

F.R. Note No. 502

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

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FIRES ASSOCIATED WITH KEROSENE BURNING APPLIANCES IN DWELLINGS,
JUNE 1960 - MAY 1961

by

J. F. Fry and R. E. Lustig

SUMMARY

Special reports received from Fire Brigades on fires in dwellings caused by kerosene burning appliances have been analysed with particular reference to portable space heaters.

It appears that drip feed heaters may be about three and a half times as likely as wick fed ones to cause a fire, but the fires caused by wick fed heaters tend to be the more dangerous from the point of view of both casualties and spread. The causes of fires are dependent on the type of heater involved.

March, 1962.

Fire Research Station,
Boreham Wood,
Herts.

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I - INTRODUCTION

This note contains an analysis of the results of a special survey of fires caused by kerosene burning appliances in dwellings in the twelve months June 1960 to May 1961. During this period Local Authority Fire Brigades throughout the United Kingdom were asked to complete a special questionnaire (Appendix I) in relation to each fire attended on private residential property which was thought to have been caused by a kerosene burning appliance of any sort (excluding only blow lamps and internal combustion engines). These reports were supplementary to the routine reports already received on every fire attended by the Brigades, and the two reports together gave a detailed picture of each incident for the special survey. Some Brigades also sent reports of fires not in dwellings, but these have been excluded from the general analysis because this would present an incomplete picture.

In this analysis attention has been focussed primarily on space heaters, which accounted for 92.5 per cent of the kerosene appliance fires reported in residential premises, but some reference is also made to cooking apparatus. There has been a marked increase in the number of heater fires in recent years as may be seen from the annual incidence figures for Great Britain shown in Table 1 and Fig. 1.

Table 1

Fires caused by kerosene space heaters in dwellings
Great Britain 1950-1960

Year	Number of fires	Index (1950 = 100)
1950	342	100
1951	390	114
1952	376	107
1953	300	88
1954	456	134
1955	564	162
1956	1100	322
1957	1266	370
1958	2148	628
1959	2340	684
1960	2188	640

It is too early yet to say whether the apparent reduction in the number of fires associated with kerosene heaters in 1960 is the result of improvements in design, of sustained propaganda following the Ware fire in 1959, or of random fluctuations.

In the special survey 3015 reports were received of fires in the United Kingdom. Of these 2603 were on private residential premises (including 182 not actually in houses or flats, but in outhouses, caravans, houseboats, etc.).

II - TYPE OF APPLIANCE

Of the fires on private residential premises, 92.5 per-cent were due to space heaters and a further 3.4 per cent to cooking appliances (see Table 2). From the reports it was clear that at least twenty-five of the eighty-five portable appliances described as cookers were being used as space heaters when the fires occurred, and this may have been true of some of the remaining sixty incidents.

Table 2

Use of kerosine burning apparatus involved in fires in dwellings
United Kingdom June 1960 - May 1961

Use of appliance	Portability		Total	
	Fixed	Portable	No.	Per cent
Space heating	11	2397	2408	92.5
Cooking	3	85	88	3.4
Lamp	0	25	25	1.0
Incubator, brooder	1	39	40	1.5
Boiler	6	0	6	0.2
Car heater	0	25	25	1.0
Other	2	5	7	0.3
Not stated	0	4	4	0.2
TOTAL	23	2580	2603	

The number of fires caused by fixed installations is lower than in earlier surveys⁽³⁾, but this is probably because the present study was confined to kerosine burning appliances whereas previous analyses included appliances burning oils of all kinds. Of the total of 2381 portable space heaters 1446 were of the drip feed (or kindler) type and 935 of the wick fed type.

In 1959 Social Surveys (Gallup Poll) Ltd estimated the total number of kerosine heaters at risk to be of the order of ten million, of which about three million were of the drip feed type. Several factors may have resulted in a change in the ratio of drip feed to wick fed heaters since that date, but if it has remained substantially the same it now appears that a drip feed heater may be about three and a half times as likely to cause a fire as a wick fed one.

III - CAUSES OF FIRES

(a) Act or defect causing fire

The differences between the cause patterns for wick and drip feed (kindler) heaters found in earlier surveys⁽³⁾ were again in evidence in this investigation (see Table 3).

Table 3

Causes of fires in portable kerosine heaters in dwellings
United Kingdom, June 1960 - May 1961

Act or defect causing fire	Type of oil feed						Total	
	Drip feed		Wick		Pressure	Other		
	No.	Per cent	No.	Per cent	No.	No.	No.	Per cent
Overfilled or fuel spilt	189	13.1	103	11.0	1	0	293	12.2
Overturned or dropped	83	5.7	164	17.6	2	0	249	10.4
Too near combustibles	125	8.6	144	15.4	1	2	272	11.3
Filling while alight	69	4.8	16	1.7	0	0	85	3.5
Exploded	7	0.5	5	0.5	1	0	13	0.5
Overheated or flared up	434	30.0	158	16.9	1	1	594	24.8
Leakage or flooding	275	19.0	35	3.7	2	0	312	13.0
Turned too high	156	10.8	236	25.3	0	2	394	16.4
Other or unknown	108	7.5	74	7.9	3	0	185	7.7
TOTAL	No.	1446		935		11	5	2397
	Per cent	60.4		39.0		0.5	0.2	

It is of interest to note the progressive decline in the relative importance in successive surveys of fires caused by "overturning and dropping". This cause accounted for 18.6 per cent of all oil heater fires in 1956, 14.3 per cent in 1959 and only 10.4 per cent in June 1960 - May 1961. This could be partly due to improved designs of the newer heaters and to greater care on the part of users, but is almost certainly related in some degree to increases in the proportion of drip feed heaters at risk, since these appear to be relatively less likely to be overturned or dropped than the wick feed types. Support for this view is the fact that the proportion of wick-fed heater fires caused by overturning or dropping was almost the same in the survey as in 1959.

There was a marked increase in the proportion of fires resulting from appliances being turned too high - 2.4 per cent in 1956, 3.6 per cent in 1959 and 16.7 per cent in the present survey. However, as the special questionnaire used for this survey contained a direct question on burner adjustment, this change may have resulted at least in part, from more specific reporting. It is clear that this cause is of greater importance with the wick fed heaters than with the drip feed type.

As in previous surveys "filling while alight" was a more common cause among drip feed than among wick feed heaters. Some makers of drip feed heaters, while not specifically recommending this procedure, offer a measure of encouragement for its adoption by providing a second fuel tank with the heater which can be filled and held in readiness for immediate insertion when the other is empty. In several incidents the cap was reported to have come off the fuel tank when it was being inverted and replaced in the heater after filling, thus spilling kerosine around the heater. With portable cookers the main cause of fire was recorded as "overturned or dropped" and, as may be seen from Table 4, this resulted in over 30 per cent of the fires, although stability should clearly be a matter of first consideration when designing apparatus for cooking purposes.

Table 4

Causes of fires in portable kerosine cookers in dwellings
United Kingdom, June 1960 - May 1961

Act or defect causing fires	Frequency	
	No.	Per cent
Overfilled or fuel spilt	7	8.2
Overturned or dropped	26	30.6
Too near combustibles	12	14.1
Filling while alight	3	3.5
Exploded	3	3.5
Overheated or flared up	10	11.8
Leakage or flooding	2	2.4
Turned too high	12	14.1
Other or unknown	10	11.8
Total	85	

(b) Effect of draught

Since the behaviour of some heaters under draught conditions is suspect, reporting officers were asked to state whether there was any evidence that the heaters involved in fires might have been subjected to draught when in use. There was said to be some evidence of draught in 647 (44.7 per cent) of the reports referring to drip feed heaters and in 267 (28.6 per cent) of those referring to the wick fed type. The numbers in which evidence of draught was reported are shown in relation to the acts or defects causing the fires in Table 5.

Table 5

Frequency of evidence of draught in relation to causes
of fires in portable kerosine heaters in dwellings
United Kingdom, June 1960 - May 1961

Act or defect causing fire.	Drip feed heaters			Wick feed heaters			Pressure and other heaters		
	Total fires	Evidence of draught		Total fires	Evidence of draught		Total fires	Evidence of draught	
	No.	No.	Per cent	No.	No.	Per cent	No.	No.	Per cent
Overfilled or fuel spilt	189	63	33.3	103	30	29.1	1	0	0
Overturned or dropped	83	17	20.5	164	27	16.5	2	1	50
Too near combustibles	125	36	28.8	144	35	24.3	3	0	0
Filling while alight	69	21	30.4	16	3	18.8	0	0	0
Exploded	7	1	14.3	5	2	40.0	1	0	0
Overheated or flared up	434	296	68.2	158	73	46.2	2	2	100
Leakage or flooding	275	103	37.4	35	14	40.0	2	2	100
Turned too high	156	64	41.0	236	62	26.3	2	2	100
Other or unknown	108	46	42.6	74	21	28.4	3	1	33
Total	1446	647	44.7	935	267	28.6	16	8	50

The fact that there was some evidence of draught does not necessarily indicate that draught was primarily responsible for, or even contributed to any particular fire, but it is of interest to note that such evidence was reported most frequently in connection with "overheating or flaring up" of drip feed heaters. It was also reported in a high proportion of the fires in drip feed heaters that were attributed to "turned too high" and "other and unknown" causes.

In the case of wick fed heaters also evidence of draught was reported in a number of incidents - 46.2 per cent of the fires due to "overheating and flaring up" and 40 per cent of those due to "leakage and flooding". From this it appears possible that the behaviour of some wick fed heaters may not be completely satisfactory under draught conditions. In two out of the five incidents in which wick fed heaters exploded there was again some evidence of draught, but the influence of draught is not known to have contributed to the accidents.

IV - CONDITION OF APPLIANCES

(a) Pin holes and corrosion

One factor which may be relevant to the fire hazard of a kerosine heater is the condition of the fuel tank, and Fire Brigades were asked to comment on this feature of heaters involved in fires. Most of the tanks were said to be in good condition, but, as may be seen from Table 6 there were some in which deterioration was observed.

Table 6

Condition of tanks in heaters involved in fires in dwellings
United Kingdom June 1960 - May 1961

Condition of tank after fire	Type of heater						Total	
	Drip feed		Wick feed		Pressure and other			
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Good condition	1299	89.8	859	91.9	13	81.2	2171	93.0
Signs of corrosion	16	1.1	22	2.4	1	6.3	39	1.6
Pinholes	44	3.0	23	2.5	1	6.3	68	2.8
Shattered by heat	47	3.3	9	1.0	0	0	56	2.3
Damaged by dropping at time of fire	1	0.1	1	0.1	0	0	2	0.1
Unknown	39	2.7	21	2.2	1	6.3	61	2.5
Total	1446		935		16		2397	

Although signs of corrosion may give a general indication of the condition of the heater the effects of corrosion are most likely to become important when it has proceeded to the point at which pinholes have developed. In Table 7 the occurrence of pinholes is related to the causes of the fires and it is seen that, as might be expected, there is an association between pinholes and "leakage or flooding". Nearly half the reports of fires attributed to "leakage or flooding" in wick fed heaters stated that there were pinholes in the fuel tanks, the equivalent proportion in drip feed type heaters being 10.5 per cent.

Table 7

Frequency of pinholes in fuel tanks in relation to
causes of fires in portable heaters in dwellings
United Kingdom, June 1960 - May 1961

Act or defect causing fire	Drip feed heaters			Wick feed heaters			Pressure and other heaters	
	Total fires	Pinholes in tank		Total fires	Pinholes in tank		Total fires	Pinholes in tank
	No.	No.	Per cent	No.	No.	Per cent	No.	No.
Overfilled or fuel spilt	189	4	2.1	103	0	0	1	0
Overturned or dropped	83	1	1.2	164	0	0	2	0
Too near combustibles	125	1	0.8	144	0	0	3	0
Filling while alight	69	0	0	16	0	0	0	0
Exploded	7	0	0	5	0	0	1	0
Overheated or flared up	434	4	0.9	158	2	1.3	2	0
Leakage or flooding	275	29	10.5	35	16	45.7	2	1
Turned too high	156	4	2.6	236	4	1.7	2	0
Other or unknown	108	1	0.9	74	1	1.4	3	0
	1446	44	3.0	935	23	24.6	16	1

(b) Burner adjustment

Also relevant to the fire hazard of oil heaters is the care with which adjustments, particularly burner adjustments are made. Fire Brigades were asked to express an opinion as to the correctness or otherwise of the adjustment of burners in heaters involved in fires. For this they would have to rely partly on information provided by the user and partly on observation of the wick or fuel valve setting of the heater under examination. It is recognised that a correct assessment of the wick or fuel adjustment of a damaged heater may present some difficulty, but it is nevertheless considered that the answers to the question are likely to be indicative of this particular feature of usage and they have therefore been summarised in Table 8.

About 30 per cent of the wick feed, 14 per cent of the drip feed heaters and 17 per cent of the cookers were, in the opinion of the reporting officers, adjusted to too high a setting. It has to be remembered that all of these heaters were involved in fires and it is not known how closely the proportions would represent the normal pattern of burner adjustment of all of the heaters in use. It does appear, however, that there may be a tendency for owners, particularly of wick fed heaters, to run them with too large a flame.

Table 8

Burner adjustment in portable kerosine heaters and cookers involved in fires in dwellings. United Kingdom, June 1960 - May 1961

Burner adjustment	Drip feed heaters		Wick feed heaters		Cookers	
	No.	Per cent	No.	Per cent	No.	Per cent
Correct	1075	74.3	513	54.9	57	67.1
Too high	197	13.6	276	29.5	14	16.5
Too low	60	4.1	90	9.6	1	1.2
Not stated	114	7.9	56	6.0	13	15.3
	1446		935		85	

(c) Cleaning and servicing

It is reasonable to assume that kerosine heaters, in common with other apparatus, are likely to give their best and safest performance when properly maintained. In order, therefore, to obtain some information on this aspect of oil heater use the owners of appliances involved in fires were asked by Fire Brigades what action they took with regard to cleaning. The replies obtained are summarised in Table 9.

Table 9

Cleaning schedules of portable kerosine heaters and cookers involved in fires in dwellings. United Kingdom June 1960 - May 1961

Frequency of cleaning	Drip feed heaters		Wick feed heaters		Pressure and other heaters		Cookers	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Never	255	17.6	106	11.3	0	0	14	16.5
Occasionally	842	58.2	588	62.9	10	62.5	51	60.0
Weekly	117	8.1	124	13.3	1	6.3	10	11.8
Monthly	104	7.2	48	5.1	0	0	2	2.4
Three monthly	55	3.8	13	1.4	1	6.3	1	1.2
Less often than 3 monthly	24	1.7	12	1.3	0	0	0	0
Not stated	49	3.4	44	4.7	4	25.0	7	8.2
Total	1446		935		16		85	

About 20 per cent of the heaters, both wick and drip feed types, were said to be cleaned at regular intervals of three months or less, most of the remainder receiving this attention either only occasionally or not at all. It is shown later in this report (Section Va) that more than three quarters of the heaters featuring in the investigation were in continuous or regular use, so that a substantial number were likely to have been receiving inadequate maintenance. The importance of cleaning, particularly of air inlets, is stressed in the instructions provided by makers and it is known that restricting the flow of air can considerably affect the character of the flame.

(d) Fuel gauges and level gauges

The importance of level adjustment with drip feed type heaters is well known and is referred to in the instructions required to be attached to heaters bearing the British Standard kite mark. B.S. 3300 requires that a heater, adjusted correctly in a level condition, should operate with a stable or reduced flame five minutes after any part of the periphery of the base or any one of its feet has been lifted out of level by $\frac{1}{4}$ inch. In these circumstances it was considered appropriate to the inquiry to include a question on the provision and condition of level gauges. The replies are summarised in Table 10; from this it will be seen that the majority of the heaters, of all types, had no level gauge so that correct adjustment of level would have to be made by using the character of the flame as a guide. There is no requirement in the British Standard for a level gauge to be fitted, but in view of the comparatively small range of level conditions tested the provision of such a gauge might be of assistance to the user wishing to use a heater under the most efficient conditions.

Table 10

Provision and condition of level gauges on portable kerosine heaters involved in fires in dwellings
United Kingdom June 1960 - May 1961

Condition of level gauge	Drip feed heaters		Wick feed heaters		Pressure and other heaters		Cookers	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
None	1363	94.3	772	82.6	14	87.4	83	97.6
Fitted but broken	7	0.5	16	1.7	0	0	1	1.2
Fitted and intact	56	3.9	130	13.9	1	6.3	1	1.2
Supplied but not fitted	1	0.1	0	0	0	0	0	0
Not stated	19	1.2	17	1.8	1	6.3	0	0
Total	1446		935		16		85	

A question was also included on the provision and condition of fuel gauges (see Table 11) which could be of obvious value in reducing the chance of over-filling the apparatus. In general drip feed heaters are provided with removable tanks, sometimes made of glass, intended to be filled at a distance from the heater, so that the provision of fuel gauges may be regarded as unimportant. On the other hand wick fed heaters, in which the tank and burner are in one unit, could easily be overfilled in the absence of some form of fuel gauge, with a serious possibility of fire starting in the spilt fuel. It is therefore encouraging to observe that a high proportion of the wick fed heaters (77.2 per cent) were fitted with fuel gauges, although some of these were said to be not in working order when the fires occurred.

Table 11

Provision and condition of fuel gauges on portable kerosine heaters involved in fires in dwellings
United Kingdom June 1960 - May 1961

Condition of fuel gauge	Drip feed heaters		Wick feed heaters		Pressure and other heaters		Cookers	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
None	1367	94.5	198	21.2	9	56.3	72	84.7
Fitted but not working before fire	4	0.3	55	5.9	0	0	0	0
Fitted and working before fire	51	3.5	666	71.3	6	37.5	11	12.9
Fitted but condition before fire not known	0	0	1	0.1	0	0	0	0
Not stated	24	1.7	15	1.6	1	6.3	2	2.4
Total	1446		935		16		85	

(e) Ages of appliances

The age distributions of the appliances reported on are shown in Fig. 2 from which it may be seen that the wick type heaters involved in fires tended to be older than the drip feed ones. The apparently small proportion of appliances purchased new less than a year before a fire may be partly the result of a tendency to "round up" ages to the nearest year when reporting them. In addition it is believed that the sales of new heaters were lower in 1960 than in the preceding few years and this would affect the age distribution of heaters at risk. Because of these two influences it cannot be assumed that the low proportion of heaters less than one year old is entirely due to the greater safety of very new heaters, although it is not unreasonable to expect them to be somewhat more reliable than old ones.

The age distribution of second-hand appliances, measured from the date of their latest purchase, was different from that of heaters bought new, and the low proportion bought less than one year before the fire was not evident in this group. This is consistent with the assumption that new heaters are likely to be more reliable than old ones. In this connexion it has to be remembered that the age distribution of second-hand heaters could be markedly affected by a number of factors. For example, if a substantial number of owners, influenced by the publicity given to the fire hazard of kerosine heaters, had sold heaters in their possession, there would have been an expansion of the second-hand market affecting both the age distribution of heaters at risk and that of heaters involved in fires.

In the absence of information on the age distribution of the heaters in use it is not possible to deduce from the fire figures the effect of age upon the fire-proneness of the apparatus.

V - GENERAL FEATURES OF USAGE

(a) Amount of use

To obtain some general background information on the usage of the kerosine heaters involved in fires owners were asked to indicate the amount of use their heaters received. The replies are indicated in Table 12.

Table 12

Amount of use of kerosine heaters involved in fires in dwellings
United Kingdom June 1960 - May 1961

Amount of usage	Drip feed heaters		Wick feed heaters		Pressure and others heaters		Cookers	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Continuously in season	580	40.1	335	35.8	2	12.5	34	40.0
Regularly but not continuously	547	37.8	372	39.8	8	50.0	38	44.7
Occasionally	294	20.3	209	22.4	4	25.0	13	15.3
First time	7	0.5	4	0.4	0	0	0	0
Not stated	18	1.2	15	1.6	2	12.5	0	0
Total	1446		935		16		85	

It is clear that most of the owners of these heaters regarded them as a regular source of heat and used them fairly frequently. From this it appears unlikely that many of the fires resulted from lack of familiarity with the apparatus; there were, however, eleven fires (seven with drip feed heaters and four with wick heaters) in appliances which were being used by their present owners for the first time. Three of the heaters of each type were new and the remainder (four drip feed and one wick) had been bought second-hand.

(b) Use of rooms in which fires occurred

The rooms in which kerosine heater fires occurred are shown in Table 13 which appears to reflect some difference between the usage of different types of heaters. Both wick and drip feed type heaters caused fires in living rooms, but these constituted a greater proportion of the drip feed heater fires than of those started by wick heaters. Fires caused by wick heaters in the less occupied parts of the house (e.g. hall, landing, bathroom) were more frequent than those caused by drip feed heaters. As would be expected a large proportion of the cooker fires (47 per cent) were in kitchens, but there were also some in bedrooms, halls and bathrooms and reference has already been made to the fact that appliances designed as cookers are sometimes used as space heaters.

Table 13

Use of rooms in which kerosine heater fires occurred
United Kingdom June 1960 - May 1961

Use of room	Drip feed heaters		Wick feed heaters		Pressure and other heaters		Cookers	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Kitchen	215	14.9	183	19.6	6	37.5	40	47.0
Living, dining, bedsitter	673	46.5	243	26.0	3	18.7	18	21.2
Bedroom	251	17.4	198	21.2	1	6.3	7	8.2
Hall, landing	31	2.1	67	7.2	1	6.3	2	2.4
Bathroom	37	2.6	74	7.9	1	6.3	2	2.4
Greenhouse*	0	0	15	1.6	0	0	0	0
Animal house*	0	0	6	0.6	0	0	0	0
Garage*	6	0.4	11	1.2	0	0	2	2.4
Other and not stated	233	16.1	138	14.8	4	25.0	14	16.5
Total	1446		935		16		85	

* Attached to dwelling

(c) Position of appliances in rooms

Again as general background information on the usage of kerosine heaters, Fire Brigades reported on the positioning of those that caused fires (Table 14). A high proportion (40 per cent) of the drip feed heaters were placed in hearths, presumably because, as radiant heaters, they are largely used as substitute for the open, solid fuel fire. In some respects this is undoubtedly a good position for the heater, but is liable to be draughty and therefore may increase the chance of a fire starting. Some of the wick fed heaters also were placed in hearths, but the tendency to place these heaters at any particular point was less apparent; almost 16 per cent of them were placed centrally in the rooms, in some respects a convenient place for a convector heater but probably bad from the point of view of overturning.

Table 14

Position of portable kerosine heaters causing fires in dwellings
United Kingdom June 1960 - May 1961

Position of appliance	Drip feed heaters		Wick feed heaters		Pressure and other heaters		Cookers	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
In hearth	578	40.0	119	12.7	1	6.3	5	5.9
Between door and window	133	9.2	120	12.8	2	12.5	11	12.9
Near door	170	11.8	159	17.0	3	18.7	20	23.5
Near window	124	8.6	115	12.3	1	6.3	11	12.9
Near fireplace	84	5.8	36	3.9	1	6.3	6	7.1
Centrally in room	130	9.0	148	15.8	2	12.5	12	14.1
In corner	46	3.2	39	4.2	1	6.3	1	1.2
Other or undefined	181	12.5	199	21.3	5	31.2	19	22.3
Total	1446		935		16		85	

(d) Presence of liquid other than correct fuel

Fire Brigades were asked, when examining kerosine heaters that had been involved in fires, to look for any indication of the presence of liquids other than kerosine. The question was included primarily to find out whether there was a tendency for the kerosine to contain small quantities of water, since this would separate from the fuel and would be likely to cause corrosion of tanks. As may be seen from Table 15 the presence of water was noted in only four reports, but petrol was present in nineteen heaters and one cooker, methylated spirit in three cookers and other liquids in four heaters. The danger of allowing petrol to become mixed with the kerosine used in heaters should be sufficiently well known not to need stressing, but these records show that there are nevertheless cases in which insufficient care is exercised.

Table 15

Presence of liquid other than fuel in portable kerosine heaters causing fires in dwellings. United Kingdom June 1960 - May 1961

Liquid other than kerosine present	Drip feed heaters		Wick feed heaters		Pressure and other heaters		Cookers	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
None	1345	93.0	873	93.4	14	87.4	77	90.6
Water	3	0.2	1	0.1	0	0	0	0
Petrol	15	1.0	4	0.4	0	0	1	1.2
Methylated spirit	0	0	0	0	0	0	3	3.5
Other liquid	2	0.1	2	0.2	0	0	0	0
Not stated	81	5.6	55	5.9	2	12.5	4	4.7
Total	1446		935		16		85	

VI - CHARACTERISTICS OF FIRES

(a) Extent of fires

From the survey it appears that wick type heaters tend to cause more extensive fires than the drip feed type, as is indicated by the figures given in Table 16. This might be expected if wick type heaters were frequently used in halls, on landings or in outhouses, where fires might develop unnoticed for some time, and there is some evidence (see Table 13) that they are in fact so used.

Table 16

Extent of fires caused by portable kerosine heaters in dwellings
United Kingdom June 1960 - May 1961

Extent of fire	Drip feed heaters		Wick feed heaters		Pressure and other heaters		Cookers	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Confined to appliance	263	18.2	217	23.2	2	12.5	2	2.4
Confined to room of origin	1057	73.1	562	60.1	10	62.5	59	69.4
Confined to floor of origin	52	3.6	40	4.3	2	12.5	3	3.5
Confined to building of origin	66	4.6	102	10.9	2	12.5	19	22.3
Spread beyond building	7	0.5	13	1.4	0	0	2	2.4
Not stated	1	0.1	1	0.1	0	0	0	0
Total	1446		935		16		85	

(b) Casualties

In the reported fires caused by portable kerosine heaters and cookers in dwellings there were thirty-three fatal and 308 non-fatal casualties requiring more than first aid treatment. There were also two fatalities in fires started by lamps being dropped. Two of the fatal and seven of the non-fatal casualties were in caravans. From Table 17, which shows the numbers of casualties related to different types of appliance, it is seen that the eighty-five fires caused by cookers resulted in fourteen non-fatal and eight fatal casualties; the fatality rate in relation to the number of fires being considerably higher than for space heaters (twenty-five fatalities in 2381 fires). About 7.8 per cent of the fires caused by drip feed heaters produced casualties, either fatal or non-fatal, compared with 11.8 per cent of the wick fed heater fires. It appears, therefore, that if fires occur wick fed heaters tend to cause more casualties than the drip feed type.

Table 17

Casualties in fires caused by portable kerosine heaters and cookers in dwellings
United Kingdom June 1960 - May 1961

Type of appliance	No. of fires with casualties	No. of non-fatal casualties	No. of fatal casualties	Total fires
Drip feed heaters	113	161	11	1446
Wick feed heaters	110	131	14	935
Pressure and other heaters	2	2	0	16
Cookers	19	14	8	85
Total	244	308	33	2482

In Table 18 the numbers of casualties have been related to the causes of the fires in which they occurred, and it is seen that ten of the fourteen fatalities in fires caused by wick fed heaters were associated with the overturning or dropping of the heaters. The largest group of non-fatal casualties with wick heaters was also associated with overturning or dropping. With the drip feed heaters no one cause of fire was associated with the incidence of fatal injuries, but most of the non-fatal casualties arose from fires caused by "overheating or flaring up" or by "leakage or flooding".

Table 18

Causes of kerosine heater fires resulting in casualties in dwellings
United Kingdom June 1960 - May 1961

Cause of fire	Drip feed heaters		Wick feed heaters		Cookers	
	Fatal casualties	Non-fatal casualties	Fatal casualties	Non-fatal casualties	Fatal casualties	Non-fatal casualties
Overfilled or fuel spilt	1	15	0	11	1	2
Overturned or dropped	1	11	10	47	3	5
Too near combustibles	1	14	2	19	3	3
Filling while alight	1	9	0	6	0	1
Overheated or flared up	2	65	1	17	0	0
Leakage or flooding	1	19	0	4	0	0
Turned too high	1	10	0	18	0	0
Exploded	0	0	0	6	1	1
Other or unknown	3	18	1	3	0	2
Total	11	161	14	131	8	14

A further indication of the relationship between the causes of the fires in heaters and the casualties resulting from them is given in Table 19. From this it may be seen that for drip feed heaters the distribution of casualties is broadly similar to the distribution of fires of different causes; "overheating or flaring up" and "leakage or flooding" between them caused 49 per cent of the fires and 50.6 per cent of the casualties. With wick fed heaters "overturning or dropping" caused 17.6 per cent of the fires, but these fires resulted in 39.4 per cent of the casualties.

Both Tables 18 and 19 emphasise the importance of stability in connexion with casualties resulting from fires in wick fed heaters.

Table 19

Proportions of fires and casualties due to different causes
of kerosine heater fires in dwellings
United Kingdom June 1960 - May 1961

Cause of fire	Drip feed heaters		Wick feed heaters	
	Proportion of fires Per cent	Proportion of casualties Per cent	Proportion of fires Per cent	Proportion of casualties Per cent
Overfilled or fuel spilt	13.1	9.3	11.0	7.6
Overturnd or dropped	5.7	7.0	17.6	39.4
Too near combustibles	8.6	8.7	15.4	14.5
Filling while alight	4.8	5.8	1.7	4.1
Overheated or flared up	30.0	39.0	16.9	12.4
Leakage or flooding	19.0	11.6	3.7	2.8
Turned too high	10.8	6.4	25.3	12.4
Exploded	0.5	0	0.5	4.1
Other or unknown	7.5	12.2	7.9	2.8

VII - MAKES AND APPROVAL SEALS

(a) Makers

The kerosine heaters associated with fires in dwellings during the period of the survey were of many different makes, some well known and others, usually those involved in small numbers of fires, not so generally known. An indication of the distribution among different makers is given in Table 20.

The drip feed heaters reported were the products of forty-six manufacturers. Three of the firms were known to be non-British and their heaters were involved in seven of the 1446 fires. About 32 per-cent of the fires involved the products of one maker and a further 27 per cent those of three other makers. Only fifty-one of the heaters were of unknown make.

Table 20

Makes of kerosine heaters causing fires in dwellings
United Kingdom June 1960 - May 1961

Nos. of fires with each maker's product	No. of makers of:			
	Drip feed heaters	Wick feed heaters	Pressure and other heaters	Cookers
1 - 5	25	48	9	8
6 - 10	3	2	-	2
11 - 20	6	4	-	1
21 - 30	3	3	-	-
31 - 40	1	-	-	1
41 - 50	2	2	-	-
51 - 100	2	-	-	-
101 - 200	3	1	-	-
201 - 300	-	-	-	-
301 - 400	-	-	-	-
401 - 500	1	1	-	-

The wick fed heaters were made by sixty-one makers; nine of these were known to be non-British and their appliances were involved in twelve of the 935 fires. Approximately 49 per cent of the fires were associated with the products of one manufacturer and 12 per cent with those of a second. Twenty-eight heaters were of unknown make and one was home made.

There were nine makers of pressure and other heaters reported and twelve makes of cookers; nine cookers were of unknown make.

Although there is no readily available information on the numbers of appliances of the various makes at risk, it is certain that the frequencies shown in Table 20 are strongly influenced by the numbers at risk over and above any possible differences in the fire proneness of different makes.

(b) Seals of approval

To assist in assessing the effectiveness of the safety aspects of the British Standards for oil heaters reporting officers were asked to state whether the heaters involved in fires carried a British Standard or other mark of approval. To a large extent, however, the result of analysing the replies was indeterminate as 61 per cent of the heaters were reported to have no seal, and only 2.3 per cent of the drip feed heaters and 2.8 per cent of the wick heaters carried any reference to British Standards. In addition there appears to have been some confusion about the significance of some British Standard markings since seven heaters were reported as being marked "B.S. 1945" which, in fact, applies to fireguards only. From this it appears possible that some of the twenty heaters (ten drip feed and ten wick feed) which were reported to carry British Standard markings, but for which no Standard number was given, may have been incorrectly assumed to comply with a British Standard for heaters.

Table 21

Seals of approval on kerosine heaters causing fires in dwellings
United Kingdom June 1960 - May 1961

Seal of approval	Drip feed heaters		Wick feed heaters	
	No.	Per cent	No.	Per cent
None	888	61.4	573	61.3
B.S.I.*	33	2.3	26	2.8
Other seals	7	0.4	1	0.1
Seal indistinguishable	30	2.1	19	2.0
Not stated	488	33.8	316	33.8
Total	1446		935	

*Not necessarily B.S. 3300

It has to be realised that changes in the design of new heaters (and modifications to old ones) brought about by recent revisions of British Standard 3300, the standard for kerosine heaters, could not have affected the fire picture obtained from this survey to any appreciable extent, as the numbers of new and modified heaters at risk at the time would have been too small. In addition, because of the large numbers of heaters already in use, it is unlikely that any marked effect attributable to new Standards will become apparent for some time, probably several years. It is nevertheless of interest to examine the causes of the few fires starting in those heaters which carried either a kitemark or a reference to British Standard 3300. There were twelve drip feed type heaters marked in this way, of which five were said to have overheated or flared up.

None of these five was more than five months old at the time of the fire. Of the remaining seven fires caused by drip feed heaters one was clearly due to misuse (child pushing newspaper inside the guard), in two there was some indication of misuse and four heaters appeared to have some fault (e.g. leaking cap on control valve).

Sixteen wick fed heaters were marked B.S. 3300 or carried a kitemark; four of these (all less than six months old) were said to have "flared up" and one (bought on the previous day) had a faulty wick tube giving rise to a leak. The remaining eleven wick fed heaters appear to have caused fires through misuse such as overfilling and overturning.

VIII - CONCLUSIONS

Attention has previously been drawn⁽⁴⁾ to the increasing frequency of fires in dwellings due to kerosine heaters in the period 1947-1959 and there are now indications that the upward trend may have passed its peak. It is, however, too early to see whether a decrease in the incidence of these fires from 1959 to 1960 is "real" or merely a fluctuation in the general trend curve.

If the ratio of drip feed to wick feed heaters has remained substantially the same as it was when estimated by Social Surveys (Gallup Poll) Ltd in 1959, it now appears that a drip feed heater may be about three and a half times as likely to cause a fire as a wick fed one. Attempts are being made, however, by modifying British Standard requirements, to improve the safety of both types of heater and in the long term, this could also affect their relative safety. Although the chance of a fire being started appears to be lower with a wick fed heater than with a drip feed heater, in the event of a fire it appears that the one caused by a wick fed heater may be the more dangerous in respect of both casualties and spread.

Any source of energy has its associated risks and efforts have to be made to reduce these to a minimum as far as possible. In the case of kerosine space heaters the risk appears to be somewhat dependent upon the type of heater and the danger of fire from "overheating or flaring up" or from "leakage or flooding" is greater with the drip feed type than with the wick fed type. On the other hand "turning too high" and "overturning or dropping" are more frequent causes of fire with wick fed heaters than with the drip feed type.

The effect of draught on the burning of some drip feed heaters has been described elsewhere⁽⁴⁾ and measures have been taken to reduce the danger from this effect in new heaters. There is, however, some indication that wick fed heaters may not be entirely immune to draught troubles.

From some of the replies to questions connected with the usage of oil heaters it appears probable that owners may not give them all the attention necessary to keep them in good working condition. It is not known to what extent this tendency can be overcome by modifications to the designs.

Acknowledgement

Thanks are due to the Home Office, the Scottish Home Department and the Ministry of Home Affairs Northern Ireland for their co-operation, and especially to the Local Authority Fire Brigades throughout the United Kingdom who completed questionnaires on the fires.

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Scientific and Industrial Research and Fire Offices' Committee Joint Fire
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APPENDIX 1

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND FIRE OFFICES' COMMITTEE
JOINT FIRE RESEARCH ORGANIZATION
Fire Research Station, Boreham Wood, Herts.

KEROSINE (PARAFFIN) BURNING APPLIANCES FIRES IN DWELLINGS

..... Fire Brigade/Service
Supplement to K 433 Report No. Date

(Please ring appropriate numbers and complete in words where space is provided)

DESCRIPTION OF APPLIANCE		TYPE OF BURNER	
1	Fixed	1	Long drum - white flame
2	Portable	2	Long drum - blue flame
3	Unknown	3	Long drum - flat wick
1	Convactor space heater	4	Long drum - unknown wick arrangement
2	Radiant space heater	5	Short drum - wick feed type
3	Radiator	6	Short drum - drip feed type
4	Cooking appliance	7	Pressure burner - hand operated
5	Lamp	8	Pressure burner - automatic pump
6	Incubator or breeder	9	Other (specify)
7	Blow lamp		.....
8	Other .....		.....
Maker's name		CONSTRUCTION OF APPLIANCE	
Model name or number		1	No legs
Other identification mark		2	Fixed leg only
Seal or mark of approval		3	Adjustable legs (state no. and type)
FUEL TANK		1	No level gauge
Capacity of tank .....gal.		2	Level gauge broken
Amount of fuel in tank at time of fire .....gal.		3	Level gauge intact
1	Tank above burner level	1	All components of metal
2	Tank below burner level	2	Some non-metal parts (specify)
SAFETY DEVICES		.....
1	Fuel gauge not fitted	1	No self extinguishing device
2	Fuel gauge fitted but not working before fire	2	Self extinguishing device fitted
3	Fuel gauge in good order before fire	1	No overflow tank
1	Tank in good condition	2	Overflow tank fitted
2	Signs of corrosion	Other safety device (please specify)	
3	Pinholes or leaks*	.....
FUEL		INSTRUCTIONS FOR USE	
1	No special fuel recommended	1	No instructions available
2	Proprietary brand recommended (specify)	2	Printed or stamped on appliance
Other recommendations		3	Otherwise available (please specify)
Fuel normally used .....		.....
Fuel in use at time of fire		1	Instructions adequate
Any trace of other liquid (e.g. water, petrol)		2	Instructions inadequate (please specify)
.....		
.....		

*If in doubt check by cleaning outside and filling with paraffin

HISTORY OF APPLIANCE		EVENTS LEADING TO FIRE	
	Acquired new years ago Acquired second hand years ago		Defect in appliance (please specify)
1	Appliance never carried about		.....
2	Appliance commonly carried about		Human action (e.g. overfilled, turned too high) (specify)
3	Appliance rarely carried about		.....
1	Appliance not known to have been dropped at any time Appliance had been dropped (please state how long before fire) .....		..... Other relevant factors (e.g. animals)
1	No sign of previous damage	1	Burner correctly adjusted
	Some sign of previous damage (specify)	2	Burner too high
	.....	3	Burner turned low
1	Appliance never cleaned or serviced	1	Level correctly adjusted when found
2	Appliance occasionally cleaned or serviced	2	Level incorrectly adjusted when found
	Appliance regularly serviced at intervals of Appliance last serviced ago	<u>POSITION OF FIRE</u>	
1	Appliance used continuously during season	Position and use of room in which fire occurred (e.g. ground floor, kitchen)	
2	Used regularly but not continuously	.....
3	Used occasionally	*Position of appliance in relation to doors, windows, etc.	
1	Appliance had given no recent trouble Some trouble experienced (e.g. smoking, uneven burning) (specify)	1	No evidence of draught
	.....	2	Some evidence of draught
	.....	1	Room not occupied at time of fire
	.....	2	Room occupied by children
	.....	3	" " " invalids
	.....	4	" " " old persons
	.....	5	" " " other persons
	.....	6	" " " animals
<u>REFUELLING</u>		<u>SPREAD OF FIRE</u>	
	Who last filled appliance?	1	No fuel spilt
	.....	2	Fuel spilt, did not contribute to spread
	Date and time of last filling	3	Fuel spilt and caused spread
1	Appliance alight when last filled		
2	Appliance not alight when last filled		

Other remarks

*Please give rough sketch where useful.

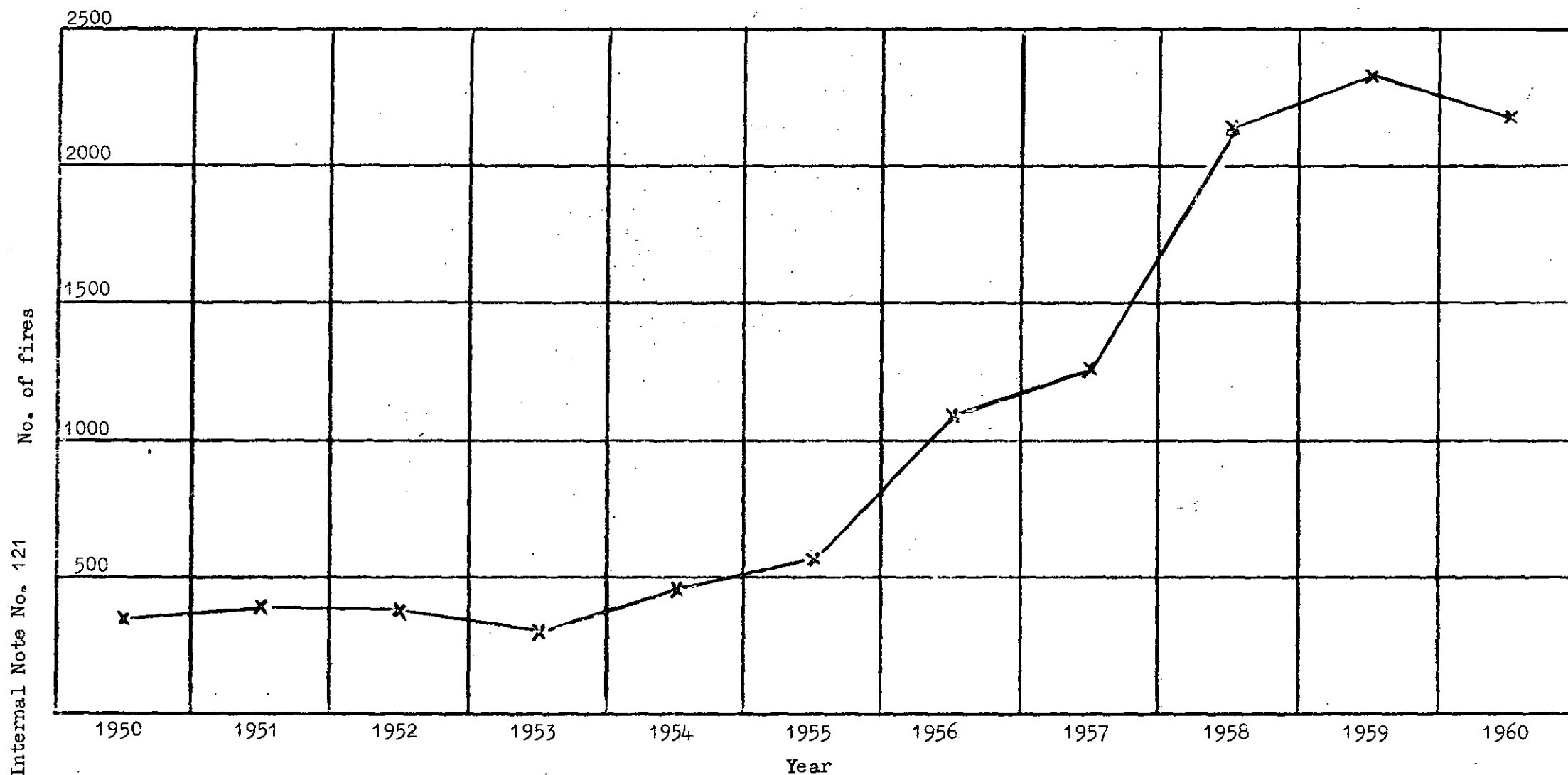


FIG. 1. FIRES ASSOCIATED WITH KEROSENE BURNING SPACE HEATERS IN DWELLINGS
GREAT BRITAIN 1950 - 1960

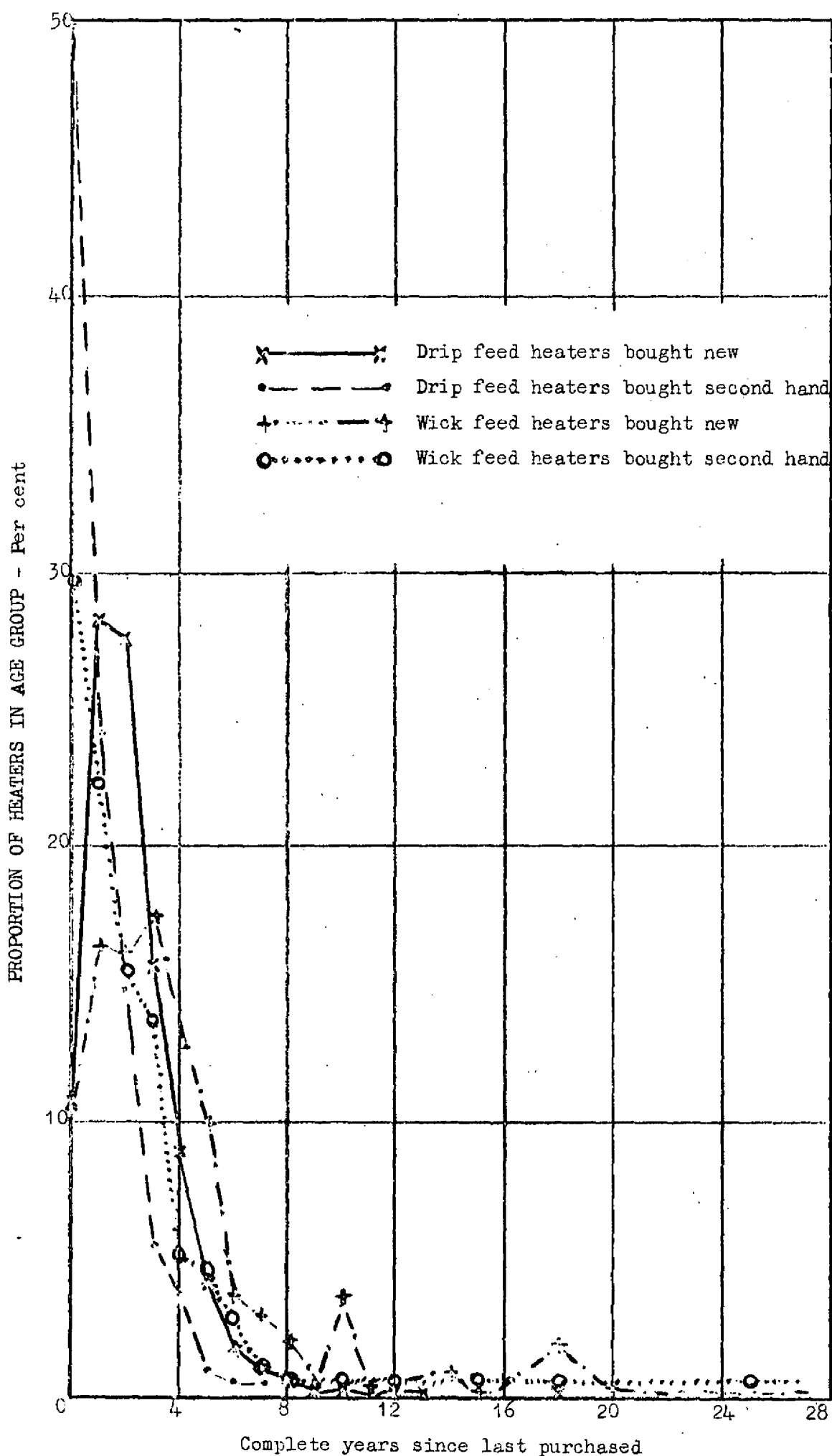


FIG. 2. AGE DISTRIBUTION OF PORTABLE SPACE HEATERS CAUSING FIRES IN DWELLINGS. UNITED KINGDOM JUNE 1960 - MAY 1961