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EVALUATION OF A HAND HELD FIRE DETECTOR

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by

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Introduction

Mop-up has been defined as the act of making a forest fire safe after it has been brought under control[1]. During the mop-up stage many man-hours are spent locating and extinguishing burning stumps, roots, and duff that could provide an ignition source for another wildfire if left unextinguished.

The Williamson Development Company of Concord, Massachusetts, has designed and built a portable, non-contact radiation detecting instrument that is theoretically capable of detecting hidden fires. Because such an instrument has the potential to greatly reduce the number of man-hours required for mop-up and thus reduce the cost of fire suppression. A sample unit was purchased by the Department of Forestry for evaluation.

Description of the Instrument

The instrument is a battery powered, infra-red radiation detector that has been tuned to detect infra-red wavelengths given off by a smouldering fire. It weights $5\frac{1}{4}$ pounds and has the demensions $9\frac{1}{2}$ x 6 x 3 inches. It comes equipped with a sensitivity control and a dial that indicates the strength of signal received. Also, it has a device to test the strength of the batteries. When a smouldering area is scanned an audible signal is given through ear-phones that are worn by the observer. The signal becomes louder as the instrument is brought closer to a heat source or as the intensity of a heat source increases. Simultanously, the strength of the signal is indicated on the dial mentioned above.

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1) Anon. 1963. Glossary of Forest Fire Control Terms. Associate Committee on Forest Fire Protection, National Research Council No. 7312, Ottawa, Canada.

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Evaluation of the Instrument

A series of tests were conducted to determine the maximum ranges at which the instrument was capable of detecting various heat sources under several different sunlight intensities.

Phase 1

These tests were conducted in the shade of a large building.

(a) A block of duff having an area of 2 square feet and a thickness of 3 inches was ignited along one edge. The radiation temperature of the smouldering surface was 840°F. When the instrument was aimed at the exposed smouldering surface, detection was possible up to 75 feet away.

(b) This same smouldering duff surface was covered with loose, top-layer duff so that the burning area was not visible. The maximum distance that the instrument was able to detect this was 40 feet.

(c) One smouldering charcoal briquette was placed on the ground. Its radiation temperature was 790°F. The maximum distance away that the instrument could detect it was 50 feet.

Phase 2

These tests were conducted at 2:00 p.m. on a sandy-gravel surface in very bright sunlight. The air temperature was 80°F and the ground surface temperature was about 150°F.

(a) A cluster of 16 smouldering charcoal briquettes was placed on the ground. With the instrument at full sensitivity, mounted on a tripod, detection was possible out to 150 feet.

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(b) A 3-foot diameter pan, filled with burning charcoal, was buried one inch below the ground. The soil surface over the pan was considerably hotter than the surrounding soil surface and was hot enough to burn one's hand if it were left on the surface for more than 3 seconds. With the instrument at full sensitivity the maximum distance away that it could detect the heat source was 3 feet.

The instrument was very sensitive to reflected solar radiation and consequently produced a loud audible signal whenever it was pointed at objects in the sunlight. Only when it was pointed at the sky or at a shawdow did it become quiet. It was noted that when the instrument was pointed at a flame in the bright sunlight the signal produced by the flame was much stronger than the signal produced by the reflected solar radiation.

Phase III

These tests were conducted at 1:00 a.m. under a cloudless sky. The ground temperature was 72°F.

(a) A cluster of 16 smouldering charcoal briquettes was placed on the ground. The instrument detected it out to 250 feet.

(b) A 3-foot diameter pan full of burning charcoal was again buried one inch below the ground surface. The soil surface temperature over the pan was 160°F. With the instrument held in the hand, it was possible to detect the heat source from 8 feet. The signal was very loud from 5 feet and it was possible to accurately outline the shape of the buried fire. At night the audio signal was very quiet except when it was pointed at a heat source.

Phase IV

The instrument was taken to a wildfire that was in the later stages of control. Over an area of 3 acres there were many small pockets of smouldering duff that gave off little or no smoke. Because of the moderately dense mixed-wood canopy, there was very little sunlight reaching the forest floor.

A large portion of the burned area was scanned with the instrument and during this time many small hidden fires were detected and dug up. Any object between the detector and the fire prevented the fire from being detected. Each 180 degree scan required about four seconds and the maximum range at which most of the hidden fires were detected was 15 feet. Thus it was possible to slowly walk across the burned area covering a strip about 25 feet wide. The larger smouldering areas that were giving off smoke could often be detected from 50 feet or more. Even in direct sunlight areas a few hidden fires were detected. The signals from these fires were audible above the noise produced by the reflected solar radiation.

While using this instrument at the fire it was soon learned that a protective carrying case was required. Also, it would be useful to have a pistol grip handle and a sighting device on the instrument.

Phase V

Shortly after the previously described tests were completed, representatives of the Williamson Development Company brought to the Department of Forestry a modified version of the same instrument that had just been tested. The modified instrument had an electronic filter designed to filter out reflected solar radiation.

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Comparison tests were made on a sandy-gravel surface in the direct sunlight. The surface temperature of the soil was 105°F.

(a) When pointed at objects in the direct sunlight the modified instrument produced only a low audible signal while the signal from the unmodified instrument was very loud.

(b) A cluster of 16 smouldering charcoal briquettes was placed on a flat surface. Detection was possible out to 150 feet with the unmodified instrument and out to 125 feet with the modified instrument.

(c) A three-foot diameter pan, filled with burning charcoal, was buried one inch below the surface. The unmodified instrument detected the heat source from 3 feet and the modified instrument from 14 feet. The surface temperature over the pan was 165°F. In the light shade of a cloud the unmodified instrument detected the heat from 6 feet and the modified instrument from 14 feet.

Costs

The Canadian price not including the duty and taxes, for the instrument with the solar radiation filter is 995.00 dollars. A set of batteries for it costs approximately 4.00 dollars and these have a life of about 35 hours if run continuously and 70 hours if run intermittantly.

Conclusions

1) The Williamson Fire Detector can detect small hidden fires and its use could very likely shorten the mop-up period. It has, of course, the line-of-sight limitation of any infra-red detector.

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2) The maximum width of strip that the instrument can scan in search of small hidden fires is about 25 feet.

3) The addition of the sunlight filter eliminated the reflected solar radiation problem that was encountered with the unmodified instrument without substantially reducing the efficiency of the instrument.

4) A pistol grip handle, a sighting device, and a protective carrying case would be desirable for the instrument.