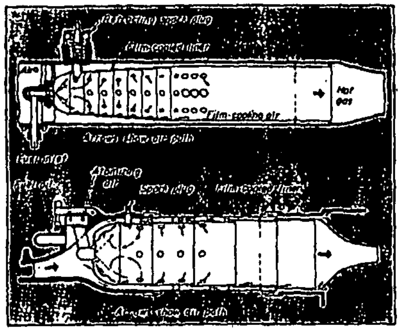
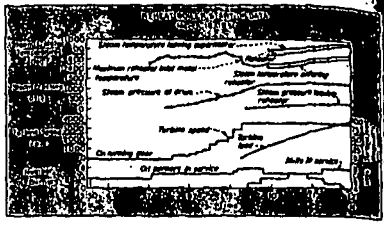
TECHNICAL BRIEFS

Latest engineering developments for busy power men

8 Digests for you on:
GAS TURBINES
FUELS AND FIRING
WATER TREATMENT





1 Flame can be stabilized by swirl vanes or jet impingement around the tube of gas turbine combustor shown at left

2 Start-up data in graph shown above covers 3-million kw experience on reheat boilers with no special difficulties

Let's Look at Gas Turbine Combustion Problems

Some Practical Aspects of Combustion in the Gas Turbine. *By H R Hazard, Battelle Memorial Institute.*

Burning fuel to produce heat and power has presented problems since man's first use of fire, and every type of engine in use today has its own combustion problems. These may result from special properties of the fuel or *its ash or from conditions surrounding* combustion and will vary from failure of equipment at one extreme to air pollution at the other. The gas turbine has most of the problems common to other engines plus a few unique problems of its own. Although solution of most of these problems is the responsibility of the development engineer, the operator should have a full understanding of all the factors behind his own operating and maintenance requirements. In this paper some of the practical aspects of combustion in present-day gas turbines are discussed.

The gas turbine differs from other engines in that fuel is burned continuously at high pressures to heat large *quantities of air to only moderate temperatures.* Heat-release rates are prodigious by boiler standards as small combustion volumes and relatively high pressure losses permit high turbulence *levels. Combustors are really direct-fired air heaters in which the air is* heated only about 500 to 1000 degrees F, utilizing for combustion less than 20 percent of the available air. Combustion products are mixed with excess air, Fig. 1, to heat entire mass to uniform temperature at turbine inlet.

In several commercial gas turbines, combustor-inlet temperatures range from about 275 F at idling to 500 F at full load, and combustor-outlet temperatures range up to 1475 F. Changes in *load are accomplished by changing* compressor speed, which has the effect of increasing both air pressure and mass flow in such a relation that the air velocity through the combustors is nearly constant regardless of load. The fuel rate is increased approximately in proportion to the air weight, since fuel/air ratios do not vary greatly over the load range except during acceleration or deceleration. Then a change in fuel rate takes place immediately, but considerable time elapses before the new air rate is established. Combustion pressures vary from 15 psi at idling to about 75 psi at full load in simple units, or may go as high as 120 psi in more complex units.

The two important characteristics of the combustor that affect performance of the gas turbine are combustion efficiency and pressure loss. Low combustion efficiency increases fuel consump*tion only, but high pressure loss not* only increases fuel consumption but reduces power output as well. A change of 1 per cent in pressure loss has approximately the same effect on cycle efficiency as a change of 1.5 per cent in combustion efficiency. The only real limit to heat-release rates in the gas-turbine combustor is the pressure loss required to force the air through the combustor. This increases as the combustor size is reduced. A usual value of pressure loss is about 5 per cent of *static pressure (about 20 in. water at* atmospheric pressure) with accompanying heat-release rates of 1.5 to 3.5 million Btu per cu ft hr per atmosphere of pressure. *APC Paper, no number.*

Corrosion Aspects of Bunker C Combustion in Gas Turbines. *By B O Buckland and C M Gardiner, General Electric Co.*

The General Electric Company's Gas Turbine Department in Schenectady started testing a Bunker C-burning gas turbine at the factory late in 1947. Since that time, approximately 80,000 hours of Bunker C operation have been accumulated. This operating experience has shown that a basic corrosion problem exists when burning residual oil *because slag-forming substances that* are present will very likely corrode the metallic parts. A great deal of progress has been made on the solution of this problem, and the work is continuing. *The present paper gives the history of* operating experience and describes briefly the laboratory and shop tests

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