NASA TECH BRIEF

Swirl-Can Combustor Segment

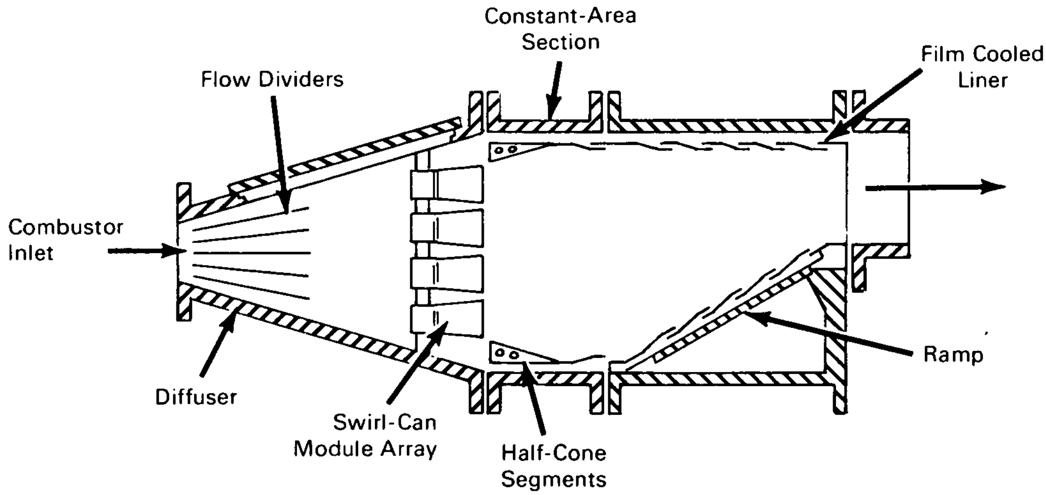

Figure 1. Combustor with Arrays and Modules

The extreme operating conditions imposed on turbine engine combustors require new approaches to combustor design. One such approach is a combustor composed of arrays of independently burning modules. A combustor consisting of such an array of 48 modules, Figure 1, has been experimentally evaluated. The combustor produced uniform circumferential and radial combustor exit temperature profiles and high combustion efficiency at high temperature loads.

Combustors consisting of an array of swirl-can modules offer the following advantages:

1. Durability by having no diluent air entry ports in combustor liners, thus eliminating stress concentration points.
2. Combustor exit temperature profile adjustments by controlling fuel flow to individual modules.
3. Nozzle fouling alleviated by the low pressure fuel system with large flow passages and control orifices located away from the combustion zone.
4. Smoke reduction by the premixing of fuel and air by the abundance of air available at all stages of the burning process.

Combustors of this type also have the potential for short overall lengths and low overall pressure loss.

Each swirl-can module consists of an inlet section which serves as a carburetor, followed by a swirler and a divergent conical combustor can, as shown in Figure 2. In operation, primary combustion air enters the carburetor and mixes with fuel. The fuel-air mixture passes through the swirler and burns in the combustor can. Secondary combustion air flows axially past the swirl-can module, recirculates in the wake, and com-

(continued overleaf)

pletes the combustion reaction. The mixing of diluent air and combustion products occurs through recirculation and eddy diffusion.

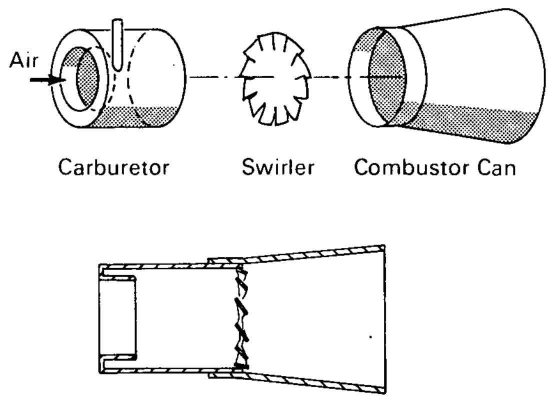

Figure 2. Swirl-Can Module Layout

Combustion tests were conducted at inlet air temperatures of 600°F and 1150°F, a pressure of 3 atmospheres, and combustor reference velocities up to 180 feet per second. Combustion efficiencies were 100% at combustor exit temperatures near 2200°F. Overall pressure loss (including diffuser loss) was 6% at a diffuser inlet Mach number of 0.25 and a combustor exit-to-inlet temperature ratio of 2.5. Good circumferential and radial combustor exit temperature distributions were obtained.

In addition to high performance turbojets for aircraft, these combustors may be applicable to industrial gas turbine engines, or for applications where heat release rates of 6×10^6 Btu/cu ft-hr-atm, or higher, are required.

Notes:

1. The following documentation may be obtained from:

   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.65)

   Reference:
   NASA-TN-D-5597 (N70-13470), Performance of a 48-Module Swirl-Can Turbojet Combustor Segment at High Temperatures Using ASTM-A1 Fuel

2. Requests for further information may be directed to:

   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B70-10322

Patent status:

No patent action is contemplated by NASA.

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