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Mechanisms of Fire Ignition and Extinguishment

by
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U. S. DEPARTMENT OF COMMERCE
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MECHANISMS OF FIRE IGNITION AND EXTINGUISHMENT

By

T. G. Lee

1. Summary

Ion concentrations in a number of flames have been measured using a symmetrical double Longmuir probe method in an attempt to determine the effect of temperature differences on the ion concentration. The ionic concentrations seemed to depend more on the nature of the inert gas than on the adiabatic flame temperature. A paper is being prepared on the results of the investigation, copies of which will be forwarded when available.

2. Ionization Studies

Calcote has shown that the ionic concentration of flames varies in much the same manner as flame temperature when plotted as a function of the air - fuel ratio as a fraction of the stoichiometric value. However, since this ratio is a dimensionless number, no information was available from his results, on the rate of fuel supplied to the flame. It seems reasonable to assume that the rate of positive ion production is a function of, among other things, the rate of fuel supply, and the steady state concentration should be related to the rate of formation of ions. It was, therefore, decided to measure the ionic concentration in flames of fuel supplied at a constant rate, and to which various inert gases were added to change the adiabatic flame temperature.

Argon, nitrogen and carbon dioxide were used as diluents. It was found that ionic concentrations were greatest with the use of argon, and lowest when carbon dioxide was used as the diluent.

Addition of inhibitors to the fuel greatly increased the ion concentrations , the increase being proportional to the amount of inhibitor added up to a certain concentration and remained almost constant as the inhibitor concentration was increased beyond this point. The concentrations of inhibitor used were considerably below those required for extinction of the flame. These results are not inconsistent with a mechanism proposed by Creitz in which the inhibitor is considered to be a stronger oxidizing agent than oxygen. Reduction of the inhibitor (decrease in valence) may be accomplished by capture of free electrons followed by dissociation to give negative halogen ions, which should result in an increase in the ionic concentration in the reaction zone.