSTION CHAMBER DESIGN

1- The distance traveled by the flame front should be minimized in order to avoid knock, because auto-ignition of a part of the fuel air mixture before the flame front from spark plug reaches it, this takes time to develop. The flame path from the ignition point to the end of the flame travel needs to occur down to minimum and knocking would be minor.

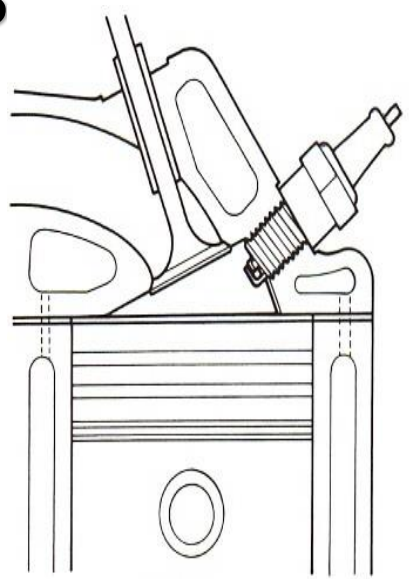
2- The exhaust valve and spark plug should be close together because exhaust value is very hot so it should be far from the end gas to avoid knock or pre-ignition.

3- Sufficient turbulence should be considered to promote rapid combustion

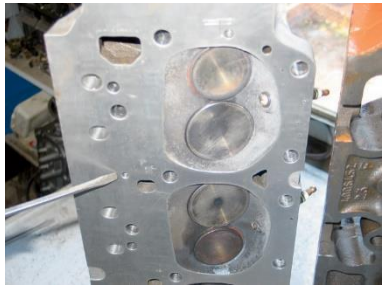
4- The end gas should be in a cool region of the com. Ch. since the IV is cooled during the induction stroke, this can be positioned in the end gas region.

SHAPES OF COMBUSTION CHAMBERS

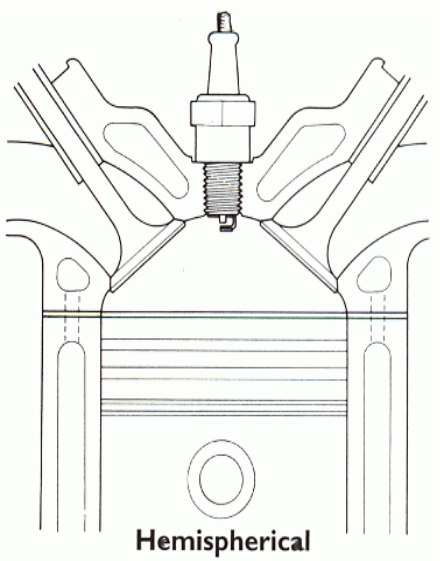
A. Wedge combustion chamber: Simple and cheep inlet and exhaust manifold have to be on the same side of the cylinder head



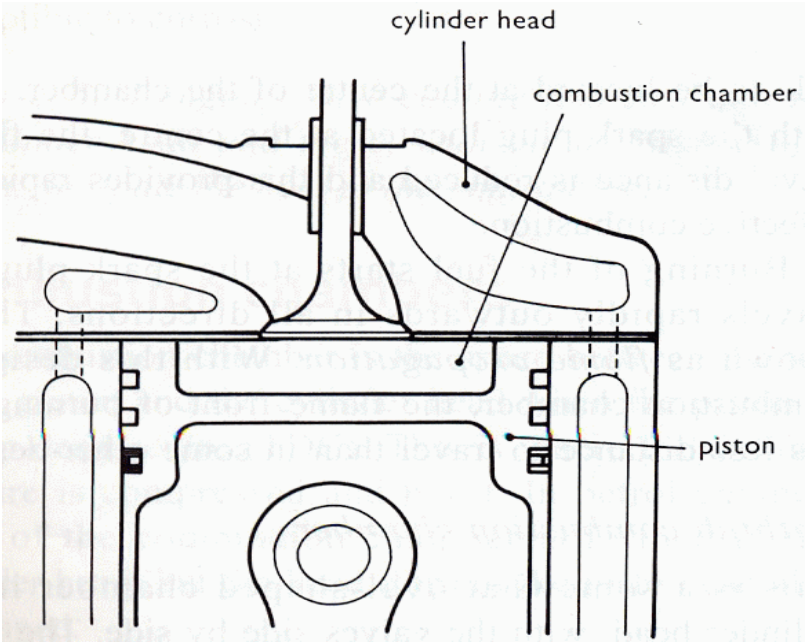
Wedge



B. Hemispherical head C.C used for high performance engines. it has twin overhead camshafts and the valves are opposite to each other to allow cross flow from inlet to exhaust, its benefit is to reduce residual gas



C. Bowl in piston C.C: cheaper than hemispherical



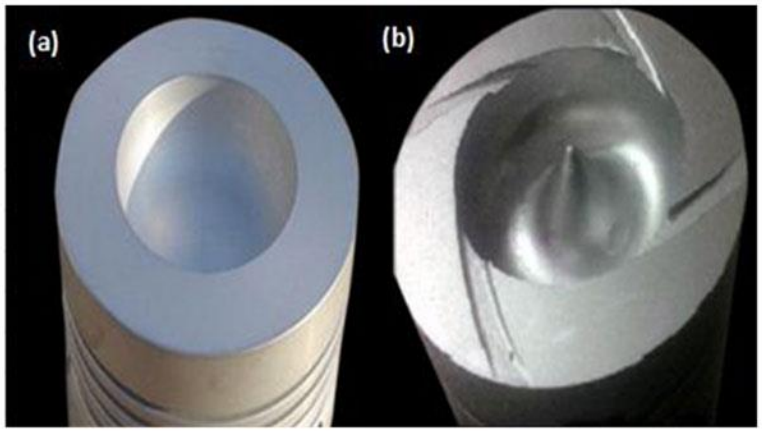


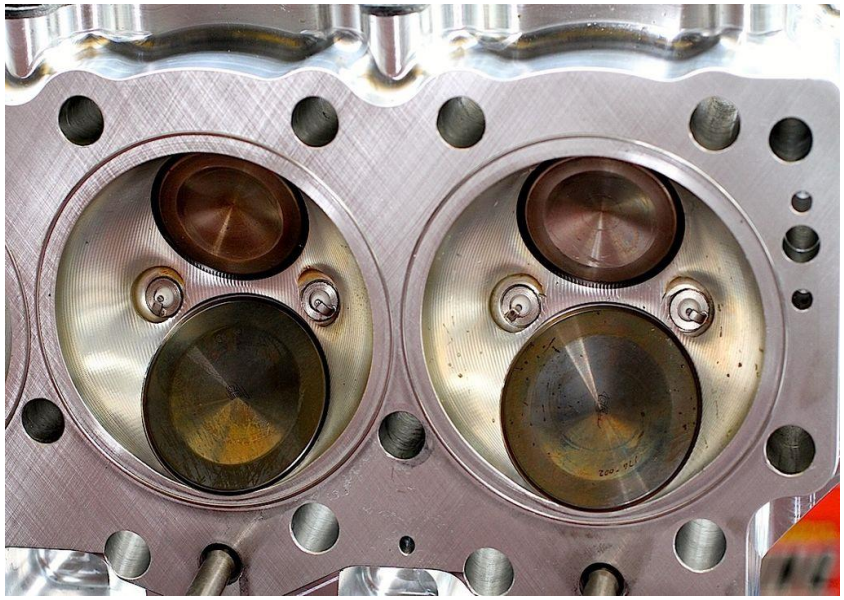
Figure 1: Piston bowl (a) standard HCC, (b) modified TSG

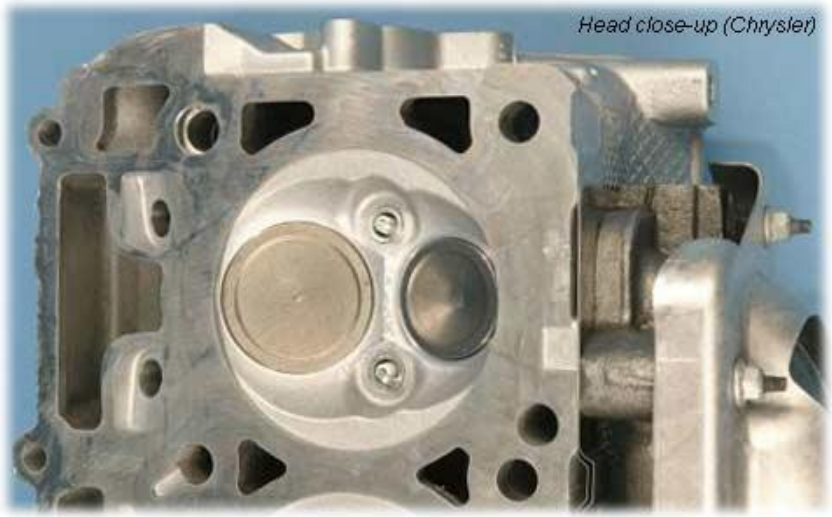
- BATH-TUB C.C ECONOMICAL AND COMPACT C.C .

E. DOUBLE SPARK PLUG C.C

Double SP with geometry of C.C. lead to large flame front area This leads to rapid combustion without the high heat transfer, also associated with high turbulence. In any C.C.

The max. temp will be from the gas burnt last, because first mixture burnt compresses the unburnt gas, also the heat transfer from the burnt gas, so the last burnt gas will be in the center of C.C and then H.T. from C.C. to the walls will be reduced





L- Jetronic fuel injection system