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A VISIT TO THE SCENE OF A FIRE AT THE NATIONAL FILM THEATRE

by

P. H. Thomas and P. L. Hinkley

Summary

A fire in the electric heating system at the National Film Theatre was due to a fault in the control system. The fusible link safety device did not operate. The installation of this device was not in accordance with the principles governing the proper use of such fusible links.

May, 1956.

Fire Research Station,
Boreham Wood,
Herts.

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General descriptions

The National Film Theatre (South Bank) was visited by the authors on 4th January, 1956. The architect Mr. Mellinger and Station Officer Bliss of the Fire Prevention Branch of the London Fire Brigade were also present.

A small fire had occurred in the air heating system on the night of 2nd - 3rd January, 1956. It was confined to a trap door which had burnt out.

Details of heating system

The heating system was contained in a chamber about 30 ft x 6 ft x 8 ft maximum height constructed of brick and concrete beneath the loudspeaker chamber below ground level at the rear of the building (see Figure (1)).

Air was drawn through two sets of fibre glass filters (F) into the centre of the chamber by two ventilating fans and is discharged through trunking into the auditorium above. Each of the two streams of air entering the chamber passed over a bank of 30 heaters each of one kilowatt output (H). These heaters consisted of wire spirals about $\frac{3}{4}$ in. in diameter which were wound round porcelain tubes about 2 in. in diameter. During operation it was seen that the wire might be red hot in a few places.

The heating chamber was separated by a 9 in. brick and concrete wall from a second chamber alongside containing the control equipment and fuses. Four wooden doors about 2 ft x 5 ft (in this wall) gave access to the heating equipment.

The floor between the heater chamber and the speaker chamber was of 9 in. concrete. The two ventilating trunks into the auditorium passed through the ceiling of the chamber, the space between the trunking and the concrete being filled by slabs of a flammable cork insulating material. There was also a 2 x 1 ft opening closed by a wooden trap door.

In the speaker chamber above the loudspeakers were contained in a wooden enclosure and there were a number of black curtains which were said to have been fireproofed.

There was a thermostat in each of the ventilating trunks near the floor of the speaker chamber. These were said to operate control equipment which switched heaters off and on as required to maintain the temperature of the air in the ducts at 95°F.

The main contactor for the heaters was in the control panel but it could be remotely controlled from the projection room from which it was usually operated at the end of a performance. The switch was interlocked with the fan motor starter so that the contactor coils could not be energised while the ventilating motor was switched off. A fusible link (L) was fitted immediately above each bank of heaters. A diagram of this device is shown in Figure 2.

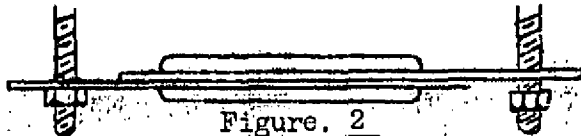


Figure. 2
Fusible link

It consisted of two strips of copper held together by a solder melting at 155°F. When the solder melts the lower link is supposed to fall away. This was said to operate the main contactor. Both supporting rods were threaded and a nut was found on each rod. It is difficult to see how this arrangement could satisfactorily break the circuit as this device is supposed to be in tension to ensure separation of the contact.

Details of the fire

The control chamber was said to be visited once or twice a day and at the time the boxes containing the electrical equipment were being painted by the operating staff.

The heating system had been in use during the performance on the day previous to the fire, January 2nd and was switched off from the projection room at about 10.30 p.m. At 2 p.m. on January 3rd the control chamber had been visited and it was noticed that the wall (c) of the heater chamber was unusually warm. On investigation by the staff it was found that the trap door in the ceiling of the heating chamber had been largely consumed by fire and the few remains had fallen into the heater chamber. The doors (A and B) between the heater and control chambers were slightly scorched on their inner surfaces, but the combustible packing between the ventilating trunks and the floor had not been ignited. Apart from damage said to have been caused to the tube of a capillary thermometer which passed close over the trap door there were no signs of damage in the loudspeaker chamber.

The staff said that the heaters were found to be off but the fusible links had not opened.

Cause of fire

The most disturbing feature of the fire was the failure of the safety devices, since similar ones may be used in other installations elsewhere.

When the heaters were switched on without the fans at the time of the visit it was found that the solder in the links melted but the links did not immediately fall apart; one eventually opened but only after some time.

It was concluded that the fusible links had not opened in the fire, and that since the heaters had not remained on that there was an electrical failure. Further investigation together with Station Officer Bliss, in which the normal procedure for closing down the heating was repeated, showed that there was a fault in the main contactor for the heaters so that, when the control current was switched off in the operating box, the contacts did not necessarily open but could be opened when the equipment was knocked. Thus, unknown to the operator in the projection room, the heaters could have remained on although the fan had stopped. The thermostats did not operate as hot air was not forced into the trunking and the safety device failed to operate so that the temperature in the room would in a matter of minutes have become sufficiently high to ignite the trap door which was the highest point in the room. It is presumed that before further damage occurred the contactor opened, probably as a result of vibration.

Discussion

This type of fusible link is unsatisfactory for this type of installation and should be redesigned or replaced by one of more suitable design. This type of link should be under slight tension and should fall apart as soon as the solder melts.

The type of heating employed depends for its safe operation upon reliable safety devices which switch off the heater should the air become too hot. These should not all be dependant on the satisfactory performance of one component i.e. the main contactor. In case of failure of the main contactor the safety device should therefore operate a separate contactor and provision should be made for periodically testing the circuit. Other obvious precautions are the elimination of all combustible materials, including wooden doors, from the heater chamber and extreme care to prevent the entry of all flammable materials, including dust, into the system.