Four strokes of SI Engine Cycle :

- **Suction/Intake stroke:** Intake of air fuel mixture in cylinder through intake manifold.
  - The piston travel from TDC to BDC with the intake valve open and exhaust valve closed.
  - This creates an increasing volume in the combustion chamber, which in turns creates a vacuum.
  - The resulting pressure differential through the intake system from atmospheric pressure on the outside to the vacuum on the inside causes air to be pushed into the cylinder.
  - As the air passes through the intake system fuel is added to it in the desired amount by means of fuel injectors or a carburettor.

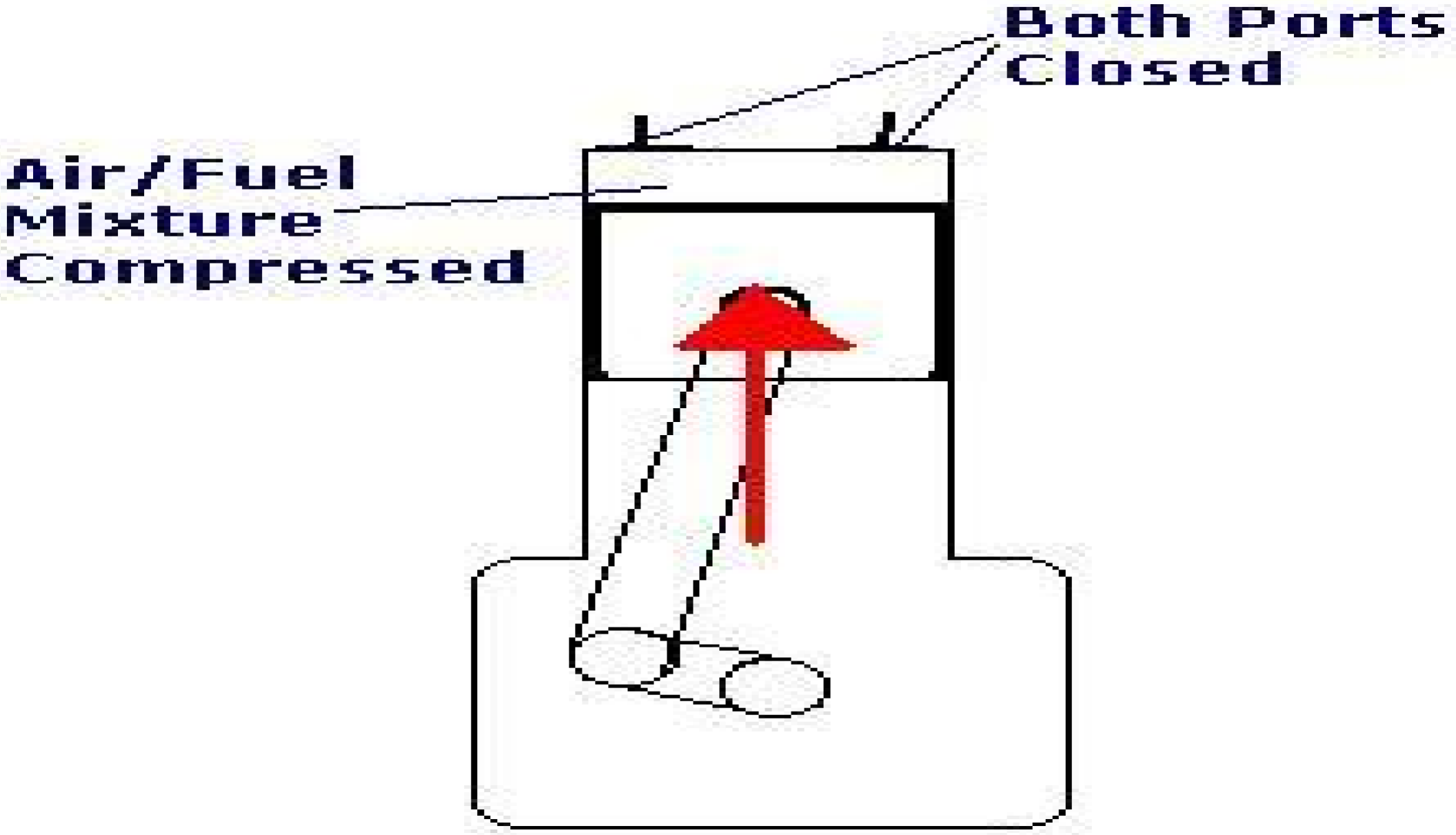

Figure5: Compression Stroke

- **Compression stroke:** When the piston reaches BDC, the intake valve closes and the piston travels back to TDC with all valves closed.
  - This compresses air fuel mixture, raising both the pressure and temperature in the cylinder.
  - Near the end of the compression stroke the spark plug is fired and the combustion is initiated.

- **Combustion** of the air-fuel mixture occurs in a very short but finite length of time with the piston near TDC (i.e., nearly constant volume combustion).
  - It starts near the end of the compression stroke slightly before TDC and lasts into the power stroke slightly after TDC.
  - Combustion changes the composition of the gas mixture to that of exhaust products and increases the temperature in the cylinder to a high value.
  - This in turn increases the pressure in the cylinder to a high value.

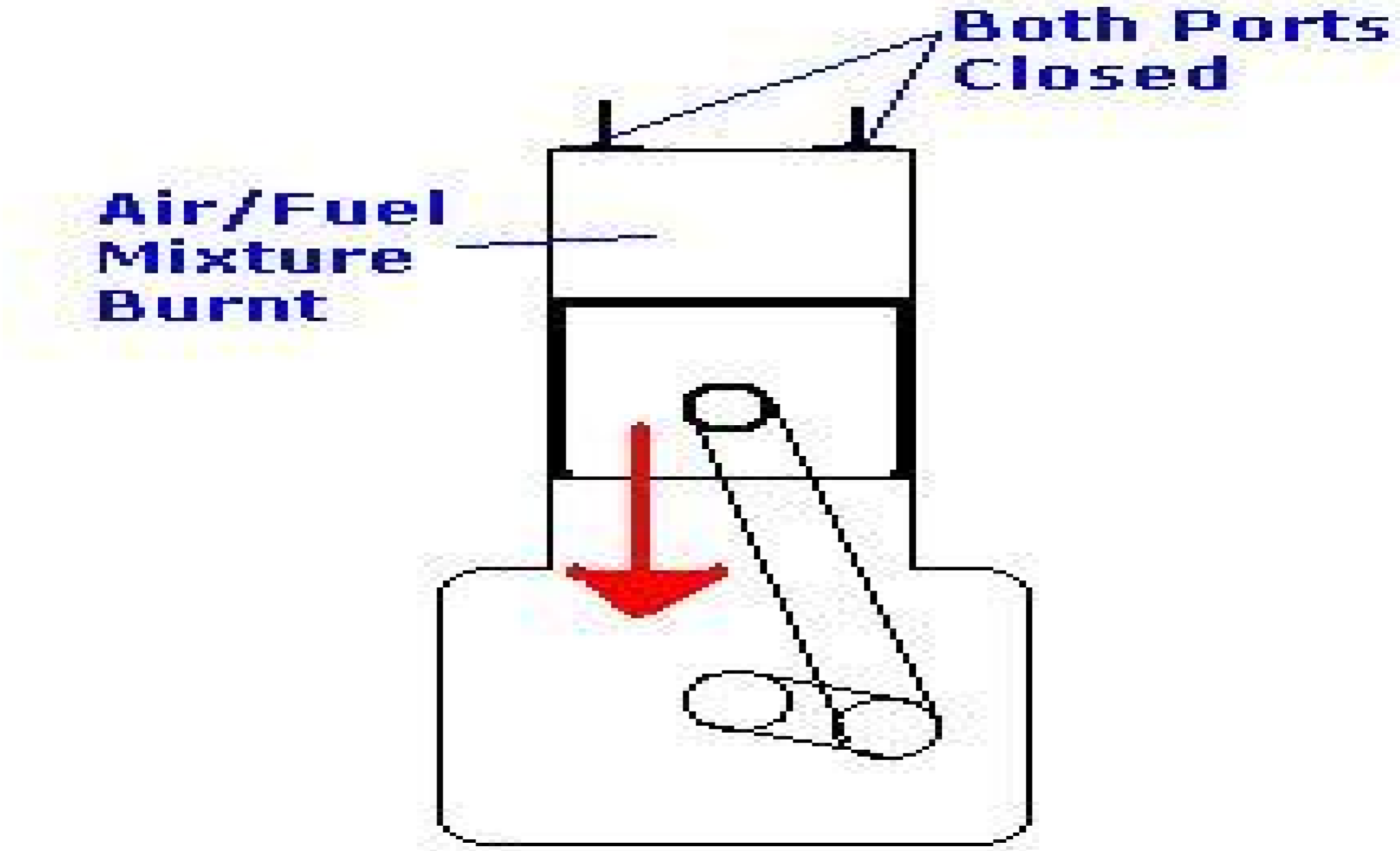

Figure6: Combustion followed by Expansion stroke.

- **Expansion stroke/Power stroke :** With all valves closed the high pressure created by the combustion process pushes the piston away from the TDC.
  - This is the stroke which produces work output of the engine cycle.
  - As the piston travels from TDC to BDC, cylinder volume is increased, causing pressure and temperature to drop.

Exhaust Blowdown : Late in the power stroke, the exhaust valve is opened and exhaust blowdown occurs.

- Pressure and temperature in the cylinder are still high relative to the surroundings at this point, and a pressure differential is created through the exhaust system which is open to atmospheric pressure.
- This pressure differential causes much of the hot exhaust gas to be pushed out of the cylinder and through the exhaust system when the piston is near BDC.
- This exhaust gas carries away a high amount of enthalpy, which lowers the cycle thermal efficiency.
- Opening the exhaust valve before BDC reduces the work obtained but is required because of the finite time needed for exhaust blowdown.

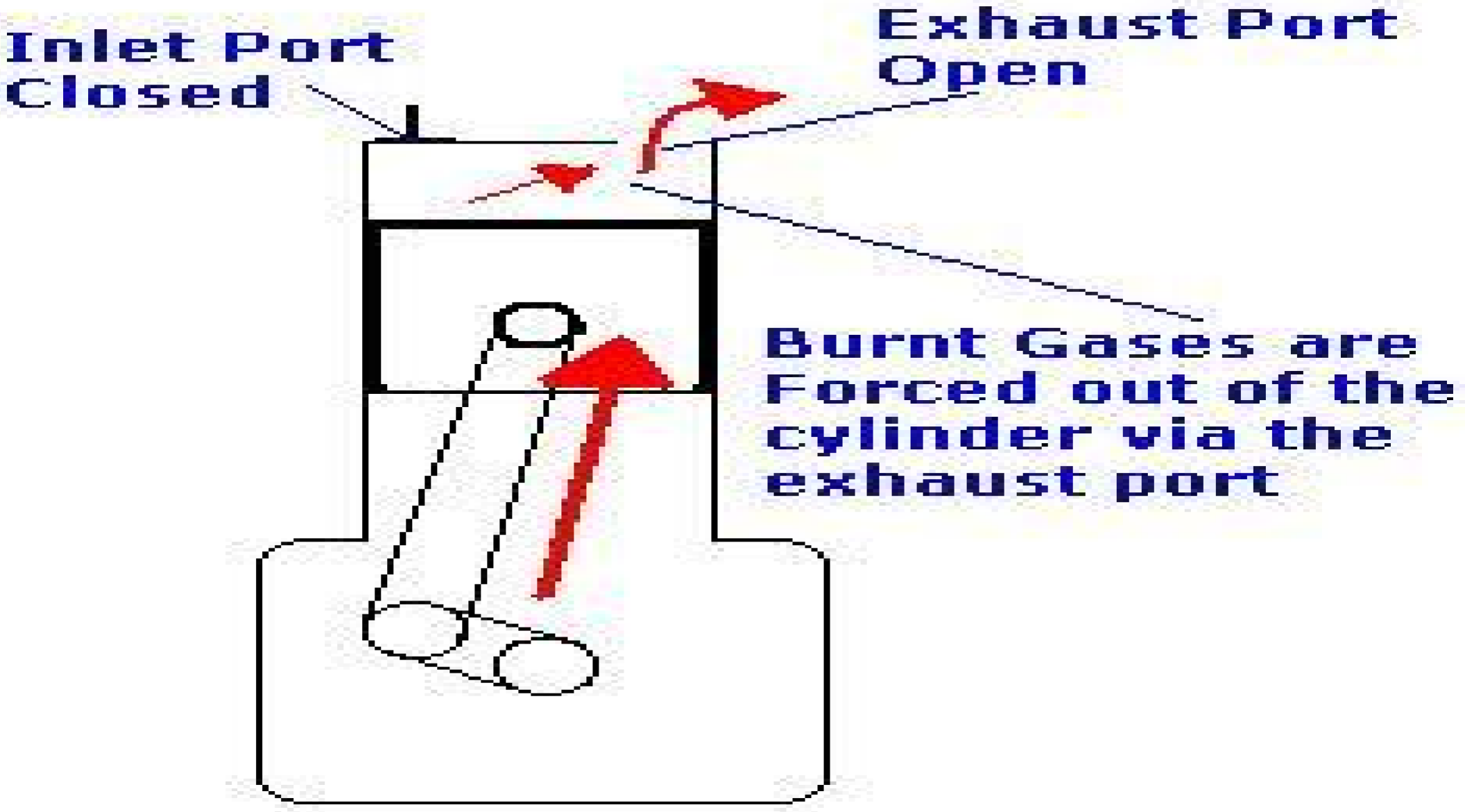

Figure7: Exhaust blowdown followed by Exhaust stroke

- **Exhaust stroke:** By the time piston reaches BDC, exhaust blowdown is complete, but the cylinder is still full of exhaust gases at approximately atmospheric pressure.
  - With the exhaust valve remaining open, the piston travels from BDC to TDC in the exhaust stroke.
  - This pushes most of the remaining exhaust gases out of the cylinder into the exhaust system at about atmospheric pressure, leaving only that trapped in the clearance volume when the piston reaches TDC.

- Near the end of the exhaust stroke before TDC, the intake valve starts to open, so that it is fully open by TDC when the new intake stroke starts the next cycle.
- Near TDC the exhaust valve starts to close and finally is fully closed sometime after TDC.
- This period when both the intake valve and exhaust valve are open is called **valve overlap,** it can be clearly seen in valve timing chart given below.