A SIMPLE IGNITION DETECTOR

by

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of the

Department of Scientific and Industrial Research
and
Fire Offices' Committee
Joint Fire Research Organization

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Summary

A fusible wire ignition detector is described which is suitable for use at nuclear trials.

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Introduction

During the course of trials in which fabric specimens have been exposed to various doses of thermal radiation, it has been found that the blast from a nuclear explosion could extinguish a flame so that for many of the recovered specimens it has proved impossible to say whether the damage has resulted from ignition or from charring. It is, however, necessary to know whether there has been ignition because in practice, conditions could occur in which the blast did not extinguish the flame. Also ignition is a convenient criterion for the correlation of laboratory and field trial data.

The requirements governing the design of an ignition detector are as follows:-

(1) It should be cheap and easy to install as many will be used.

(2) It should be robust so as to withstand the effects of blast and leave a permanent record of ignition.

(3) It should have a rapid response since the flame might only exist for a very brief period before being extinguished by blast.

This report describes a fusible link type of detector which fulfils these requirements.

Construction

The specimen holder is illustrated in Fig. 1. It consists of a sheet of $\frac{1}{2}$ in. plywood, faced with polished aluminium, in which a 3 in. x $1\frac{1}{2}$ in. hole is cut. The specimen is mounted behind the hole. A strip of polished aluminium is attached to the holder to shield the detector wire from direct radiation. The detector itself is a fusible link of 32 S.W.G. lead/tin alloy, type G (B.S.S. 219/1949).

Performance

In studying the performance of this ignition detector the fracture of the fusible link was arranged to close the shutter of a carbon arc source. It has been shown previously[1] that the closure of the shutter takes less than 0.05 second. After irradiating specimens at intensities of radiation ranging between 5 cal cm^{-2} s^{-1} and the maximum available 12.5 cal cm^{-2} s^{-1} to melt

the detector wire in times ranging from 0.6 second to 14 seconds, it was found that the specimen had always ignited before the shutter had been closed by the melting of the wire and that ignition always melted the wire. There were thus no false records of ignition.

Delay in operation

The delay time between ignition and the fracture of the wire was measured to determine whether the wire would in fact fracture before blast extinguished a flame. A double beam cathode ray oscilloscope and a drum camera were used; one beam registered the fracture of the wire and displayed a time marking 50 c/s sine wave, the second beam was connected in series with an ionisation gap mounted near to the fusible wire ignition detector. Fig. 2 is a record of a typical result: in this particular case the delay time was 0.10 second whilst the time to ignition was 1.1 second. On a few occasions the wire fractured before the ionisation gap registered, but this seems to be associated with a feature of the ionisation gap. From Fig. 2 it can be seen that, after ignition has occurred, there can be substantial periods when the gap is not surrounded by flame. This was found to be the case for various locations of the gap. One of these periods could sometimes coincide with the fracture of the wire. This suggests that the wire detector is in fact a more useful device than the ionisation gap for recording ignition.

Experiments over a range of ignition times between 1.1 and 14 seconds showed no tendency for the delay time to be correlated with ignition time, and out of 13 tests the largest delay time recorded was 0.45 second.

Conclusions

A simple apparatus has been developed which is suitable for recording the ignition of materials exposed to radiation from nuclear weapons.

Reference

(1) HINKLEY, P. L. A source of high intensity radiation employing an arc lamp and an ellipsoidal mirror. Department of Scientific and Industrial Research and Fire Offices' Committee Joint Fire Research Organization F.R. Note No. 270/1956.

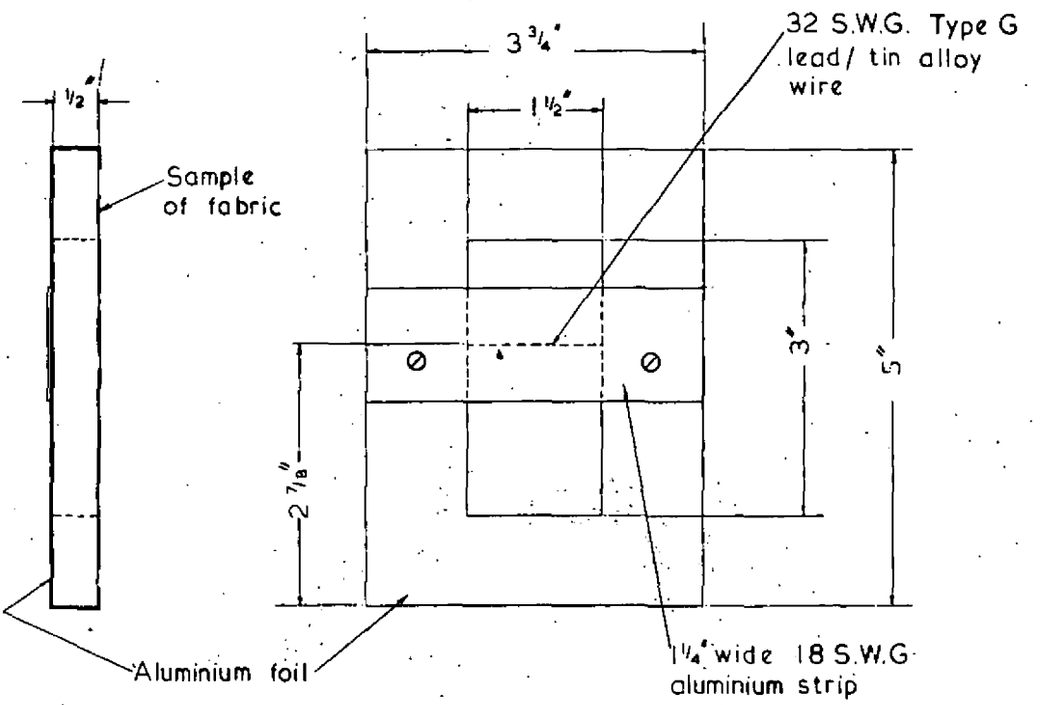

FIG. 1. CONSTRUCTION OF EXPERIMENTAL IGNITION DETECTOR

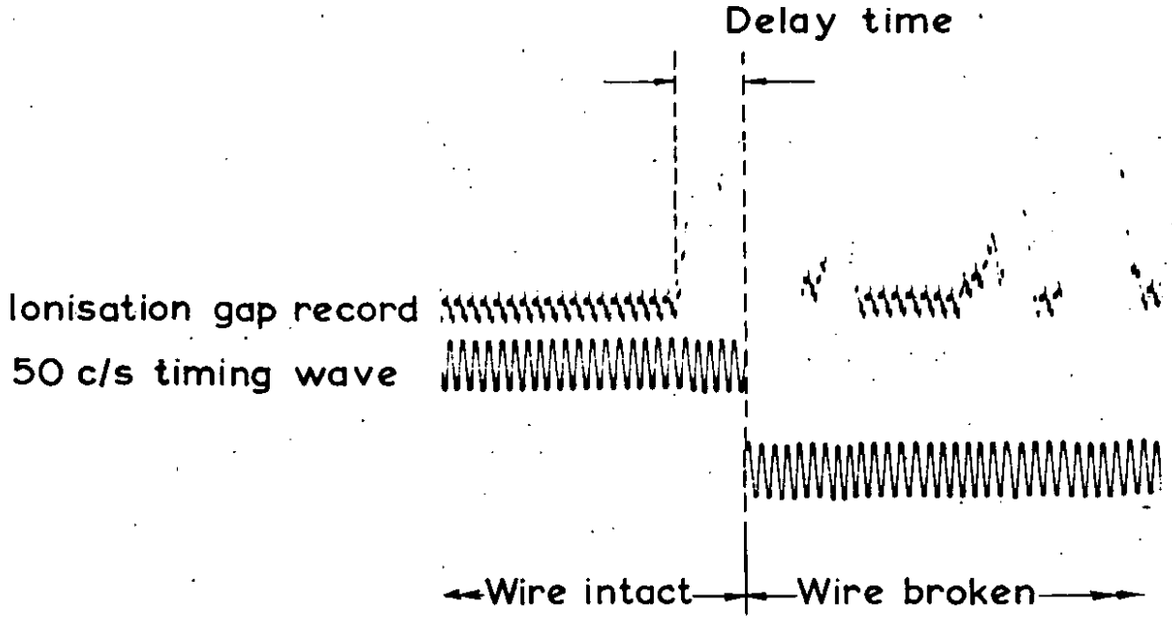

FIG. 2. TYPICAL OSCILLOSCOPE RECORD