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FIRE RESEARCH STATION

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SUMMARY

The number of fires in buses, coaches and mini buses reported by fire brigades in the United Kingdom increased from 190 in 1964 to 562 in 1969 (58 fires in mini buses in 1969). Fires in Great Britain per thousand buses, coaches and mini buses licenced increased from 2.5 in 1964 to 7.1 in 1969.

The most common single supposed cause is the ignition of wire and cable due to short circuits. Mechanical heat in its various forms however is the most commonly reported group of causes.

Fifty-eight per cent of the fires start in the engine of the vehicle, 15 per cent inside the vehicle, 15 per cent in the wheels.

Eighty-six per cent of the fires occur when the vehicle is on the road.

The greatest number of fires in buses occur during the 'rush' hours.

There are more fires in the summer months in buses, coaches and mini buses although in mini buses the peak is much less marked than in the other two classes of vehicle.

The age of the vehicle does not appear to be an important factor in connexion with the outbreak of fire.

Sixty-per cent of the fires are tackled before the arrival of the Brigade though only 35 per cent of these are successfully extinguished.

There were no fatal casualties in fires in buses, coaches and mini buses and the estimated number of non-fatal casualties was only 6 in 6 incidents during 1969.

KEY WORDS: Fire statistics, vehicles

DEPARTMENT OF THE ENVIRONMENT AND FIRE OFFICES' COMMITTEE

JOINT FIRE RESEARCH ORGANIZATION

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INTRODUCTION

In the six years 1964-69 the number of fires in buses, coaches and mini-buses reported by fire brigades in the United Kingdom increased by an average of 32 per cent p.a.[1]. From Table 1 it may be seen that this increase cannot be attributed to greater numbers of buses and coaches on the road because until 1969 the number of these vehicles licenced in Great Britain was in fact decreasing at about 1 per cent each year[2]. Nor can it be attributed to an increased usage of the vehicles because the number of fires per million miles travelled trebled between 1964 and 1969.

Table 1 - Frequency of fires - Great Britain

	1964	1965	1966	1967	1968	1969
No.of fires	188	234	300	318	396	524
No.of buses, mini-buses coaches licenced	75,864	75,483	74,766	74,285	73,322	73,656
No.of fires per 1,000 buses, coaches and mini-buses	2.5	3.2	4.0	4.3	5.4	7.1
No.of vehicle miles(millions)	2,358	2,326	2,304	2,280	2,253	2,211
No.of fires per million miles travelled	0.08	0.10	0.13	0.14	0.18	0.24

The Table gives figures for Great Britain only, as comparable data for Northern Ireland are not readily available.

In an effort to provide an explanation of the increase in fire frequency an examination was made of a 1 in 2 sample of United Kingdom fire reports for 1969. An initial theory put forward was that mini-buses which for the purposes of fire statistics are included in the classification 'buses and coaches', were becoming a relatively greater hazard and inflating the total figure for the number of fires in buses and coaches.

Table 2 Frequency by class of vehicle - 1969 - U.K.

Hazard	No.of fires
Single-Decker Buses	124
Double-Decker buses	182
Buses (Unspecified)	48
Coaches	150
Mini-buses	58
	562

However examination of the reports showed that the number of fires in mini-buses constituted only 10 per cent of the total (see Table 2) and this was not of sufficient magnitude to explain the high annual increase.

SUPPOSED CAUSE

The supposed causes of the fires are shown in Table 3. The most common single cause was ignition of electrical insulation due to short circuits. This was of particular importance in the mini-buses category, accounting for 48 per cent of the fires compared with 28 per cent of the total for fires in all three categories.

Mechanical heat, in various forms, constituted the most important group of causes. When the fire started inside the engine compartment oil and grease were usually ignited. Outside the engine compartment the fires attributed to these causes usually started in oily rags left or tied onto exhaust pipes.

Most of the fires due to malicious ignition were started by petrol bombs during the disturbances in Ulster.

The sample of reports examined contained only one of a fire which occurred after a crash. This was between a motor-cycle and a double-decker bus and the damage was not substantial.

Table 3 Supposed cause of fires in buses, coaches and mini-buses - 1969 - U.K.

	TOTAL	Frequency of fires				
		Single decker buses	Double decker buses	Buses (Unspec.)	Coaches	Mini-buses
TOTAL	562	124	182	48	150	58
1) Wire and cable	158	40	34	12	44	28
2) Exhaust manifold	142	34	58	4	28	18
3) Mechanical heat and sparks	112	28	40	8	36	-
4) Exhaust pipe	26	2	10	-	14	-
5) Malicious ignition	22	2	4	14	2	-
6) Ignition, starter, magneto, sparking plug	18	4	8	2	4	-
7) Smoking materials	16	2	4	-	8	2
8) Children with fire	8	-	6	-	-	2
9) Dynamo	4	2	2	-	-	-
10) Other known causes	12	2	6	-	4	-
11) Unknown	44	8	10	8	10	8

LOCATION OF THE FIRE IN THE VEHICLE

The majority (58 per cent) of the fires in buses, coaches and mini-buses started in the engine compartment (see Table 4). Of these about two thirds were caused by the engine overheating and igniting oil and grease. The other third were chiefly caused by electrical faults.

Fifteen per cent of the fires started inside the vehicle itself. The main causes of these fires were malicious ignition, careless disposal of smoking materials and children playing with fire.

The wheels of the vehicles (particularly coaches) were a frequent location of fires. These fires were mainly due to overheating of the brake shoes and to friction caused by a deflated tyre.

Table 4 Location of the fire in the vehicle - 1969 - U.K.

	TOTAL	Frequency of fires				
		Single decker buses	Double decker buses	Buses (Unspec.)	Coaches	Mini-buses
TOTAL	562	124	182	48	150	58
1) Engine compartment	322	78	116	14	76	38
2) Inside vehicle	82	8	26	16	20	12
3) Wheel of vehicle	80	16	18	10	36	-
4) Wiring (not in engine)	36	12	6	4	6	8
5) Underneath vehicle	32	10	10	2	10	-
6) Drivers cab (buses)	6	-	4	2	-	-
7) Heater compartment	2	-	-	-	2	-
8) Outside	2	-	2	-	-	-

LOCATION OF VEHICLE AT THE TIME OF FIRE

As can be seen from Table 5 the majority (86 per cent) of the fires in buses, coaches and mini-buses occurred when the vehicle was on the road. This is the situation to be expected as most fires occur when the vehicle is in use. The bus depot was the next most important location of vehicles at the time of the fires, though these are only 5 per cent of the total. Motorways were the site of 3 per cent of the fires.

Table 5 Location of vehicle at time of fire - 1969 - U.K.

	Single decker bus	Double decker bus	Bus (Unspec.)	Coach	Mini-buses	
Road	106	162	48	128	44	488
Bus depot	8	18	0	0	0	26
Motorway	2	2	0	12	4	20
Field/open ground	4	0	0	0	6	10
Yard	4	0	0	4	0	88
Car park	0	0	0	2	2	4
Drive/garden	0	0	0	0	2	2
Private road	0	0	0	2	0	2
Petrol filling station	0	0	0	2	0	2
	124	182	48	150	58	562

TIME OF DAY OF FIRES

The variations in frequency throughout the day are shown in Table 6 and Fig.1.

The peaks in the distribution of fires in buses correspond approximately to those in the frequency of bus services. There were peaks between 08.30 and 90.30, around lunch time and (the greatest number) around 17.30 ie the periods of heaviest demand.

The peaks in the distribution of fires in coaches follow a different pattern probably corresponding to their outward and return journeys, with a noticeable decline between 11.30 and 18.30. There were periods when there are no fires in buses and coaches; for buses this period was a single hour between 05.00 and 06.00 (before the timetable starts), but for coaches the period was longer, lasting from 03.00 to 07.00.

The fires in mini-buses were more evenly distributed throughout the day, though there were three periods when no fires occurred,03.30-05.30, 12.30-13.30 and 22.30-23.30.

Table 6 Time of day when fire occurred - 1969 - U.K.

	TOTAL	All buses	Coaches	Mini-buses
TOTAL	562	354	150	58
00-	20	12	6	2
01-	12	4	2	6
02-	8	4	2	2
03-	4	4	-	-
04-	2	2	-	-
05-	-	-	-	2
06-	8	6	-	-
07-	16	12	-	4
08-	26	16	2	8
09-	20	16	4	-
10-	30	10	18	2
11-	38	20	14	4
12-	28	22	6	-
13-	26	16	10	-
14-	36	30	2	4
15-	12	6	6	-
16-	48	30	12	6
17-	52	38	10	4
18-	40	28	10	2
19-	44	22	18	4
20-	32	20	8	4
21-	26	14	8	4
22-	16	10	6	-
23-	18	12	6	-

MONTH IN WHICH THE FIRE OCCURRED

The number of fires in buses and coaches showed seasonal variation (see Table 7 and Fig.2) both having a probounced increase in the summer months and reaching a peak in July. The graph of fires in buses shows also two lower peaks in February and December. The numbers of passenger journeys made in these quarters[2] were lower than for the summer so that the fire frequency would be expected to be lower but climatic conditions may have contributed to these secondary peaks.

The fires in mini-buses showed less seasonality than those in buses and coaches though there were peaks in February and in June and July. January, April and October had the lowest number of fires in mini-buses.

Table 7 Month in which fire occurred - 1969 - U.K.

	TOTAL	Single decker buses	Double decker buses	Buses (Unspec.)	Coaches	Mini-buses
TOTAL	562	124	182	48	150	58
January	28	6	8	6	6	2
February	52	10	22	2	12	6
March	34	10	10	2	8	4
April	36	8	16	4	6	2
May	36	12	10	2	8	4
June	62	10	20	2	22	8
July	92	18	22	8	36	8
August	74	10	20	14	24	6
September	48	16	12	2	12	6
October	34	4	14	4	10	2
November	28	8	10	2	4	4
December	38	12	18	-	2	6

YEAR OF MANUFACTURE OF VEHICLE IN WHICH FIRE STARTED

The date of manufacture of buses, coaches and mini-buses was omitted from 24 per cent of the fire reports in 1969. On the basis of the remaining 76 per cent there is no evidence to suggest that particular years were hazardous or that older vehicles presented greater hazards. But from Table 8 it can be seen that the minor causes of fires in buses, coaches and mini-buses ie malicious ignition, ignition, starter, magneto, sparking plugs, smoking materials, children with fire, dynamo etc were generally associated with vehicles made in or before 1963.

The make of vehicle was recorded in about 80 per cent of the reports, but no relationship could be discerned between particular makes and particular causes of fire.

Table 8.

YEAR OF MANUFACTURE OF VEHICLE IN WHICH FIRE OCCURRED - 1969 - U.K.

Cause \ Year	Total	Total Year Specified	Total Year not Specified	Pre 1963	1963	1964	1965	1966	1967	1968	1969
TOTAL	562	428	134	262	24	26	30	12	22	32	20
1) Wire and Cable	158	120	38	66	8	4	10	2	8	12	10
2) Exhaust manifold	142	114	28	72	2	12	8	6	2	6	6
3) Mechanical heat and sparks	112	88	24	46	8	6	6	2	6	10	4
4) Exhaust pipe	26	20	6	10	2	2	4	2	-	-	-
5) Malicious ignition	22	4	18	4	-	-	-	-	-	-	-
6) Ignition starter magneto, sparking plug	18	12	6	8	2	-	-	-	-	-	-
7) Smoking materials	16	16	-	16	-	-	-	-	-	-	-
8) Children with fire	8	4	4	4	-	-	-	-	-	-	-
9) Dynamo	4	4	0	4	-	-	-	-	-	-	-
10) Other known causes	12	12	0	8	-	-	-	-	4	-	-
11) Unknown	44	34	10	24	2	2	-	-	2	4	-

METHOD OF FIRE FIGHTING BEFORE BRIGADE ARRIVED

Approximately 60 per cent of fires in buses, coaches and mini-buses were tackled before the arrival of a fire brigade. Of these about 20 per cent were extinguished before the brigade arrived.

A greater proportion (76 per cent) of the fires due to electrical causes were tackled than of those due to mechanical heat in one form or another (60 per cent). This is probably because in the majority of cases where the cause was mechanical heat the material first ignited was grease or oil and this would flame immediately. Smoking or smouldering insulation on wiring may be more likely to be tacked by the driver before the fire becomes serious.

The most common method of extinguishing the fire was with C.T.C. extinguishers which extinguished 52 of the 216 fires successfully tackled (see Table 9)

Table 9 Method of fire fighting before the arrival of the Brigade 1969 - U.K.

		Successfully Extinguished
TOTAL	562	116
1)No fire fighting attempted	220	-
2)C.T.C.extinguisher	216	52
3)Foam extinguisher	18	6
4)Water from buckets	18	6
5)Disconnection of fuel supply	12	12
6)Dry powder extinguisher	12	8
7)Water,soda acid,gas expulsion extinguishers	10	4
8)Burned out	8	-
9)Extinguishers-other vapourising liquids	4	-
10)Water from garden hose reel	2	-
11)Smothering	4	4
12)Other	14	14
13)Two or more of above methods	24	10

METHOD OF EXTINCTION USED BY THE BRIGADE

The methods of extinction used by fire brigades are shown in Table 10. In 55 per cent of the fires not out on arrival only one hose reel jet was necessary to extinguish the fire. Only about 6 per cent were large enough to need one or more jets fed from pumps and hydrants. About 24 per cent of the fires attended were out on arrival. Fires caused by electrical faults appear to have spread more than those due to mechanical heat; 14 per cent of the former requiring the use of jets as opposed to 7 per cent of the latter.

Table 10

METHOD OF EXTINCTION USED BY THE BRIGADE - 1969 - U.K.

		Total 562
1)	1 Hose reel jet	244
2)	2 " " "	44
3)	3 " " "	4
4)	4 " " "	4
5)	Jets and hose reels	40
6)	C.T.C. extinguisher	34
7)	1 jet from pump and hydrant	20
8)	2 jets from pump and hydrant	6
9)	Disconnection of fuel supply	18
10)	Extinguishers (other vaporizing liquid)	8
11)	Dry powder extinguisher	4
12)	1 hose reel jet not using original supply in tank	4
13)	Other	8
14)	Out on arrival (Extinguished before and burned out)	124

CASUALTIES

The frequency of casualties estimated from the 1 in 2 sample of reports was 6 (all non-fatal) in fires in buses, coaches and mini buses in 1969 and these occurred in 6 incidents. This is in comparison with an estimated 8 non-fatal casualties in 1968. Thus, with an estimated casualty rate of 10 per thousand fires in 1969 buses, coaches and minibuses do not appear to present a great fire casualty hazard. The overall rate of fire casualties (fatal and non-fatal) was 16 per thousand fires in 1968; for tankers this figure was as high as 34.1 per thousand fires[3].

CONCLUSIONS

The number of fires per thousand buses, coaches and minibuses licenced has almost trebled in six years. This increase cannot, as had been suspected, be attributed to an increase in the number of fires in mini-buses because this number is too small to influence the total significantly. The fire hazard with mini-buses is certainly different from that with buses and coaches but whether they are an increasing hazard cannot be judged without knowing the number of mini-buses licenced and the number of fires in mini-buses in previous years, neither of which figure is readily available.

The age of the vehicle does not appear to affect the chance of the outbreak of fire as might have been suspected. Though it is possible that if the dates of the vehicles not specified on the reports were known it might be necessary to modify this conclusion.

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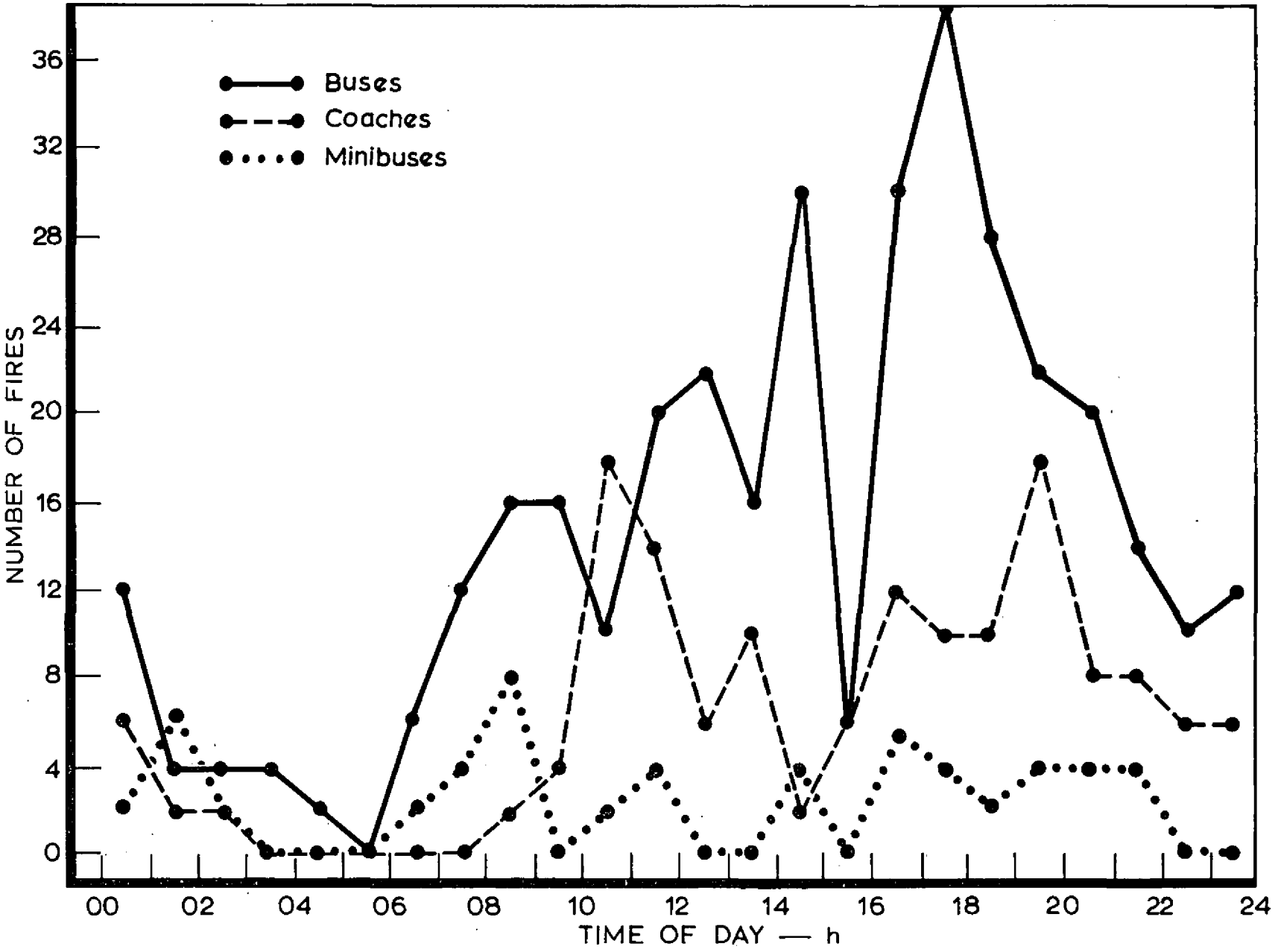

FIG. 1 TIME OF DAY OF FIRES IN BUSES, COACHES, MINIBUSES

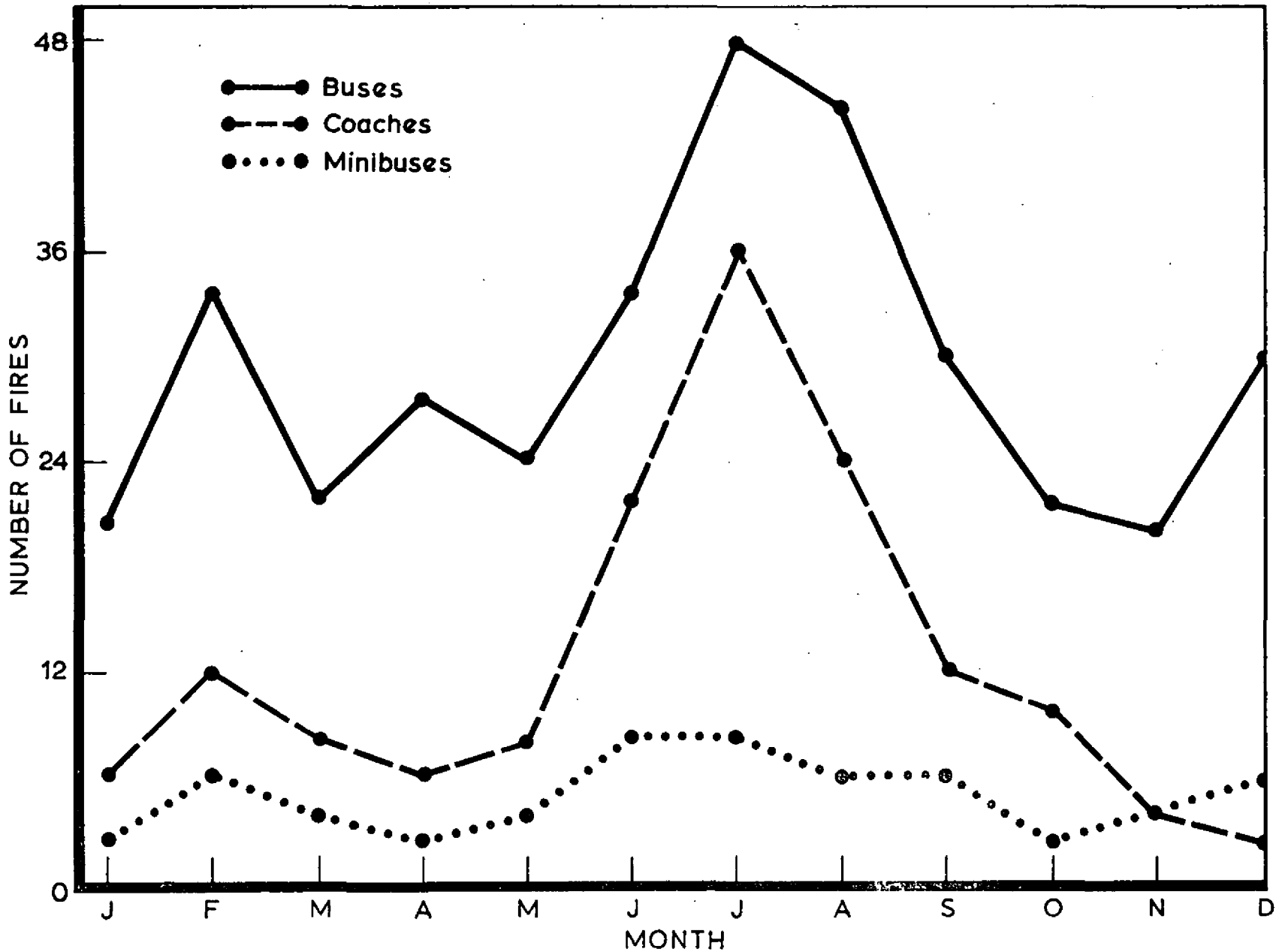

FIG. 2 MONTH IN WHICH FIRE OCCURRED