Combustion and Dilution:

Combustors will not generate smoke when the equivalence ratio in the primary zone is below 1.5. Visible smoke is considered an air pollution problem. Following combustion, the rich burning mixture leaves the combustion zone and mixes with the air jets entering the liner, resulting in intensive turbulence throughout the combustor. Dilution air enters through holes in the liner and mixes with the combustion products to lower the temperature of the products. The mixture enters the turbine at a suitable temperature for the blade materials.

Film Cooling of the Liner:

The liner is exposed to the highest temperature in the gas turbine due to combustion and heat radiated by the flame. The life of the liner is extended by using material having a high resistance to thermal stress and fatigue and by cooling the liner using an air film. This cooling is accomplished by admitting air through rows of small holes in the liner.

Fuel Atomization and Ignition:

The liquid fuel used in gas turbines should be atomized in the form of a fine spray when it is injected into the combustors. Figure (7) illustrates a typical low-pressure fuel atomization nozzle.

immediately. Igniters are only installed in a few combustors. Figure (8) illustrates an igniter plug. It is a surface discharge plug. Thus, the energy does not jump over an air gap. A semi conductive material covers the end of the plug. It permits an electrical leakage to the body from the central high tension electrode. This discharge provides a high-intensity flash from the electrode to the body.

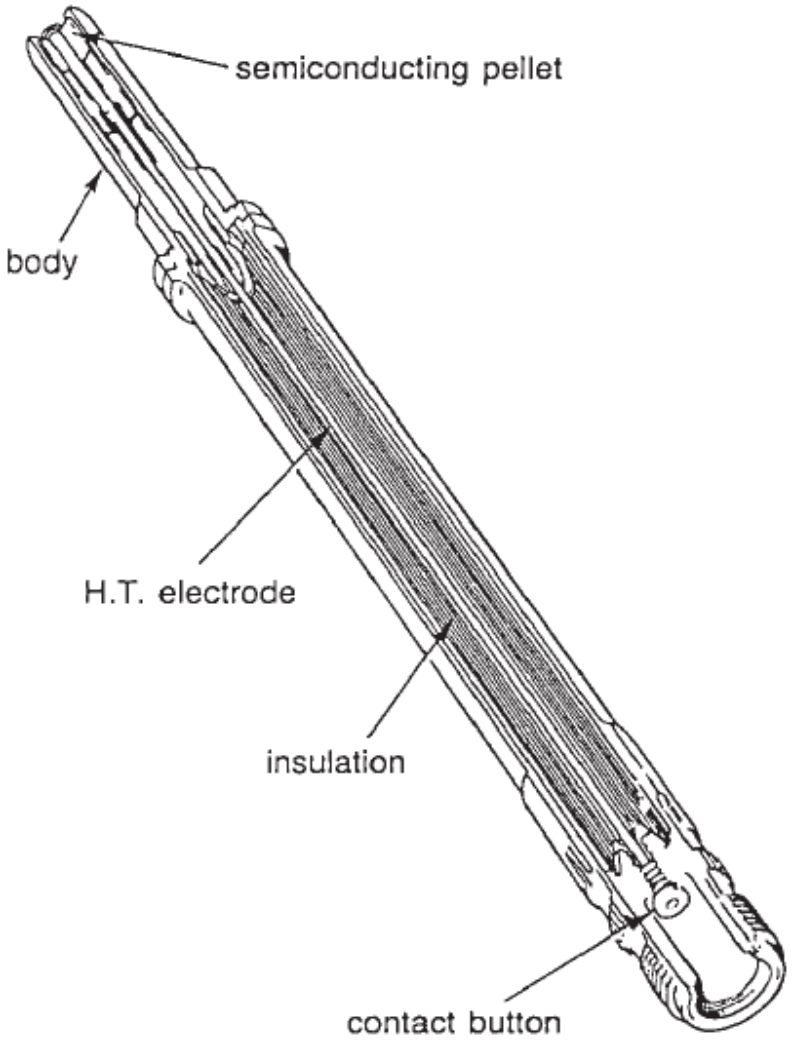

FIGURE (8) An igniter plug.

TYPICAL COMBUSTOR ARRANGEMENTS

The three major categories of combustors are

1. Tubular (single can)

2. Tuboannular

3. Annular

Most of the gas turbines manufactured in Europe use tubular or single-can combustors. These combustors have a simple design and a long life.

They can be up to 10 ft (3 m) in diameter and 40 ft (12 m) high. These combustors use special tiles as liners. Damaged tiles can easily be replaced. Tubular combustors can be *straight-through* or *reverse-flow* designs. The air enters these combustors through the annulus between the combustor can and the hot gas pipe, as shown in Fig. (9). The air then flows between the liner and the hot gas pipe and enters the combustion

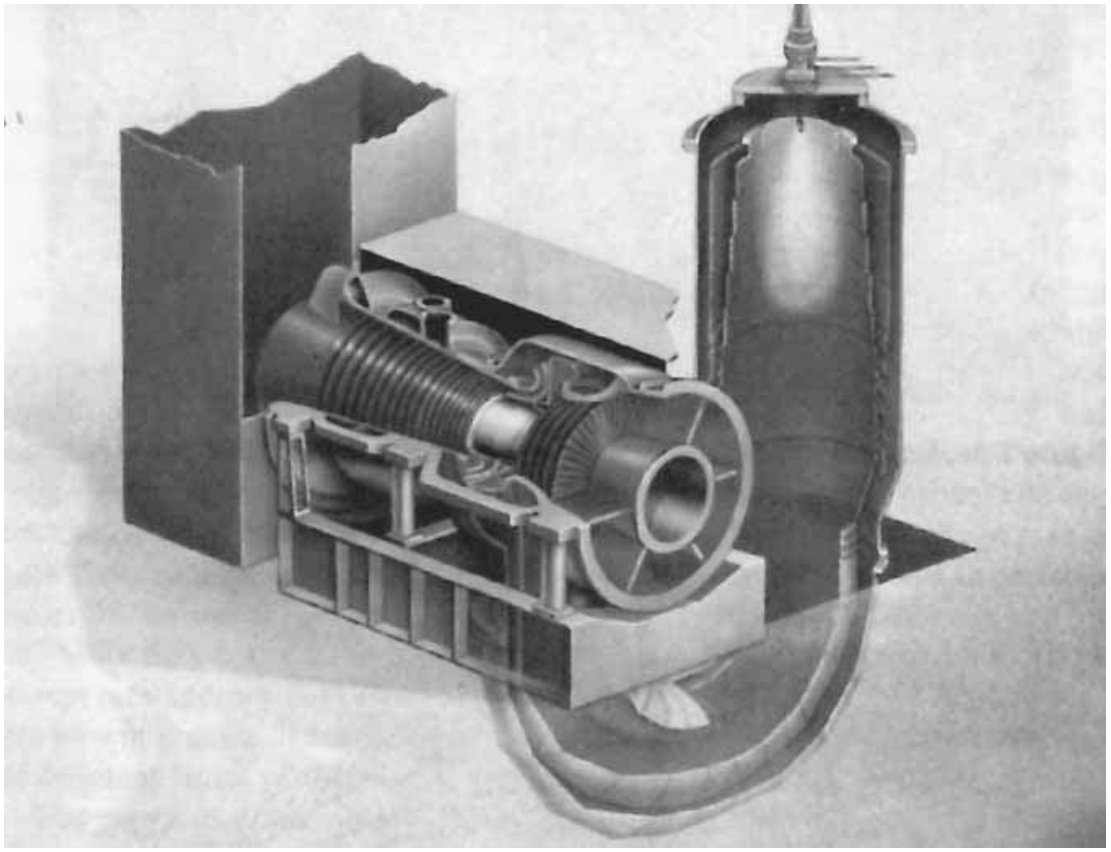

FIGURE (9) Single-can combustor. (*Courtesy of Brown Boveri Turbomachinery, Inc.*)

region through the various holes shown. Only 10 percent of the air enters the combustion zone. Around 30 to 40 percent of the air is used for cooling.The rest of the air is used for dilution purposes. Combustors having reverse-flow designs are much shorter than the ones having straight-through designs. These large combustors normally have a ring of nozzles placed in the primary zone area. Tuboannular combustors are the most popular type of combustors used in gas turbines.

Figure (10) illustrates the tuboannular or can-annular type of combustors. These combustors are easy to maintain. Their temperature distribution is better than side single-can combustors. They can be a

straight-through or reverse-flow design. Most industrial gas turbines use the reverse-flow type.

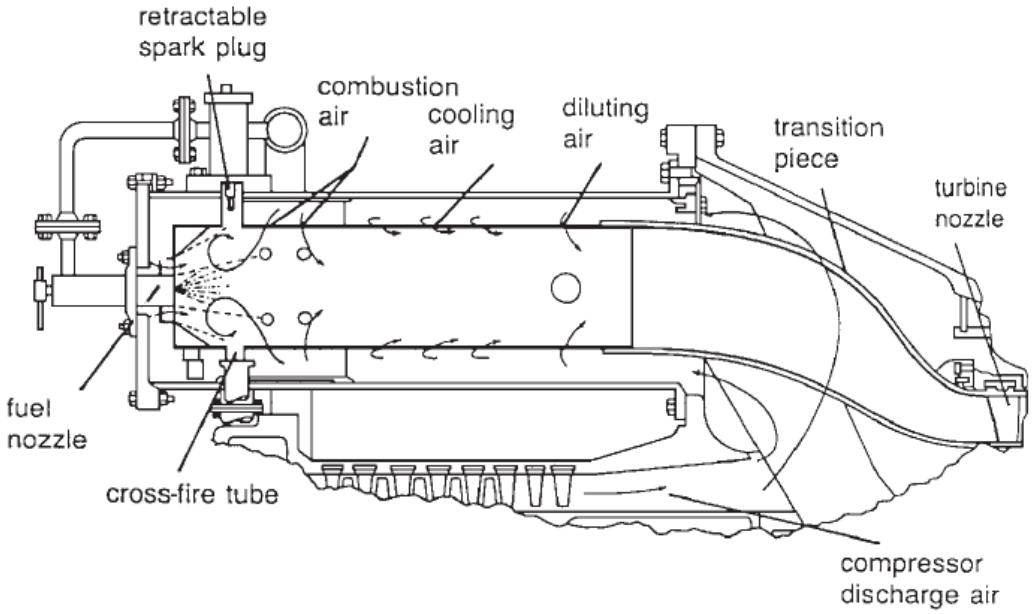

FIGURE (10) Can-annular, reverse-flow combustor for a heavy-duty gas turbine. (*Courtesy of General Electric Company.*)