Fifth
Progress Report
on

Fire Detection in Aircraft Engine Nacelles

by

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for
Headquarters
Wright Air Development Center
Wright-Patterson Air Force Base
Dayton, Ohio
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1. Summary

From measurements of the spectral emission in five separate wavelength bands on a number of different types of gas-air flames, it appears that the flicker characteristics are the same in each of the selected parts of the spectrum. Wave analyses of the flicker frequencies between 2.5 and 750 cycles per second show a distinct maximum amplitude between 5 and 20 cycles per second for each of the flames studied. This maximum amplitude occurred at a higher frequency for the flames of premixed gas and air than for diffusion flames.

Studies of the ionization properties of flames have been initiated and are being continued.

2. Flame Radiation Measurements

The spectral emission in five separate wavelength bands has been recorded simultaneously for a number of different flames. The records show that the variation of the emission in the five bands with respect to time is in unison. Consequently, the flicker characteristics appear to occur in all parts of the spectrum simultaneously. Therefore it seems that wave analyses of the flicker in any one part of the spectrum should be sufficient for further studies. We have chosen the infrared for this purpose.

The wave analyses of the flicker frequencies between 2.5 and 750 cycles per second have been obtained for various flames. Under ordinary conditions in a large unventilated room, with no air movement except the convection currents caused by the flame, the amplitude of the flicker at a given frequency varies with time. The amplitude varies considerably with frequency, the maximum ordinarily occurring at a frequency between five and twenty cycles per second. Diffusion flames in still air may be observed to flicker with very regular periodicity. The wave analyses of the flicker of such flames show a fairly sharp maximum at a fundamental frequency and several lesser peaks at higher harmonics. This type of flicker was

not been observed in flames of premixed air and gas. In general, these flames have a maximum amplitude of flicker at a somewhat higher frequency than diffusion flames.

Plans have been made and equipment procured to study the correlation between gas jet velocity and flicker frequency. Equipment has been constructed with the objective of producing substantial open gasoline fires at a constant level and constant rate of burning for use in flicker studies.

3. Electrical Properties of Flames

A series of experiments is being conducted to determine the conduction and rectification properties of flames. When two parallel wires are placed a short distance apart in a Bunsen flame and a potential of a few hundred volts d-c is impressed, a current will flow across the gap, the magnitude of which will fluctuate considerably with time. Peak currents of several microamperes have been measured. The magnitude of the current increases with applied voltage and the area of the wires heated. When wires of different sizes are used, the system acts as a rectifier. The current through a diffusion flame was found to be about twice that through a flame resulting from the burning of premixed gas and air. Although no studies have been made of the correlation between the fluctuations in the current and the visible flicker, an attempt to do so is being considered.

4. Financial Condition

Expenditures and commitments on this project:

April 25, 1952 through March 31, 1953	$ 15,500.64
April 1 through June 30, 1953	5,335.23
Total through June 30, 1953	$ 20,835.87

With additional qualified personnel available, our rate of effort on this project was essentially doubled as of June 1, 1953.