

F.R. Note No. 347/1958
Research Programme
Objective

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION

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THE SAFETY OF FIREMEN WEARING BREATHING APPARATUS

by

D. I. Lawson

Summary

This note examines the problem of ~~locating~~ ^{locating} firemen in smoke-logged buildings, and describes a communication system whereby the fireman is connected to the control point by cable. A source of sound on the fireman is operated from batteries at the control point, either manually or automatically should the fireman become unconscious. The control point is made aware by a local indicator if a state of alarm arises. The line is continuously monitored and both the control point and the fireman are alerted if the line should break. Telephonic facilities are also provided.

March, 1958.

Fire Research Station,
Boreham Wood,
Herts.

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Introduction

Firefighting in smoke-logged buildings is more than usually hazardous because the sense of sight is removed and the firefighter is immersed in a noxious and oxygen-deficient atmosphere which necessitates the use of breathing apparatus. Under these conditions it is particularly important to maintain contact with the fireman; to be quickly made aware of danger, and to be able to find him and render help when necessary. The problem has two aspects: that of warning, and that of locating the fireman.

Location

Individuals are usually located by fitting to them some identification signal on which a bearing can be made. Obviously in very smoky conditions the sense of sight is ruled out so that no light carried on the fireman would be useful. Long-wave infra-red radiation will penetrate smoke, but as it travels in straight lines and is absorbed by walls it would be unsuitable for an underground labyrinth of passages.

Sound traverses smoke well, but here again in an underground labyrinth estimates of the direction from which sound carries is likely to be erroneous due to reflections from walls of stored material. In addition to this the noise from the fire is likely to mask sounds at some distance.

Use is also made of radio signals for location, either by producing crossed bearings, or by a pulsed radar system. The latter with the best equipment at present available has an accuracy of about 50 ft, and this is not good enough. Crossed bearing location would be liable to serious errors in a steel-framed building.

The method of sending a man into a smoky building with a line, has the merit of both simplicity and certainty, though it is somewhat clumsy. This could be overcome to some extent by making the line light enough to be carried by the fireman and paid out from a reel as he progresses, thus avoiding the difficulty of dragging the line round corners and obstructions. A suitable line would be the steel/copper stranded Don 8 cable used by the services for signalling. It would have the added advantage that it could be used for transmission, as detailed later. Once an emergency arose the line could be followed out from the base in order to find the fireman.

The alarm

The efficient warning system resolves itself into two problems, the provision of a switch which will automatically close when the fireman loses consciousness and that of giving the alarm. The provision of a switch is partly a medical problem. It may be that the state of unconsciousness involves falling down, muscular relaxation, etc., and these could be made to operate a switch. Any one property by itself might not be acceptable, e.g. it is probable that a fireman in the course of his duties may have to crawl or lie down, and possibly the simultaneous occurrence of a number of properties may be required to avoid false alarms. These conditions could no doubt be met simply, but the question needs expert consideration.

The other problem is that of giving the alarm. Over a limited distance, hearing is undoubtedly the sense that should be used in smoky conditions, so that the fireman should be provided with a source of sound. If he is linked to base by a cable, as suggested, the power for the operation of the sound source could be conveyed along the cable, thus dispensing with the need for carrying batteries. The basic equipment for the fireman to carry is therefore a gong, a buzzer B (Fig. 1), an "unconsciousness" switch S_1 and an overriding switch S_2 , so that the fireman could manually give an alarm should he be trapped, but still conscious. The batteries A are located at the base.

If, as is probable, the fireman is required to penetrate several hundred feet into the building, the gong will be inaudible at base and it is therefore necessary to warn base that an emergency has arisen. This is done by including a relay R_2 at base in series with the line so that when current is being drawn to actuate the gong, the relay closes and raises an alarm at base.

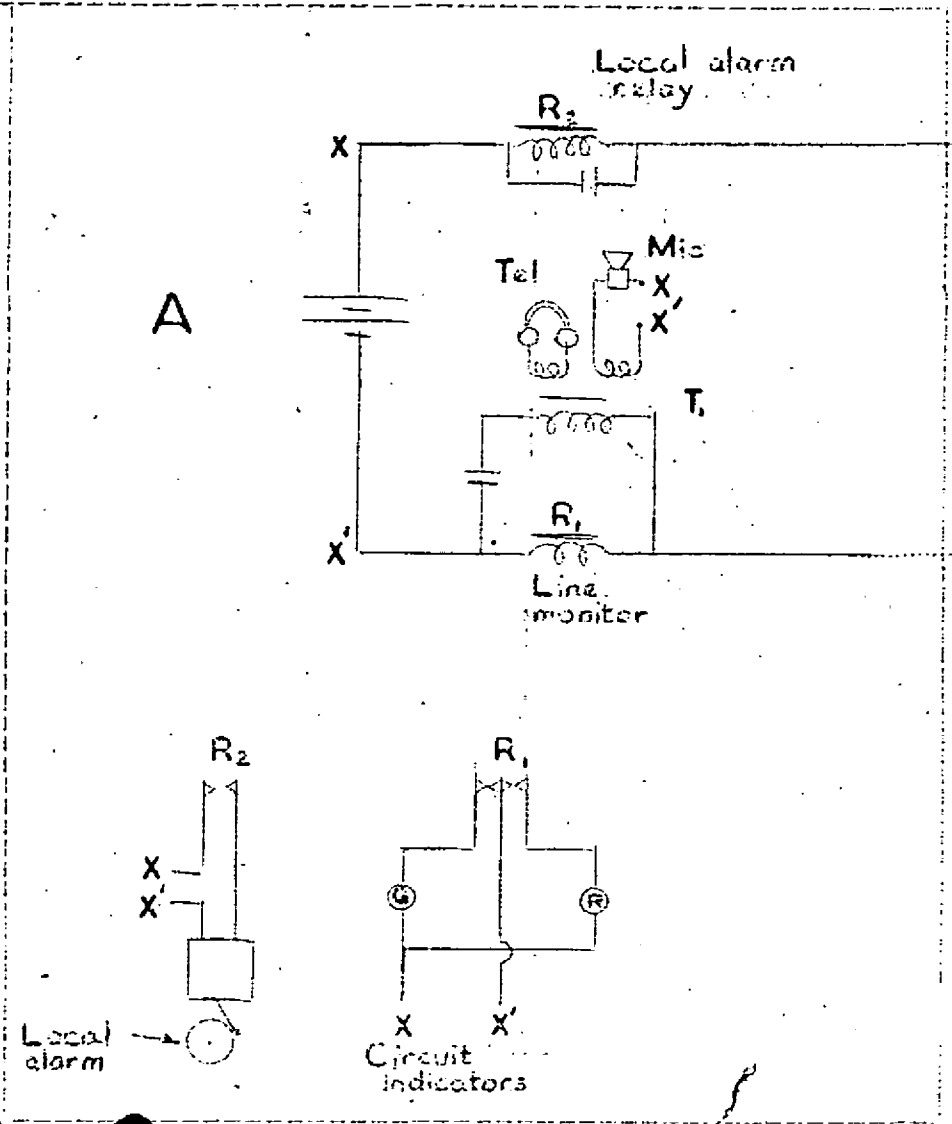
The system as described at present would not "fail safe". If the line were cut, for example, neither base nor the fireman would be warned. This is catered for by monitoring the line continuously by a small current (insufficient to operate the buzzer B or the base alarm) which operates relay R_1 , this in turn operates a green light when the line is continuous and a red light should the line be broken. In the same way relay R_3 closes the circuit of a small transistor oscillator, putting a low tone into the fireman's telephones when the line is continuous. This is interrupted when the line is broken.

Telephone facilities are provided to base through the transformers T_1 and T_2 .

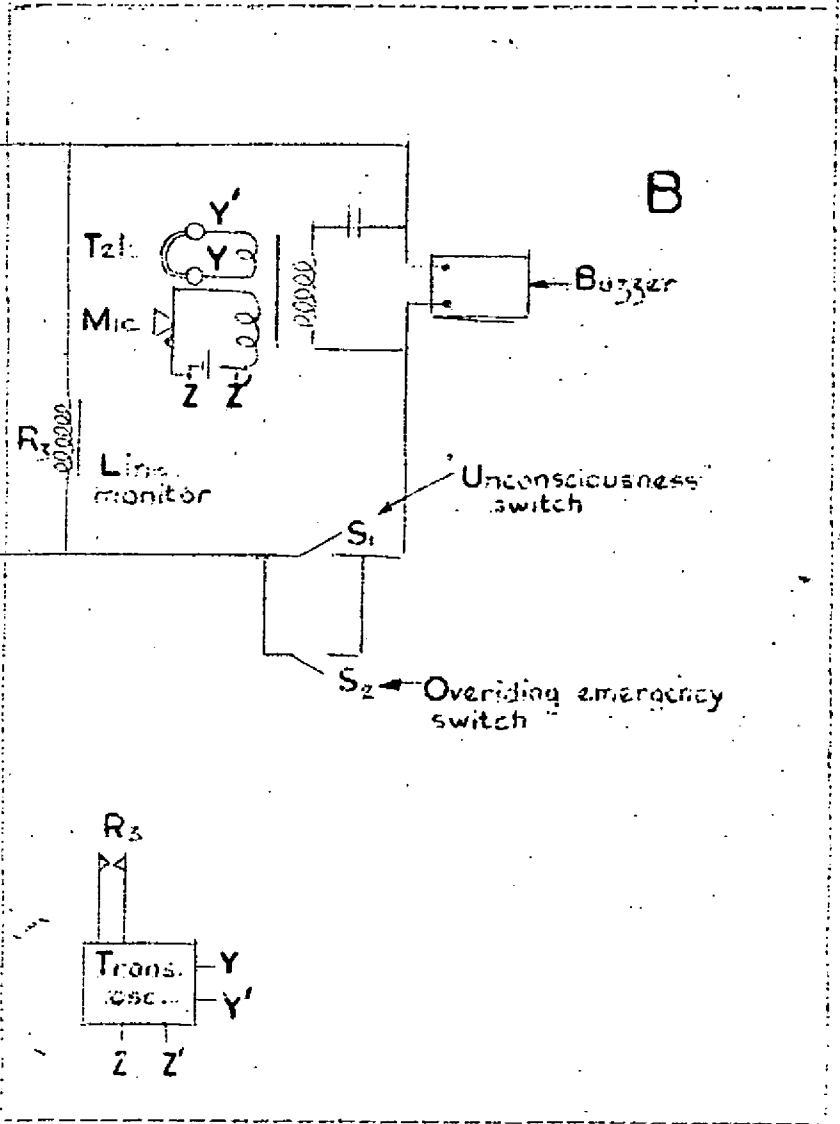
There is no reason why the size of both the base and fireman's equipment should not be small and light and fit into a convenient harness.

Operationally there are obvious disadvantages in using lines and to avoid confusion even if a colour system were adopted it would be necessary to reduce this number to an absolute minimum. A way of doing this would be to have firemen working in groups, each with a harness with one only, connected to base by cable. His function would be to act as a communications centre, and ensure the safety of the workers with him.

CONTROL SET



FIREMAN'S SET



Line

B

Unconsciousness switch

Overriding emergency switch

Trans. osc.

Buzzer

Line monitor

Local alarm relay

Tel

Mic

Line monitor

Circuit indicators

Local alarm