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

FIRE HAZARDS OF ELECTRICAL APPARATUS

I Some preliminary analyses

by

R. E. Lustig

Summary

This note considers some preliminary analyses of a special survey conducted in 1957/58 of fires associated with electrical equipment. In all 9385 reports were received, of which 6489 referred to fires originating from electrical appliances (as distinct from fixed installations) and these are covered by this note. Dwellings suffered 57.1% of the fires, although domestic consumption of electricity accounts for less than a third of the total sales of electricity. Cooking appliances with 1406 fires and space heating equipment with 1345 fires were the most frequent sources of ignition.

December, 1960.

Fire Research Station,
BOREHAM WOOD,
Herts.

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INTRODUCTION

In recent years there has been a very pronounced increase in the number of fires associated with electrical apparatus, as is illustrated in Table I.

TABLE I

FIRES ASSOCIATED WITH ELECTRICAL APPARATUS
GREAT BRITAIN 1947-1958

Year	Number of fires	Index 1947 = 100
1947	3872	100
1948	3871	100
1949	4756	123
1950	5304	137
1951	5512	142
1952	5660	146
1953	5820	150
1954	6082	157
1955	7244	187
1956	7296	188
1957	7635	197
1958	7936	205

This increase, coupled with the likelihood of further increases as electricity consumption expands in the future[1] has given rise to considerable concern, and to a desire to know more about these fires than could be learnt from the available statistical data, based as it was on analyses of routine reports of fires attended by Local Authority Fire Brigades[2]. To remedy this deficiency the Joint Fire Research Organization undertook a detailed survey of all fires associated with electrical equipment. A special questionnaire (Appendix I) was devised with the co-operation of the Electrical Research Association, Sub-Committee V/B (Fire Risks), the Home Office Fire Service Department and H.M. Electrical Inspection of Factories, and H.M. Chief Inspector of Fire Services arranged for the co-operation of all Brigades.

The survey covered all fires attended by Local Authority Fire Brigades in Great Britain in which electrical equipment was the source of ignition, both indoor and out, excluding only fires in vehicles; it included not only fires caused directly by electrical faults but also those due to misuse of, mechanical defects in, etc., any equipment using or transmitting electrical energy. Reports were received for the twelve months from September, 1957, to August, 1958. In all 9385 reports were received, of which 6489 referred to fires attributed to apparatus, and 2896 to fixed installations.

PREMISES

As can be seen from Table II, electrical fire hazard is not equally important in all occupancies:-

TABLE II

FIRES ATTRIBUTED TO ELECTRICAL APPARATUS IN BUILDINGS
GREAT BRITAIN 1958

Occupancy	"Electrical Apparatus Fires"	
	Number	% of all fires in the occupancy
Agriculture	60	2.3
Industry	664	10.1
Clubs, hotels etc.	372	13.4
Dwellings	4108	17.2
Commerce	1016	23.5
ALL BUILDINGS	6844	13.4

Some of this variation may be explained by differences in electricity consumption; in particular, the very low proportion of electrical appliance fires in agricultural buildings (which exclude the residential quarters on farms) almost certainly reflects low power consumption. However, there is a real difference in the incidence rate of electrical fires in relation to power consumption.

During the period of the survey, 57.1% of the apparatus fires occurred in dwellings (see Appendix II), whereas domestic consumption of electricity (including allowances for domestic parts of farms and combined domestic and commercial premises) accounted for less than a third of the sales of electricity. On the other hand industry, which has a power consumption (including its own generation) nearly double that of the domestic sector, suffered only 8.5% of the electrical apparatus fires. Part of the reason for this difference may lie in the fact that industrial concerns may be able to provide better maintenance and are more likely to have skilled men available to tackle faults quickly which might otherwise cause fires necessitating the attendance of a Fire Brigade. The larger industrial organizations also have their own fire brigades so that some fires may not be reported. But this is by no means the whole explanation, and differences in the manner of utilizing electricity are an important factor, as can be seen below.

APPARATUS INVOLVED

A third of the electrical appliance fires in industry were caused by motors, whereas in dwellings cooking (32.7%) and space heating (23.0%) were the most common causes, and in commercial premises fires caused by refrigerators (32.5%) and lighting (24.7%, largely fluorescent lights) predominate.

Very little is known about the pattern of industrial electricity consumption, but electricity is largely used to provide motive power and experience in the domestic field suggests that motors are relatively safe appliances - vacuum cleaner motors, which are owned by some 65% of all housewives in Great Britain[7] are seldom reported as causes of fire. From this it may be argued that industrial motors, many of which are not much bigger than their domestic counterparts, are equally safe and this would help to explain the low fire incidence in industry.

One of the main drawbacks to statistical analyses of causes of fire in the past has been the difficulty of computing any satisfactory incidence rates to serve as a basis for comparison, because of the lack of adequate background data (e.g. number at risk, consumption, time at risk etc.). Though this deficiency still remains to a large measure, it has been slightly alleviated in the domestic field by the publication in recent years of the results of a number of surveys(3), (4), (5), (6) and (7), which fill in at least some of the gaps in our knowledge. These surveys provide little continuity from year to year and consequently apparent trends over time should be regarded with some suspicion, but comparisons of rates of fire incidence in any one year (i.e. bases on any one survey) are probably reasonably accurate, and their ranking remains remarkably constant from year to year as maybe seen from Table III.

TABLE III

FIRES OF ELECTRICAL ORIGIN IN DWELLINGS IN ENGLAND AND WALES
INCIDENCE PER MILLION APPLIANCES AT RISK

Appliance	1955		1956		1957/8	
	Incidence rate	Ranking	Incidence rate	Ranking	Incidence rate	Ranking
Cooking	269	1	313	1	331	1
Refrigeration	136	2	110	2	75	2
Space heating	76	3	64	3	53	3
Television	41	5	40	4	35	4
Water heating	42	4	34	5	21	5
Radio	26	6	18	6	19	6
Iron	22	7	13	7	11	7
Kettle	8	8	6	8	5	8
Washing machine	5	9	5	9	3	9

Source: 1955 figures are based on the results of a survey made by the Electricity Council(5) and those for 1956 and 1957/8 are based on the "Woman" surveys (6), (7).

One disturbing feature disclosed by the above table is that although the incidence rates in general seem to be decreasing, that for cookers has increased, so that not only have they the highest rate of fires per million appliances at risk, but this rate is apparently becoming progressively worse. At present this cannot be accounted for satisfactorily. It is possible that this could be explained by an increase in average power consumption by cookers, but no figures on this are available, and the problem will have to be looked at in greater detail. Some other apparatus, however, appears to have become less fireprone. Most notable, has been the reduction in the rate for refrigerators, which is probably due to improved design of the compressor type ones. In earlier models, thermostat failure, leading to overheating and fire was disturbingly common and this seems to have been eliminated to some extent, though the incidence rate for refrigerators still remains second only to that for cookers.

A number of explanations have been put forward for the persistent differences between incidence rates of the various appliances, but only a partial solution is so far clear. Calculations based on estimates of consumption by several appliances in 1955(5) show that this does not provide the whole answer - cookers and space heaters are still at the upper end of the scale with 0.209 and 0.203 fires per million units of electricity consumed, compared with 0.004 fires for immersion heaters and 0.002 for other water heaters. Power consumption must have some affect on fires, but from the above rates it is evident that there are some other factors which exert a powerful influence on fire incidence. More detailed and more up-to-date consumption figures would be very useful, but are not available.

CAUSE OF FIRE

Possibly a more cogent explanation of the differences may be that appliances such as space heaters and cookers provide a concentrated heat source which is normally accessible and thus liable to misuse, whereas the water heating appliances in general have their heating elements immersed in water, or at least encased, so that they offer less scope for carelessness. This is amply borne out in Table IV from which it can be seen that 96.0% of the cooker fires and 82.7% of those starting from space heaters were attributed to faults in usage, whereas only 26.0% of the water heater fires were so caused. Again this does not provide the whole answer and exceptions are apparent. On the one hand, refrigerators, which had a high incidence rate, measured against appliances at risk, also had a high proportion of fires attributed to failure of equipment; this is probably a special case where mechanical failures developed, and steps have already been taken to overcome this defect in more recent models, in particular by the introduction of sealed motor/compressor units for domestic refrigerators. On the other hand, electric irons have a relatively low incidence rate, and misuse is still the most common cause. It is interesting to speculate whether the comparative safety of these appliances is the result of sustained publicity in the past which laid stress on their fire hazards, but it is impossible to go beyond this for want of comparable data. Similarly, the low rate may be accounted for by the fact that irons, when on, are generally attended, thus making a call to the Fire Brigade less likely.

In all, 51.1% of the fires were due to faults in usage and 38.7% were attributed to faults in the equipment. The border line between the two is rather nebulous, depending on the extent to which one expects the designer to anticipate, and hence safeguard against, misuse, but it is evident that there is scope for improvement in both technical design and in usage, though with varying degrees of importance, in all appliances, and future work should help to pinpoint possible safeguards.

AGE OF APPLIANCE

One of the aims of this survey was to discover whether ageing has any affect on the fire hazard of appliances. The first analyses (Table V) suggest that newer appliances are more prone to misuse while older ones are more prone to faults in equipment, but the difference is not as marked as might be expected.

Faults in equipment are more frequent in appliances eleven years old or more, while faults in usage are more frequent for appliances between one and eleven years old.

Perhaps the most intriguing feature of the age distribution of appliances from which fire originated (illustrated in figure 1) is the low proportion of new appliances. It is tempting to assume that this reflects a genuinely low fire incidence rate for new appliances, but it must be remembered that this survey was taken during a period of economic stagnation which affected sales of electrical equipment, so that there were probably fewer new appliances which could start fires. The subsidiary peaks of five and ten year old appliances are probably the result of vagaries of human memory which, in the absence of receipts or outstanding events with which dates can be connected, tends to approximate long time intervals of less significant events, such as the purchase of domestic equipment, to five or ten year periods. The progressive reduction in the number of appliances in older age groups is almost certainly a reflection of the smaller number of appliances at risk in those groups, but for an accurate assessment of the influence of age on fire hazard it would be necessary to know the number of appliances at risk in each age group.

TABLE IV

FIRES ASSOCIATED WITH ELECTRICAL EQUIPMENT
GREAT BRITAIN 1957/58

Allocation of fault by appliance groups

Appliance Group \ Fault	Fault in equipment	Fault in installing or connecting	Fault in use	Needing maintenance or lubrication*	Mains supply surge or failure*	Other	Unknown	TOTAL
Cooking	39	7	1349	1	-	2	8	1406
Space heating	79	47	1111	-	1	75	32	1345
Radio and Television	637	19	32	1	4	6	35	734
Refrigeration	566	19	13	12	-	3	31	644
Motors	409	14	63	25	4	9	38	562
Lighting	290	31	152	1	1	27	16	518
Blankets and bedwarmers	134	13	157	-	-	-	25	329
Irons	20	5	227	-	-	1	2	225
Lead, plug etc.	73	46	34	2	-	2	6	163
Water heating	80	20	39	-	-	-	11	150
Generation and Transmission	100	6	16	1	-	3	16	142
Industrial	26	3	55	2	1	6	2	95
Drying	10	-	35	-	1	-	-	46
Hospital	5	2	6	-	-	-	-	13
Miscellaneous and unknown	42	8	26	-	-	3	8	87
TOTAL No.	2510	240	3315	45	12	137	231	6489
TOTAL %	38.7	3.7	51.1	0.7	0.2	2.1	3.6	100.0

Source:- Special reports from Local Authority Fire Brigades

* Items marked with an asterisk were not specified on the original questionnaire and may, therefore, have been included under other headings by some Brigades.

TABLE V

FIRES ASSOCIATED WITH ELECTRICAL APPLIANCES
GREAT BRITAIN
SEPTEMBER 1957 - AUGUST 1958

AGE OF APPLIANCE AND ALLOCATION OF FAULT

Age of Appliance \ Allocation of Fault	Fault in Equipment	Fault in Installing or Connecting	Fault in Use	Other	Unknown	TOTAL No.	TOTAL %
less than 1 year	123	25	133	10	19	310	4.8
1 yr & " " 2 yrs	241	29	406	20	31	727	11.2
2 yrs " " " 3 "	233	19	377	18	17	664	10.2
3 " " " " 4 "	166	18	215	12	14	425	6.5
4 " " " " 5 "	127	10	168	9	11	325	5.0
5 " " " " 6 "	174	11	188	8	9	390	6.0
6 " " " " 11 "	406	31	453	24	23	937	14.4
11 " " " " 21 "	305	18	300	18	19	660	10.2
21 " " " " 31 "	100	4	50	6	5	165	2.5
31 " " " " 41 "	4	2	4	2	-	12	0.2
41 " " " " 51 "	3	-	1	-	1	5	0.1
Unknown	628	73	1020	67	81	1869	28.8
TOTAL No.	2510	240	3315	194	230	6489	100.0
TOTAL %	38.7	3.7	51.1	3.0	3.5	100.0	

Source:- Special reports from Local Authority Fire Brigades

It should be possible to gain some further insight into the problem by analysing the age and fault distribution of separate appliance groups for which background data are available. Further work is required for this.

SPREAD OF FIRE

To a certain extent fires are already graded, and the smallest ones eliminated, by the method of reporting, as the Brigades can only report fires to which they are called. A finer grouping is necessary, but the problem of choosing an adequate measure of the size of fires is considerable, particularly when different occupancies are concerned. In this case one convenient breakdown presents itself - whether the fire was confined to the originating appliance or spread beyond it, though even here there is a degree of uncertainty in definition; for example, it is probable that in most of the relevant reports food on a cooker has been regarded as part of the appliance and the fire reported as "confined to the appliance" by the Brigade, otherwise it would be difficult to explain how such a large number of fires were confined to cooking appliances which must be, by and large, non-flammable.

However, even with these limitations in mind the differences in extent of fire between different appliances is marked (Table VI). In general, a large proportion of the fires appear to have been quite minor - 41.9% confined to the appliance of origin and a further 28.5% spreading only to the contents of the premises. At the same time it must be remembered that even small fires can be costly either in monetary terms, or in terms of human lives and suffering. This may particularly be the case with electric blankets which are reported to have damaged only the contents in 78.4% of the fires attributed to them; but in this case "contents" is most likely to be bedding, possibly with invalids or people asleep in the bed. Similarly the "contents" ignited by space heaters may well be clothing on person.

TABLE VI

FIRES ASSOCIATED WITH ELECTRICAL APPLIANCES
GREAT BRITAIN 1957/58

Extent of damage and appliance of origin

Appliance group \ Damage	Confined to appliance	Structure only	Contents only	Structure and Contents	Burns to *person only	Total
Cooking	556	82	428	340	-	1406
Space heating	72	60	629	578	6	1345
Radio and T.V.	429	12	118	175	-	734
Refrigerator	577	16	15	36	-	644
Motor	461	21	32	48	-	562
Light	260	68	115	75	-	518
Blanket	17	2	258	52	-	329
Iron	9	27	107	111	1	255
Generation	101	8	9	24	-	142
Leads and plugs	59	16	42	45	1	163
Water heating	61	10	31	48	-	150
Industrial	43	6	29	17	-	95
Driers	19	5	10	12	-	46
Hospital	9	-	2	2	-	13
Sundry	47	3	15	21	-	86
Unknown	-	-	-	1	-	1
TOTAL No.	2720	336	1840	1585	8	6489
TOTAL %	41.9	5.2	28.4	24.4	0.1	100.0

* Burns to person only were not specified on the original self-coding questionnaire and may, therefore, have been included under another heading by some Brigades.

Source:- Special reports from Local Authority Fire Brigades.

POWER TAKEN BY APPARATUS AND FUSING

An attempt was made to obtain a number of items of technical information which had not been systematically collected in the past, but this met with only limited success. In particular it had been hoped to obtain some data on fusing and power consumption, but it is evident that there was some confusion about this section of the questionnaire and the term "power taken by the apparatus" seems to have been variously interpreted as either power rating or amount of power actually being consumed. For this reason little information could be obtained from analysis of these features. There was, however, some indication that in most cases reported the power taken corresponded fairly closely to the normal power rating (as distinct from power consumption) for the particular appliance, and as might be expected, the majority of fires were associated with relatively low powered appliances - 26% under 200 watts and no less than 60% under 1 Kilowatt. This is presumably a reflection of the power rating of appliances at risk, but again no background data are available.

MAKE OF APPARATUS

This section of the investigation also attempted to break new ground, and again was only partly successful. In over a quarter of the instances the maker's name was not reported, but the ratio varies considerably from one appliance group to another. The maker may be returned as "unknown" either because the appliance was damaged beyond recognition, in which case the proportion of unknown makers would be a measure of the severity of fires caused by that appliance group, or because of inadequate labelling. The latter explanation seems the more likely in the light of the variation in proportions of appliances of unknown make; it seems that the smaller and cheaper appliances have a high proportion of unknown make (63% for unguarded heaters) while the make of more expensive equipment is more commonly known (e.g. television only 4% unknown).

Rather more than 750 different makers names have been recorded. The ten most frequently reported makes accounted for 41% of all appliances, and over half of them are attributed to fifteen manufacturers; these, as would be expected, are the largest firms in the field, which together account for a very high proportion of the equipment on the market. About 60% of the makes were reported once only, and there is reason to believe that some of these are misrecorded versions of more common makes.

CONCLUSIONS

Even from the rough analysis of the causes of fires that has been attempted in this paper it is evident that misuse, whether due to carelessness, ignorance, or even deliberate recklessness, is the major cause of fires associated with electrical appliances, so that there is a great deal of room for improvement in handling electrical equipment, particularly the domestic varieties; but the very fact that so many fires occur as a result of misuse, suggests that improvements in design might be a more profitable approach. Obviously it is impossible, or at least impracticable, to make equipment absolutely foolproof, but it might be worthwhile making it proof against the average sort of person who comes into daily contact with it.

Appliances should be designed so as to minimise the risk of misuse, bearing in mind that the average user may not be particularly careful in the use of everyday appliances. This need is especially important in residential premises, and indeed has already been partially accepted in the Fireguard Acts, which recognise that people tend to be thoughtless, and attempt to protect them (and the community at large) against their own folly, by making adequate fireguards compulsory. Perhaps this principle should be extended to other, possibly less obvious safety devices. This seems to be an ergonomic problem - if not exactly fitting the job to the man, then at least designing the appliances to the individual who is intended to use them.

At the same time, the number of fires caused by faults in the appliances themselves, often even in quite new appliances, indicates another field for possible improvement among some appliances. That such improvements can be effective is amply illustrated by the record of refrigerators, which have been responsible for progressively fewer fires, over recent years, despite the very obvious increase in the number of refrigerators at risk. Further detailed analysis of the data may reveal what remedial measures might profitably be taken.

ACKNOWLEDGMENT

Acknowledgment is due to Miss Nicola Savage who carried out much of the tabulation of information and to various members of the Statistics Unit who coded and prepared the data for analysis.

Acknowledgment is also due to members of the Fire Service for returning the reports on which this note is based.

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APPENDIX I

REPORT OF ELECTRICAL FIRE

This side of form to be used for reporting fires due to electrical apparatus, including outdoor fires but excluding fires in vehicles.

Code	ITEM	Cols.
	Fire Brigade.....	1-3
	K.433 No.....	4-7
	Date	8-13
	Day of week.....	14
	Time of discovery.....	15-16
	PREMISES	17-18
00	House	
01	Flat built as flat	
02	Flat in converted house	
03	Club, hotel, restaurant, etc.	
04	Office	
05	Shop or showroom	
06	Warehouses, wholesale dealers	
07	School, college	
08	Hospital, home, institution	
09	Factory, workshop, other industrial premises	
	Other than above.....	
	.....	
	LOCATION OF FAILURE	19
0	Indoor	
1	Outdoor	
	APPARATUS PRIMARILY INVOLVED	20-21
00	Boiling ring	
01	Cooker, oven (domestic)	
02	Drier (other than oven)	
03	Hot-plate	
04	Kettle	
05	Oven (industrial)	
06	Fire (guarded)	
07	Fire (unguarded)	
08	Heater (convection)	
09	Heater (off peak storage type)	
10	Radiator or tubular heater	
11	Lamp (portable)	
12	Light or light fitting (fixed)	
13	Fluorescent lighting (or choke)	
14	Immersion heater	
15	Water heater (other than immersion)	
16	Radio or radiogram	
17	Television	
18	Accumulator	
19	Blanket or bed-warmer	
20	Iron	
21	Motor	
22	Motor controller	
23	Plug, adaptor or connector	
24	Projector	
25	Refrigerator (compressor type)	
26	Refrigerator (heater type)	
27	Thermostat or thermal relay	
28	Transformer	
29	Washing machine	
30	Welding apparatus	
31	Wire or cable (lead to apparatus)	
	Other than above.....	
	.....	
	.....	
	INDICATOR LAMP	22
0	Pilot lamp fitted	
1	No pilot lamp	

Code	ITEM	Cols.
	THERMOSTATIC CONTROLS	23
0	Thermostat fitted	
1	No thermostat	
	POWER TAKEN BY APPARATUS	
	(a) Watts.....	24-27
	or (b) Horse power.....	28-30
	FUSE IN CIRCUIT FEEDING APPARATUS	31-32
	Size of fuse amps.....	
99	Unknown	
	MAKE OF APPARATUS	33-34
	Maker's name.....	
	.....	
99	Unknown	
	AGE OF APPARATUS	35-36
	Age in years.....	
99	Unknown	
	ALLOCATION OF FAULT	37
0	Fault in equipment	
1	Fault in installing or connecting equipment	
2	Improper or careless use	
	Other causes.....	
	.....	
99	Unknown	
	CAUSE OF FIRE	38-39
00	Heating due to bad contact	
01	Heating due to defective insulation	
02	Overheating other than by overloading	
03	Overloading	
04	Short circuit by mechanical defect or external agency	
05	Earth fault leading to generation of heat elsewhere	
06	Direct contact with combustible material	
07	Ignition of combustible material without direct contact	
	Other causes.....	
	.....	
	.....	
99	Unknown	
	SPREAD OF FIRE	40
1	Fire confined to apparatus of origin	
2	Fire spread beyond apparatus of origin damaging-structure only	
3	-contents only	
4	-structure and contents	
	EXTINCTION OF FIRE	41
1	Fire died out	
2	Fire extinguished before arrival of Fire Brigade	
3	Fire tackled before arrival of Fire Brigade, extinguished by Brigade	
4	Fire not tackled before arrival of Fire Brigade, extinguished by Brigade	

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

19 Cornwall Terrace,

REPORT OF ELECTRICAL FIRE

London, N.W.1.

This side of form to be used for reporting fires due to wire and cable and equipment forming part of permanent electrical supply installation, including outdoor fires but excluding fires in vehicles

Code	ITEM	Cols.
	Fire Brigade.....	1-3
	K.433 No.....	4-7
	Date	8-13
	Day of week.....	14
	Time of discovery.....	15-16
	PREMISES	17-18
00	House	
01	Flat built as flat	
02	Flat in converted house	
03	Club, hotel, restaurant, etc.	
04	Office	
05	Shop or showroom	
06	Warehouses, wholesale dealers	
07	School, college	
08	Hospital, home, institution	
09	Factory, workshop, other industrial premises	
	Other than above.....	
	.....	
	LOCATION OF FAILURE	19
0	Indoor	
1	Outdoor	
	PART OF INSTALLATION FAILING	20-21
00	Cable or flex	
01	Ceiling rose	
02	Circuit breaker	
03	Fusebox (metal)	
04	Fusebox (bakelite, plastic)	
05	Fusebox (other than above)	
06	Joint box (compound filled)	
07	Joint box (not filled)	
08	Plain socket	
09	Switch socket	
10	Switch	
11	Distribution board	
	Other than above.....	
	.....	
	AGE OF INSTALLATION	22-23
	Age in years.....	
99	Unknown	
	TYPE OF LABOUR USED FOR INSTALLATION	24
0	Professional	
1	Amateur	
2	Unknown	
	TYPE OF FUSE	25
0	Enclosed	
1	Open	
2	Cartridge	
3	Miniature circuit breaker	
4	Enclosed fuse with earth-leakage circuit breaker	
5	Open fuse with earth-leakage circuit breaker	
6	Cartridge fuse with earth-leakage circuit breaker	
7	Miniature circuit breaker with earth-leakage circuit breaker	
	Other than above.....	
	.....	
	SIZE OF FUSE OR RATING OF CIRCUIT BREAKER	26-27
	Amps.....	
99	Unknown	

Code	ITEM	Cols.
	TYPE OF WIRING CAUSING FIRE	28
0	V.R. lead covered	
1	V.R. other than lead covered	
2	T.R.S.	
3	P.V.C. or other plastic covered	
4	Flexible cable (flex)	
5	Temporary wiring	
	Other than above.....	
	.....	
	PROTECTION OF CABLE	29
0	Unprotected	
1	Casing and capping	
2	Steel conduit	
3	Plastic conduit	
4	Ducting	
	Other than above.....	
	.....	
	SIZE OF CONDUCTOR	30-31
	Size — Current Rating	
00	1/.044 — 6.1 amps	
01	3/.029 — 7.8 ,,	
02	3/.036 — 12.0 ,,	
03	7/.029 — 18.2 ,,	
04	7/.036 — 24.0 ,,	
05	7/.044 — 31.0 ,,	
06	7/.052 — 36.8 ,,	
07	Other cables with 7 strands or less	
08	Cables with more than 7 strands	
99	Unknown	
	DEFECT IN MAIN CONDUCTORS	32-33
00	Circuit overloaded	
01	Defective contact	
02	Broken conductor	
03	Insulation damaged mechanically e.g. by chafing and piercing	
04	Insulation damaged from other causes e.g. moisture, heat, age, chemical action	
	Other than above.....	
	.....	
99	Unknown	
	DEFECT IN PROTECTIVE SYSTEM	34-35
00	Defective contact in earthing circuit	
01	Earth continuity conductor touching gas pipe	
02	Earth fault not associated with gas pipe	
	Other than above.....	
	.....	
99	None	
	SEAT OF GENERATION OF HEAT CAUSING FIRE	36
1	Any defect in main conductors	
2	Any defect in protective system	
	EXTINCTION OF FIRE	37
1	Fire died out	
2	Fire extinguished before arrival of Fire Brigade	
3	Fire tackled before arrival of Fire Brigade, extinguished by Brigade	
4	Fire not tackled before arrival of Fire Brigade, extinguished by Brigade	

APPENDIX II

PREMISES IN WHICH FIRES ORIGINATED

Premises	England and Wales		Scotland		Great Britain	
	Fires	%	Fires	%	Fires	%
DWELLINGS						
Flat built as flat	270	4.6	152	25.8	422	6.5
Flat in converted house	289	4.9	14	2.4	303	4.7
House	2774	47.0	183	31.0	2957	45.6
*Private garage	21	0.4	1	0.2	22	0.3
Total	3354	56.9	350	59.4	3704	57.1
COMMERCIAL						
Office	90	1.5	12	2.0	102	1.6
Shop, showroom	1011	17.1	90	15.3	1101	17.0
Warehouse, wholesaler	60	1.0	3	0.5	63	1.0
Total	1161	19.7	105	17.8	1266	19.5
INDUSTRIAL						
Factory, workshop and other industrial premises	504	8.5	45	7.6	549	8.5
PUBLIC BUILDINGS						
Club, hotel, restaurant	270	4.6	28	4.7	298	4.6
*Cinema, theatre and outdoor entertainment	44	0.7	4	0.7	48	0.7
*Municipal buildings	16	0.3	1	0.2	17	0.3
*Places of worship	12	0.2	6	1.0	18	0.3
Total	342	5.8	39	6.6	381	5.9
AGRICULTURAL	143	2.4	18	3.1	161	2.5
HOSPITAL, HOME, INSTITUTION	116	2.0	7	1.2	123	1.9
TRANSPORT AND COMMUNICATION						
*Transport and communication	36	0.6	6	1.0	42	0.6
*Petrol pump	8	0.1	1	0.2	9	0.1
*Ship	23	0.4	-	-	23	0.4
*Mobile apparatus (outdoor)	3	0.1	-	-	3	-
Total	70	1.2	7	1.2	77	1.2
SCHOOL COLLEGE	64	1.1	7	1.2	71	1.1
PUBLIC UTILITIES						
*Electricity sub station	2	-	-	-	2	-
* Gas, water, sewage	9	0.2	-	-	9	0.1
*Power station	2	-	-	-	2	-
Total	13	0.2	-	-	13	0.2
MISCELLANEOUS						
*Fire station, service premises	38	0.6	-	-	38	0.6
*Premises in course of construction or demolition	5	0.1	-	-	5	0.1
*Professional establishments	5	0.1	3	0.5	8	0.1
*Shed, hut, glasshouse	35	0.6	1	0.2	36	0.6
*Street lamp	5	0.1	-	-	5	0.1
*Other	44	0.7	8	1.4	52	0.8
Total	132	2.2	12	2.0	144	2.2
Grand Total	5899	100.0	590	100.0	6489	100.0

* Items marked with an asterisk were not specified on the original questionnaire and may, therefore, have been included under other headings by some Brigades.

Source:- Special reports from Local Authority Fire Brigades

APPENDIX III

ELECTRICAL FIRES SURVEY

TYPE OF APPLIANCE AND PREMISES

GREAT BRITAIN 1957-1958

Appliances \ Premises	Dwellings	Commercial	Industrial	Public Buildings	Agricultural	Hospitals Homes Institutions	Transport and Communication	Schools and Colleges	Public Utilities	Miscellaneous and Unknown	Total	
											No.	%
Cooking	1213	66	25	47	-	18	5	18	-	14	1406	21.7
Space Heating	841	152	78	59	108	23	16	21	1	46	1345	20.7
Radio and Television	661	26	7	17	-	14	2	1	-	6	734	11.3
Refrigeration	114	411	17	78	1	8	-	6	-	9	644	9.9
Motors	31	178	183	75	10	24	25	6	9	21	562	8.7
Lighting	67	313	40	47	23	4	5	4	-	15	518	8.0
Blankets and Bedwarmers	316	-	-	9	-	-	2	-	-	2	329	5.1
Iron	192	21	26	6	-	7	-	2	-	1	255	3.9
Lead, Plug etc.	98	21	19	6	5	3	4	1	-	6	163	2.5
Water Heating	106	12	16	5	1	3	3	1	-	3	150	2.3
Generation and Transmission	28	41	22	15	6	4	8	2	2	14	142	2.2
Industrial	-	3	84	4	-	1	2	1	-	-	95	1.5
Drying	22	9	9	1	-	3	-	2	-	-	46	0.7
Hospital	1	-	1	-	-	8	-	-	-	3	13	0.2
Miscellaneous and Unknown	14	13	22	12	7	3	5	6	1	4	87	1.3
Total No.	3704	1266	549	381	161	123	77	71	13	144	6489	100.0
%	57.1	19.5	8.5	5.9	2.5	1.9	1.2	1.1	0.2	2.2	100.0	

Source:- Special report from Local Authority Fire Brigades

APPENDIX IV

SUPPOSED SOURCE OF IGNITION
GREAT BRITAIN 1957/8

Appliance	Dwellings		Other Occupancies		Total			
	Fires	%	Fires	%	England and Wales	Scotland	Great Britain	
					Fires	Fires	Fires	%
COOKING								
Boiling ring	128	3.5	36	1.3	155	9	164	2.5
Cooker, oven (domestic)	900	24.3	52	1.9	854	98	952	14.7
*Frying range	-	-	60	2.2	55	5	60	0.9
Hotplate	151	4.1	32	1.1	177	6	183	2.8
Kettle	30	0.8	10	0.4	33	7	40	0.6
*Toaster	4	0.1	3	0.1	6	1	7	0.1
TOTAL	1213	32.8	193	6.9	1280	126	1406	21.7
SPACE HEATING								
Fire (guarded)	428	11.6	141	5.1	524	45	569	8.8
Fire (unguarded)	330	8.9	102	3.7	387	45	432	6.7
Heater (convector)	24	0.6	29	1.0	45	8	53	0.8
Heater (off peak storage)	-	-	32	1.1	28	4	32	0.5
Radiator or tubular heater	59	1.6	200	7.2	223	36	259	4.0
TOTAL	841	22.7	504	18.1	1207	138	1345	20.7
RADIO AND TELEVISION								
Radio or Radiogram	300	8.1	52	1.9	322	30	352	5.4
Television	361	9.7	21	0.7	341	41	382	5.9
TOTAL	661	17.8	73	2.6	663	71	734	11.3
REFRIGERATION								
Refrigerator (compressor)	108	2.9	518	18.6	611	15	626	9.7
Refrigerator (heater)	6	0.2	9	0.3	14	1	15	0.2
*Refrigerated display	-	-	3	0.1	3	-	3	-
TOTAL	114	3.0	530	19.0	628	16	644	9.9
MOTORS								
*Drill	-	-	3	0.1	3	-	3	-
*Fan	-	-	10	0.4	10	-	10	0.2
Motor	31	0.8	463	16.6	434	60	494	7.6
Motor controller	-	-	55	2.0	52	3	55	0.8
TOTAL	31	0.8	531	19.1	499	63	562	8.7
LIGHTING								
Fluorescent light, choke	2	0.1	316	11.3	304	14	318	4.9
Lamp, portable	48	1.3	62	2.2	98	12	110	1.7
Light, fixed	17	0.5	73	2.6	78	12	90	1.4
TOTAL	67	1.8	451	16.2	480	38	518	8.0
BLANKET OR BEDWARMER	316	8.5	13	0.5	297	32	329	5.1
IRON	192	5.2	63	2.3	212	43	255	3.9
GENERATION AND TRANSMISSION								
*Generator	-	-	13	0.5	11	2	13	0.2
Transformer	19	0.5	88	3.2	99	8	107	1.6
*Trickle charger	9	0.2	13	0.5	19	3	22	0.3
TOTAL	28	0.8	114	4.1	129	13	142	2.2

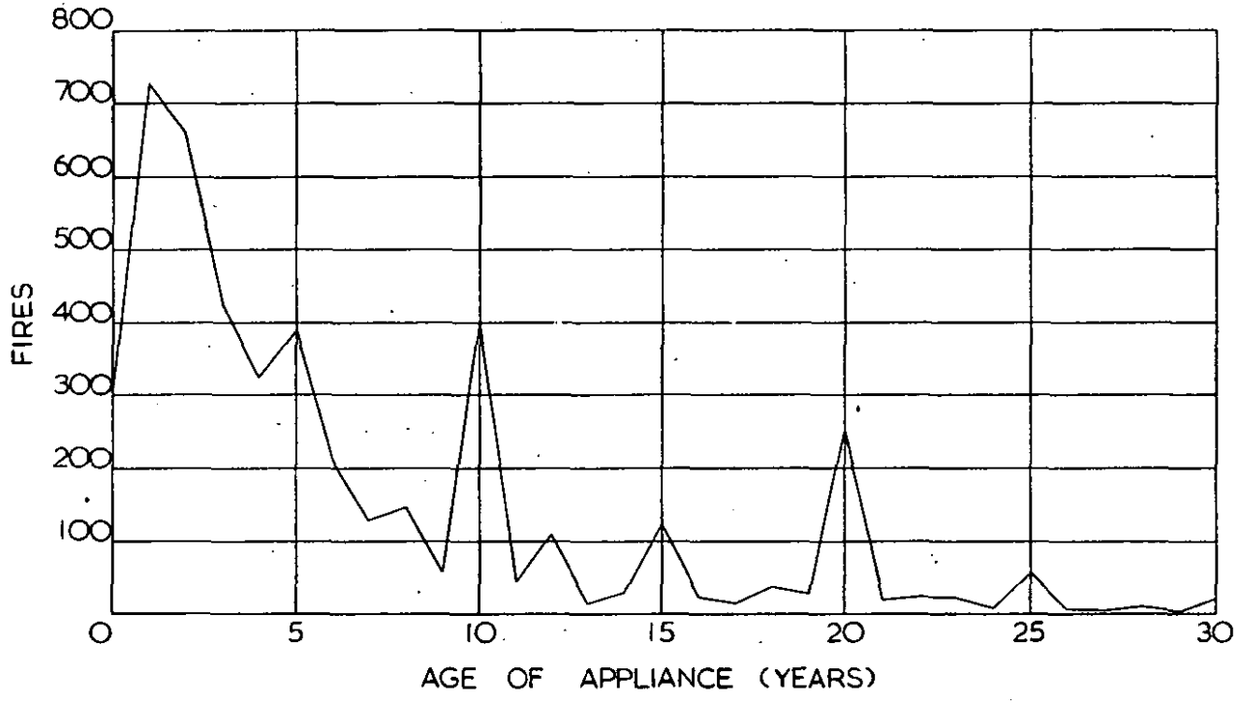
APPENDIX IV (Continued)

SUPPOSED SOURCE OF IGNITION
GREAT BRITAIN 1957/8

Appliance	Dwellings		Other Occupancies		Total			
	Fires	%	Fires	%	England and Wales	Scotland	Great Britain	
					Fires	Fires	Fires	%
LEADS, PLUGS, ETC.								
Plug adaptor, connector	19	0.5	11	0.4	26	4	30	0.5
Thermostat or thermal relay	3	0.1	9	0.3	10	2	12	0.2
Lead to apparatus	76	2.1	45	1.6	106	15	121	1.9
TOTAL	98	2.6	65	2.3	142	21	163	2.5
WATER HEATING								
Immersion heater	76	2.0	19	0.7	90	5	95	1.5
Water heater, not immersion	13	0.4	18	0.6	28	3	31	0.5
*Wash boiler	1	-	1	-	2	-	2	-
Washing machine	16	0.4	6	0.2	22	-	22	0.3
TOTAL	106	2.9	44	1.6	142	8	150	2.3
INDUSTRIAL								
*Industrial appliances	-	-	52	1.9	48	4	52	0.8
Welding apparatus	-	-	25	0.9	21	4	25	0.4
Oven (industrial)	-	-	18	0.6	17	1	18	0.3
TOTAL	-	-	95	3.4	86	9	95	1.5
DRIERS								
Drier (other than oven)	20	0.5	21	0.8	36	5	41	0.6
*Hair drier	2	0.1	2	0.1	4	-	4	0.1
*Hand drier	-	-	1	-	1	-	1	-
TOTAL	22	0.6	24	0.9	41	5	46	0.7
HOSPITAL EQUIPMENT								
*Dentist's drill	-	-	1	-	1	-	1	-
*Equipment other than Xray	1	-	7	0.3	7	1	8	0.1
*Xray equipment	-	-	4	0.1	4	-	4	0.1
TOTAL	1	-	12	0.4	12	1	13	0.2
SUNDRY								
Accumulator	-	-	4	0.1	4	-	4	0.1
*Agricultural (not infra red lamps)	1	-	9	0.3	10	-	10	0.2
*Air conditioning	-	-	2	0.1	2	-	2	-
*Banks of resistances	-	-	2	0.1	2	-	2	-
*Cash register	-	-	1	-	1	-	1	-
*Clock	2	0.1	-	-	2	-	2	-
*Dry battery	2	0.1	-	-	2	-	2	-
*Electric locking device	-	-	3	0.1	2	1	3	-
*Electric systems to boilers	2	0.1	9	0.3	10	1	11	0.2
*Electro magnetic devices	1	-	4	0.1	5	-	5	0.1
*Fly abater	-	-	1	-	1	-	1	-
*Oven or kiln (not domestic or industrial)	-	-	3	0.1	3	-	3	-
*Paint stripper	1	-	-	-	1	-	1	-
*Photographic processing	-	-	3	0.1	2	1	3	-
*Pintable	-	-	1	-	1	-	1	-
Projector	-	-	2	0.1	1	1	2	-
*Rheostat	-	-	4	0.1	4	-	4	0.1
*Scientific equipment	-	-	5	0.2	5	-	5	0.1
*Soldering iron	3	0.1	5	0.2	8	-	8	0.1
*Telephone equipment	1	-	6	0.2	7	-	7	0.1
*Window display	-	-	2	0.1	2	-	2	-
Other	-	-	7	0.3	5	2	7	0.1
TOTAL	13	0.4	73	2.6	80	6	86	1.3
UNKNOWN	1	-	-	-	1	-	1	-
GRAND TOTAL	3704	100.0	2785	100.0	5899	590	6489	100.0

* Items marked with an asterisk were not specified on the original questionnaire and may, therefore, have been included under other headings by some Brigades.

Source:- Special reports from Local Authority Fire Brigades



Source — Special reports from Local Authority Fire Brigades

FIG. 1. AGE DISTRIBUTION OF APPLIANCES FROM WHICH FIRES ORIGINATED GREAT BRITAIN 1957/58