Internal Combustion Engine 1

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Combustion Chambers for SI engines

Combustion Chambers for SI Engines

The design of the combustion chamber for an SI engine has a significant influence on engine performance and knocking tendencies. The design involves:

- Shape of the combustion chamber
- Location of the spark plug
- Location of inlet and exhaust valves

Combustion Chambers for SI Engines

Research and development over the last fifty years have raised the compression ratio from 4 to 11. Key requirements include:

- High power output with minimum octane requirement
- High thermal efficiency
- Smooth engine operation

Smooth Engine Operation

Objectives for smooth operation:

- **Moderate Rate of Pressure Rise:** Apply the greatest force to the piston as close to TDC on the power stroke as possible.
- **Reducing Knocking:**
  - Centralize the spark plug and avoid pockets of stagnant charge.
  - Ensure satisfactory cooling of spark plug and exhaust valve areas.
  - Reduce temperature of the last portion of the charge with high surface-to-volume ratio.

High Power Output and Thermal Efficiency

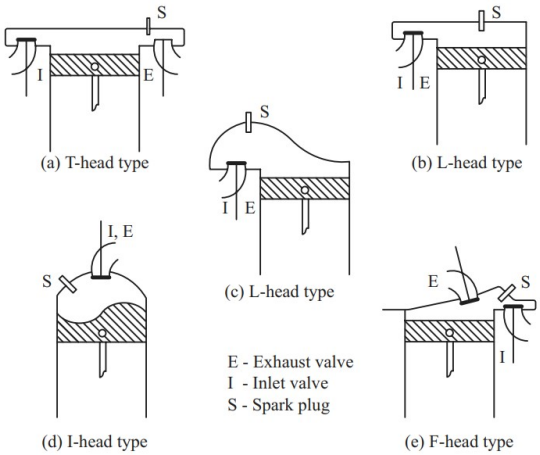
Achieving high power and efficiency:

- **Turbulence:** Achieve high flame front velocity through inlet flow configuration or squish.
- **Volumetric Efficiency:** More charge during suction stroke by providing ample clearance around valve heads and large diameter valves.
- **Antiknock Characteristics:** Improve antiknock features to permit higher compression ratios.
- **Compact Chamber Design:** Reduces heat loss and increases thermal efficiency.

Ricardo's Turbulent Head Design

Ricardo's Turbulent Head Design:

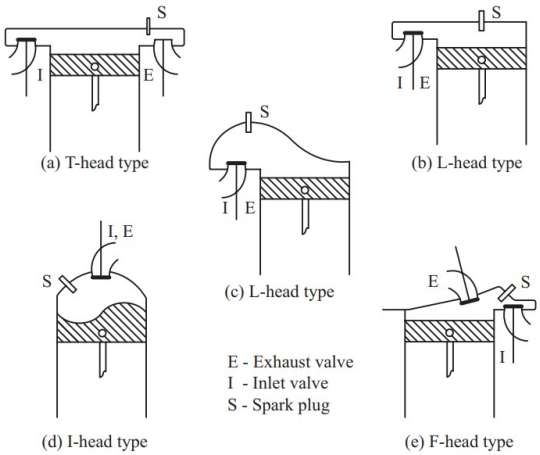
- Concentrates chamber body over valves.
- Creates additional turbulence and reduces knocking.
- Shortens effective flame travel length.



T-Head Type

T-Head Type:

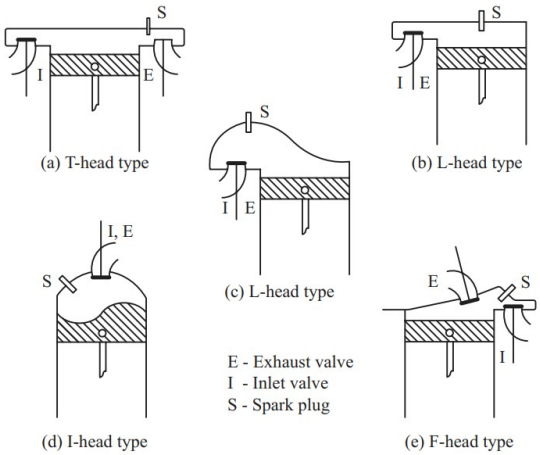
- Early design with long distance across the chamber.
- High knocking tendency.
- Requires two camshafts.



L-Head Type

L-Head Type:

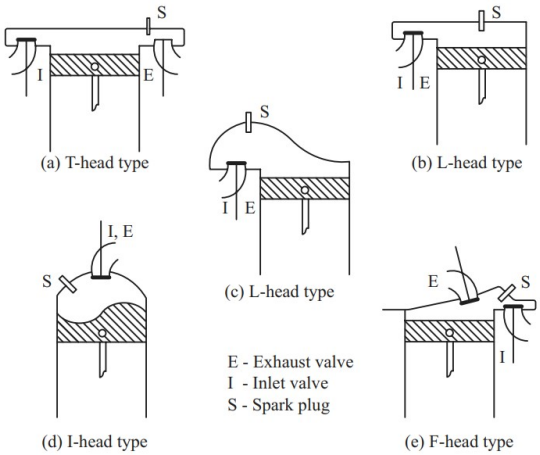
- Valves on the same side, operated by a single camshaft.
- Easier lubrication and removable head.
- Airflow loss due to right angle turns.



I-Head Type

I-Head Type (Overhead Valve):

- Both valves on the cylinder head.
- Superior to side valve or L-head at high compression ratios.



Characteristics of I-Head Type

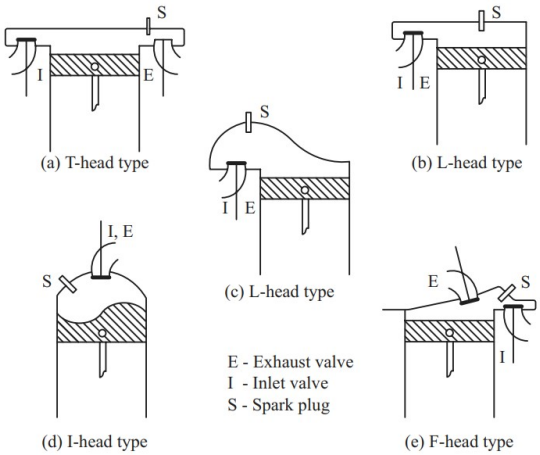
Key Characteristics:

- Less surface-to-volume ratio, resulting in less heat loss.
- Shorter flame travel length.
- Higher volumetric efficiency with larger valves or valve lifts.
- Confinement of thermal failures to cylinder head.

F-Head Type

F-Head Type:

- Compromise between L-head and I-head types.
- One valve in the cylinder head, one in the block.
- Requires separate cams for intake and exhaust valves.



Summary

Summary of Combustion Chambers:

- Combustion chamber design significantly impacts performance and knocking.
- Various types include T-head, L-head, Ricardo's turbulent head, I-head, and F-head.
- Design considerations include reducing knocking, achieving high power output, and improving thermal efficiency.

End of Lecture 18