Different types of SI engine combustion chambers:

A few representative types of combustion chambers of which there are many more Variations are enumerated and discussed below:

1. T-head combustion chamber.
2. L-head combustion chamber.
3. I-head (or overhead valve) combustion chamber.
4. F-head combustion chamber.

It may be noted that these chambers are designed to obtain the objectives namely:

- A high combustion rate at the start.
- A high surface-to-volume ratio near the end of burning.
- A rather centrally located spark plug.

T Head Type Combustion chambers:

This was first introduced by Ford Motor Corporation in 1908. This design has following disadvantages.

- Requires two cam shafts (for actuating the in-let valve and exhaust valve separately) by two cams mounted on the two cam shafts.
- Very prone to detonation. There was violent detonation even at a compression ratio of 4. This is because the average octane number in 1908 was about 40 -50.

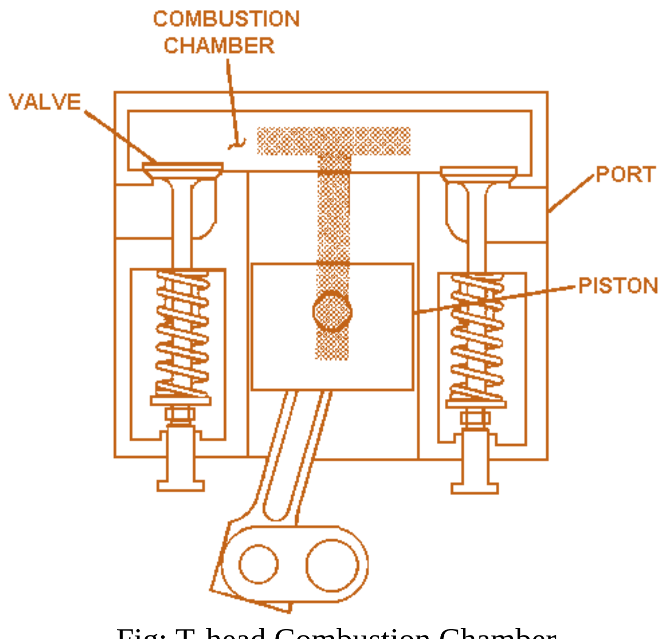

Fig: T-head Combustion Chamber

L Head Type Combustion chambers:

It is a modification of the T-head type of combustion chamber. It provides the two values on the same side of the cylinder, and the valves are operated through tappet by a single camshaft. This was first introduced by Ford motor in 1910-30 and was quite popular for some time. This design has an advantage both from manufacturing and maintenance point of view.

Advantages:

- Valve mechanism is simple and easy to lubricate.
- Detachable head easy to remove for cleaning and decarburizing without disturbing either the valve gear or main pipe work.
- Valves of larger sizes can be provided.

Disadvantages:

- Lack of turbulence as the air had to take two right angle turns to enter the cylinder and in doing so much initial velocity is lost.
- Extremely prone to detonation due to large flame length and slow combustion due to lack of turbulence.
- More surface-to-volume ratio and therefore more heat loss.
- Extremely sensitive to ignition timing due to slow combustion process
- Valve size restricted.
- Thermal failure in cylinder block also. In I-head engine the thermal failure is confined to cylinder head only

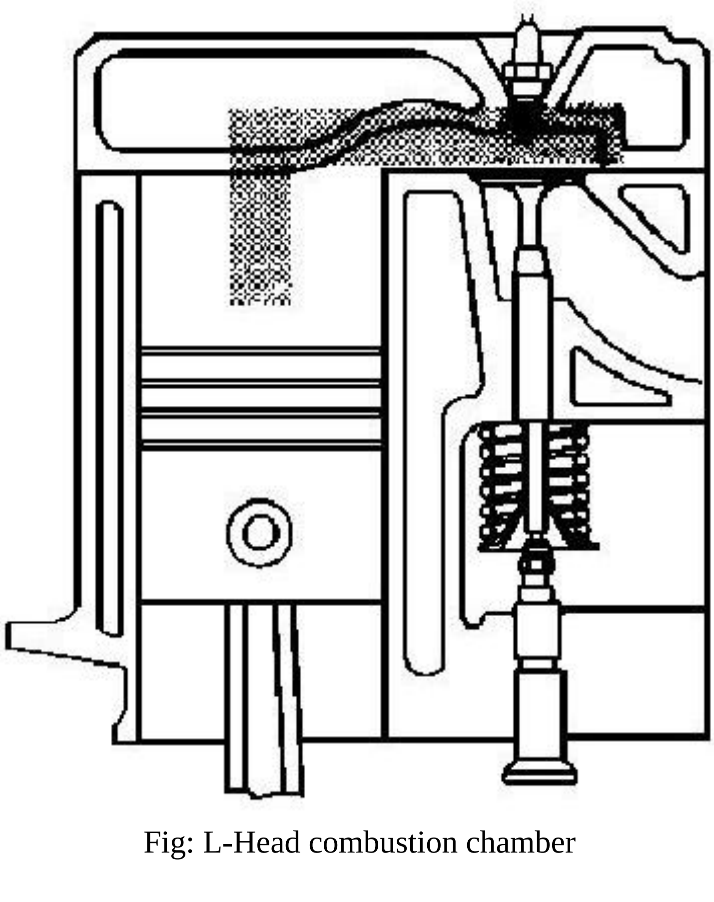

Fig: L-Head combustion chamber

Ricardo's turbulent head– side valve combustion chamber:

Ricardo developed this head in 1919. His main objective was to obtain fast flame speed and reduce knock in L design. In Ricardo's design the main body of combustion chamber was concentrated over the valves, leaving slightly restricted passage communicating with cylinder.

Advantages:

- Additional turbulence during compression stroke is possible as gases are forced back through the passage.
- By varying throat area of passage designed degree of additional turbulence is possible.
- This design ensures a more homogeneous mixture by scoring away the layer of stagnant gas clinging to chamber wall. Both the above factors increase the flame speed and thus the performance.
- Deign make engine relatively insensitive to timing of spark due to fast combustion
- Higher engine speed is possible due to increased turbulence
- Ricardo's design reduced the tendency to knock by shortening length of effective flame travel by bringing that portion of head which lay over the further side of piston into as close a contact as possible with piston crown.
- This design reduces length of flame travel by placing the spark plug in the centre of effective combustion space.

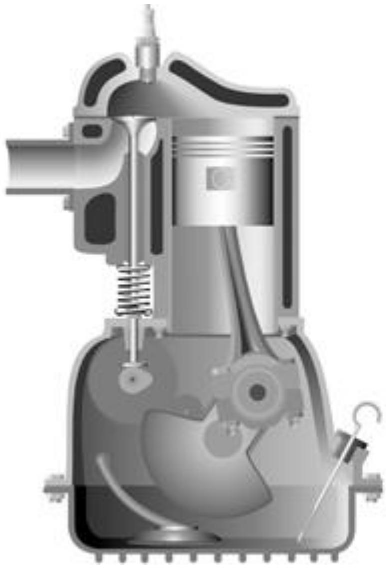

Fig: Ricardo turbulent head

Disadvantages:

- With compression ratio of 6, normal speed of burning increases and turbulent head tends to become over turbulent and rate of pressure rise becomes too rapid leads to rough running and high heat losses.
- To overcome the above problem, Ricardo decreased the areas of passage at the expense of reducing the clearance volume and restricting the size of valves. This reduced breathing capacity of engine; therefore these types of chambers are not suitable for engine with high compression ratio.

Over head valve or I head combustion chamber:

The disappearance of the side valve or L-head design was inevitable at high compression ratio of 8:1 because of the lack of space in the combustion chamber to accommodate the valves. Diesel engines, with high compression ratios, invariably used overhead valve design.

Since 1950 or so mostly overhead valve combustion chambers are used. This type of combustion chamber has both the inlet valve and the exhaust valve located in the cylinder head. An overhead engine is superior to side valve engine at high compression ratios.

The overhead valve engine is superior to side valve or L-head engine at high compression ratios, for the following reasons:

- Lower pumping losses and higher volumetric efficiency from better breathing of the engine from larger valves or valve lifts and more direct passageways.
- Less distance for the flame to travel and therefore greater freedom from knock, or in other words, lower octane requirements.
- Less force on the head bolts and therefore less possibility of leakage (of compression gases or jacket water). The projected area of a side valve combustion chamber is inevitably greater than that of an overhead valve chamber.
- Removal of the hot exhaust valve from the block to the head, thus confining heat failures to the head. Absence of exhaust valve from block also results in more uniform cooling of cylinder and piston.
- Lower surface-volume ratio and, therefore, less heat loss and less air pollution.
- Easier to cast and hence lower casting cost.

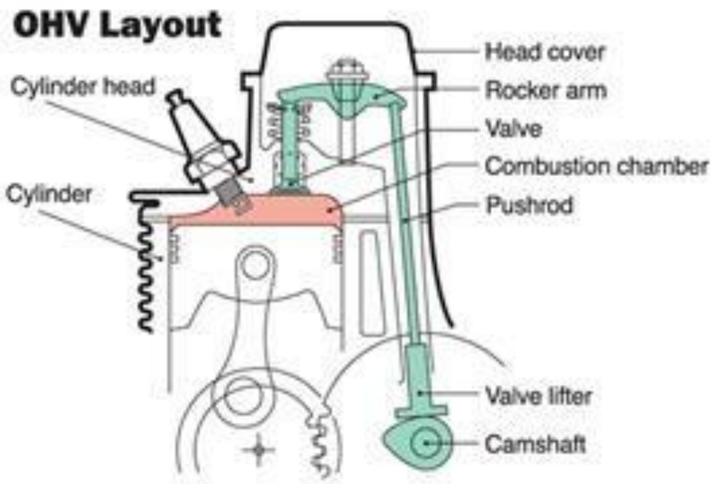

Fig: Overhead valve combustion chamber.

Bath Tub Combustion Chamber: This is simple and mechanically convenient form. This consists of an oval shaped chamber with both valves mounted vertically overhead and with the spark plug at the side. The main drawback of this design is both valves are placed in a single row along the cylinder block. This limits the breathing capacity of engine, unless the overall length is increased. However, modern engine manufactures overcome this problem by using unity ratio for stroke and bore size.

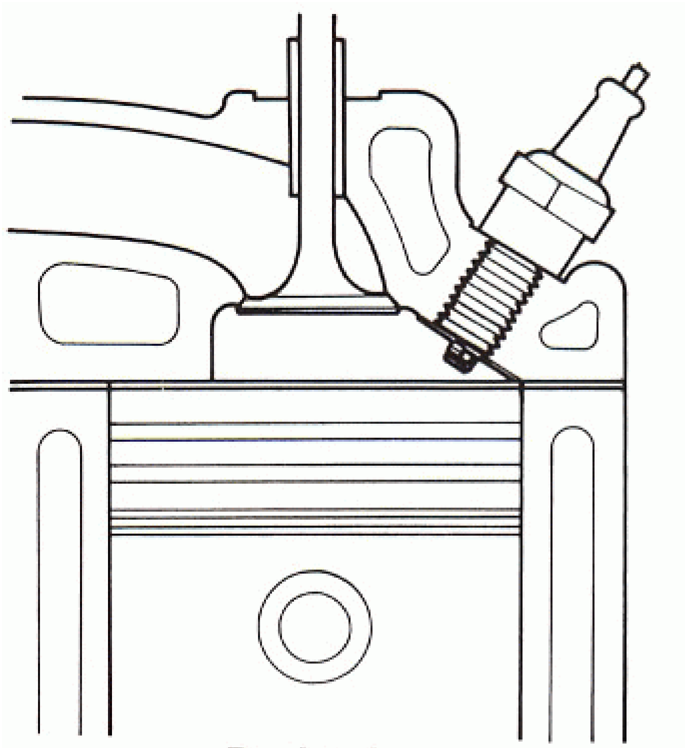

Fig: Bathtub Combustion Chamber

Wedge Type Combustion Chamber: In this design slightly inclined valves are used. This design also has given very satisfactory performance. A modern wedge type design can be seen in for Plymouth V-8 engine. It has a stoke of 99 mm and bore of 84mm with compression ratio 9:1

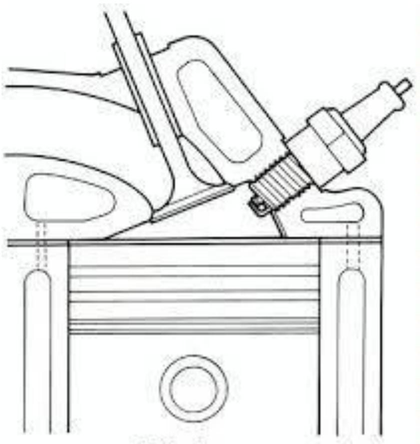

Fig: Wedge type combustion chamber.

F- Head combustion chamber:

In such a combustion chamber one valve is in head and other in the block. This design is a compromise between L-head and I-head combustion chambers. One of the most F-head engines (wedge type) is the one used by the Rover Company for several years. Another successful design of this type of chamber is that used in Willeys jeeps.

Its advantages are:

- High volumetric efficiency
- Maximum compression ratio for fuel of given octane rating
- High thermal efficiency
- It can operate on leaner air-fuel ratios without misfiring.

The drawback

- This design is the complex mechanism for operation of valves and expensive special shaped piston.

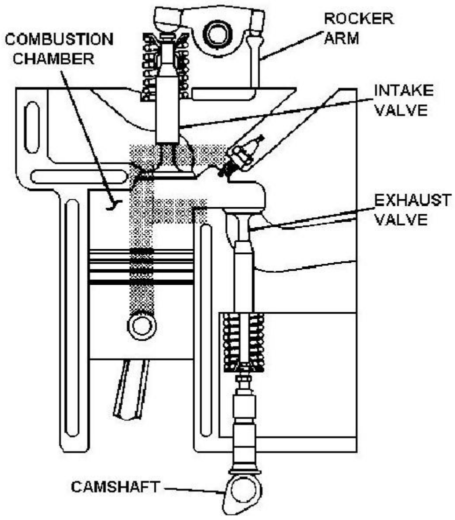

Fig: F- Head Combustion chamber

Divided Combustion Chamber:

In this type of chambers usually with about 80 percent of the clearance volume in the main chamber above the piston and about 20 percent of the volume as a secondary chamber. Main chamber is connected to secondary chamber through a small orifice Combustion is started in the small secondary chamber. As the gases in secondary chambers are consumed by combustion, pressure rises and flaming gas expands back through orifice and act as torch ignition for main chamber.

Secondary chamber has high swirl and designed to handle rich mixture. The rich mixture with very high swirl in secondary chamber will ignite readily and burn very quickly. The flame gas expands through orifice and ignites the lean mixture in the main chamber. The net result is an engine that has good ignition and combustion and yet operates mostly lean to give good fuel economy.

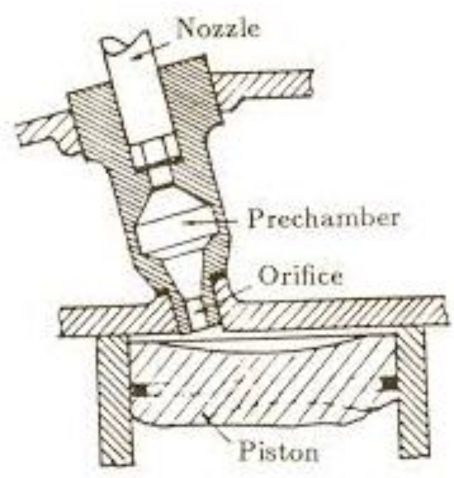

Fig: Divided Combustion Chamber

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