Chapter 5

The Turbojet Engine with an Afterburner

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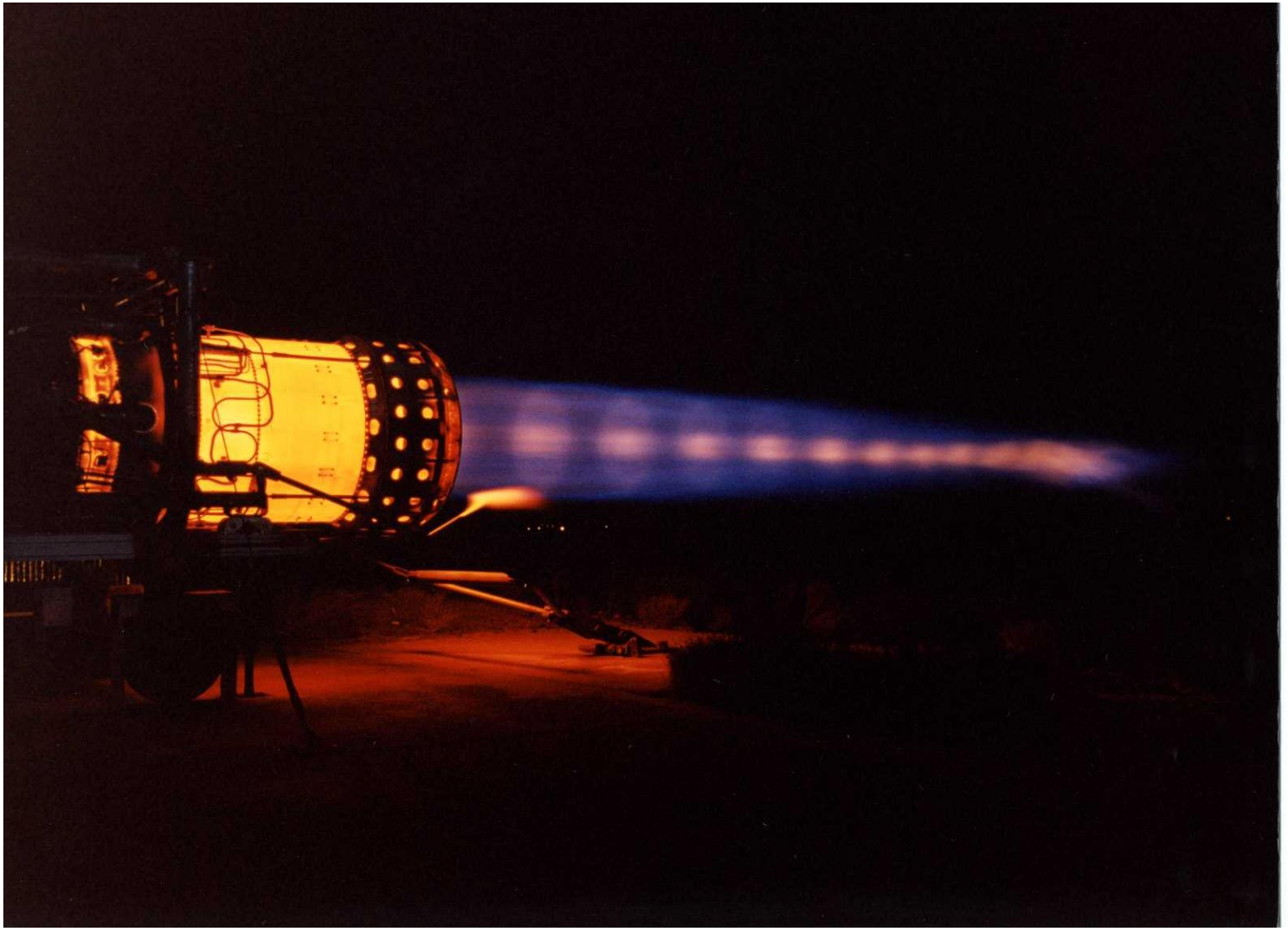
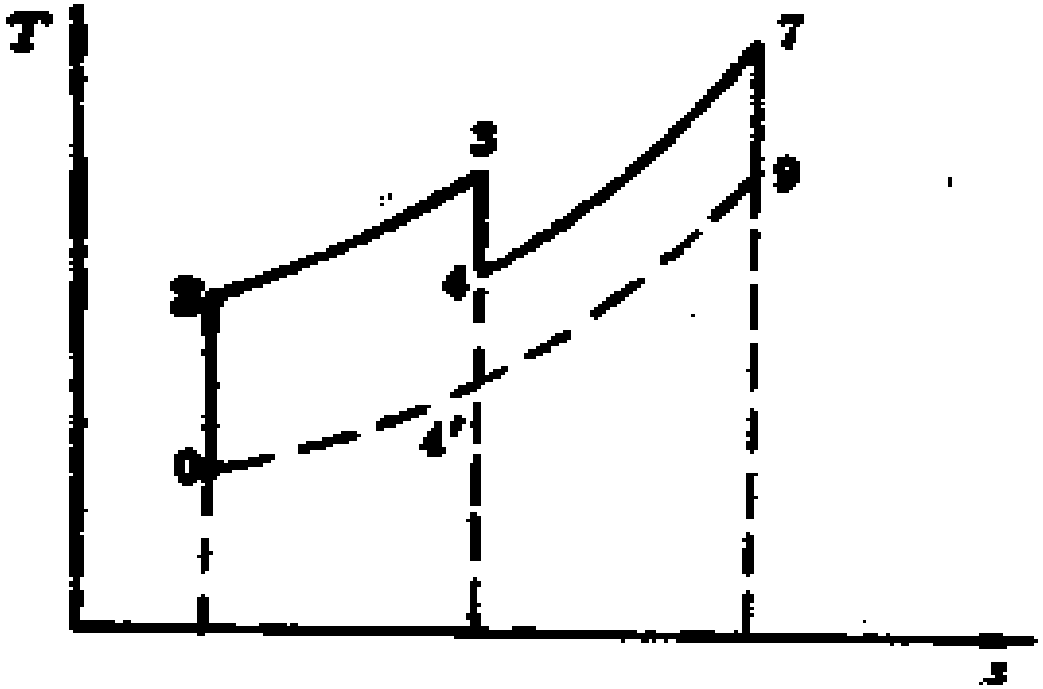
The Afterburner



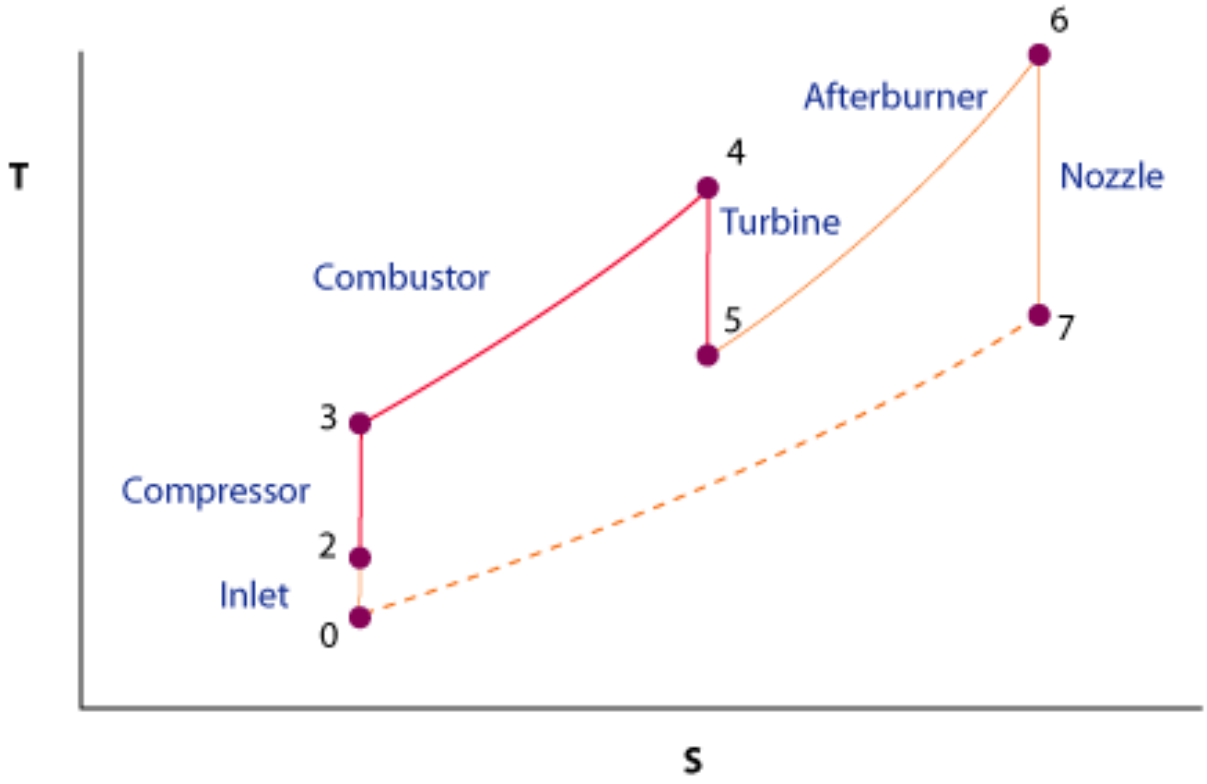
The Afterburner

The Afterburner



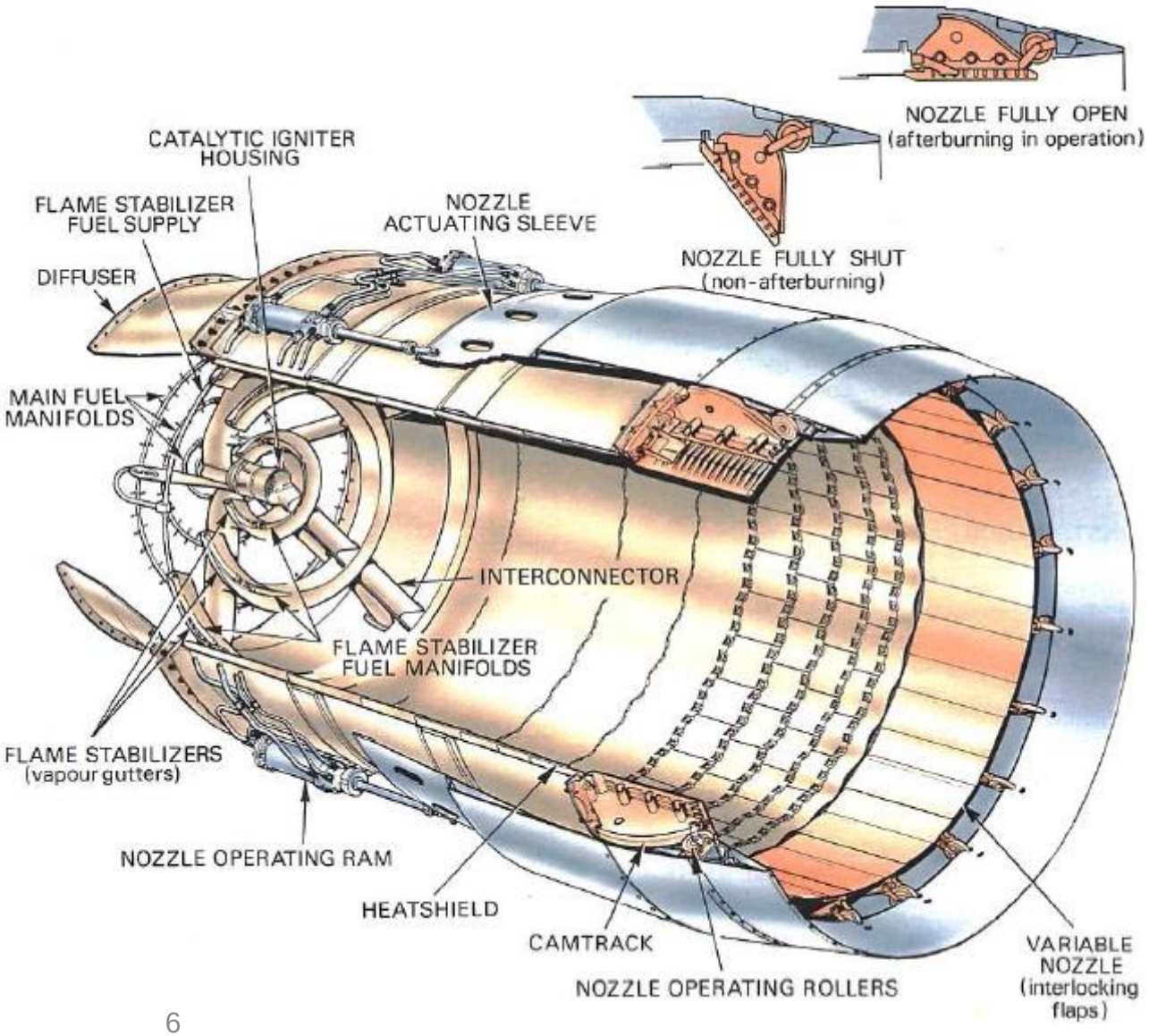
When afterburner is working, the core machine may stay in the same working point/state. An (virtually) independent afterburning cycle is added to the process.

The Afterburner



When afterburner is working, the core machine may stay in the same operating point. An (virtually) independent afterburning cycle is added to the process.

The Afterburner



The Afterburner

Basic requirements of an Afterburner

- Reliable ignition
  - Compared to main CC, advantage of A/B is high *T* (better for chemical reaction), disadvantages are low total pressure, high flow speed, and less oxygen.
  - In general, it's still easier to ignite except at high altitude.
- Complete combustion
  - Because of low total pressure, high velocity, and high fuel flow, burning efficiency is lower (0.85~0.90).
  - Especially at high altitudes, it decreases significantly even under rich fuel conditions.
- No oscillation
  - Burning in afterburner might be oscillating, with low frequency of 50~200Hz. This might cause flameout or breaking of parts.
  - Heat shields are used for structural protection.

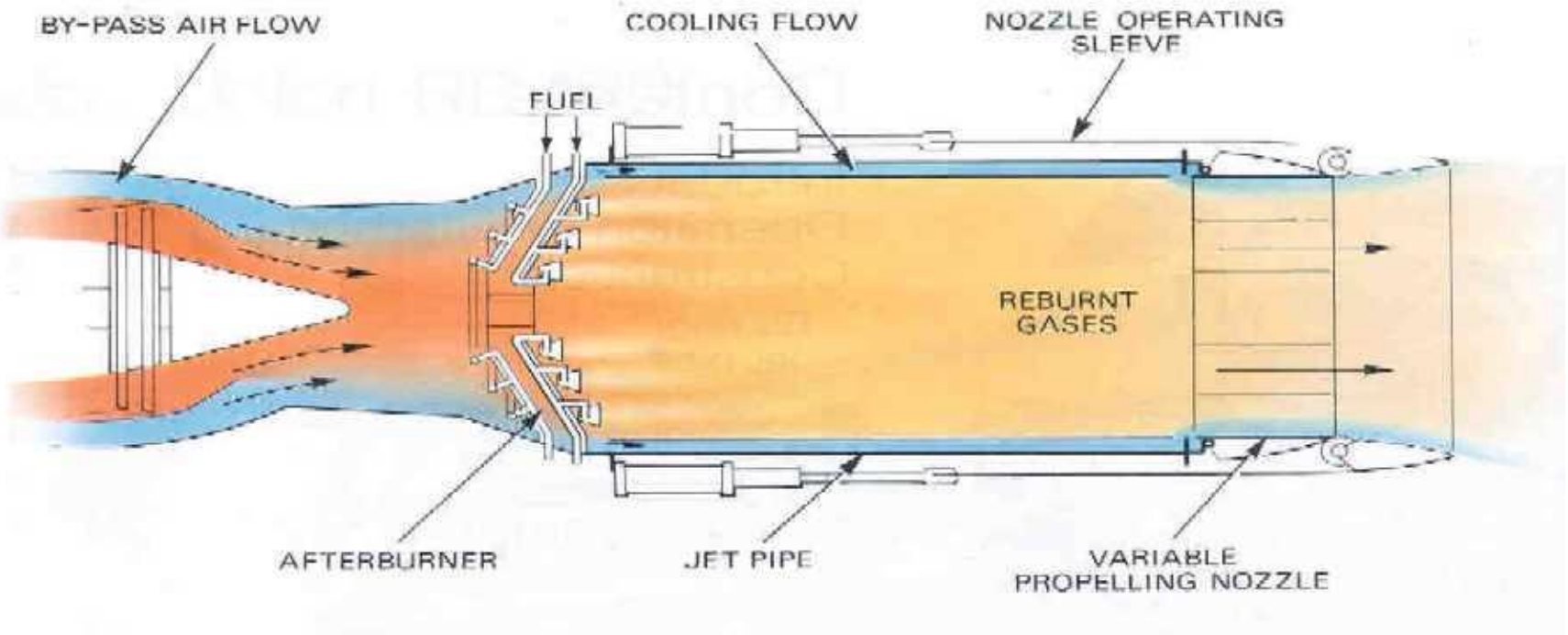
The Afterburner

Basic requirements of an Afterburner

- Low total pressure losses
  - Although velocity decreases in the diffuser, it is still quite high.
  - Afterburner does not work during most part of the flight time. It causes drag for air flow (due to its length, flame stabilizers, fuel manifolds).

The Afterburner

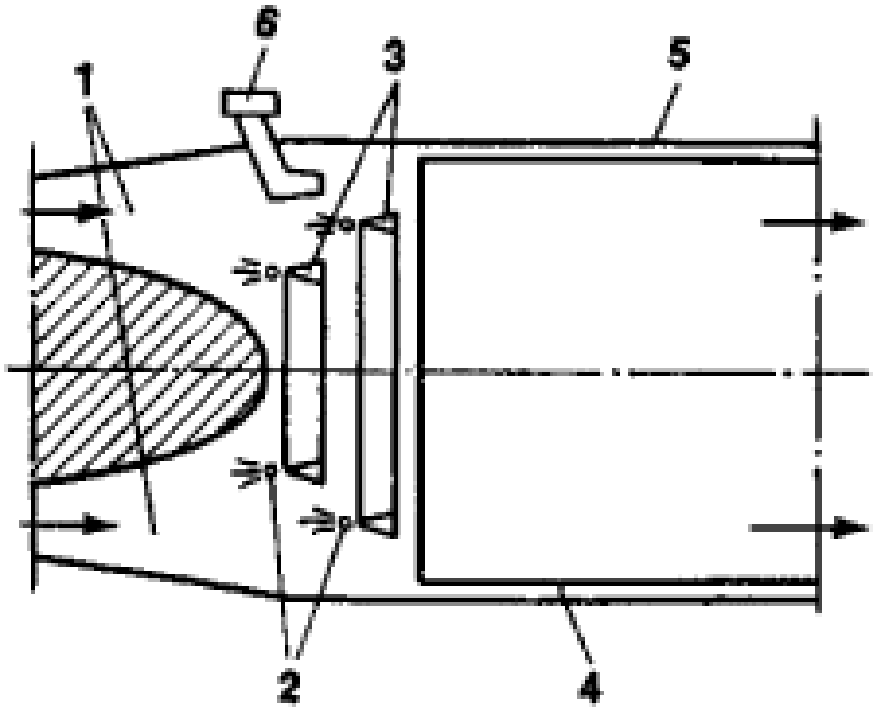
Afterburning Process and Main Parts



The Afterburner

Afterburning Process and Main Parts

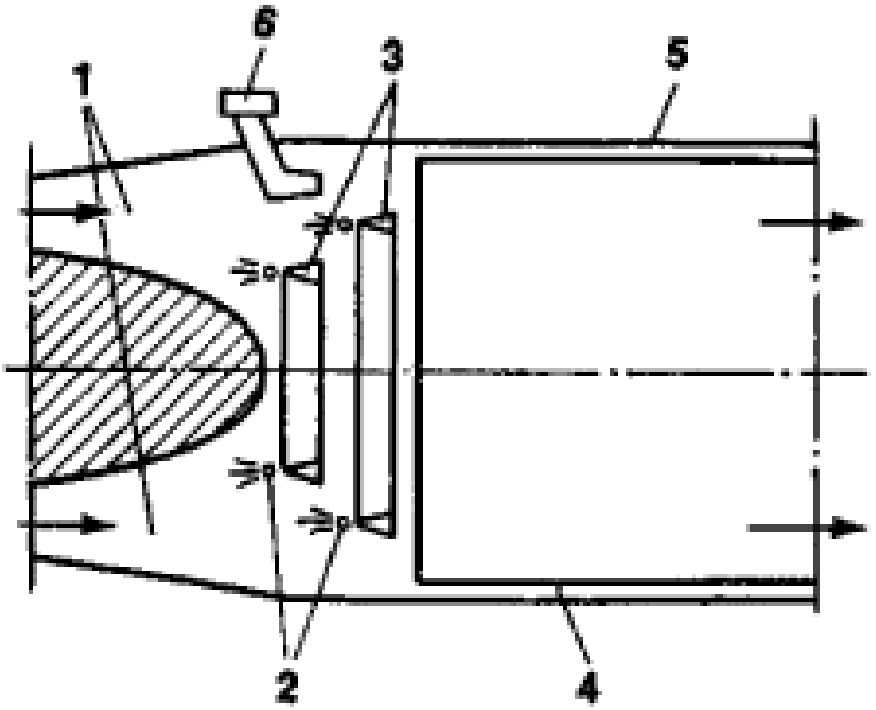
- Diffuser
  - Reduce flow speed from 400 m/s to 150m/s.
  - Redress the core flow to the axial direction.



The Afterburner

Afterburning Process and Main Parts

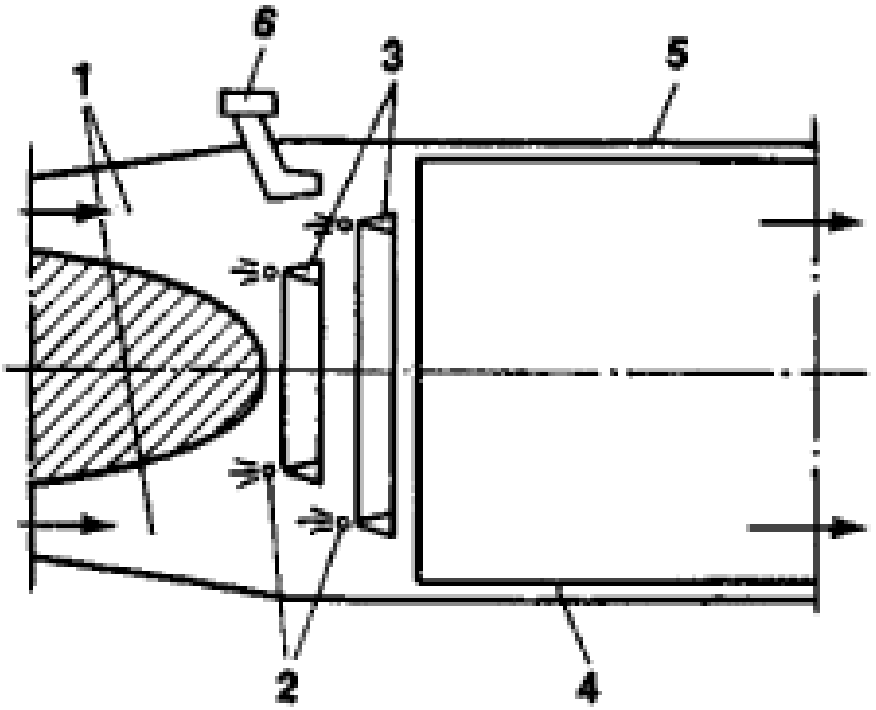
- Fuel injection and vaporization
  - Injection direction is against flow direction.
  - Fuel supply can be divided in 2-3 zones.



The Afterburner

Afterburning Process and Main Parts

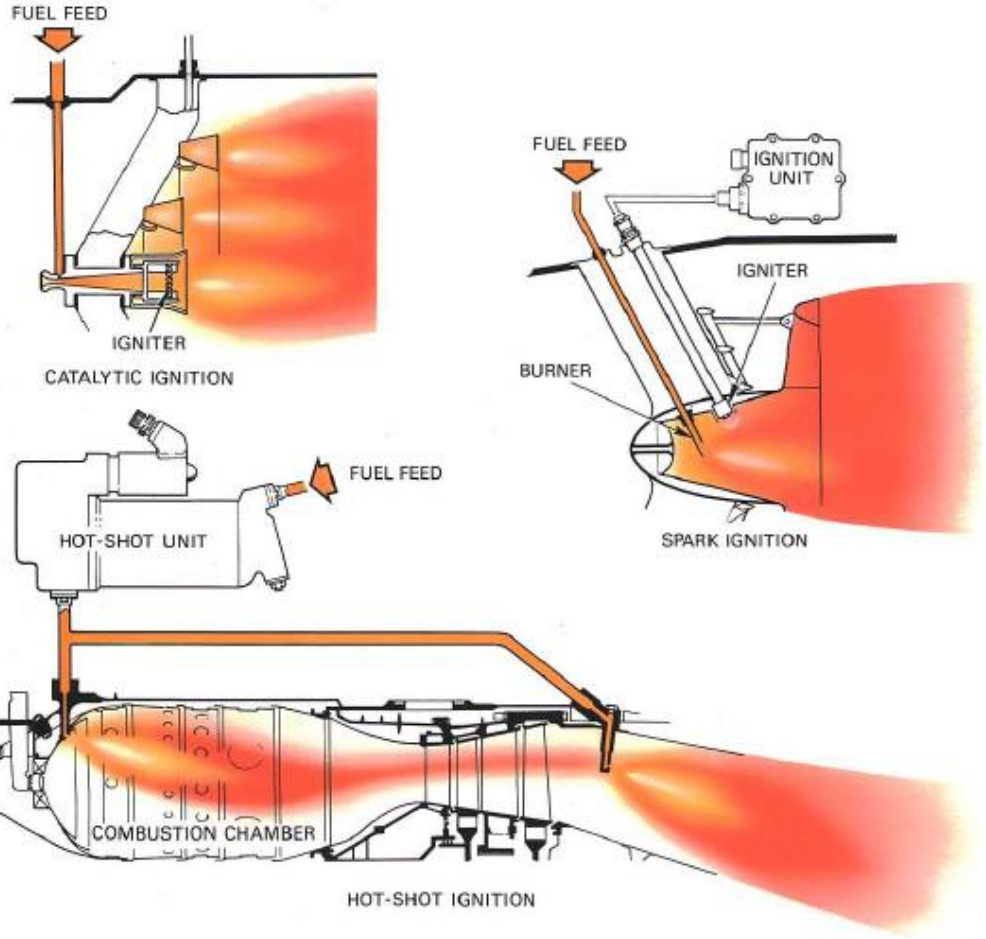
- Ignition methods
  - Spark
  - Catalytic
  - Hot-shot



The Afterburner

Afterburning Process and Main Parts

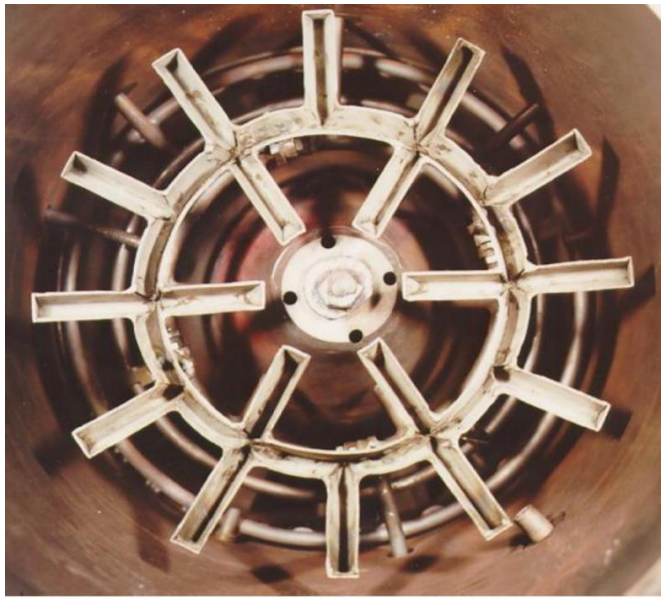
- Ignition methods



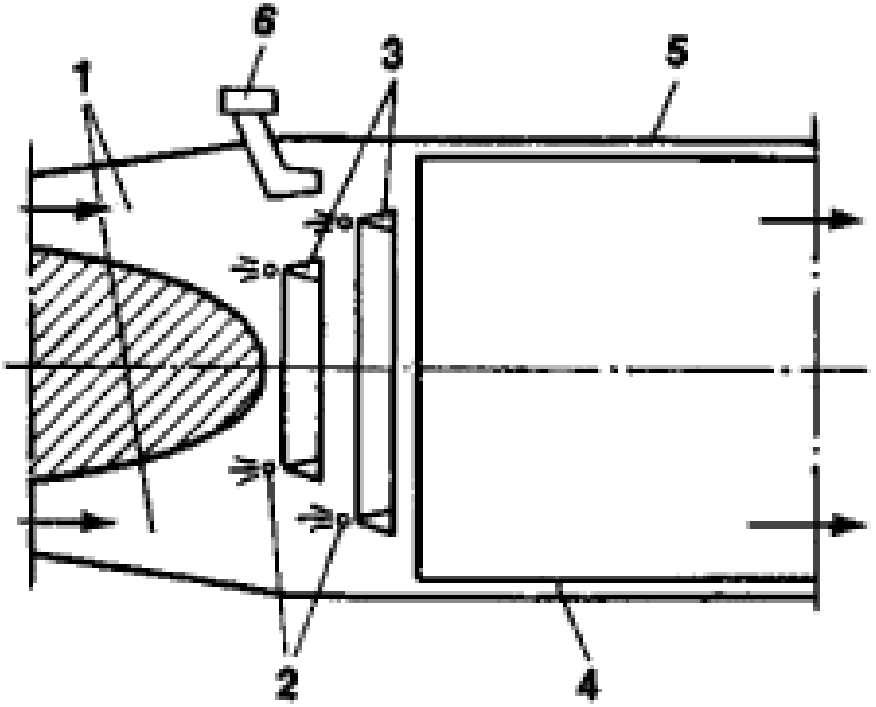
The Afterburner

Afterburning Process and Main Parts

- Flame stabilizers
  - Form V (Radial, circumferential).
  - Sand dune (Chinese invention).



End-on view of the V- gutter



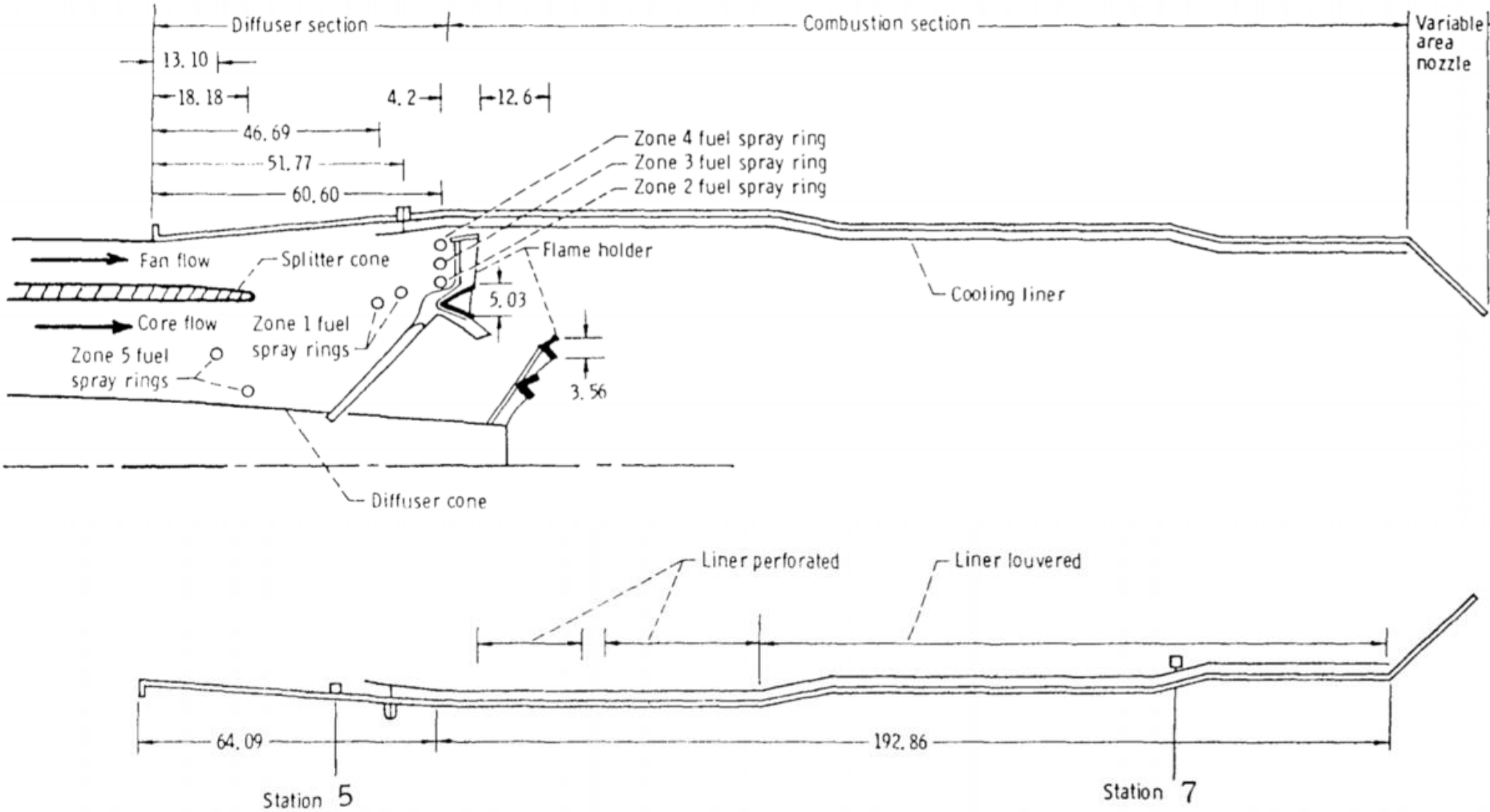


Fig. 2.38 Afterburner for TF30-P-3 augmented turbofan engine [all dimensions are in centimeters (from Ref. 29)].

The Afterburner

Afterburning Process and Main Parts