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

FIRES DUE TO ELECTRIC CABLES

,by

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Summary

Samples of T.R.S. (1/044), P.V.C. (3/029) and V.I.R. (3/029) cables were subjected to overload currents and it was found that ignition occurred where the currents were greater than 35, 55 and 65 amps respectively.

Breakdown of the insulation between conductors, or between a conductor and a metal earth shield, and the presence of moisture did not appear to be important as causes of fire.

Samples of V.I.R. cable over thirty years old appeared to behave similarly to new cable.

Only in the case of V.I.R. cable (new and old) did fire or excessive currents reduce the insulation to a conducting material.

Introduction

This work was undertaken to find the circumstances under which the following electric cables could cause fires:-

- (1) Twin rubber covered 250 v cable (1/044 rated at 6.1 amps).
- (2) Twin 660 v P.V.C. covered cable (3/029 rated at 7.8 amps).
- (3) Single V.I.R. cable (3/029 rated at 7.8 amps).
- (4) Samples of old V.I.R. cable installed in 1916 and withdrawn in 1952. (3/029 rated at 7.8 amps).

Experimental procedure

Various overload currents were passed through the cables under test. The conductors of the twin cables, which each carried the test current, were maintained at different potentials so that it could be observed when the conductors touched. In the case of single cables the potential was maintained between the conductor and a forl of thin copper containing the cable. The cables were placed between half inch thick sheets of fibre insulating board and observations were made of the times at which the conductors broke through the insulation to form a short current and also of the times at which fires broke out.

Results

The results are shown graphically in figure 1, where it will be seen that the short circuit fault in both P.V.C. insulation and rubber is distinct from the commencement of the fire. These two events occurred almost simultaneously when higher currents were passed through the P.V.C. cable though closer inspection showed that the fusing of the circuit and the outbreak of fire were not related. This was not so, however, for the V.I.R. cable in which the two occurrences appear to be simultaneous.

From the curves it appears that there was a greater tendency for short circuits to develop with P.V.C. insulated conductors at lower currents than with rubber covered cable but a lower tendency to cause fires as the current is increased.

The minimum currents at which fires occurred in the various cables are shown in Table 1.

Table 1

Currents necessary to cause fires in various cables

Туре	Current	Power per ft run watts	Shunt resistance (ohms per ft) to give same power with 230 v.
Twin mibber covered 1/044 Twin P.V.C. 3/029 V.I.R. 3/029	35	13	4,100
	55	25	2,100
	65	17*5	3,000

Some experiments were made with cables which had been boiled in water for 15 minutes. With P.V.C. and tough rubber cable the moisture evaporated on test due to the heating of the current carrying cable, and the insulation between the conductors remained good until the current was increased to the short circuiting point. The water appeared to affect the resistance of the V.I.R. insulation reducing it to about 50,000 ohms per inch. The insulation would recover as the cable dried out.

There appeared to be no significant difference in performance between old and new V.I.R. cables although the insulation of old cable was harder and rather more friable.

The insulation resistance was measured before and after test for the various types of cable and the results are shown in Table 2.

Insulation resistance of the various types of cable before and after test

Тура	Megger test before experiments	Megger test after experiments	Remarks
Imbber and) P.V.C.)	CV2	්	Even when material was reduced to powder, by flame, this still applied.
New V.I.R.) Old V.I.R.)	60	~ છ	Currents of 60 amps and less.
New V.I.R.) Old V.I.R.)	∞	Values be- tween zero and 👀	Currents in excess of 60 amps, whether fire occurred or not.

Conclusions

In all samples of cable investigated the currents necessary to cause fires were greatly in excess of the rated currents. A current of this magnitude would flow only if the local fuse was incorrectly rated. It is understood that the Electricity Authority's fuse rating for domestic premises is 60 amps and it is perhaps interesting that this current would cause a fire in T.R.S. and P.V.C. cables within a few minutes, but attempts to cause a fire by passing this current through the more traditional V.I.R. cables failed.

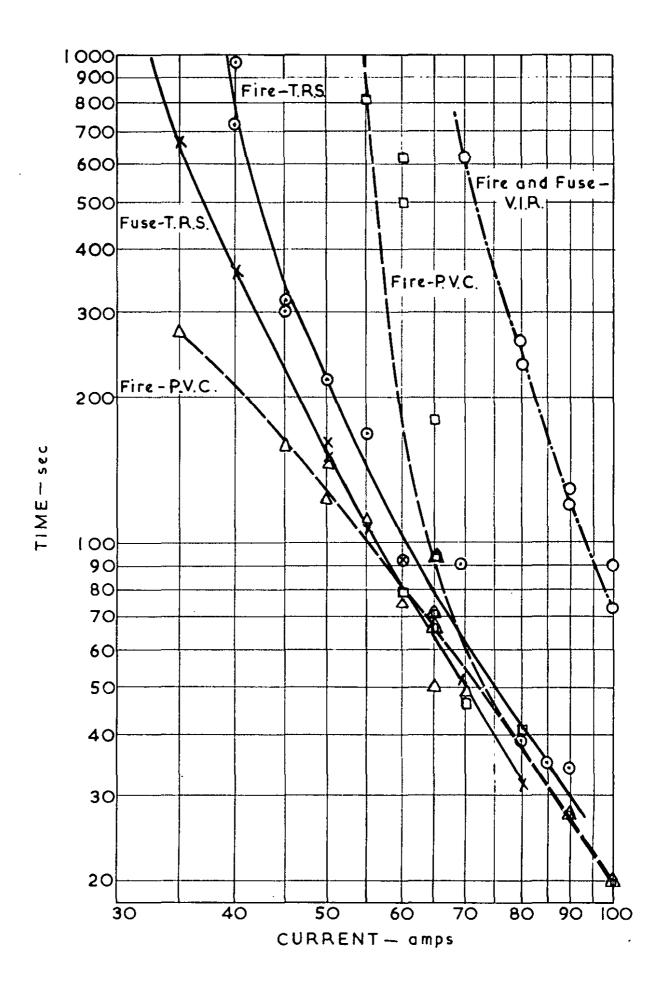


FIG. I. TIMES OF SHORT CIRCUIT AND FIRE IN OVERLOADED CABLE