Home Office (Fire Department)

Manual of Firemanship

Practical Firemanship I

Book 11

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Manual of Firemanship

A survey of the science of firefighting

Book 11
Practical Firemanship I

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Preface

When a fireman has mastered the use of his equipment, he must go on to learn techniques of rescue and firefighting. The more incidents he attends the more experienced he becomes and the more his firemanship improves. A fireman now has at his disposal, and needs, a wide range of extinguishing media including low, medium and high expansion foam; halons; dry powder; 'light' and 'wet' water.

The rapid increase in the number and types of hazardous materials, and their transport around the country, has required the introduction of new firefighting methods, new equipment and new safety measures.

The development of automated high-bay warehouses, huge shopping centres, high rise office blocks and many other modern innovations, make it essential for firemen to constantly improve their basic skills. Their standards of firemanship must keep up with developing risks.

This part of the *Manual* includes many of the traditional techniques of firemanship which are still used but also attempts to show some later developments.

Reference in this book to the male person should be construed as applying, as appropriate, to the female person also. The ranks of junior firewoman, firewoman and leading firewoman have been introduced by the *Fire Services (Appointments and Promotion) (Amendment) Regulations 1976* to equate with the ranks of junior fireman, fireman and leading fireman, and references to the latter should, where appropriate, be construed as references to the former.

The Home Office is indebted to all those who have assisted in the preparation of this work.

Home Office
1981

Metrication

List of SI units for use in the Fire Service

Quantity and basic or derived SI unit and symbol	Approved unit of measurement	Conversion factor
Length metre (m)	kilometre (km) metre (m) millimetre (mm)	1km = 0.621 mile 1m = 1.093 yards = 3.279 feet 1mm = 0.039 inch
Area square metre (m^2)	square kilometre (km^2) square metre (m^2) square millimetre (mm^2)	1km^2 = 0.386 $mile^2$ 1m^2 = 1.196 $yards^2$ = 10.764 $feet^2$ 1mm^2 = 0.002 $inch^2$
Volume cubic metre (m^3)	cubic metre (m^3) litre (l) ($= 10^{-3}m^3$)	1m^3 = 35.7 $feet^3$ 1 litre = 0.22 gallon
Volume, flow cubic metre per second (m^3/s)	cubic metre per second (m^3/s) litres per minute (l/min)	1m^3/s = 35.7 $feet^3/s$ 1l/min = 0.22 gall/min
Mass kilogram (kg)	kilogram (kg) tonne (t)	1kg = 2.205 lbs 1t = 0.984 ton
Velocity metre per second (m/s)	metre per second (m/s) international knot (kn) (= 1.852km/h) kilometre per hour (km/h)	1m/s = 3.281 feet/second 1km/h = 0.621 mile/hour
Acceleration metre per $second^2$ (m/s^2)	$metre/second^2$ (m/s^2)	1m/s^2 = 3.281 $feet/second^2$ = 0.102'g'

Quantity and basic or derived SI unit and symbol	Approved unit of measurement	Conversion factor
Force		
newton (N)	kilonewton (kN) newton (n)	1kN = 0.1 ton force 1N = 0.225lb force
Energy, work		
joule (J) (= 1Nm)	joule (J) Kilojoule (kJ) Kilowatt/hour (kW/h)	1kJ = 0.953 British Thermal Unit 1J = 0.738 foot lb force
Power		
watt (W) (= 1J/s = 1Nm/s)	kilowatt (kW) watt (W)	1kW = 1.34 horsepower 1W = 0.735 foot lb force/second
Pressure		
newton/metre^2(N/m^2)	bar (= 10^5N/m^2) millibar (mbar) (= 10^2N/m^2) metrehead (= 0.0981 bar)	1bar = 0.991 atmosphere = 14.5lb force/in^2 1mbar = 0.0288 inch Hg 1 metrehead = 3.28 foot head
Heat, quantity of heat		
joule (J)	joule (J) kilojoule (kJ)	1kJ = 0.953 British Thermal Unit
Heat flow rate		
watt	watt (W) kilowatt (kW)	1W = 3.41 British Thermal Units/hour 1kW = 0.953 British Thermal Unit/Second
Specific energy, calorific value, specified latent heat		
joule/kilogram (J/kg) joule/m^3 (J/m^3)	kilojoule/kilogram (kJ/kg) kilojoule/m^3 (kJ/m^3) megajoule/m^3 (MJ/m^3)	1kJ/kg = 0.43 British Thermal Unit/lb 1kJ/m^3 = 0.0268 British Thermal Unit/ft^3
Temperature		
degree Celsius (°C)	degree Celsius (°C)	1 degree Celsius = 1 degree Centigrade

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9 At this fire the fire-resisting sliding door on the right operated and effectively contained the fire. Unfortunately the sliding shutter, although operating successfully, jammed in the position shown allowing some spread.
Photo: Bedfordshire Fire Service

10 Construction in a modern terrace of houses where the tile battens were taken across the separating wall. The unfire-stopped gaps between wall and tiles allowed fire to spread into the adjoining roof.
Photo: Fire Research Station

11 In this example of bad building construction the timbers have been set into the brickwork of the chimney flue which can be seen in the centre. Defective mortar allowed heat to reach the rafter which subsequently ignited. The resulting fire destroyed the top of the building.

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Photo: London Fire Brigade

13 The effect of a severe fire on a stone staircase in a hotel.
Photo: London Fire Brigade

14 A severe fire in this bus garage caused considerable movement in the brickwork. Note the cracking even continues across the buttress.
Photo: Dorset Fire Brigade

15 An almost explosive collapse of a warehouse wall which has, obviously, not given much warning.
Photo: Daily Express, Manchester

16 Covered market within a shopping precinct. In the foreground, left and hanging down from the roof, are panels of sprayed concrete on wire mesh. These became detached from their metal hangers and collapsed during the fire.
Photo: Merseyside Fire Brigade

17 Example of modern light roof design. Wood wool panels covered externally by a layer of bituminous felt and copper cladding. The framework for them is of steel joists on reinforced concrete columns. The steelwork was protected by panels of sprayed concrete (see Plate 16) before their collapse.
Photo: Merseyside Fire Brigade

18 A mechanical saw being used to remove bars from a window at a large departmental store. Several women were rescued after being cut off by the fire.
Photo: Daily Express, Manchester

Part 1
Practical firefighting

A fireman, to be successful, must enter buildings; he must get in below, above, on every side, from opposite houses, over back walls, over side walls, through panels of doors, through windows, through loopholes, through skylights, through holes cut by himself in the gates, the walls, the roof; he must know how to reach the attic from the basement by ladders placed on half burned stairs, and the basement from the attic by rope made fast on a chimney. His whole success depends on his getting in and remaining there and he must always carry his appliances with him, as without them he is of no use.

> *So wrote Sir Eyre Massey Shaw in his book,* Fires and Fire Brigades. *These words, though penned nearly a century ago, are as true now as on the day they were written.*

In this Part we propose to survey the knowledge required by the individual member of the crew if he is to perform his duties as a fireman at a fire, and the term 'officer' or 'officer in charge' is used commonly to denote the man who is in charge of the crew irrespective of his rank. We will try to treat the subject in the sequence in which action usually takes place in dealing with a fire. Not all the information dealt with below will be required at any single outbreak, nor will the order in which the various steps are taken necessarily follow that adopted here.

'No two fires are alike' is an old and very true Fire Service saying. Technical knowledge must be backed up by intelligence and the ability to grasp the fundamentals of a situation, to initiate a plan of action and to improvise on the spur of the moment.

Chapter 1
Preliminary

1 The fireman

A fireman must be physically fit, for work at a fire will almost always involve considerable physical exertion. He must be courageous and yet be calm, for on these qualities will depend his reactions in an emergency. He must be patient, for often he will need patience when dealing with persons whose property is involved or threatened by fire and who are in a state of considerable mental distress. He must have initiative and must possess the will to keep going for long periods under adverse conditions. He must cultivate his powers of observation to the utmost and must also possess an enquiring mind. He must have a keen sense of discipline, for unless he himself is able to obey orders without question he cannot expect others to carry out his orders. Finally, he must never forget that, as a member of a local authority fire brigade, he is a servant of the public, and that it is to him that the public turns in an emergency. His duty may be summed up as, firstly, to save life, secondly, to prevent the destruction of property by fire and, thirdly, to render humanitarian services.

The fireman who wishes to progress in his profession should study every outbreak which he has the good fortune to attend and try to learn something from it. After a few years he will have built up a store of practical knowledge which will equip him to deal with most of the problems which come his way.

2 Before the fire

a. Knowledge of the station's ground

A comprehensive knowledge of the station's ground is the first requisite for successful firefighting, the information gained growing with time and with attendances at fires on the ground. Every fireman, and especially the officer in charge of the station, should know all the important details, such as hydrants, the lay-out and capacity of the mains, etc., and whether, by previous arrangements with the water undertaking, the supplies or pressure can be increased in any particular district. He should be familiar with the location of all supplementary water supplies which would help in firefighting, both in cities and in rural areas.

He should have detailed information of the theatres, cinemas and places of public entertainment, and of the hospitals, institutions, and other places where numbers of people will be sleeping at night. He should know which buildings are sprinklered, and which have a metered supply on which a by-pass can be operated to feed internal hydrants. He should be aware of buildings which have electric sub-stations; he should know the whereabouts of foam inlets, dry risers, drenchers (noting whether these are automatic or hand-operated and whether fitted with Fire Service inlets), and of all other aids to fighting a fire. In particular, he should endeavour to learn as much as possible of any special manufacturing processes or industries carried on, so that if he is called to a fire on the premises, he will be aware of the conditions he will meet, and of any precautions he must take.

Enquiries before a fire will tell him if the police or other person hold keys to certain classes of premises. He should also make local contacts with appropriate individuals, such as the occupiers of large premises and the officers in charge of industrial or private fire brigades, for good liaison with them will produce that effective co-operation which is essential for smooth working should the fire brigade be called to a fire on their premises.

He should be aware of telephone facilities on his station's ground, as a knowledge of alternative means of communication to radio will be of benefit.

In rural areas, the fireman should know the whereabouts of all the important water supplies, the best way of reaching them and whether or not they are likely to dry up in the summer or autumn, or be unapproachable in the winter because of mud. He should know if suitable streams exist, how they can be dammed and he should be able to estimate roughly how much water they will yield. He should know of the various farm tracks and to what extent they can be used to reach isolated farmsteads. In winter he should keep himself posted, as far as possible, about changes in road conditions due to the weather.

In some areas, level crossings, toll or swing bridges may cause considerable delays. Prior contact with railway officials or the bridge authority will show how far it may be possible to prevent such delays. Also of importance will be a knowledge of any tunnels and the times of sailing of any ferries which may have to be used.

b. Station routine

At the station, it is part of the duty of a fireman to maintain his appliances in a high state of preparedness and he should not overlook the less obvious details, such as the sharpening of cold chisels, saws, axes, etc., or the inspection and testing of the small items of gear which are rarely used. Regular inspection, testing and cleaning help to build up confidence in the equipment and ensure a thorough knowledge of where items of gear are stowed on the appliance. This

can be checked by periodical drills in the dark, sending men for particular items of equipment to ensure, not only that they know what each item is, but where it can be found on the appliance, with the minimum of delay.

Personal equipment not being worn should be stowed neatly on the appliance so that it may be donned with the least delay. A satisfactory method is to arrange it in the order of dressing, with the last garment to be put on at the bottom of the pile. At night, when asleep, boots should be kept by the bed or trestle, with leggings in place on them, and tunics and other fire gear on the appliance. If fire gear cannot be left in this way (because of lack of space on or near the appliance) it should be hung on pegs or otherwise suitably arranged where it can be reached without confusion.

c. Change of watches

Crews should always be fallen in and detailed as riders on coming on duty. A riders' board showing the availability of all appliances at the station and the names of the men riding them is maintained by the watchroom staff at most stations. Every appliance should carry a nominal roll in order that the identities of all firemen in attendance at an incident can be quickly ascertained in an emergency.

When the officer in charge takes over an appliance at the beginning of a tour of duty he must not forget that he is responsible for the appliance and the equipment being ready for any calls which may be made upon them. He may wish to check these for himself or, alternatively, may delegate the duty to the driver. When he is satisfied that everything is in position, he must report to the officer in charge of the station that his appliance is complete and available.

Engines of appliances should **not** be started up nor run for short periods when handing over as this creates engine wear and is no guarantee that the engine will start next time. An on-coming driver should check oil, petrol or fuel oil and water levels, lights and audible warning devices and should see that the water tank on the appliance is full. Most brigades adopt a standard method of stowing gear on appliances, and checks should be made that all the gear is correct and in place.

After roll call, or as necessary at other times during each watch, a man detailed to wear breathing apparatus should perform the general check of his set as detailed in the *Fire Service Drill Book*. He should also complete the information on the identification tally attached to the breathing apparatus set.

Retained firemen detailed to wear breathing apparatus should normally check their sets en route to a fire; alternatively the checking may be done by the B.A. Control Officer at the fire, or as otherwise directed.

Some brigades make an entry in the occurrence book of the names of breathing apparatus riders as they take over, and of the contents of the cylinder of the set they are detailed to wear. If nominal roll boards are carried on appliances, every change in the disposition of riders on an appliance must be noted accordingly.

3 The turn out

a. First attendance

The number of appliances which will respond to a fire call is predetermined in accordance with the fire grading of the area or the type of risk within that area. Numbers and types of appliance and the stations from which they will come are laid down as part of the mobilising scheme of the brigade concerned. The appliances which respond to the initial call are termed collectively the *'first attendance'*.

The time taken to turn out will, of course, depend upon conditions at the station, but, whatever the conditions, the greatest possible speed is necessary in getting the first appliance away. Where the first appliance crew rests at night partially dressed within easy reach of the appliance, twenty seconds is a good turn-out time. Men should complete dressing in fire gear on the way to the fire, the aim being to arrive at the call fully dressed. If the address is close to the station, it may be wise to complete dressing before the appliance turns out. A driver should complete his rigging in fire gear as soon as possible after arrival at the fire.

If hook ladders are carried on the appliance, Nos. 3 and 4 generally wear the hook ladder belts. On arrival at the fire, if it is found that hook ladder belts are not required, they should remove them as soon as circumstances permit. Similarly No. 3 of the crew of a turntable ladder should wear the special turntable ladder hook belt.

Some brigades adopt the practice that firemen, detailed as breathing apparatus riders on pumps, rig in breathing apparatus en route to a fire, unless specifically instructed not to do so. Where a breathing apparatus set with a mouthpiece is donned, the mouthpiece should not be inserted but should be secured to one side of the head harness and the nose clip left off. If a full face mask is fitted, this should not be put on. The main valve of the set should not be opened until instructions are given by the officer in charge after arrival at the fire when he has determined whether breathing apparatus is required.

As soon as the appliance leaves the station, the radio set should be switched on, so that the appliance can be contacted or redirected as necessary and on arrival the officer in charge will be able to send back a message to his mobilising control without delay.

Some brigades 'book mobile' en route and check the address of the fire with the mobilising control.

Most large fires grow out of small beginnings so, apart from speed turning out to the call, whether or not the fire is confined and extinguished with little damage or gets away completely will depend entirely on the skill, initiative and resource of the officer in charge and his crews on the first appliances to arrive.

b. The address of the fire

A driver must be sure not only that he knows, before he leaves the station, the address to which he is called, but also the way to it. Where there is any possibility of confusion, for example, where the same name is used for a street, a square or avenue, time is saved if this is checked before leaving the station. When control accepts a fire call it is always wise to obtain a subsidiary landmark to assist accurate location of the incident: for example, *'10 High Street, opposite Palace Cinema'* or *'25 Green Lane, off Market Hill'*.

It is essential, particularly where mobilising is centralised, to obtain, and include in turnout instructions, the name of the town, village, hamlet or district. In the case of large cities include the name and/or code reference of the district.

Where the station public address system is used to broadcast turnout instructions all members of the crew should make as little noise as possible during the turn-out, so that everyone can hear the address of the call. Where automatic systems, such as teleprinters or public address systems are used for transmitting turnout instructions, alternative arrangements must exist for use in the event of a breakdown. Where a fire call is received locally e.g. a 'running call', the dutyman (the man on duty in the watchroom) should hand the address in writing to the officer in charge of the appliance, giving him verbally any additional information he may have about the call.

Some brigades provide route cards or route books for addresses off the station's ground, and, when the call is given by the mobilising control, the number of the route card is included in the ordering message. The dutyman in the watchroom should see that the appropriate route card is handed to the officer in charge of the appliance. Route books carried on an appliance are especially useful if the crew are re-directed from one fire to another by radio, or are sent on to a fire when, for example, they are out testing hydrants.

Where teleprinters have been installed at fire stations, a delegated member of the station personnel should go to the teleprinter to get the address of the fire.

4 Proceeding to a fire

a. Traffic regulations

In law it is the driver of a motor vehicle who is responsible for its safe passage along the public highway. In this country, there is no exemption (with certain exceptions) for drivers of fire appliances, and fire brigade drivers are subject to the same statutory requirements as any other motor driver.

The exemptions which apply to fire brigade vehicles are as follows:

1 *Prohibition of driving motor vehicles elsewhere than on roads.* Section 36 of the *Road Traffic Act, 1972* states:

> '(1) Subject to the provisions of this section, if without lawful authority a person drives a motor vehicle on to or upon any common land, moorland or other land of whatsoever description, not being land forming part of a road, or on any road being a footpath or bridleway, he shall be liable on summary conviction to a fine not exceeding five pounds, or in the case of a second or subsequent conviction to a fine not exceeding ten pounds.
>
> (2) It shall not be an offence under this section to drive a motor vehicle on any land within 13.7m of a road, being a road on which motor vehicles may lawfully be driven, for the purpose of parking the vehicle on that land.
>
> (3) A person shall not be convicted of an offence under this section with respect to a vehicle if he proves to the satisfaction of the court that it was driven in contravention of this section for the purpose of saving life or extinguishing fire or meeting any other like emergency.'

2 *Exemption of fire engines, etc., from speed limits.* Section 79 of the *Road Traffic Regulation Act, 1967,* states:

> ' No statutory provision imposing a speed limit on motor vehicles shall apply to any vehicle on an occasion when it is being used for fire brigade, ambulance or police purposes, if the observance of those provisions would be likely to hinder the use of the vehicle for the purpose for which it is being used on that occasion.'

3 *Limitation of hours of duty of certain drivers.* Section 102 of the *Transport Act, 1968* lays down the maximum periods of time a person may drive certain classes of vehicles for any continuous period. Sub-section (4) states:

> ' This section shall not apply to vehicles used for fire brigade or ambulance purposes.'

4 *Use of audible warning instruments.* Regulation 118 of the *Motor Vehicle (Construction and Use) Regulations, 1978* prohibits

the use of audible warning instruments (i.e., horns, gongs, bells, sirens or two-tone horns) on stationary vehicles at any time, or on vehicles in motion on a restricted road between 2330 and 0700 hours except for a vehicle which is being used for one of the relevant purposes specified in Regulation 29(5)(a) (which includes vehicles used for fire brigade, ambulance or police purposes), when the audible warning device may be sounded to warn other road users.

5 *Parking of vehicles.* Regulation 123 of the above *Regulations* prohibits any vehicle being allowed to stand on any road during the hours of darkness otherwise than with the left or near side of the vehicle as close as may be to the edge of the carriageway. Subsection (2) gives various exemptions to this Regulation and includes:

'(a) any motor vehicle when it is being used for fire brigade, ambulance or police purposes...if compliance with the Regulation would hinder the use of the vehicle for the purpose for which it is being used on that occasion.'

6 *Stopping of engines and application of brakes.* Regulation 124 of the above *Regulations* stipulates:

'No person shall cause or permit to be on a road any motor vehicle which is not attended by a person duly licensed to drive it unless the engine is stopped and, where the vehicle is fitted with a brake capable of being set, the brake is set so as effectively to prevent two at least or in the case of a vehicle with only three wheels one of the wheels, from revolving:

Provided that the requirements of this Regulation as to the stopping of the engine shall not apply in the case of—

'(a) a fire brigade vehicle the engine of which is being used for any fire-fighting purpose; or...'

b. En route

Notwithstanding that a driver on his way to a fire is authorised to exceed the speed limit, it is essential that he should drive with caution and consideration. The great proportion of the traffic he encounters will be sympathetic towards him and will endeavour to facilitate his passage. At any point where a temporary traffic control is in force, the driver of an appliance going to a fire should follow the directions of the police officer on duty there. If it is necessary for a vehicle to pass a street refuge on the wrong side, the greatest care should be exercised to ensure that there is no possibility of a collision, or of endangering anyone. At roundabouts drivers should normally follow the direction of flow unless a police officer directs otherwise. Drivers of fire brigade vehicles on their way to a call may, under *Regulation 34(1)* of the *Traffic Signs Regulations 1975,* use their discretion to treat a red traffic light as if it were a 'Give Way' sign. This need not preclude the driver from

taking advantage of any priority that drivers of other vehicles may give him, provided he can proceed safely. The audible warning device should be sounded and extreme caution used. Signals by pedestrians indicating that a crossing is safe should be disregarded. Accidents have occurred in such circumstances, and the onus is entirely on the fire brigade driver, who should also remember that a collision might well prevent his appliance from reaching its destination and might block the road for other essential services. No call is so urgent as to justify such a risk.

It is true that '*only one man at a time can drive an appliance*', yet the experienced officer in charge can exercise a steadying influence on the driver and give him greater confidence. For instance, he may indicate, preferably with a sign of the hand, that he is driving too fast for safety. An officer in charge should never take the attitude that he has no control over, or responsibility for, the actions of his driver. He should never use an expression such as '*step on it*' which might be likely to excite an inexperienced driver and lead him to be rash.

If a driver has been at fault, it will often be best for the officer in charge of the appliance to leave criticism until the driver has returned to the station. Here he can be seen quietly and dispassionately in an office and his driving errors pointed out to him. It must always be borne in mind that it is the duty of an officer to continually train his drivers.

c. Audible warning devices

Under modern traffic conditions it may be extremely difficult for other road users, especially the drivers of heavy goods lorries, to hear the warning of an approaching fire appliance, or to gauge the direction from which it may be approaching. As a result of the recommendation of the Central Fire Brigades Advisory Council, fire appliances are fitted with an electrically-operated two-tone horn, an electrically or mechanically operated firebell or a siren. In addition a hand-operated firebell should be retained as an alternative to any other warning device that may be fitted.

The audible warning device not only serves to warn traffic on the road that a fire appliance is on its way to an emergency but also tells people awaiting rescue under extreme nervous distress that help is on the way. This may give them the strength to hold on for those extra moments until the appliance arrives. Where firebells are fitted they should be rung vigorously in sharp bursts with a distinct pause between bursts, but the two-tone horn is generally kept going continuously during heavy traffic. The sounding of an audible warning device should always be continuous at a crossing or a roundabout, or where there is a danger from converging traffic.

When called to a hospital, theatre, cinema or similar building

where the public are likely to be gathered in large numbers, the sounding of the audible warning device should cease in ample time before arrival, so as to avoid alarming those in the building. Also show discretion in sounding audible warning devices in proximity to horses, since these animals, if frightened, might bolt.

Audible warning devices must not be used when returning from a fire, or when on exercises and the driver of the appliance must comply with all traffic regulations.

d. Accidents

Under *section 25 of the Road Traffic Act, 1972, as amended,* the driver of a vehicle involved in an accident in which occurs injury to any other person, damage to any other vehicle or to other property or to an animal (other than one in or on that vehicle), must stop and, if required to do so, give anyone having reasonable grounds for requiring the information, his name and address, the name and address of the owner of the vehicle (e.g. the fire authority) and its registration number. (NOTE: In this section of the Act, 'animal' means any horse, cattle, ass, mule, sheep, pig, goat or dog.) If, for any reason, the driver of the vehicle does not give his name and address as required, he must report the accident within 24 hours to the police.

The following advice has been compiled in the absence of legal precedents to establish how the requirements of section 25 apply to the driver of an emergency vehicle involved in an accident. The courts have so far taken the view that the requirement to stop and provide information is a personal duty on the driver and that he should stop for a reasonable time in the light of all the circumstances to enable the duty to be performed.

An appliance which is involved in a minor collision while it is responding to an emergency call, but is still roadworthy, may, subject to any directions given by the police, proceed to the emergency provided that the driver has complied with the statutory requirement to give the particulars specified above or he remains behind at the scene of the accident to do so. Where the driver is the only person qualified to drive the appliance, and it is imperative that he should proceed, having regard to any serious consequences that seem likely to arise from delay in attendance, he should endeavour to comply with the statutory requirement before proceeding. A prepared card with the name and address of the fire authority owning the vehicle, the registration number of the appliance and space to insert the driver's name and address may help to facilitate the passing of the required information to those with a right to it, although use of such a card on its own is unlikely to be sufficient to satisfy the duty placed on the driver by section 25.

If an appliance responding to an emergency call is involved in a serious accident which results in death or injury, there is an additional need for the driver and the appliance to remain at the scene

of the accident to assist the police with their enquiries. Where, in such circumstances and subject to any directions given by the police, the appliance subsequently proceeds to the emergency, it will usually be desirable for steps to be taken to minimise the distress caused; a member of the crew should be dropped off the appliance with the medical box and a message sent to the mobilising control ordering on an ambulance where necessary.

In the case of any accident the mobilising control should be informed and where it is impossible for an appliance to proceed, or if serious delay is probable, a message should be sent immediately to the mobilising control so that a substitute appliance can be ordered on to the incident."

e. Punctures

If an appliance fitted with twin rear wheels is on its way to an incident and sustains a puncture in one of the rear wheels and the companion wheel is sound, the appliance should continue to its destination at a reduced speed. If the front wheel of any appliance, or the rear wheel of any vehicle fitted with single rear wheels, becomes punctured, the appliance should be halted and a message should be sent to the mobilising control so that an additional appliance may be ordered. If the puncture occurs within walking distance of the address of the incident, the crew should go on foot taking with them the appropriate gear and equipment. If necessary the ladder should be slipped and carried to the fire.

f. Advance planning en route

On the way to an incident the officer in charge should always remind himself of the various things he may have to do, or consider on arrival. This is when all the local knowledge, pre-planning and experience mentioned in Section 2(a) will be of great assistance.

For example, in rural or coastal areas information on seasonal changes in water supplies, population or traffic is very important.

He should consider:

(1) Evacuation if called to hospitals, theatres, shopping precincts and other life risks.

(2) Wind direction for a chemical accident.

(3) Special appliances such as turntable ladders, foam tenders or hose-laying lorries at certain special risks.

(4) The need for assistance if he can see considerable smoke or fire towards the incident and

(5) The type of message required to get that assistance.

Some pre-arrival information, warnings of hazards and orders to his crew could help them appreciate the possible situation and the methods of tackling the incident.

Chapter 2
Action on arrival

1 Arrival at an incident

a. Calls by telephone

Called to an address which has been given over the 999 system and, on arrival, finding no trace of fire, a message should be sent back asking for the address to be verified. In the meantime, the officer in charge, with his appliance and crew, should make a short tour of the adjacent streets, as persons giving a fire call by telephone are often excited and sometimes provide a garbled address.

Remember that, in large premises which abut on to more than one road, the address given may not be that by which the premises are usually known. If nobody is present at the door at which the first arrival is made, a search should be made for an alternative entrance. Should the address of the fire prove to be a building, such as a cinema or theatre, in which members of the public are present, action to prevent panic should be the first consideration.

b. Locating hydrants

When nearing the address, all members of a crew should be on the lookout, firstly, for signs of fire, and, secondly, for the nearest hydrant or other water supply. Hydrants should be clearly identifiable by the hydrant tablet, showing the size of the main; as already stated, hydrant positions may be shown on route cards or route books. If a hydrant cannot immediately be located, a man with a standpipe key and bar should search in the direction of the nearest main road. (See also Chapter 8 Section 3f).

c. Whereabouts of the fire

If, on arrival at the address of the call, the whereabouts of the fire is not immediately obvious, one of the occupants may be able to act as an informant. If not, firemen will have to locate the fire for themselves. The various signs which may be of use to him are described later in this chapter, on page 15.

d. Slipping the escape

The officer in charge of an escape-carrying appliance should consider whether to slip the escape immediately on arrival. Many modern appliances have the pump mounted amidships, and in these

circumstances it is always possible to slip the escape at any time, even after the pump has been got to work. In the case of an escape-carrying appliance with a rear-mounted pump, it may be necessary to slip the escape in order to be able to get at the pump to operate it, unless the pump has the controls, deliveries and inlets positioned on a side panel. When an escape is slipped in this way and is not to be used, it should be left in a safe position, out of the way of traffic.

e. Responsibility of the first officer

The first task of the officer in charge of the first appliance to arrive is to carry out any necessary rescues. For this he must ascertain whether or not persons are in the building and, if so, exactly where they are or, if that is not known, where they were last seen. It will be necessary to survey the situation, enter the premises if at all possible, decide from which points the fire should be attacked and assess the appliances required to deal with it. The subject of control at a fire and the responsibilities of officers in charge are dealt with in detail in Part 3, 'Control at a fire'.

f. Further appliances arriving

Where two or more appliances comprise the first attendance, the officers in charge of all appliances after the first to arrive, should, except in very unusual circumstances, report to the most senior officer, who will be in charge of the fire, and get instructions. In the event of there being an obvious rescue to be carried out, they would get to work without prior instructions and report afterwards what had been done.

g. Sprinklered buildings

In his preliminary assessment of the outside of the premises an officer would see whether the building is fitted with sprinklers, drenchers or has an inlets to dry risers. Well-trained firemen should be thoroughly familiar with all the premises on the ground covered by their station, but reinforcing crews will have to rely on observation. The sprinkler gong will give an audible warning and both the gong and the sprinkler stop valve notice will be seen on the outside of the building. A member of the crew should be detailed to stand by the main stop valve, with instructions not to close it until ordered to do so by the officer in charge of the fire (see Chapter 8 Section 3(g)).

If no obvious sign of fire can be found, a thorough search of the building should be made, since the alarm may have been caused by the operation of a defective sprinkler head or through some other defect such as a fractured water pipe. (The subject of sprinklers and drenchers is dealt with in detail in Book 9 of the *Manual,* Part 1).

h. Automatic fire alarms

If the call is to a building fitted with automatic fire alarms, the appropriate annunciator on the indicator panel will show the compartment or part of the building affected. If no fire is found at the point indicated, all floors should be searched, in case the wrong annunciator has operated. If no annunciator is showing on the indicator panel but the alarm has functioned, the building should be searched. In either case, a message that the fire is not yet located and that a search is in progress should be sent back to the mobilising control. (The subject of automatic fire alarms is dealt with in Book 9 of the *Manual,* Part 2).

j. Equipment required on entry

A cardinal rule in firefighting is never to enter a building empty-handed. The type of building and its contents will dictate the equipment necessary. The officer in charge will normally give instructions to the various members of the crew regarding the equipment to be taken into a building. If the location of the fire is not obvious, however, he will probably prefer to reconnoitre, accompanied by one man carrying suitable equipment.

The gear to be taken in will depend on circumstances, but apart from a hand lamp or any radio which forms part of personal equipment, it will usually comprise the hose reel tubing or a suitable extinguisher; a long line carried pack fashion (see Book 2 of the *Manual,* Part 3) can be useful.

k. Hose reels

A large proportion of fires in domestic and many other types of property can be dealt with by means of the hose reel equipment. Unless the outbreak is obviously beyond the extinguishing capacities of this equipment, one or both hose reels should be taken in to the building on first entry. The first action of the pump operator will therefore be to engage the pump and operate the appropriate valve to the hose reel (see Part 2 of the *Manual,* Chapter 1 'Pumps, primers and pumping appliances'). A line of hose should be connected from the nearest hydrant to the pump inlet in order to supplement the supply of water. This will save time in getting a delivery to work from the main pump if the fire should require more than a hosereel or jets.

At fires on upper floors the hose reel, or the first line of hose, is normally got to work up the staircase, but it may save time in a high building not fitted with a rising main, to take a line up to the floor below the fire via the stairs and drop one end of the line from a window down to the street. The hose reel hose, or any other item of gear required, can then be hauled up the face of the building. Hose reel hose taken up a staircase wastes time due to the extra distance traversed and the hose may then prove to be too short to reach the fire. It may be quicker to carry a hose reel up a ladder.

l. Setting into hydrants

In order to prevent accidents to vehicles or to passers-by, it is a good practice where the construction of the hydrant permits, to place the hydrant cover at an angle across the pit. Open hydrant pits, if left unattended at night, must have a lamp beside them. After shipping the standpipe but before connecting the hose, the hydrant valve should be turned on to flush the hydrant and remove any foreign matter which may have collected in the outlet. A hydrant should always be opened up in this way except when it is obvious that only hand equipment will be required.

A double-headed standpipe, if available, should be used from a hydrant, and, if the hydrant has to be connected to the pump, the laying of twin lines of hose in the first place will ensure that the maximum output of the main is available to the pump. If more than one delivery is necessary from the pump and if the water supply is adequate, a second or even a third delivery can be got to work, without having to waste time in shutting down the hydrant to twin the lines of soft suction.

Even in areas where the pressure in the mains is good, it is always good practice to connect the pump to the hydrant by means of soft suction and to run out hose from one of the pump deliveries rather than to take the delivery line direct from the hydrant to the fire. The former method has the advantage that the pump can be used to adjust the pressure required for firefighting operations, and that additional hose lines can be connected to the spare deliveries without having to shut down the line of hose already at work.

2 Searching for the fire

The initial outside examination will be carried out more or less as the appliance draws up and the next essential is to enter the building in order to carry out any necessary rescues, and check the spread of fire by attack at the closest possible quarters. The methods of obtaining an entry are dealt with in Part 2, and methods of rescue are discussed in Book 12, Part 1 (currently Part 6a of the *Manual*).

The whereabouts of the fire will often be obvious, but firemen will attend calls where it will require a lot of ingenuity and resource to track down the seat of the fire without causing damage out of all proportion to the size of the outbreak. The search becomes a question of systematic elimination, and a highly developed detective instinct.

For example, in terraced houses, the first step must be to discover which is the particular building affected, especially if there is a common roof void. It is obviously important to be sure about the house if it is necessary to break in to get at the fire.

a. External indications

There may be signs visible from the outside, such as smoke emerging from some part of the building (though this is by no means a certain guide to the actual seat of the fire), the sound of crackling or the discolouration of window glass. At night, or if the curtains are drawn, windows may be felt for heat with the palm of the hand, and the letter box flap lifted to test whether smoke can be detected by smell.

When the right building or part of the building has been found, the fire must be tracked down, and, for this, understanding of the principles of smoke travel will be important.

b. Smoke travel

Although visible flame is a definite indication, the issue of smoke from any part of a building does not mean that that is the part on fire. This is because smoke can travel considerable distances from its source by reason of air currents, etc. Neither is the volume of smoke a true guide to the size of the outbreak. Small fires 'bottled up' for some hours can cause large quantities of smoke which can seep to all parts of a building.

Various materials will give off different quantities of smoke, even when burning under the same conditions. The type and colour of smoke may sometimes give a valuable guide to the nature of the burning material, whilst that from certain substances such as wood, soot, or rubber, has a very characteristic smell.

(1) *Mushrooming.* Smoke when heated will tend to rise, owing to its lesser density compared with air but, as it cools, so the density increases, until the heavier particles tend to sink again. Near the fire there is a definite upward surge which drives the smoke up lift shafts, staircases and light wells, or any vertical openings which are in communication with the compartment in which the fire has occurred. The smoke will rise more or less vertically until it strikes a roof or ceiling, when it will spread sideways. This is called 'mushrooming', and can be responsible for a great deal of damage if overhead venting of the fire cannot be carried out (see Book 12, Part 3, currently Part 6a of the *Manual*).

In tall buildings the staircases and lift shafts, unless they are totally enclosed, will allow smoke to rise from basement to roof and, unless it can escape, mushroom out on the top floor. If the smoke encounters an obstruction such as a stationary lift in the shaft at an intermediate floor, it will mushroom out at this level. If no fire doors are fitted to the shaft, or if, as sometimes happens, they have been wedged open, the intermediate floor or floors will become smoke-logged. Open or badly fitting doors and transom lights in internal partitions will also allow smoke to diffuse over a wide area.

(2) *Influence of air currents.* Remember that anything which will cause air currents in the building will assist in the spread of smoke. The effect of ventilation ducts in large buildings may result in smoke being drawn into them and being discharged far from the fire or, if a plenum system (see Book 8 Part 3 Chapter 11 'Building construction and structural fire protection') is in use, the excess air in the neighbourhood of the fire will tend to drive the smoke into the most unlikely places.

In tracing the travel of smoke, the type and construction of the building will prove a useful guide. Hollow partitions and lightweight construction may have communicating cavities over considerable distances and carry the smoke far from the fire.

In old office premises which have been altered and sub-divided, there may be many partitions either going up to the ceiling or ending approximately 2 to 2.5 m above the floor, and these may greatly confuse firemen by the influence they will have on smoke travel.

In buildings having panelled walls, smoke travel may be particularly difficult to trace. Such buildings present a serious hazard because of the concealed spaces behind the panelling, and the way in which heat and flame can travel along them unseen. Again, the cavity in a mansard roof will allow smoke to travel considerable distances from the seat of the fire to appear in the most unexpected places. Roof voids and basements common to more than one house will assist in fire or smoke travel, as will defective brickwork.

At night, when there is only a smell of smoke, firemen should turn off all lights in a room, even throughout the building, and use the beam from an electric torch. This will often show up a wisp of smoke which would not otherwise be seen. The smoke can then be followed to its source in the same way.

(3) *Misleading evidence.* Care must be taken not to be misled by the presence of smoke. In old property with a common roof void, smoke escaping through slates or tiles on a roof may not be an indication that the roof is on fire because the brickwork of the flue is sometimes faulty and smoke may escape from the chimney through the mortar joints into the roof cavity (see Fig. 5.3) and then through the slates, giving a false impression of a roof fire. Firemen should seek evidence before opening up; for example, the underside of the topmost ceiling will often indicate by touch and the presence of discolouration that there is a fire in the roof void.

c. Other signs

If smoke cannot be used to trace the fire there are several other signs which can be used. Ordinarily the temperature increases as the fire is approached, although, in the immediate vicinity of the fire, it may be cooler because of the inrush of air to feed the fire, but then the sound of burning should be apparent. Firemen should feel

woodwork, doors, etc., for heat is a most reliable guide, while blistering of paintwork and discolouration of plaster provide visual evidence.

When visible smoke is slight or absent, firemen should use their sense of smell. Most substances, when burning, have a characteristic smell, and that of cellulosic material, such as upholstered furniture, can be distinguished from the sooty smell of a chimney on fire. Other common substances with recognisable smells when on fire are wood, cardboard, plastic-covered electric wiring, and electric motors. All firemen should try to develop a 'nose for smoke' so that they can readily identify burning material by the smell of the smoke given off.

If the smell of the smoke is not what might be expected from the supposed location of the fire, further investigation should be carried out before it is decided to open up. Thus, if coal smoke is smelt where wood smoke might be expected, a further search should be made for a defective flue before opening up a roof void to which no means of access is provided.

The technique of 'listening' may sometimes give results. Two firemen should enter the building, and every endeavour should be made to prevent all extraneous noise. They should search for the most probable location, with ears kept close to the floor and near the skirting boards. Provided all movement is suspended when this is done it may be possible to hear the fire burning. Occasionally, in piles of packed merchandise, collapse in the pile will indicate the seat of the fire.

Firemen, as a general principle, should never put a jet on smoke—even hot smoke—but it may very occasionally be necessary to use a spray-type branch to drive the smoke back and thus enable them to locate the seat of the fire. Water used under such circumstances, however, may do far more damage than the actual fire, particularly if it strikes such commodities as textiles on racks or machinery.

In warehouses and similar premises stock is often piled with narrow aisles between the stacks. Where the fire is in a different aisle from the branch, water may simply strike the stock pile and cause unnecessary water damage without doing any good. Such jets can prove dangerous by knocking over insecurely stacked bales or boxes. If one side of a bale is wetted it can expand and tip over or burst and collapse. Piles of capsized stock make it very difficult for firemen to move about.

When searching for the fire, doors which are left open when the fire has not been located can cause extra draught and result in spreading the fire. Firemen, therefore, should always close doors after them unless they intend to carry out ventilation operations. When it is desired to keep swing doors open, to avoid narrowing the available space, they should be wedged so that they open into the room and not on to a staircase or passageway.

Chapter 3
Uses of extinguishing media

1 Fire extinguishing media

The following are the various media employed for extinguishing fires, although they may not always be available to fire brigade personnel:

A. Water
   (i) portable extinguishers
   (ii) hand pumps
   (iii) hose reel equipment
   (iv) hose lines

B. foam

C. vaporising liquids

D. carbon dioxide

E. inert gas

F. dry powder

G. sand

H. steam

A small fire which does not require the use of one of the above media may be extinguished by:

J. blanketing

K. beating out

L. removal

Other reference to these agents will be found in Book I of the *Manual,* Part 3, Chapter 12. Those found as installed equipment are dealt with in Section 16.

2 Water from portable extinguishers

Extinguishers which expel water, or a dilute chemical solution, have been dealt with in Book 3 of the *Manual,* Part 2, Chapter 3 'Water type extinguishers'. The most common of these was, tra-

ditionally, the soda-acid extinguisher, but there are drawbacks in the use of water containing sodium sulphate on certain fires. Stored pressure extinguishers expelling only water should preferably be used where clothing or fabrics could be affected by the soda-acid type.

3 Water from hand pumps

The construction and use of hand pumps has been dealt with in Book 3, Part 1, Chapter 1 'Hand and stirrup pumps'. When hand pumps are used provision has to be made for re-filling the buckets.

4 Water from hose reel equipment

When dealing with small outbreaks the equipment most used is the hose reel. It possesses considerable advantages, the more important being:

(i) It is ready for use immediately the appliance draws up at the fire;

(ii) The jet can be controlled at the nozzle, and water damage kept to a minimum;

(iii) The hose is coiled on a revolving drum from which only as much as is required need be run out;

(iv) The charged hose reel hose is considerably lighter and easier to manhandle than normal delivery hose.

The limitations are:

(i) The radius of operation is limited to approximately 60 m from the appliance. Hose reel equipment, however, is fitted with couplings so that additional lengths can be added to extend the range. Alternatively, hose reel can be connected to delivery hose by means of a hose reel adaptor;

(ii) The capacity of the hose reel tank must be not less than 360 litres and arrangements have to be made to replenish the tank if the quantity carried is insufficient. In built-up areas where hydrants are numerous, there will be little difficulty in doing this before the tank is empty, but elsewhere it can be more difficult to arrange. Hose reel tanks on water tenders contain not less than 1800 litres of water and this is usually sufficient to extinguish most fires which can be dealt with by the size of jet provided by the hose reel nozzle.

5 Water from hose lines

When water in the quantities provided by the three methods mentioned above is insufficient to extinguish the outbreak, the use of one or more hose lines becomes necessary.

a. General considerations

The normal size of delivery hose (see Book 2 of the *Manual,* Chapter 2, 'Delivery hose') in use in the Fire Service is 70 mm diameter, but many brigades also use 45 mm hose. Hose which is to be used inside buildings is invariably non-percolating but in rural districts, or on fireboats, unlined hose may be employed.

45 mm hose is used with smaller diameter nozzles or diffuser branches, and many brigades use this type of hose as the first line to be taken into a fire, keeping a length or two flaked on the back of the appliance. It is often used in rural districts where water is scarce, and is therefore carried on water tenders.

Larger hose, such as 90 mm is used for water relaying (being carried on some hose laying lorries), on fireboats, for feeding monitors and may be used as soft suction when getting to work from a hydrant. For this latter purpose, special short lengths are carried. The greater weight of charged 90 mm hose would make it extremely difficult to handle if it were used coupled directly to branches, which have to be reasonably mobile.

The correct method of running out hose is described in Book 2 of the *Manual,* Chapter 2, 'Delivery hose', and the *Fire Service Drill Book*, so that only those factors which influence its use from the practical firefighting point of view will be considered here.

b. Type of hose

Firemen should always use non-percolating hose in preference to unlined hose for those lengths which pass into, or through, a building, to prevent water damage which might otherwise occur. On the other hand, unlined hose is to be preferred in rural areas or for hose lines which must be laid out over hot materials, since the wetting of the jacket, by percolation, will prevent scorching.

c. Size of nozzle

The aim of the fireman is to bring the fire under control in the minimum time, while causing as little water damage as possible. When he sees the fire requires the use of hose lines an important point to decide is the type of branch and size of nozzle to be used. At a relatively small fire, the first branch to be got to work should be the hand-controlled type, preferably incorporating a choice of fine or coarse spray. Branches capable of providing finely divided spray are very effective in dealing with small general fires. They have extremely efficient cooling properties, ease of control, avoid

water damage and are generally manoeuvrable. For large fires, the branches used should have plain nozzles. These give better jets and can be of larger diameter than 20 mm, the size which is normally used with a hand-controlled branch.

Branches having nozzles of 12.5, 15 or 20 mm diameter are more easily handled than those of larger size (25 or 28 mm), and at certain fires, such as in hotel or office corridors, when a number of rooms must be entered, a considerable amount of movement of the branch will be necessary. Firemen may prefer to use two or three branches with small nozzles rather than one larger one or to use 45 mm instead of 70 mm delivery hose. If, however, considerable quantities of stock are burning and entry into the building is difficult, it will be essential to use large nozzles, because only they will:

(i) deliver the volume of water required;

(ii) give the throw necessary to strike the materials which are actually burning; and

(iii) reach the fire without the jet breaking up.

When a long throw is required, the efficiency of the jet will depend on the nozzle being circular without damage to the internal surface.

d. Laying out hose lines

Firemen should lay hose out as straight as possible, avoiding kinks. It should be laid on the pavement, whenever possible, but if laid in the road, should be kept clear of gutters where there is a risk of contamination by oil and grease. Hose laid across a road should be ramped, and a fireman stationed at the crossing to warn drivers to slow down and to ensure that the ramps are not displaced by vehicles passing over them. The ramps should be illuminated during the hours of darkness. To ensure that the branch can move forward without the necessity to shut down and add a length, sufficient hose should be provided in the form of a bight as near the branch as possible (Fig. 3.1).

Modern buildings more than about 20 m in height have either dry or wet risers incorporated and details of these should be known from inspections carried out under Section 1(1)(d), *Fire Services Act, 1947*. But if on a strange ground, firemen should spend a few moments checking whether risers are installed before taking a line of hose into the building and up the stairs. This will save time and hard work.

The first line of hose often has to work up the staircase. To work charged hose up a staircase which is on fire or heavily laden with hot smoke and gases is an exhausting process, and may require as many as four men. Two men should be on the branch and two

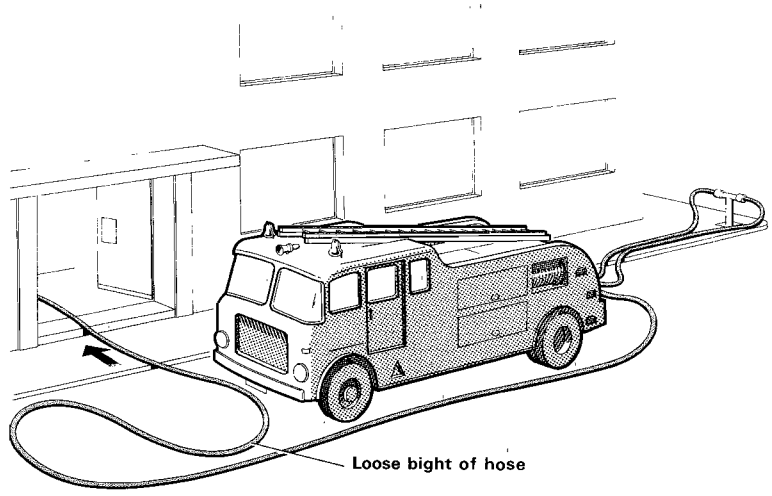

Fig. 3.1 Method of laying out hose so as to provide an adequate bight in order that the branch can be advanced into the building without having to be shut down to add an extra length.

behind supporting and backing them up. If insufficient men are available, it will be necessary for the pressure to be reduced while the branch is moved and increased again when the branch is in its new position.

Better progress can often be made with a hand-controlled branch, since firemen can reduce the flow or cut it off entirely when it is necessary to advance and open it up again when the new position is reached. When a hose line is being worked up a staircase, the jet should not be allowed to strike the walls at close range, otherwise burning materials and hot plaster will be thrown into the faces of the branchmen.

Hose laid out on a staircase should avoid kinks, which restrict the flow severely and may cause bursts. When it is being worked up the staircase it will normally be laid up the treads, but it is preferable to suspend it vertically up the well. Take care that it is adequately supported in the same manner as when hoisted up the outside of a building.

With the exception of the first line of hose to be got to work, hose lines should, whenever possible, be taken up outside a building and should enter at the most convenient floor from which to reach the fire because:

(i) the hose lines are much shorter, and there will be less frictional resistance;

(ii) staircases and passageways are kept free;

(iii) the hose can be more easily hoisted into position and time is saved;

(iv) the hose lines are easier to trace.

The hose can either be hoisted up by a line or carried up a ladder.

(1) Hoisting hose aloft by means of a line

To hoist hose up the outside of a building by means of a line, a fireman carrying a line must gain access to the appropriate part of the building and then lower one end to those below. The end is made fast to the uncharged hose (see Fig. 3.2) about 3 to 3.5 m from the branch by means of a rolling hitch. The tension of the rolling hitch must be adjusted so that when the hose is charged the flow will not be restricted. A clove hitch is then made round the narrowest part of the branch, the length of line between the two hitches being so arranged as to leave a bight of hose between them. The fireman in the building then hauls up the hose while the man below guides it and tries to prevent the branch striking any projections.

When the hose has been hauled up to where it is to be taken into the building, the clove hitch is removed from the branch and the line made fast to some suitable object which will take the weight of the charged hose. Before the line is secured the rolling hitch should be positioned about half a metre below the coping or window sill

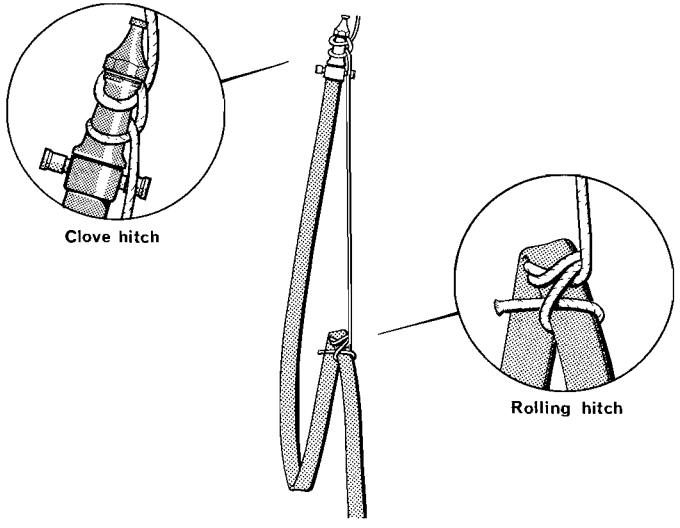

Fig. 3.2 Hoisting aloft a length of hose and a branch using a rolling hitch and a clove hitch.

over which the hose runs into the building. Suitable material such as sacking or a doormat should be placed between the hose and the point of contact with the building to prevent chafing of the hose.

To add a length of hose to a charged line suspended in this way, the coupling at ground level should be broken and the vertical lengths allowed to drain. Further lengths of hose are then connected at the break and the hose line hoisted up the building, resecured and again charged. With this method, only the amount of additional hose which is actually required need be drawn into the building. Alternatively, if it is impossible to break the coupling at ground level, the additional length of hose may be added at the branch.

(2) Hose taken up a ladder

When taking hose up a ladder or escape, the branch should be connected and the hose led up under the armpit and brought up over the shoulder, with the branch hanging down the back (Fig. 3.3(1)). Alternatively, the hose may be brought up under the arm, passed across the chest and over the other shoulder with the branch down the back (Fig. 3.3(2)). The advantage of the first method is that if the hose line should be charged by mistake whilst a fireman is still on the ladder, it is easy to cast it off. The disadvantage is that the hose does not grip very well and tends to slip off his shoulder when he is climbing. With the second method there is a possibility of him being thrown off the ladder if the hose is inadvertently charged, but the purchase on the hose is much firmer.

Hose reel nozzles are often fitted with a sling (Fig. 3.3(3)), which can be slipped over the shoulder and takes the weight of the hose reel hose, leaving both hands free. Where no sling is provided, the arm may be placed through a large overhand knot, which is formed by using the first metre approximately of hose reel hose (Fig. 3.3(4)).

The fireman then climbs the ladder, the hose being eased up by one or more members of the crew.

The weight of charged hose lying on a ladder must always be taken by some means of support (Fig. 3.4) such as a hose sling, or, if this is not available, by making it fast with a belt line using a rolling hitch. A branch taken up a ladder may, in the first place, be got to work from the ladder, but as soon as possible it should be taken into the window or over the parapet against which the ladder is pitched. The hose should be led over the head of the ladder into the building. If, however, this hose is likely to be required for some time, then it should be removed from the ladder and suspended by a line.

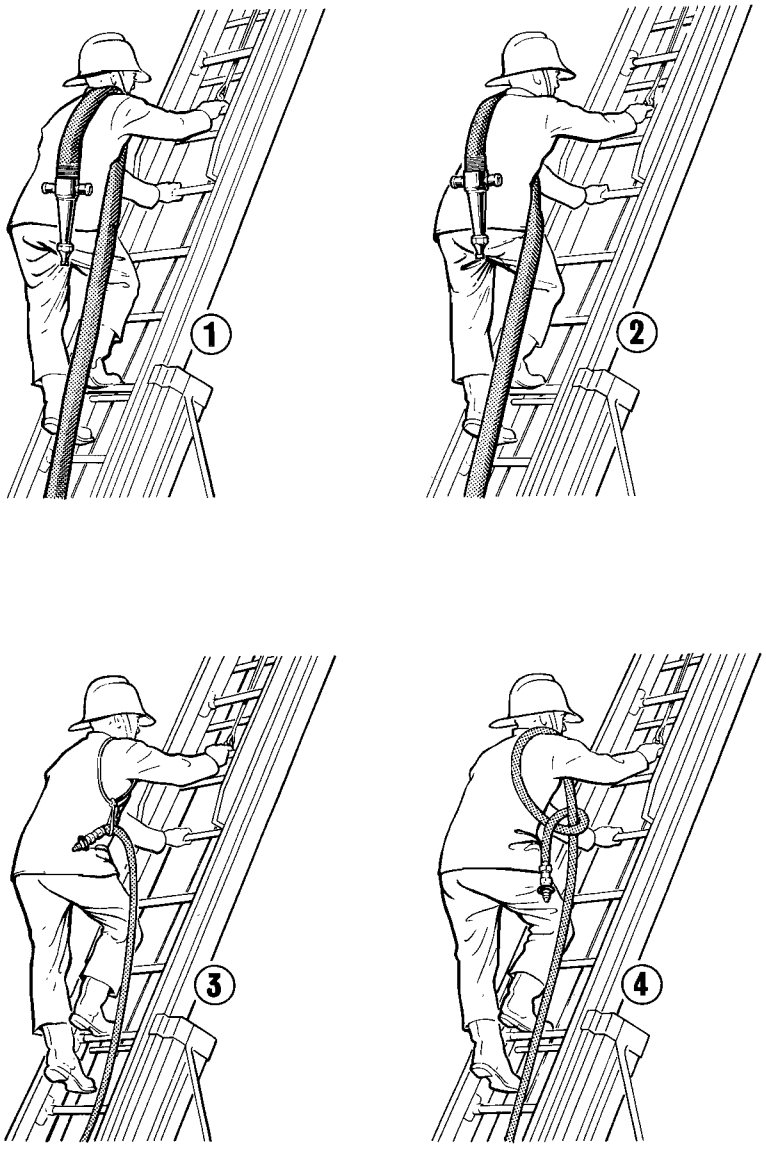

Fig. 3.3 (1) and (2) Alternate methods of taking a line of hose up a ladder.
(3) and (4) Alternate methods of taking a hosereel up a ladder.

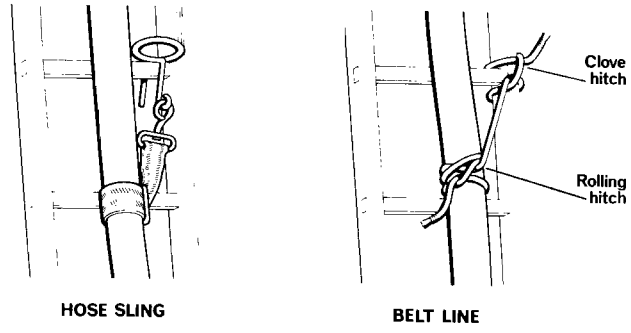

Fig. 3.4 Various methods of supporting the weight of charged hose lying on a ladder.

e. Branch holding

At a fire, correct branch holding will do much to reduce fatigue and prevent accidents. The following are some of the more important points to which attention should be paid:

(1) On first entry. When working a branch into a room which is well alight, firemen should crouch in the shelter of a doorway or other suitable opening and first direct the jet overhead and slightly in front of them, to dislodge anything which may be hanging insecurely. This action should be repeated periodically as they advance. They should not look up while doing this, and should hold the branch so that hands are kept as close into the body as possible, to protect them from falling debris (Fig. 3.5). This is particularly important on top floors, where the roof may be partly glazed. This may be cracked by the heat and liable to fall.

(2) On the ground. When holding a branch (Fig. 3.6), the man on the left of the hose (when facing forward towards the nozzle, i.e., the man on the right in the illustration) should allow the hose to come up under his right arm. His right hand should be on the coupling underneath but not grasping the lug and his left hand should be on the nozzle with the back of the hand uppermost. An alternative method of holding a branch is to support the right hand on the left arm, thus tucking the hose into the crook of the right elbow (Fig. 3.7).

The man standing on the right of the hose will generally best be employed supporting the hose and exerting a forward pressure to counteract the jet reaction. The hose should be laid out behind the branchmen in as nearly a straight line as practicable, as this will serve to absorb some of the jet reaction. If a third man is on the branch he should stand on the left behind the more forward man and help to support the hose.

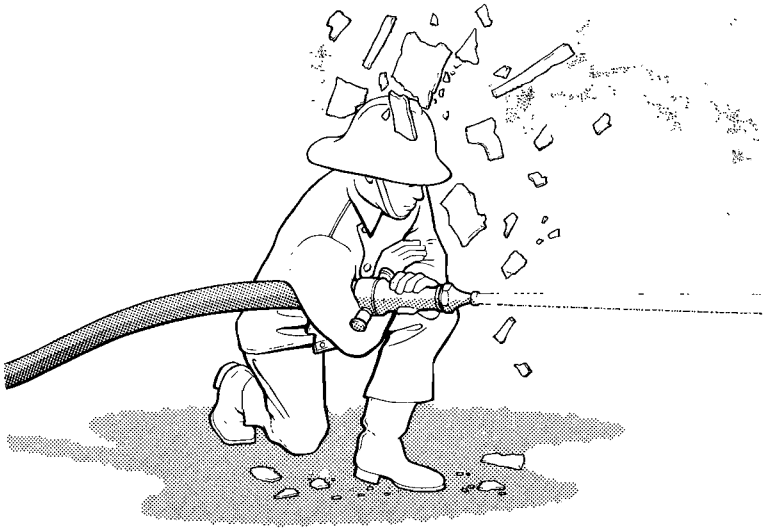

Fig 3.5 Holding the branch so that the hands are protected from debris falling from above.

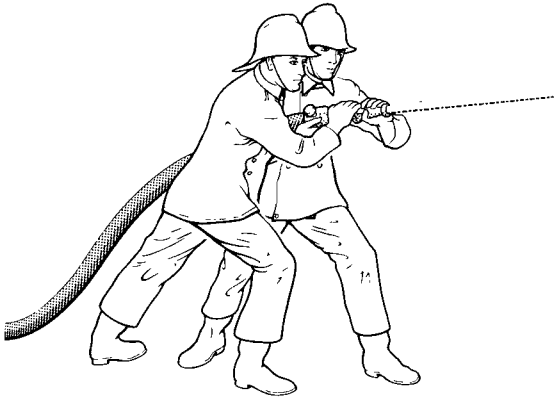

Fig. 3.6 The standard method of holding a branch (two men).

Fig. 3.7 Alternative method of holding a branch so that the weight of the charged hose is supported on the right forearm.

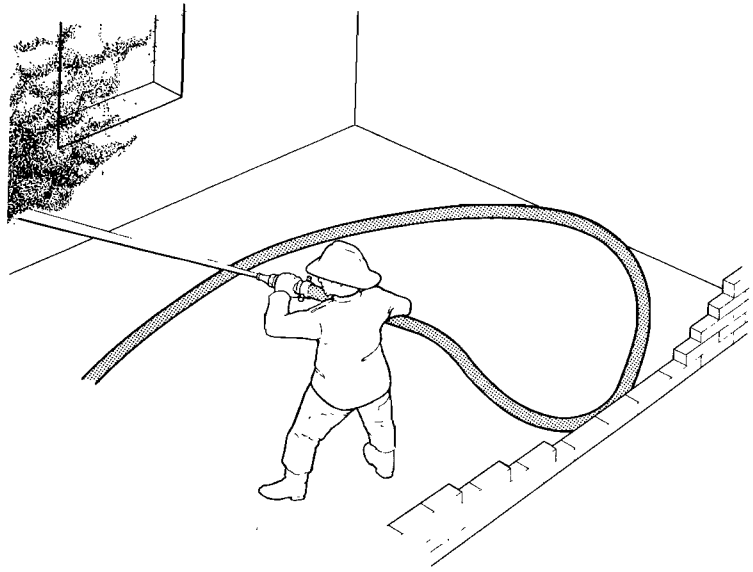

Fig. 3.8 Diagram showing how a corner of a room may be used to take part of the reaction of the branch by supporting the hose line.

Except when one of the smaller jets is in use, two men should always be on the branch before the full pressure is allowed to develop. When for any reason this is impracticable, a fireman may find it helpful to position himself against a wall preferably in a corner, in order that he may obtain the maximum support to resist the jet reaction. Alternatively, it may be possible for him to place the hose (Fig. 3.8) so that the walls of a corner take part of the reaction.

Once control of a branch is lost it is difficult to regain. If he feels that he is losing control, the branchman should throw himself on top of the branch, holding on to it tightly and pinning it between him and the floor until assistance arrives.

Should a charged branch get out of control the order 'Knock off' should be given immediately. Control of the branch can only be achieved by crawling along the line of hose towards the branch, slowly limiting the movement until control can be regained.

A branch out of control can cause serious injury to anyone it strikes.

Correct branch holding is of particular importance when a fireman is working in difficult positions, such as on a roof or ladder. Any pump operator who has a delivery at work under such conditions must also be alert, so that he can immediately reduce pressure if he sees that a branchman is losing control.

If a branch becomes out of control on a ladder an immediate warning should be given to personnel working in close proximity.

(3) On a ladder. Operating a branch from a ladder is usually only a preliminary to entering the room, and arrangements must always be made to have a sufficient bight of hose available which can be worked forward when entry is made. The hose line should be led up the ladder and secured by means of a line or hose sling in order to relieve the branchman of the weight or, if this is impossible because the branchman is advancing, one or more men should assist in lightening the hose up the ladder. Remember that hose, when it becomes charged with water, increases in length and tends to 'snake'. The fireman at the foot of the ladder should be ready to ease the hose back to prevent it coming off the ladder or making the ladder unstable.

There are several methods of holding a branch on a ladder, the most suitable are illustrated in Fig. 3.9. In the first method (Fig. 3.9(1)), the hose is led up over the right shoulder, the branch being held in position with both hands. This method, whilst not suitable for continuous working, has the advantage that, when the fireman is first attacking a fire in the room to which the ladder is pitched, the face can be kept almost at sill level, and is protected from the heat and smoke escaping from the window.

In the second method (Fig. 3.9(2)), used when the head of the ladder is pitched to but not above the sill, the branch is held very much as when on the ground. The third method (Fig. 3.9(3)) can

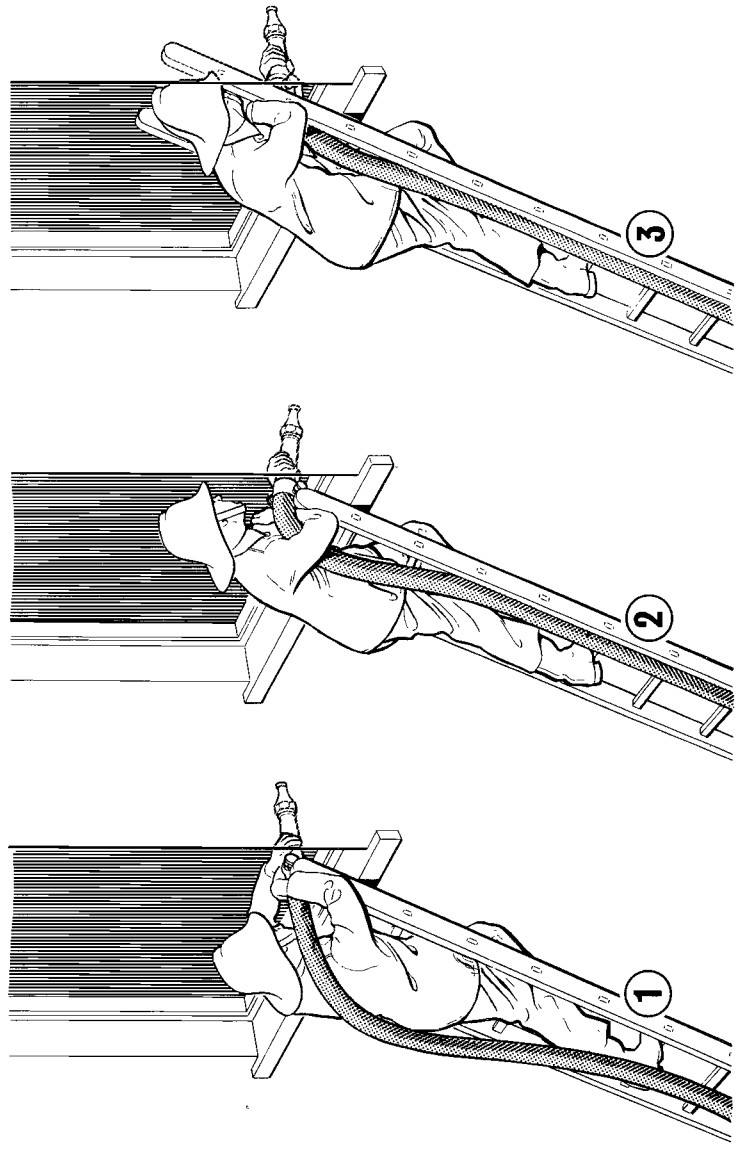

Fig. 3.9 Three methods of holding a branch at the head of a ladder preparatory to entering a room on fire.

most suitably be employed when the ladder projects several rounds above the sill. If it is necessary to work from an intermediate position on a ladder, the branch should be held close to the string, one arm being passed through the ladder to grasp the branch, whilst the other supports the base of the branch or forward end of the hose line.

A man operating a branch from a ladder should always take a leg-lock (see Part 1 of the *Manual,* Chapter 6, 'Ladders'); if working to the left, the lock should be taken with the right leg, and with the left leg if working to the right. A wise precaution is to take an arm hold, as well as a leg-lock, by passing one arm round the string before grasping the branch, while the other hand holds the base of the branch. This can be particularly important during cold weather when there is a possibility of ice forming on the ladder.

The heel of a ladder from which a branch is to be got to work should always be drawn farther out from the building than when in normal use, and, whenever conditions permit, the head of the ladder should be secured with a line. There must be a man at the foot of the ladder at all times whilst a man is on the ladder. Although it is essential to hit the fire with the jet, it is well to remember that if the branch is directed too far to one side the stability of the ladder may be affected by the sideways thrust, causing it to capsize.

When a line of hose is taken aloft up a ladder the hose coupling nearest the base of the ladder should be left uncoupled until the branchman gives the order 'Water on'. In the interests of safety this is essential to ensure the branchline is not charged before the branchman is safely in a secure position.

f. Use of jets

When fighting a fire with water, every attempt should be made to strike the burning material with the jet, the principal requirement being to cool the material actually burning to a temperature below its ignition point. Surrounding materials which may become involved should be damped down with a quick splash round and the jet immediately re-directed at the heart of the fire; water which strikes flame or smoke does little good. It is virtually useless to keep a jet directed at one spot only; it should be kept in constant movement so that the maximum area of burning material is cooled. Aim to cool and extinguish a small section which can be then progressively enlarged. Where a vertical surface is involved start low down, in order to reduce the effect of the rising flames and hot gases which, otherwise, will continually re-ignite material above.

When, on account of obstructions, it is impossible to strike the fire directly with a jet, use a ceiling or a wall to deflect the water on to the burning materials.

The angle at which the jet will be directed, will depend on the relative positions of branch, obstruction and fire (Fig. 3.10). If the

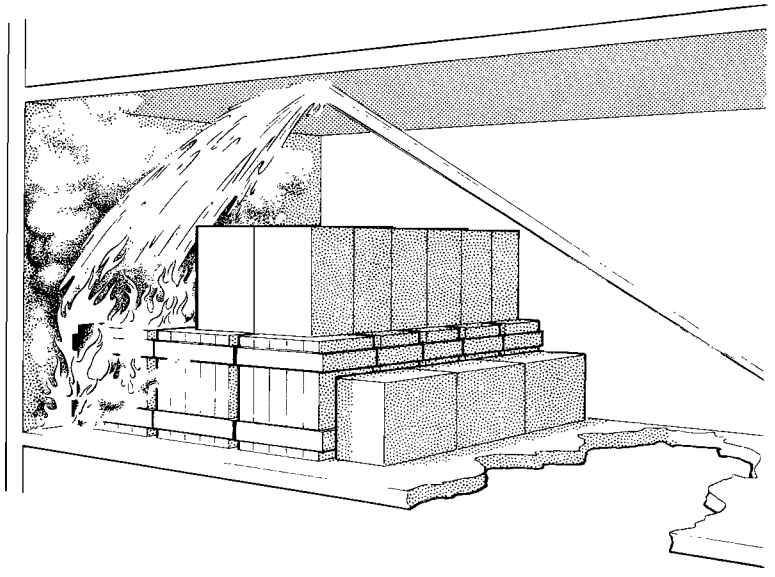

Fig. 3.10 Sketch showing how a ceiling can be used to direct water on to a fire which is unapproachable because of a collapsed floor.

building cannot be entered and it is necessary to direct a jet into a window from a ladder or from street level, angles should be kept in mind. This is clearly indicated in Fig. 3.11 *left*. To get maximum penetration it is obvious that the branch should be placed as far away from the building as the reach of the jet permits, to obtain a lower trajectory. It is apparent why jets used from ground level outside a building are not usually effective.

One of the principal virtues of the turntable ladder or hydraulic platform monitor is that when operated on a level with a window or other opening (Fig. 3.11 *right*) it can project a jet almost horizontally and strike a fire well inside the building which could not otherwise be reached by jets from outside. The particular advantage is for a fire on a top floor when the roof has collapsed or when access from inside is particularly difficult. A fireman at the head of the ladder should satisfy himself that by his elevation and angle he can strike the fire with maximum effect. He should ask the turntable ladder operator to make the necessary adjustments which the changing fire situation demands. The man at the head of a hydraulic platform has greater flexibility with a jet as he is able to alter the angle of elevation, within reason, without requiring adjustment to the platform.

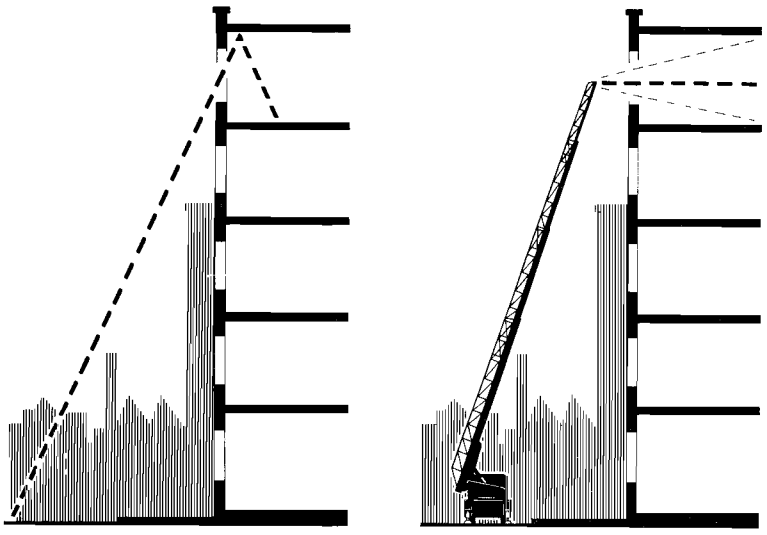

Fig. 3.11 Diagrams showing the influence of angles on the reach of a fire stream. Left: jet directed into a window from street level which fails to penetrate into the building. Right: jet from a turntable ladder level with a window showing effective reach into the building.

g. Use of spray

Many fires can be tackled very effectively with spray, because the finely-divided state of the water permits it to vaporise more readily and absorb more heat. Spray nozzles are used extensively in the Fire Service, especially on hose reel equipment, and have proved successful in dealing with quite large fires. Spray can be used at most fires except where a solid jet of water is necessary to reach the heart of the fire.

Spray nozzles are useful when first entering a burning building or room. A quick circular movement with the branch will immediately reduce the temperature, drive back the smoke and greatly facilitate the fireman's entry. Spray also has the advantage of reducing water damage. If all the water used on a fire can be converted into steam, then none is being wasted; when rivers of water are seen running out of a building, a great deal of water is being wasted through not reaching the fire.

When it is necessary to cool a large surface, such as a steel bulkhead or storage tank, to prevent fire spread, use spray. Less water is required, which, in a ship fire, may help stability. Also better distribution is obtained, more heat absorbed and there will be less risk of causing distortion and consequent damage.

If attacking a flammable liquid fire with water it must be as a spray because a jet will disperse the fire widely. A spray is also essential on fires involving flammable powers or dusts. Use of a jet could raise clouds of the substance with the possibility of explosions.

h. Use of dividing breechings

Dividing breechings (see Book 2 of the *Manual,* Chapter 8) are used to divide a single line of hose or a single outlet to give two lines of hose. They are of two main types:

1. simple dividing breechings;
2. control dividing breechings, in which the flow in either or both legs may be shut off by one or more valves.

The amount of water which a line of hose will pass depends, amongst other factors, on:

(i) the pressure at the pump;

(ii) the diameter and type of the hose;

(iii) the length of the hose line;

(iv) the size of the nozzle in use.

Factor (i) is limited by the type of pump and by the normal working pressure of the hose, whilst (ii) is limited, for hose run out by hand, to 45 mm, and 70 mm diameter hose, non-percolating or unlined. Factors (iii) and (iv) are dictated entirely by the location and nature of the fire, and (iv) also by the quantity of water available.

To run out a long line of hose and divide it into two lines by means of a breeching is to create hydraulic conditions which may render it impossible to get two efficient jets of any substantial size. Such a lay-out is, therefore, only justified where:

(a) Small diameter jets only are required, for example, for cooling down and for turning over. Preferably run out a single line of standard delivery hose and divide into two 45 mm lines, if this size hose is available. This requires less water to charge the hose, and the smaller diameter hose makes it easier to handle, particularly where the position of the branch must be frequently altered. For turning over, it may be possible, by sub-dividing hose lines in this way, to supply up to four small-size nozzles.

(b) Where the long hose lines are required there may not be sufficient to provide two complete lines. Decide whether one line of hose with one good get or a divided line with two smaller jets will be the more suitable. If two shut-off branches are available, a divided line may prove of value, for by closing one, pressure can be increased in the other to deal with a temporary difficulty.

Except in unusual circumstances, the use of dividing breechings in hose lines should be avoided for the following reasons:

(i) a single line of hose is usually incapable of conveying the quantity of water required to supply two efficient fire-fighting jets, unless they are relatively small;

(ii) unless a control dividing breeching or hand-control branches are available, shutting down one jet involves shutting down the other;

(iii) damage to the single hose line before the breeching will shut down two jets instead of one;

(iv) unless a control dividing breeching is available, the order for '*water on*' must be delayed until both lines of hose are completed and both branches are in position.

A plain breeching connected to the delivery of a pump will be open to the same objections, with the exception of (i) above, but a control dividing breeching will have the same effect as adding an extra delivery plus some loss of hydraulic efficiency.

As a general rule, a separate line of hose should be run out for each branch which is to be got to work, particularly in the initial stages of the operations, when rapid changes in the fire situation may necessitate moving individual branches without shutting off others. Even if it is essential to use small jets, because of shortage of water, the nature of the fire or inadequate manpower, individual hose lines should be used because of the greater control obtainable.

Whenever a dividing breeching is put in a hose line the size of nozzle in use will normally have to be reduced, to provide two effective jets. It is useless to divide a line of hose supplying a 25 mm nozzle and put a 25 mm nozzle on the second line also.

j. Maintaining a useful jet

Do not be content with an indifferent jet and, if it appears inadequate, remedy the position; for example, send a man back to check that the pump pressure is as asked for, check the hose line for leaks or a burst, or see whether it has been constricted by debris falling or by a vehicle parked on the hose. An officer seeing a jet is not doing useful work should have the pressure increased if possible, change its position, substitute a smaller nozzle or, if necessary, shut it down.

k. Burst or damaged hose

When a length of hose bursts or is otherwise damaged on the fireground and replaced, tie an overhand knot at each end to identify it as unserviceable. Damaged couplings should be identified by a piece of string tied round the coupling or lug.

6 Foam

Portable foam extinguishers are dealt with in Book 3 Part 2 of the *Manual* and the foam-making equipment for larger fires in Part 3 of the same publication. The principles of foam application are laid out together with points to be borne in mind during operational use. Note also the list of practical considerations on page 124 of Book 3 which should be studied in conjunction with Table 10 on page 113 of Book 3.

7 Vaporising liquids—'Halons'

Book 3, Part 2, Chapter 6 and Book 1, Chapter 12, Section 6, deal with vaporising liquid fire extinguishment and a considerable amount of information on the physical properties of the 'Halons' is given.

The main points to remember in operational use of these types of extinguishers are:

(i) The toxic effects of the agent, especially in a confined space;

(ii) The effect on the materials with which they come into contact;

(iii) Their properties, e.g. density as liquids and vapours; and

(iv) Their extinguishing capabilities.

Applied in the correct way to small or incipient fires, they can effect a rapid knock-down. Their suitability for electrical and electronic equipment is apparent and they are also efficient on small burning liquid fires. Bear in mind that they have little or no cooling effect.

The most common substances used are chlorobromomethane (CBM), bromochlorodifluoromethane (BCF) and bromotrifluoromethane (BTM).

8 Carbon Dioxide

a. Extinguishers

Carbon dioxide extinguishers and their uses are fully explained in Book 3, Part 2, Chapter 7. Section 3 of this chapter underlines the salient points to be considered when using a CO_2 extinguisher. The use of CO_2 in fixed installations is discussed in Book 9, Chapter 8, and Part 7, Chapter 3, of the *Manual*.

b. In bulk

At certain fires, particularly in large basements, underground storage warehouses, ships, etc., because of difficulty in gaining access, consideration has to be given to flooding the compartment

involved with water, inert gas, high-expansion foam or CO_2. In premises of exceptional hazard or where there are contents which could be damaged by water or foam the use of bulk CO_2 is obviously better.

Fire Service Circular No. 32/1967 first drew attention to the availability, by agreement, of bulk CO_2 road tankers to attend incidents if required by a Fire Authority. (See Plate 5).

The tankers usually have a capacity of about 10 tonne. One tonne of liquid CO_2 at about 20 bar will produce approximately 560 cubic metres of gas. Remember that fire is usually extinguished when about one third, by volume, of the atmosphere is CO_2, but allowance should be made for a loss of gas through leakage.

Tankers will be driven to the incident by the firm's driver under normal traffic conditions and officers in charge should consider the time that will be taken to attend. The drivers are instructed to ensure that fire service personnel are competent to operate the tanker and there are arrangements for prior training of personnel and for the availability of the proper discharge equipment.

Care should be taken when discharging bulk CO_2 as there is the possibility of a static electricity build-up and also low-temperature embrittlement of any pipe-work used to feed the gas into the system or compartment. CO_2 should not be used for inerting compartments or tanks which could contain an explosive atmosphere.

9 Inert gas generators

The use of inert gas to extinguish or control a fire has been the subject of numerous experiments in recent years but is now mainly used aboard ships. The use of the combustion products of diesel oil in an inert gas system is described in Part 7 of the *Manual,* Chapter 3.

10 Dry powder

The use of dry powder to extinguish fires is dealt with in Book 3, Part 2, Chapter 5, and Book 1, Part 3, Chapter 12, of the *Manual.*

Types of extinguishers are explained in the former, together with a comment on the precautions to be taken when recharging.

Consideration should also be given to the inherent dangers of dust inhalation when a dry powder extinguisher is used at a fire, especially in a confined space.

Although dry powder does not have any cooling effect on the burning liquid or metal, it does provide heat-shielding properties which reduce the risk of the operator getting burned from radiated heat, as it is necessary to tackle the fire at close quarters. Allow time for the liquid or metal to cool down to below its ignition temperature after the flames having been knocked out, and watch carefully to see that re-ignition does not occur.

In some premises, stocks of special powder may be found for dealing with fires in commodities, such as magnesium, for which other media are unsuitable. If these powders are readily available they should be used, but generally it will be found they are only suitable for relatively small fires. The whole of the burning mass should be covered with the powder to exclude oxygen.

11 Sand

Some burning materials which cannot be extinguished by the use of water may be dealt with by means of dry earth or sand which excludes the air. Dry sand may also be used for dealing with fires in letter boxes and for preventing burning liquids such as paints and oils from flowing down drains or basement lights. Also for confining shallow layers of such liquids, and permitting the use of foam or spray branches. Do not use sand for extinguishing fires in machinery such as electric motors. Its use may well necessitate dismantling the entire machine for cleaning even though the fire damage is negligible. Sand should be applied with a spade or by hand, working progressively across the burning material—using a sweeping action such as is used to grit a road.

12 Steam

Steam, for the obvious reason that it is available continuously and in large quantities, can often be used aboard ship.

As a fire extinguishing medium it is mentioned in Book 1, Chapter 12, but for more general information, especially on the operational advantages and disadvantages, reference should be made to Part 7, Chapter 3, and Book 9, Chapter 7, of the *Manual.*

13 Blanketing

People whose clothing is on fire should be laid down and covered with, or rolled in, a rug, coat, jacket, woollen blanket, etc. If they are standing or running, as will often be the case, they should be brought to the ground. Keep persons burned in this way wrapped up in the rug or whatever was used until they can be removed for medical attention. Remember, however, that fire sparks may continue to smoulder in the victim's underclothes and, if he or she is unconscious, may lead to further burning.

When dealing with small cooking fat fires, smothering with for example a fibreglass blanket may prove effective. This has the advantage of obviating damage due to the use of water or chemicals. Fire blankets are installed in kitchens of large hotels, restaurants or hospitals for dealing with fires involving fats. The blanket (Fig. 3.12) should be opened out to its full extent, held

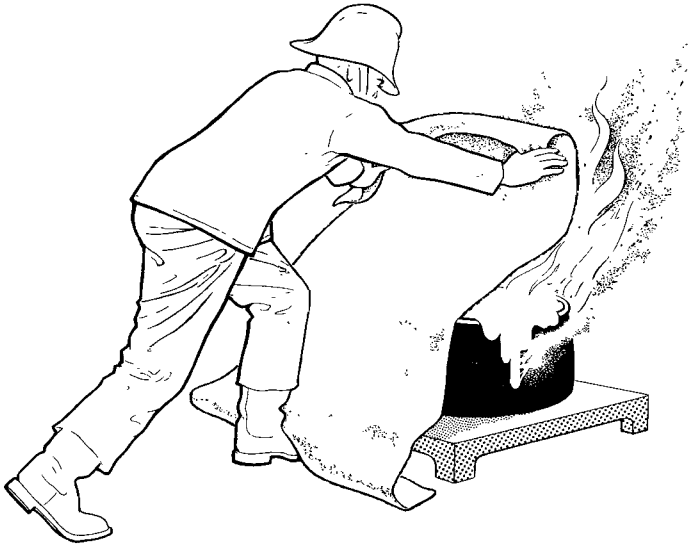

Fig. 3.12 Smothering a small fire with a fire blanket. Note how the fireman holds the blanket to protect his face and body from the heat.

more or less vertically in front of the operator and then swept over the burning material, working away from him, thus shielding him from the heat and flames. Alternatively, if a large blanket is being used on an open surface such as a vat or oil bath, two men should hold it, standing at opposite sides of the container and draw it slowly over the surface. When a fire has been smothered in this way, do not remove the blanket or the fire may flash back again. The materials should always be given adequate time to cool. If no fire blanket is available it may be possible to make use of a doormat which has been wetted. Small fires in certain substances can be extinguished by smothering them with the substance. For example, this is often done with powdered sulphur.

It is occasionally possible to exclude the oxygen from a fire by mechanical means and then allow it to burn out. Some types of vat are provided with lids which can be fitted for this purpose and fires in the machinery space of ships are also sometimes dealt with in this way.

14 Beating out

Small fires in materials such as textiles may often be extinguished by beating them out or by rolling or screwing up the burning materials tightly to exclude the air. Beating is the method normally

employed to extinguish heath, crop and other similar fires when water is not available.

15 Removal

When the fire in a room is on a very small scale a fireman can remove the burning material from the room, using an ordinary domestic metal dustbin or bucket. Hold the container in such a way that the heated fumes rising from the burning material cannot reach the face and other materials are not ignited on the way out placing the burning substance where it will not endanger other property. If a small quantity of highly combustible material, such as a mattress or curtains, is burning in a room it is advisable to throw it out of the window rather than carry it out through the house. Take precautions against any such material striking passers-by and make arrangements to extinguish it outside the building.

16 Installed equipment

Most commercial or industrial premises now come within the scope of the *Fire Precautions Act 1971*. This Act stipulates that appropriate means for fighting fire must be provided and maintained on the premises concerned. This firefighting equipment may include buckets of water or sand, various types of chemical extinguisher, hose reels and hose cradles. Sometimes special extinguishers may be provided for dealing with the risks inherent in the processes carried on in the premises, e.g., halons, carbon dioxide or dry powder extinguishers. See Book 9 of the *Manual*.

Whether or not firemen will use such equipment depends on several factors. If it has been maintained efficiently, as it should be under the Act, and where good fire protection and firefighting arrangements are in force in the premises, then considerable time can be saved by using it. The correct extinguishing medium will also be available, since this equipment will have been placed where it is likely to be required. In large premises with private installations there may be a plan of the installation showing the section covered.

A fireman who knows his station ground will be aware of the premises in which special equipment is installed. Such firefighting equipment is intended to be used by the occupants of the premises to attack a fire in its initial stages and at least to hold it in check until the arrival of the fire brigade.

A fireman will generally get to work with his own equipment but he should consider the possibility of making use of equipment on the premises. In high rise buildings this may be imperative. The use of hose reels, internal hydrants or hose connected to risers installed on the premises can be advantageous, obviating the necessity for

running out considerable lengths of hose from the street to the scene of the fire. This reduces friction loss, lessens the amount of equipment needed and leaves the staircases clear of hose lines. This is important when people may be escaping from the building.

There is a practical difficulty in operating risers to which hose in cradles is connected. The risers are usually located on enclosed staircases and all the hose must be pulled and laid out without undue kinking before water can be turned on. When getting a branch to work close to the hydrant, a considerable length of hose must be disposed on the staircase, adding to the handling difficulties. A satisfactory method of disposing of this hose is to expend the surplus by running it out up the flight of stairs and back down again. As the branch is advanced, the hose can be pulled down off the stairs, the slope assisting the branchman.

The tubing of hose reels is of considerably smaller diameter than hose in cradles, and is suitable only for dealing with relatively small outbreaks. Tubing carried on reels has the advantage that it allows the water to be turned on irrespective of the amount of hose drawn off the reel. In most models of hose reel, a valve must first be operated to charge the reel in addition to the control given by the shut-off nozzle. Types of hosereels are discussed and illustrated in Book 9, Chapter 7 of the *Manual.*

Internal hydrants, used in the early stages of a fire, are sometimes left open when the staff have been driven out of the building by spread of fire. The consequent fall in the mains pressure may hamper operations by causing a shortage of water. When this occurs, find the master control valve, normally at the front of the building on the pavement or in the roadway, and turn it off.

When a serious fire occurs in a building fitted with dry risers, charge them as a matter of routine, so that water is immediately available in the building (see page 86).

A description of dry (and wet) risers will be found in Book 9, Chapter 7 of the *Manual.* Their advantages and disadvantages are discussed, together with points about regular inspection and the ever present danger of vandalism.

Chapter 4
Fighting the fire

1 General considerations

The necessity for getting some water (or other appropriate extinguishing medium) on to a fire at the earliest possible moment has already been emphasised in earlier sections. Here we deal with a few general considerations.

a. Action taken on first entry

At any fire on enclosed premises, a quick glance before the order *'water on'* is given, can reveal, by the light of the fire, the nature of the materials burning, their location and whether the fire is spreading up stairs, lift shafts, or into other rooms. This important information will be difficult to obtain once water has been applied to the fire, due to the consequent increase in smoke and steam.

Firemen should not crowd into a small room. If only two men tackle a job then congestion and disturbance to the occupier is reduced.

Keep spare men clear of doorways and staircases. This allows fresh air to men working inside and keeps the way clear for the men at the fire to beat a retreat, if necessary. Men working under difficult conditions need reliefs at intervals, and reliefs will be much fresher if they have been in the open air instead of immediately outside the floor on fire.

b. Securing a line of retreat

When working hose into a building containing quantities of stock, firemen should make sure fire does not get behind them. Travelling, unnoticed, behind stock it can cut off their retreat and, perhaps, operate fusible links closing doors or shutters. This could restrict water supplies, fresh air and any back-up by other crews.

An officer directing men to take up a position should see that their line of retreat is secured. The rapid advance of a roof fire may cut men off from a ladder, or means of retreat may be blocked by falling debris. The safety officer should always be alert to the possibility of dangerous conditions. If necessary, he should ask for additional officers to watch particular areas within his own sector.

c. Water supplies

A main can only yield a certain quantity of water, and if too many pumps are set into it, some will be starved. The obvious solution is to set pumps into mains of larger diameter, even though they may be some distance away, or into open water. Here again, good local knowledge is invaluable. Where water supplies are inadequate for firefighting, arrangements can be made for the mobilising control to ask the Water Authority to improve supplies on the fireground.

d. Siting of pumps

Correct siting of a pump at a fire is important. It will be influenced by numerous factors such as wind direction, danger from falling debris and the chance of the fire spreading. To have to reposition a working appliance during firefighting can have a disastrous effect on the control of the fire. Pumps located relatively close to a fire allow short deliveries, reduce friction, economise on hose and help with control between the branchmen and the pump-operator.

The pressure in the main, type of terrain (uphill or downhill) and the amount of hose, and men available to lay it, will have to be considered. If the water source is too far for an efficient flow, despite twinning the soft suction, a water relay will have to be set up.

2 Working in smoke, heat or darkness

a. Working conditions

Working conditions close to a fire, particularly at floor level, are considerably better than would appear when it is being approached. Hot smoke and gases, as they expand and escape, tend to give a false impression of the conditions, and in a confined space, such as a room on fire, it is the first minute of attacking the fire which is the worst. When a jet first strikes the fire, large quantities of steam and smoke are formed which drive toward the outlet but, once this initial surge is over, conditions tend to improve considerably.

b. Electrical circuits

On entering a building, one of a fireman's chief difficulties will be his inability to see, if the premises are in darkness or if thick smoke is encountered. He must decide whether, if the electricity supply is on, it should be switched off at the main, or whether, if it is already off, it should be switched on. (For the subject of electricity generally, see Part 6b of the *Manual*, Chapter 3, 'Electricity and the Fire Service'.)

He will have to be guided by circumstances at the time, the general principle being that lights should always be used unless any definite danger would result to firemen working in the building, as

they will help movement about the building and will save much time. If the building is seriously damaged by fire and there is a chance that the electric wiring may have been damaged, the current should be cut off in order to obviate the danger of firemen coming into contact with exposed wiring (see Plate 6). In buildings used by the public it will be necessary, irrespective of the conditions, to leave the current on until all occupants have been cleared. Switching off in such circumstances might trap persons in lifts or, if the lights went out suddenly, might lead to panic. Power circuits should be switched off irrespective of the conditions except where it would interfere with the working of lifts. Such circuits are often at a higher voltage and are more dangerous.

If it is found that the current is switched off at the main, enquire why before it is switched on again. It may have been cut off because of some defect or because persons are working on machinery. Examine main switches before operating, for the design varies greatly. It is not unknown for the current unwittingly to be turned 'on' instead of 'off' or *vice versa*.

If building lights cannot be switched on, use fire brigade emergency lighting. Use hand lamps when it is necessary to move about the premises, but for prolonged lighting of the various floors, box lamps or other types of portable floodlight are best. (See Book 2, Part 4). Do not use naked lights of any type if explosive or flammable gas vapours are likely to be encountered. Box lamps are particularly useful for lighting stairs or landings. Put at doorways they will throw their light in both directions and can also serve to indicate the exit.

c. Working and moving in smoke

Firemen working in smoke should wear breathing apparatus and its operational use is fully discussed in Book 6 Part 2 of the *Manual*. The difficulties of fighting fires in basements and underground buildings are dealt with later in Chapter 5.

There may be occasions, however, when firemen not wearing breathing apparatus will seek to enter smoke to effect a quick rescue. Officers must always discourage this because trained firemen can don breathing apparatus, carry out the proper procedures and enter premises in a very short time. Wearing breathing apparatus they will be able to search quickly, thoroughly and relatively safely. Without breathing apparatus they will probably have to crawl about on the floor to be able to breathe, be under little control and, without safety devices, could easily become casualties themselves. It would follow that additional breathing apparatus wearers would have to be committed to search and rescue them instead of members of the public.

When unable to see, a fireman should remember to shuffle rather than walk, keeping a free hand moving in front to feel for obstruc-

Fig. 4.1 Method of moving backwards down stairs towards a fire in a basement.

tions. Hold the fist lightly clenched, back uppermost, so that, if a live electric wire is touched, the shock will throw it clear and not, instead, cause the hand to grasp the wire. When negotiating stairs, especially downwards, keep the weight on the back foot and feel carefully for the next step before easing the weight on to it (see Fig. 4.1). Keep to the wall side if possible to take advantage of maximum support.

d. Lost in smoke

The possibility of getting lost in a smoky building must always be borne in mind, and a mental note should be made of any features which will assist in retracing routes to safety. When breathing apparatus is being worn, guide lines will be used but in the absence of guide lines, a fireman can always find his way to safety by following back a hose line which has been taken into a building by fire brigade personnel by keeping it between the feet, but it should not be forgotten that it may run over the edge of a flat roof or out of a window or loophole far above ground level. (A loophole (see Chapter 6) is an opening above ground level through which goods can be loaded into, or unloaded from, a building by means of a rope and pulley or a crane). The branchman can always be found by following up the appropriate hose line.

In large public halls it may often be possible to feel the run of the floorboards and so keep in one direction by following them along by touch. If a man is lost in a room he should make for a wall and

then continue round it in the same direction until the door or a window is reached. Sounds from outside can often prove a guide as to the whereabouts of an exit. If it is suspected that a man is lost in smoke it may sometimes be possible to indicate to him the whereabouts of the way out by standing close to it and giving intermittent loud *slow* handclaps, as recommended for men wearing breathing apparatus.

On certain floors in some buildings (particularly the basements of large stores) there may be a central staircase only. If a circuit of the walls has been made without a way out being found, the centre should be explored. In thick smoke, mirrors may look like windows or may reflect the fire, whilst showcases may also in some instances give the same impression.

3 Preventing fire spread

There are three ways by which a fire can spread (see Book 1, Chapter 4):

(a) convection;

(b) conduction;

(c) radiation.

Although convection is probably the greatest single cause of the spread of fire, especially in multi-storied buildings, nevertheless, most fires develop by

(d) a combination of all three processes.

a. Convection

Since smoke and heated gases tend to rise (Fig. 4.2) they will find any openings in horizontal surfaces which permit them to escape. The natural path of travel is therefore vertically above the seat of the fire until the smoke and hot gas or flame reaches the ceiling, when it will mushroom. If there are open doors, transom lights, ventilation ducts, holes for pipework or cable ducts, the smoke will escape through these until it reaches a staircase or other opening in a horizontal surface. Such paths may be direct openings such as lift shafts (Plate 7) and stairwells of all types, trap-doors, skylights, belt races, conveyors or escalators, or partially or wholly enclosed openings, like overhead bridges spanning between adjacent buildings, ducting for ventilation, heating, dust or fume extraction. Where pipework passes through from one floor to another, a bad fit and gaps may allow sufficient space for hot gases to percolate through. A later size-up of the situation will include a quick recognition of such features which could allow fire to spread to adjoining compartments, laterally or vertically.

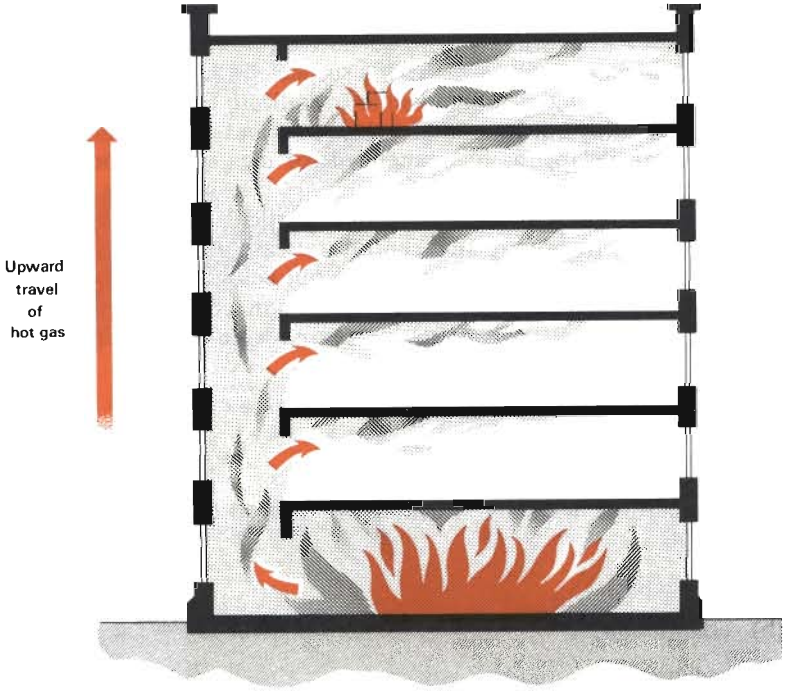

Fig 4 2 Sketch showing how fire on a lower floor can spread to upper floors by convection

Windows can spread fire, for heat rapidly breaks exposed plain glass and allows flames to curl up into the windows on floors above (Fig. 4.3) sometimes even missing a floor. Wired glass, however, is a good reducer of fire spread. Wired glass panes in metal frames will hold back a relatively intense fire for a considerable period. Materials in adjacent rooms or buildings can be ignited by heat or flames passing through windows which are open or break with the heat, and separating walls cannot be relied on to provide a fire-break if flames can pass round them.

b. Conduction

Most metals are good conductors of heat, and therefore inspect the ends or sides of all joists, piping, shafting and other similar objects outside the affected compartment which might transmit the heat of the fire to adjacent compartments. Central heating or machinery, for instance, is often installed long after the building was completed, and openings for the pipes or shafting may be cut through walls which were originally designed as fire breaks (see

Fig 4.3 Fire can spread from floor to floor via windows which are open or which have been broken by heat.

Plate 8). These do not present a great hazard if they are well away from all combustible materials but often goods are stacked on or against them. Central heating piping, carried close to the walls or under the floors, is nearly always close to timber and dust in floors or skirtings. Pipes for steam heating present a greater hazard than those used with low pressure hot water.

Machinery shafting may cause fire spread, for it may be suspended from wooden roof members in bearings which transmit the heat and ignite the wood. The bearings are usually well lubricated, and large oilers may contain sufficient oil, or oil-soaked dust and cotton waste, to catch fire and fall to the floor, or alternatively, to involve the roof structure above.

The modern trend in building is to use reinforced concrete, but a large number of premises still have steel beams and joints as part of the structure. A common cause of the spread of fire by direct conduction is through such steel beams. In some premises these beams are exposed, and capable of receiving and transmitting heat generated in their compartment. In multi-floored buildings with a steel frame structure with brick panel walls, the walls may resist the transmission of heat, but any exposed steelwork will act as a good conductor and ignite combustible materials in adjoining compartments.

On the other hand, steelwork which has been encased in brick or concrete can withstand a considerable amount of heat before it is affected by the fire, and before it will conduct heat into adjoining compartments. The encasing of the steelwork tends not only to prevent it heating up when surrounded by fire, but also to confine any heat it may have gained. (See Book 8 Part 2 of the *Manual*)

A fire-resisting door will usually form an effective fire break (Plate 9), but inspect carefully on the far side to see that fire has not broken out there. The door may have been left partially open or occupier's goods stacked too close to the door for it to close. The solid iron doors, which are sometimes found in commercial premises, should not be regarded as being necessarily fire-resisting and should be carefully watched. They may buckle with heat and allow flames to pass through the resulting gap between door and jamb.

c. Radiation

Radiation is when heat is transferred from source to receiver without heating the intervening medium or without the existence of a material medium. An example is heat received by the earth from the sun entirely in the form of electro magnetic waves or radiation and it is well known that sun's rays can ignite combustible materials, especially if concentrated by means of magnifying glass.

Radiation can spread fire when it has attained any magnitude by 'jumping' from one side of a street to the other. Intensity of radiation diminishes rapidly with distance, so that an open space of sufficient width is the most effective type of fire break.

Radiation of sufficient intensity can ignite woodwork of windows or doors and break windows in exposed property, permitting the entry of heat and flying brands. Radiant heat can also pass through windows without breaking them and cause a fire. Examples of this are the fires which occasionally occur as a result of the concentration of the sun's rays through carafes of drinking water.

Radiant heat from a fire falling on a vertical surface of slate which has been nailed in position or fixed with lead clips, may crack the slates, allowing them to fall away, or melt the lead clips, with the same result. The exposed timber battens to which the slates are fixed, unless cooled, will probably ignite. Radiant heat may also soften or melt the lead in leaded glass windows used for decorative purposes, allowing the glass panels to fall out.

(1) Water or foam curtains

The effects of radiant heat can be countered by forming a water curtain between the burning building and that to be protected. The spray and steam formed absorb a considerable proportion of the radiant heat, and the building to be protected is also cooled to

below the ignition temperature of any exposed combustibles. In keeping the whole of the surface of an exposed building cool, avoid water damage, if possible.

High expansion foam has good insulating properties and can, in suitable circumstances, be very useful in protecting against radiated heat.

(2) Drenchers

Drenchers are sometimes fitted to protect the openings in the face of a building which are particularly vulnerable to radiated heat (see Book 9 of the *Manual,* Chapter 7 'Other installations using water'). Where it is installed, an officer should try to get the equipment into operation if it will assist in preventing the spread of fire. The system will normally protect the building better than fire brigade branches, and will release personnel for other firefighting duties. Remember a large drencher system may cause a serious drain on the mains, and the officer in charge of the fire should plan the best use of his available water resources.

d. Combination of methods

The great majority of fires are spread by a combination of these three processes—convection, conduction and radiation. At large fires, convection and radiation probably produce the greatest fire spread, but conduction is often a contributory cause. The following paragraphs deal with the effects and the prevention of fire spread as a result of all three methods.

(1) Fire-resisting walls

Most property is isolated into sections by fire-resisting walls. A fire-resisting wall is one which is, or can be, completely closed against direct communication of fire from one side to the other. Separating walls (formerly known as party walls) (i.e., the dividing walls between adjoining buildings as defined by the *Building Regulations 1976*, which were made under the *Public Health Acts 1936 and 1961*) fall into this class but, owing to the age of a large proportion of the buildings in this country and to irregular methods of building in the past and present (see Plate 10), they frequently do not fulfil this requirement.

In older buildings, wooden beams or roof timbers may run right through or over the separating walls from one side to another. The ends of the timbers of two adjacent houses may be separated by only a few inches of brickwork in which mortar is cracked, allowing the fire to pass.

(2) Concealed spaces

Direct burning is the principal method of fire spread in partitions (Fig. 4.4) and concealed spaces generally (see Plate 3). Hollow

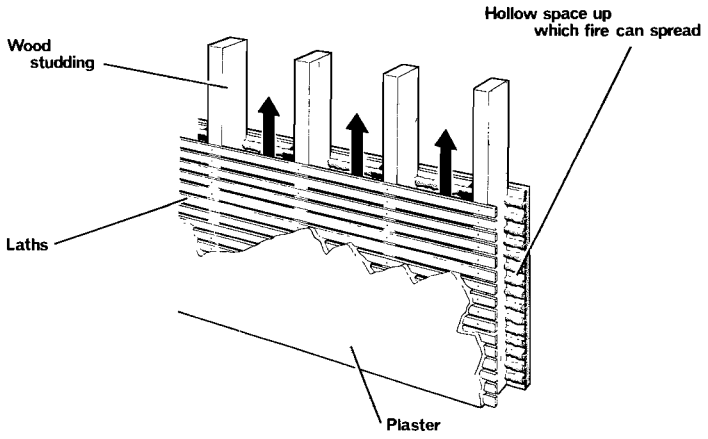

Fig. 4.4 The construction of a hollow partition and the spaces up which fire can travel undetected. These spaces form excellent flues and can allow the fire to travel with considerable speed. Alternatively the hollow space may sometimes be packed with combustible filling such as sawdust or wood-wool.

partitions may occasionally be found in very old buildings, extending through more than one floor, usually in adapted property as, for example, in a room with a high ceiling which has been divided into two by inserting a false floor. It is necessary to feel carefully for heat both above and below the fire if it is suspected that such a partition may have become involved.

Hollow partitions will sometimes be found packed with straw, sawdust, shavings or foamed plastic, but this type of construction is more usually associated with heat or sound insulation. Fire will continue to spread through this type of construction and, though more intense, is not usually so rapid as through hollow partitions, where a free current of air can carry the smoke and heat with great speed.

Systematic feeling of walls and skirting boards gives a good indication of the extent of fire travel in concealed spaces. Check the hottest parts at frequent intervals to ascertain whether they are cooling down. This can often determine, with some degree of accuracy, whether there is fire behind them. Heat may cause discolouration of plaster or wallpaper and smoke will frequently percolate through cracks in the plaster itself.

If any doubt remains, small portions of the partition or skirting should be carefully cut away to check whether there is fire in any concealed place. In the room where fire has occurred the plaster of lath and plaster walls may be too hot on the surface to be touched by the bare hand. The lath behind may be unaffected by the fire

and much unnecessary damage can be caused by cutting away indiscriminately instead of finding out definitely whether there is any concealed fire. The presence of cobwebs is an indication that fire has not passed the point at which they are found.

In some buildings there will often be loose boards where electrical wiring or gas piping has been installed, and these can be lifted with little trouble when looking for the spread of fire under floors.

(3) Ducts, etc.

Be careful when introducing water into a duct, as the water may be carried for considerable distances and damage caused.

(4) Flying brands

Flying brands are the result of convection currents and direct burning. The uprush of heated air above the fire carries small pieces of flaming material sometimes to a great height, and considerable distances. Brands alighting on combustible material will ignite it, and, in the vicinity of a large fire, occupiers of premises should be warned to watch for further outbreaks.

Considerable danger arises from brands being carried into open windows, so warn residents in the vicinity to shut their windows. Detail firemen to shut open windows of unoccupied property nearby or, if they are broken, to patrol with a hand pump parts of buildings which might become involved by flying brands.

4 Explosion risks

A serious danger with fires in certain premises is the risk of explosion, which may be due to:

(a) dangerous gases evolved in the course of combustion of the materials on fire, or town or other gas escaping from fractured or burst pipes;

(b) the nature of the contents.

a. Dangerous gases

Where combustion is taking place on a larger scale, there is always danger from the development of explosive mixtures of gas and air. Even if the explosion is not violent it may suffice to drive a flame back and burn persons nearby. A good example is furnished in steam boiler practice. When a Lancashire boiler is shut down overnight or at meal times, the fuel bed may be covered with raw fuel. Under the influence of heat, gas will be given off and drawn by the slight chimney draught into the flues. When the time comes to start up the boiler, if the damper is incautiously opened there is

danger of air explosion in the flue system with consequences which may vary from minor burns to the fireman to a very destructive explosion. In such cases, there will have accumulated gas-air mixtures which, in composition, approach the appropriate limit of flammability. The opening of the damper allows the inrush of air, bringing the mixtures within the range of flammability and only a flame or spark may be necessary to cause ignition. Remember that great damage can be caused by the flammation of weak mixtures when the bulk is large.

Analogous phenomena can occur in burning buildings, if circumstances allow pockets of mixtures of air and unignited combustible gas to accumulate. Wood, for instance, decomposes to give gaseous products at quite low temperatures. Some materials such as celluloid are even more unstable. Hydrocarbon oils especially, such as petrol or naphtha, may readily give rise to rich mixtures of air and vapour. An inrush of fresh air from any source or cause, will bring a mixture into a dangerous condition, with the possibility of a 'flashover' occurring. Hot gases in a burning building, being lighter than air, provide inward draught like the chimney of the boiler and only await the opening of a door or window to draw in air, sufficient to produce an explosive mixture.

Escaping gas forms the other major explosion hazard. Gas escapes may be due to a variety of causes, by the fracture of a pipe through a settlement in the premises caused by the fire, by expansion or contraction of the pipes due to heating or cooling or by the melting of the lead pipes by which gas meters are usually connected into the system. In this last instance, however, the escaping gas will normally ignite and will not therefore cause an explosion danger. In some industrial premises where large scale welding operations are carried out, acetylene or liquefied petroleum gas in cylinders and fixed pipework may be found. Escapes of acetylene due to fractures in the pipework may therefore lead to explosive concentrations, since the explosive range (see Part 6B, Chapter 2, 'Fires in Gas Works') is very great. Remember that liquefied petroleum gas, e.g. propane or butane, escaping from a leak and being heavier than air, may collect in basements or low lying areas. (see Part 6C, Chapter 45, Section 5 of the *Manual*).

b. Nature of Contents

The nature of the contents of industrial premises will vary greatly, and it is impossible to do more than touch on a few of the points to which consideration should be given.

(1) Dust explosions

As is pointed out in Part 6C of the *Manual,* Chapter 45, certain combustible substances, of which flour and starch are outstanding examples, when in a fine state of division are capable of behaving

like gases and can give rise to serious explosions (dust explosions) when mixed with air in the correct proportions and then ignited. Where there is any such possibility, operations should be carried on so as to disturb the powdered material as little as possible. In particular, jets from branches should not strike the finely divided material and stir up dust clouds. Spray should be used to attack the fire and damp down any dust which might otherwise fly. Where explosive conditions are believed to be present, branches should be laid out to cover possible spread and every available aperture in the building opened to vent any possible explosion.

(2) Protecting sealed containers

When siting branches, provision must be made for protecting any surrounding hazardous commodities. In premises where compressed gas cylinders (oxygen, acetylene, etc.) or sealed drums of liquid are stored, there is danger that the heat of the fire might raise the temperature of the cylinders or drums sufficiently to cause them to burst. This also applies to empty drums which have contained flammable liquids or the petrol tanks of motor vehicles. To guard against this, water must be applied liberally as a spray.

Water should be kept off the hot fronts of boilers or pipes carrying superheated steam, or the sudden cooling could cause a fracture with consequent release of large quantities of boiling water or steam.

5. Dangerous fumes

Dangerous gases or fumes resulting from fire may also be encountered in industrial premises. These may be poisonous, such as chlorine, flammable and explosive, such as hydrogen, or corrosive and evolving dangerous fumes, such as hydrochloric or nitric acids. There is also a group of substances, known as organic isocyanates, which have an unusual degree of toxicity and which are being increasingly used in chemical plants for the manufacture of polyurethane foam and synthetic rubber. Not only is the vapour of these isocyanates a great respiratory irritant, and a serious risk to the vital internal parts of the body, but they also require extreme care in handling because of their chemical reactivity.

Firefighting techniques will vary according to the substances involved and the more common hazardous chemicals likely to be encountered are dealt with in Part 6C of the *Manual*, Chapter 45 'Special and unusual risks'. Breathing apparatus and protective clothing will certainly be required for personnel working inside the premises but it must also be remembered that other personnel outside the premises, not wearing B.A., will have to be kept away, and upwind, from the incident.

If they are in attendance, the guidance of works chemists or other qualified persons should be sought on how to tackle the substances involved and minimise the risk to personnel.

In other circumstances it will be necessary to obtain information on the hazards, means of extinguishment and appropriate action to be taken by operating the Brigade's chemical incident procedure.

The amount, or nature, of gases and fumes emitted at a particular incident may require the evacuation of the civilian population down wind. The co-operation of the police and local authorities should be obtained to ensure this is carried out quickly and efficiently.

Carboys, particularly if half empty, also constitute a hazard, and, generally, should not be moved unless it is absolutely necessary, since the risk of breakage is probably greater than that from the fire. Since carboys are usually made of glass, they will break if dropped, releasing their contents, which are often dangerous. If carboys have to be moved and the wicker or iron handles appear unsafe, make a line fast around them and carefully drag them away, or a plank might be used as a stretcher to carry them.

6 Collapse of building

a. Overloading

Throughout firefighting operations maintain a close watch to ensure that dangerous conditions which might lead to the collapse of the building are not set up. Heavy machinery on the upper floors of a building can prove dangerous in the event of weakening of the walls or supports and water should be removed from upper floors as soon as possible. A few inches of water spread over a large floor area may weigh several tons and, together with the merchandise already stacked there, may load the structure beyond its capacity.

A detailed account of the various methods of clearing water from a burning building will be given in Book 12, Part 4 of the *Manual* (currently Part 6a). In exceptional circumstances, however, (e.g., in certain categories of cotton warehouse), it may be desirable to arrange to cover the floor above the fire with a thin sheet of water to prevent the spread of the fire upwards.

b. Expansion

Water played on to absorbent substances is a twofold risk. First it will cause them to expand considerably and, if tightly packed, may force out the walls or displace columns. Second, all water so absorbed cannot be cleared and adds to the floor loading. Of these substances, the most important are tea, hops, cereals, many forms of textile fibres (wool, hemp, jute and rags), paper and wood pulp.

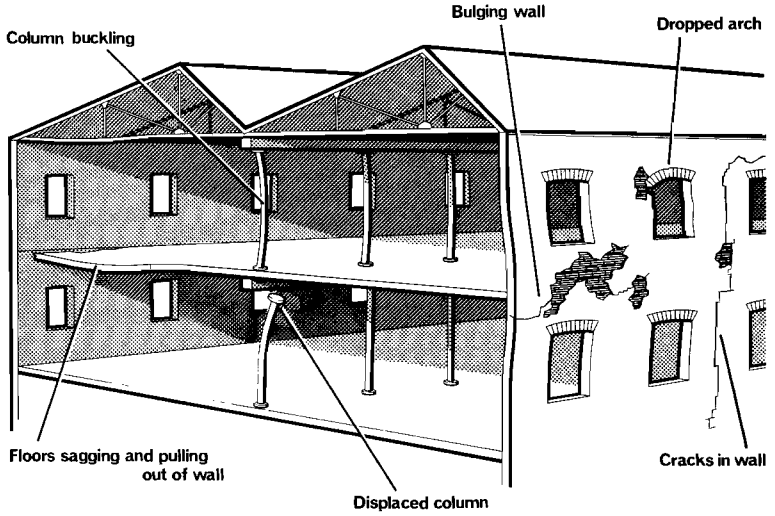

Fig. 4.5 Diagram showing (greatly exaggerated) some of the more usual signs of collapse in a building.

Another example of an expansion hazard can happen at a fire in a modern building finished with 'curtain' walls. The unequal expansion of the elements of cladding can allow the glass panes or facing panels to fall out.

c. Symptoms of collapse

The first signs of impending collapse of a building (Fig. 4.5) are often the fall of pieces of mortar, stone, etc., from the walls. These are sometimes accompanied or followed by leaning, cracking or bulging, and when these symptoms occur collapse may be imminent. Leaning or bulging can often be detected by going to one end of the building and looking along the face.

In assessing the probable tendency of a wall to collapse, consideration should be given to its apparent age, to the condition of the mortar, to the intensity of the fire (Plate 14) and to the length of time it has been burning. Points to watch are long stretches of wall which are not keyed to cross walls at intervals and which are relatively thin in relation to their height.

In buildings having steel joists, walls may fail through the expansion of the joists pushing the walls sufficiently out of perpendicular to cause them to collapse. Sometimes the result of the expansion is to punch a hole through the brickwork lying at the end of the joist. If the wall does not collapse, the joists will contract when they are cooled through the application of water or through

the extinction of the fire and, since the walls will not also return to the perpendicular, the shortening of the joists may cause them to fall off the wall plates and the floors to collapse.

Stone walls, especially those made of granite, sometimes give relatively little warning of impending collapse but, since they are very robustly constructed, they are only likely to fail if the fire is serious.

Cracks appearing in a horizontal line over windows and doorways are usually more indicative of danger than vertical cracks. Unprotected steelwork is very vulnerable to the effects of high temperature, and cases have been recorded of the collapse of a complete steel-framed building through the distortion of exposed steelwork, after a relatively short exposure to the fire.

Walls will usually fall outwards (Plate 15), but may be brought down inwards, particularly by the collapse of one or more floors. At fires of great intensity where it is considered possible that walls may collapse, appliances should never be placed where they would be endangered. The corners of a building will be safer points from which to work.

In premises with load-bearing walls, a considerable measure of stability is given by the support of the floors. If these have collapsed, the walls will be weak and should (unless they are unusually thick) be regarded with suspicion.

The principal signs of collapse of a building are:

(1) cracked or dropping arches over doors, windows and other openings;

(2) spalling of stonework, falling of cornices, etc., particularly on buildings with heavy facings of ornamental stone;

(3) sagging floors or beams or gaps between the edges of floors and the walls;

(4) displacement of steel or cast iron pillars supporting joists or beams. (See Plate 12)

No officer should risk the lives of his men if there is the probability of collapse. He should order them clear of danger immediately.

7 Dealing with occupants of premises

When dealing with a small fire in a private house, the fireman should consider the occupants, because for them it is a time of stress. Avoid carrying unnecessary dirt about on boots and do not stand on furniture without first covering it up. A fire in a private house is just a technical problem to the fireman, but it is a misfortune to the occupants involving sentimental considerations and, often, financial loss. In addition, the suddenness with which a

fire occurs may lead, particularly at night, to shock, causing over-excitement and hysteria. Deal firmly but sympathetically with people affected.

If the occupiers are particularly concerned about any object of intrinsic or sentimental value, a special effort should be made to meet their wishes, provided that firefighting considerations are not affected. Do not allow anyone to remove materials from the premises unless the officer in charge is satisfied about ownership. Money found should be counted in front of a witness, and valuables should be handed over to the owner, or if not available, to the police.

In commercial buildings the manager or owner should be contacted. He may consider certain areas (drawing offices, computer suites, record vaults etc.) to be very important and ask for an extra effort to be made to protect them.

There may be a large staff on the premises who will have to be evacuated as quickly as possible. An officer in charge should remember that some people have no sense of urgency or danger and will have to be assisted from the building. Others tend to want to go back into the building for personal articles and this, of course, must be prevented.

8 Evacuation of premises

Many fire brigades use some form of evacuation signal, although some prefer verbal instructions to the officer in charge of crews. The *Central Fire Brigades Advisory Council* has recommended that a standard signal should be adopted by those brigades which use an evacuation signal.

The signal recommended is repeated short blasts on a whistle of the Acme 'Thunderer' type. The advantage of whistles over other loud signals made outside premises is that they can be relayed inside a building so that there is a better chance that all persons concerned will hear them. They also allow the warning to be localised if it is desired to evacuate only part of the premises. A further advantage is that the sound of a whistle is distinctive.

In brigades where an evacuation signal is used, whistles should be carried by all leading firemen and ranks above; in addition, a whistle should always be available for the officer in charge of an appliance. Whistles should be used *only* for the standard evacuation signal and *not for any other purpose* (e.g., they should not be used for pumping signals).

On hearing repeated short blasts from a whistle firemen should make their way as quickly as possible out of the premises. The withdrawal should be orderly so that a dangerous situation is not caused. Everything possible should be done to achieve complete and immediate clearance of all personnel including members of the

public and other Services from the risk to a place of safety. Equipment that cannot be immediately withdrawn should be left *in situ* and branches which may be still working should be shut down if possible or made as safe as circumstances permit.

The use of alarm horns as a warning to firemen working at incidents on railways (see Part 6B of the *Manual,* Chapter 3, 'Electricity and the Fire Service') is not affected.

Chapter 5
Dealing with various types of fire

In this *Manual* it is impracticable to deal with the many types of fire which the fireman may face at some time in his career. Hints are given on a few of the normal fires which will often be met and the general principles on which they may be tackled. Some details are also given of some of the particular incidents which require special consideration.

1 One room fires

A hose reel should usually be adequate to tackle a fire in a single room, and the attack should be through the doorway, as this will prevent the fire spreading. If the door into the room is shut, before opening up, the branch must be in position with water available. A severe fire even in one room will normally be visible from the outside. If smoke is thick, the branchman should wear B.A. and crawl along the landing or passage with his head well down. As soon as the door has been opened (see Part 2, 'Methods of entry into buildings', Fig. 7.9) he should direct the water on to the ceiling and should keep the branch moving, after which he can attack the main portion of the fire. Working his way sufficiently into the room, he should direct his jet or spray behind on to anything previously obstructed by the door, until the fire has been extinguished.

Immediately the fire has been extinguished, water should be shut off and the room ventilated. Other members of the crew should examine the rooms adjoining, and those above and below for traces of fire.

Upholstered furniture, bedding, etc., which are on fire should be removed, where possible, through the window. They can be extinguished outside without causing further damage. Except where it is necessary to inspect adjacent rooms, men should not tramp through unaffected rooms carrying dirt about the premises and possibly causing damage to floor coverings.

Fires in private houses present the greatest opportunity of doing a good salvage job, as well as fire extinction. Every opportunity should be taken to prevent damage by water or unnecessary cutting away (see Book 12, Part 4 of the *Manual*, present Part 6a).

2 Chimney fires

Chimney fires can lead to serious results, particularly in old houses, and their successful extinction is often a long and difficult task. More chimney fires are attended than any other single category (in 1978 it is estimated that fire brigades in England and Wales attended 39 000 chimney fires as compared with 115 000 attendances at fires in property, i.e., approximately one chimney fire to every three other property fires) so the fireman comes into contact with the public at this type of fire more than any other. The efficiency and consideration shown by firemen is therefore frequently judged by their method of dealing with chimney fires. Every effort should be made to extinguish each outbreak in a manner which will cause the least damage and inconvenience to the occupiers.

The technique used for extinguishing chimney fires varies throughout the country, but the more common methods are given below. The particular method to be adopted will depend upon the circumstances. A fire low down in the flue would normally be tackled from the grate and one at a higher level from the roof. There is seldom any great urgency when dealing with these fires, and impulsive and hasty action should be avoided. Consider the situation carefully and decide upon a definite plan of action before making any attempt to tackle the fire. The four principal methods employed are:

(a) attacking from the grate;

(b) attacking from the roof;

(c) attacking either from the soot door or register plates in the chimney breast or at intermediate levels.

a. Attacking from the grate

This is usually the simplest and quickest method, particularly in the short, straightforward flues found in dwelling houses of two or three storeys only, and is likely to cause less damage. The affected grate can usually be found without difficulty by the particles of burning soot falling onto the hearth or from the roar in the chimney.

When the fireplace has been identified, clear away rugs, carpets, etc., from in front of the fire, clear the mantelpiece and push any furniture to the side of the room farthest from the fireplace, and, if possible, cover it. A dam should then be made in front of the fireplace with sacking, rags, soaked newspaper or any other convenient material, to contain any water or debris which may fall from the flue. A little water should then be applied to extinguish the fire in the grate. This causes steam to rise and will often itself extinguish the fire in the flue. If this is not successful, then the use

of a hand pump or hose reel will be necessary. Before using a jet up the chimney, it is advisable to examine the flue in order to see, if possible, where the pocket of fire is. Use a mirror (any household mirror will serve), since falling particles of burning soot may cause eye injuries if any attempt is made to peer up the chimney.

If the seat of the fire can be found and is within a short distance of the grate a jet from a hand pump may be sufficient to extinguish it. If it cannot be found, or it is a considerable way up the flue, chimney rods (see Book 2, Part 4, 'Small gear'), which can be pushed up the chimney, will have to be used. The special chimney nozzle of the hand pump should be screwed to the upper section of the rods and pushed slowly up the chimney, water being pumped through at such a rate that the greater part of it is vaporised, the steam helping to blanket the fire farther up the flue. These methods will usually result in the rapid extinction of the fire, except in long or tortuous flues.

Simple chimney fires can sometimes be extinguished from the grate by excluding the supply of oxygen to the flue. Some older fireplaces are fitted with a register plate (marked A in Fig. 5.7, *above*), which can be pulled down so as to close the chimney completely. When this is possible, it will often be successful, except in old houses with faulty chimney construction. Most modern open fireplaces do not have any means by which the flue can be closed.

In very old property attacks from the grate will be difficult because an oven has been installed. This will have to be removed before the fire can be tackled. These are usually held in position by a single large wing-nut inside the oven at the back which can easily be taken off. In some old houses kitchen ranges are still found, and there is usually a register plate (Fig. 5.1) or other inspection opening fitted above the range through which a jet can be inserted.

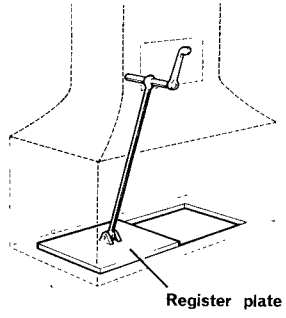

Fig. 5.1 Diagram showing how the flue above certain old types of domestic range can be shut off by means of a register plate.

b. Attacking from the roof

If the fire is in the upper part of a long flue, attack from the roof will often be the only means of extinguishment. Before attempting to deal with a chimney fire from the roof, ensure that the correct chimney has been found, as water poured down the wrong flue will damage the contents of the room served by the chimney. Some of the various methods which can be used to identify the correct chimney are as follows:

(1) It will usually be possible to identify the correct stack or group of chimneys without any difficulty. When this has been done, the easiest method of identifying the correct chimney is to place a hand carefully over each chimney in turn. The chimney on fire will usually be indicated by great heat so take care not to get a burnt hand. If excessive heat is not apparent, the one which is on fire should blacken the palm.

Although now prohibited under *Building Regulations,* old houses may have two fireplaces served by a single divided flue (Fig. 5.2, *right*). Check by counting the number of fireplaces in the house, and then the number of chimneys. If there are fewer chimneys than fireplaces, then one of the flues is divided. It will still be possible to find which flue is affected, but special precautions against damage must be taken.

(2) Water can be applied to the affected grate, when the rising steam from the chimney will reveal which is the correct one.

Once the correct chimney has been identified, the fire should be attacked with, if possible, hose reel equipment after the precautions against damage to the contents of the room described in paragraph (a) above have been taken. They must be taken in all the rooms likely to be affected if it is suspected that the chimney serves a divided flue. A hose reel is more effective, simpler and safer to use than a hand pump or buckets, owing to the difficulty of working on the confined space of a chimney stack or roof ridge.

When putting water into a flue do not lean over the chimney, since the sudden generation of steam and possible blow-back when the water reaches the fire may cause serious injury. Close co-operation and communications between the men working in the room and those on the roof is necessary to minimise water damage. The man below should give the order *'knock off'* immediately water is seen to be issuing from the grate, since this is usually a sign that a fire is extinguished.

When tackling a chimney from the roof the following points should be noted:

(1) Chimney stacks are often difficult to get at and, unless access can be simply and safely achieved by the stairway, trap-door or skylight, or by means of a roof or hook ladder, do not hesitate to order on an escape, turntable ladder or hydraulic platform. It is far better to turn out another appliance than to endanger a man's life

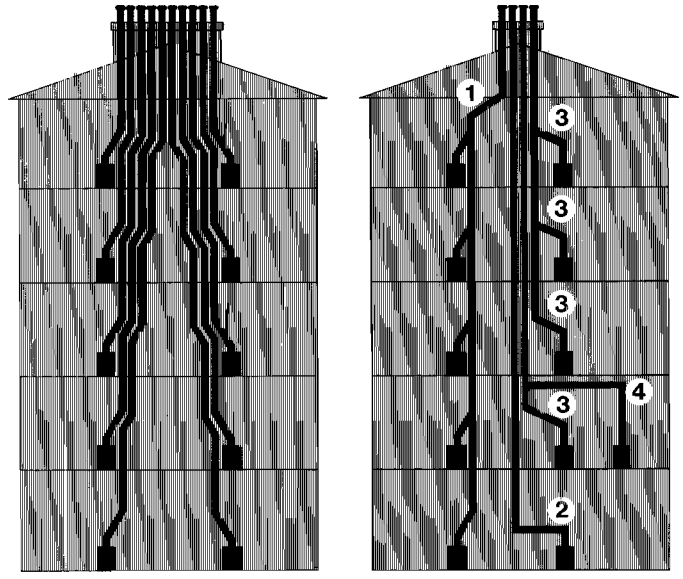

Fig. 5.2 Left: Arrangement of individual flues to fireplaces as required by Building Regulations. Note that all bends are constructed so that pockets of soot cannot lodge in them. Right: bad features in some old types of chimney showing (1) one flue serving several fireplaces; (2) horizontal bend in which soot can collect; (3) flues with insufficient slope; (4) flue subsequently constructed to take a domestic boiler.

by making it necessary for him to work in a difficult and dangerous position. Sometimes the chimney is virtually unreachable without the assistance of a turntable ladder or hydraulic platform. If an escape, turntable ladder or hydraulic platform is used, the fire can be tackled quickly and simply by taking up the hose reel tubing.

(2) The brickwork of chimney stacks may often be faulty, owing to age or lack of repairs. Do not rely on it to give a firm hold unless it has been carefully examined to ensure that the mortar is in good condition. The brickwork at the base, in the ridge of the roof, is more solidly constructed and should be used.

(3) Chimney pots crack very easily with heat, and care should be taken not to handle them or to allow water to fall on to them. Pots have been known to break up with an almost explosive effect on the application of water and cause serious injury to men on the roof. If a chimney pot is at all suspect it should be carefully removed and lowered (not thrown) to the ground.

(4) Remember old roofs can be porous so do not splash too much water around. Also take care not to break or damage slates and tiles.

c. Attacking at different levels

Old houses with a roof void sometimes have an inspection door in the chimney breast, which can be reached from the roof void. If access to the roof is difficult, it may help to tackle the fire through this door. If this is done, avoid water damage to the ceiling below. Inspection doors are also sometimes fitted at various levels in the flues above the grates. If the fire has been particularly fierce and heat is still apparent after water has been applied from above or below, if possible, open these doors and introduce a hand pump or hose reel nozzle to cool the chimney. If inspection doors are not fitted, remove a brick or two at the hottest point for the same purpose.

Again, during the preliminary inspection of the chimney, it may be found that the greatest heat is concentrated at one point. In this case, if an inspection door is fitted near-by, attack the fire first through this, and it may be possible to extinguish the fire quickly by this means. This should only be necessary in long or involved chimneys when the seat of the fire is difficult both to locate and attack.

As with all fires, care should be taken when dealing with chimney fires to ensure that the fire is extinguished. If there is any doubt, a visit should be made later. The occupier should be told that, if the flue shows any signs of heat after sufficient time has elapsed for it to cool, the fire brigade should again be notified.

When it is believed that the fire has been extinguished, the rooms on every floor should be examined for hot walls or ceilings. If the flue is located on a separating wall, inspect the adjoining premises, if possible. Ceilings should be carefully examined for discolouration. It is not unknown for sparks to ignite the soot which sometimes collects in the space between ceiling and floor above as a result of a defective flue. An accumulation of soot is also sometimes found in roof voids as a result of defects in the chimney breast (Fig. 5.3) and ceilings of upper floors should be examined for discolouration or signs of heat.

When it is certain that the fire has been extinguished, leave the premises clean and tidy. Affected rooms should be cleared up, any water or soot on the floor swept up and removed, and carpets and furniture replaced.

Before firemen leave the premises, the occupiers should be advised not to leave the room empty for some hours because of the danger from particles of burning soot, which may fall into the room. If a fireguard is available, this should be placed in front of the grate but, if not, leave the carpets rolled back from the fireplace. Occupiers may ask if they can relight the fire. It is best to recommend that the chimney be left to cool for 4 or 5 hours.

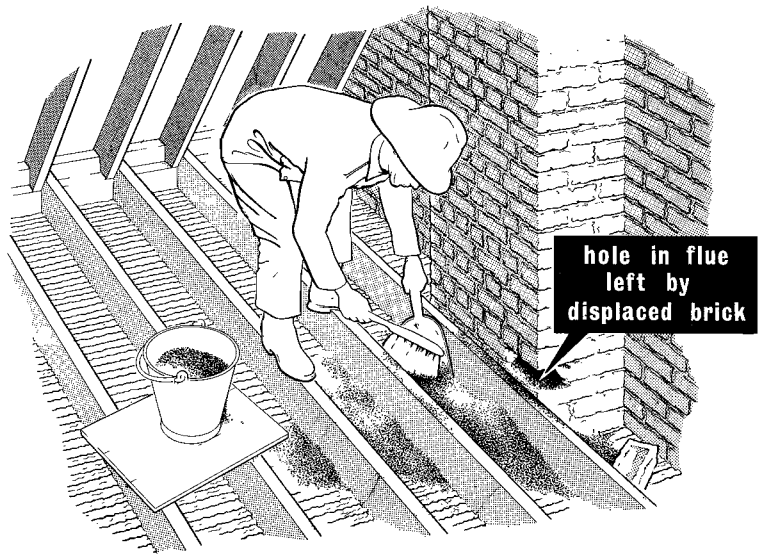

Fig. 5.3 Working in a roof void. Note how the fireman is standing on the joists and has placed a bucket on a board to prevent it resting on the laths. The way in which a displaced brick can allow smoke to escape and soot to collect in the roof void is clearly shown

3 Hearth fires

Defective hearths and fireplaces are a source of fires in old houses. The correct construction of hearths and chimney breasts has been dealt with in Book 8 of the *Manual*, Part 2, 'Building construction and structural fire protection'. In old houses trimmer joists were often not used and the flooring joists projected into the brickwork of the chimney, or were laid immediately below the hearth. In the former case, the breaking away of the pargeting in the chimney may expose the ends of the joists, which will then smoulder and char, and, if sufficient oxygen can reach them, burst into flame. The thin layer of hearthstone was reasonably safe with the Victorian type of fireplace (Fig. 5.4, *left*), where the fire itself was some distance above the hearth. In houses which have been reconstructed or fireplaces modernised, however, well type grates (Fig. 5.4, *centre* and *right*) are often installed without suitable precautions being taken to insulate the joists below from the heat of the fire (see Fig. 5.5, *left*). The fire is therefore in close proximity to the joists, and it is only a matter of time before they catch fire, and the fire spreads below the floorboards.

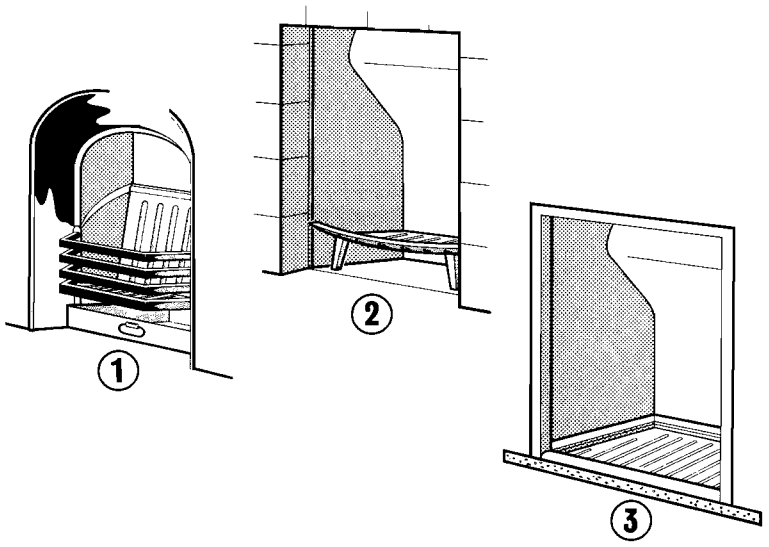

Fig. 5.4 Various types of fireplace. Left: Victorian type with ash pan which screens the hearth from the full heat of the fire. Centre: semi-well type. Right: well type in which the hearth is exposed to the full effects of the fire.

Good firemanship can be best demonstrated to the public when dealing with hearth fires. The difference between a neat and workmanlike cutting away (together with the careful removal of all debris) and the mess which results from a carelessly tackled job, is immediately apparent, even to the most inexperienced eye. A difficult hearth fire, properly handled, should result in little more damage to property than that caused by the fire itself. Such a fire may have been smouldering for a considerable time (sometimes even weeks), and a few extra minutes for thought and organising the arrangements will not be wasted. Operations should be carefully planned before work is started, and the whole job carried out with care and deliberation.

a. Locating the affected hearth

Smoke from a hearth fire may sometimes travel for considerable distances and emerge near another hearth which is not affected by the fire. Make certain, therefore, that the correct hearth has been found before attempting any cutting away. It should not be assumed that the fire is necessarily in the room (or even in the house) in which the greatest volume of smoke is found. Smoke from a hearth fire has first been noticed several houses away from

that containing the actual fire. There are many examples on record of hearths having been opened up in error when the fire was actually in the adjoining house, particularly when fireplaces back on to each other, as is common in semi-detached property.

If the seat of the fire is not immediately apparent, search carefully. Enquiry should first be made from the occupier. There may have been only one fire alight in the house for many weeks (though this may not always prove an infallible guide) or a new grate may recently have been installed. In some cases it may be found that a fire basket has recently been removed and the fire lit on the hearth itself. If so, this could be the likely one.

If preliminary enquiries do not help, all suspected hearths should be examined for signs of heat, cracking or the presence of smoke. Ceilings should be examined for signs of heat or discolouration, since a hearth fire can reveal its presence on the ceiling below. If a particular hearth is suspected, the fire in the fireplace should be extinguished and the grate removed. The centre of the hearth beneath the fire should be inspected for cracking, since this is usually the point at which a fire starts, and consequently the centre of greatest heat. The correct hearth can usually be found by this means.

b. Preliminaries

Before any attempt is made to attack the fire the same precautions should be taken against unnecessary damage as when dealing with a chimney fire (see 2. Chimney fires). Similar precautions should be taken in the room below. Containers such as a dustbin or buckets should be provided for the considerable quantity of debris which will result. The *hearth kit* (see Book 2 of the *Manual,* Part 4, 'Small gear') should be made ready, together with some water for extinguishing the fire.

The principal difficulty with hearth fires is getting at the burning material. Once this is exposed, extinguishment is usually a simple matter, and little water will be required, in most cases a bucket or two will suffice. It should be applied either with a cloth or a cup, rather than a jet, to avoid unnecessary damage to the ceiling below. Soda acid extinguishers are unsuitable for this type of work, since, once operated, they cannot be controlled. The water (stored-pressure) type of extinguisher can be used as it can be shut off. Water is normally only required in small quantities and at intermittent intervals. A spare bucket of clean water should be available, to be used for settling the dust in the hearth.

Finally, before operations are begun, station a man in the room below to deal with any outbreak of fire caused by the ceiling below the affected hearth giving way and allowing embers to drop into the room.

c. Attacking the fire

When everything is ready, decide whether or not the hearthstone can be removed intact.

(1) Removing the hearthstone

To remove the hearthstone, the battens around the stone or tiles should be stripped away, and the manner in which the hearth is laid should be examined. The tendency to run gas pipes and electric cables close to a hearth (to supply portable gas or electric fires) and their presence below the floor boards must be considered. With certain types of hearth it may be possible to remove the stone in one piece by levering it up gently with a crowbar and rocking it from side to side until it is sufficiently loosened to be lifted, when it should be taken outside.

If it will not move, it will have to be broken up. The first attack should be made in the centre of the fireplace, since this is the most likely place for the seat of the fire. A simple hearth fire can sometimes be extinguished by cutting a neat hole about 30 cm square in this position and applying water, but if any of the surrounding timber is seen to be charred, have the whole hearth up to make certain that there is no danger of subsequent re-ignition.

Break up the stone carefully and methodically, remove to the open air piece by piece, clearing all dust and debris as the operation

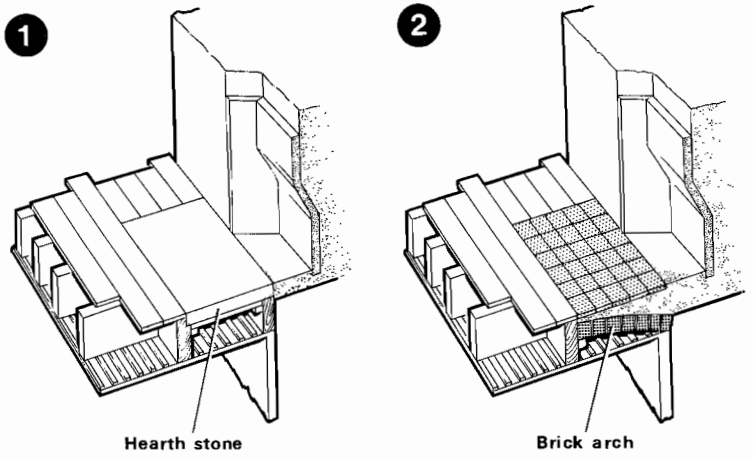

Fig. 5.5 Left: incorrect type of hearth construction liable to lead to fires. The thin slab of concrete below the hearthstone is laid direct on to tongued and grooved boarding. The construction of this type of hearth can be seen in plan Fig. 5.6 (centre). Right: well constructed hearth showing trimmer arch and concrete carrying the tiled hearth.

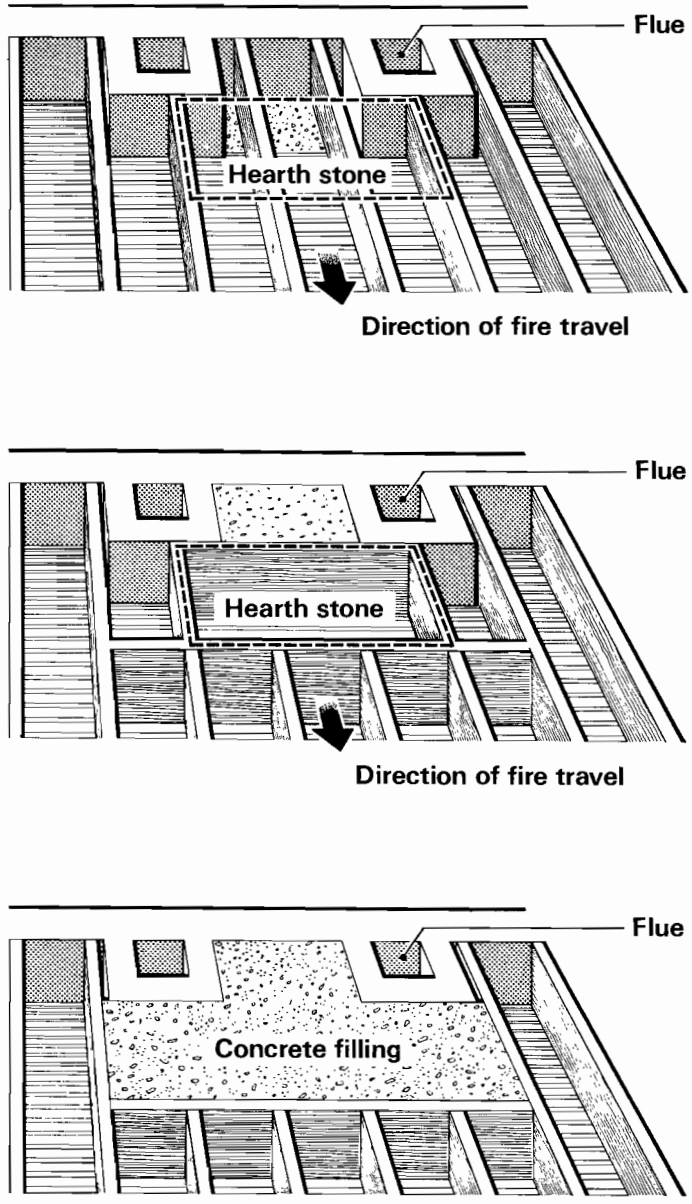

Fig. 5.6 Above and centre: methods of laying hearthstones on the joists which are first covered with tongued and grooved boarding. Below: construction with a trimmer arch.

proceeds, damping down with water to lay the dust. A pair of protective gloves will be found useful when handling pieces of hot hearthstone.

Be careful if a tiled hearth is fitted, because the tiles are frequently of special design and therefore difficult to replace. If the tiles are fitted on top of the hearthstone, operations should not begin at the back, since any such breaking will crack the tiles. These tiles are sometimes laid on a thin layer of plaster of Paris and held in place by a wooden fillet. Remove these and once the first tile (preferably in a corner) has been taken out, the others can be prised up without difficulty with a chisel. Tackled methodically, it should not be necessary to break more than the first tile to be removed. Stack the tiles as they are removed to prevent them being broken by anyone treading on them.

Many modern fireplaces are made in two sections, the hearth and the surround. The hearth is generally a solid slab of concrete, tiled on the top, front and sides, laid on the hearthstone. By careful levering, it should be possible to ease the tiled hearth away complete, without damaging any of the tiles (see Fig. 5.8).

(2) Cutting away

When the hearthstone or tiles have been removed, the construction of the hearth will be revealed. If well constructed there should be a bed of concrete several inches thick resting either upon a brick trimmer arch (Fig. 5.5 *right,* and Fig. 5.6 *below*) or upon tongued and grooved boarding. With old hearths it will often be found that the stone is laid direct upon the tongued and grooved boarding (Fig. 5.5 *left,* and Fig. 5.6 *above* and *centre*). Continue breaking up or cutting away until all the smouldering woodwork is exposed and extinguish it with the minimum of water. Surrounding woodwork should then be carefully examined for signs of charring and any affected portions cut away.

Continue cutting away until it is certain that no charred or weakened portions remain. If in any doubt about a particular section, make a clean saw cut so that the middle of the timber can be examined. As a general rule, it is better to take out too much rather than too little, but take care not to cut into any timber or stonework which may affect the structure of the building. In some fireplaces, for example, a stone wallplate may be found tied into the separating wall. This should not be damaged, as otherwise parts of the wall may have to be rebuilt. Similarly, do not cut joists unnecessarily, as this will weaken the floor and possibly bring it down. Take particular care when dealing with fireplaces which are set back to back in a separating wall. It may be necessary to remove both hearths to make certain that the fire is extinguished.

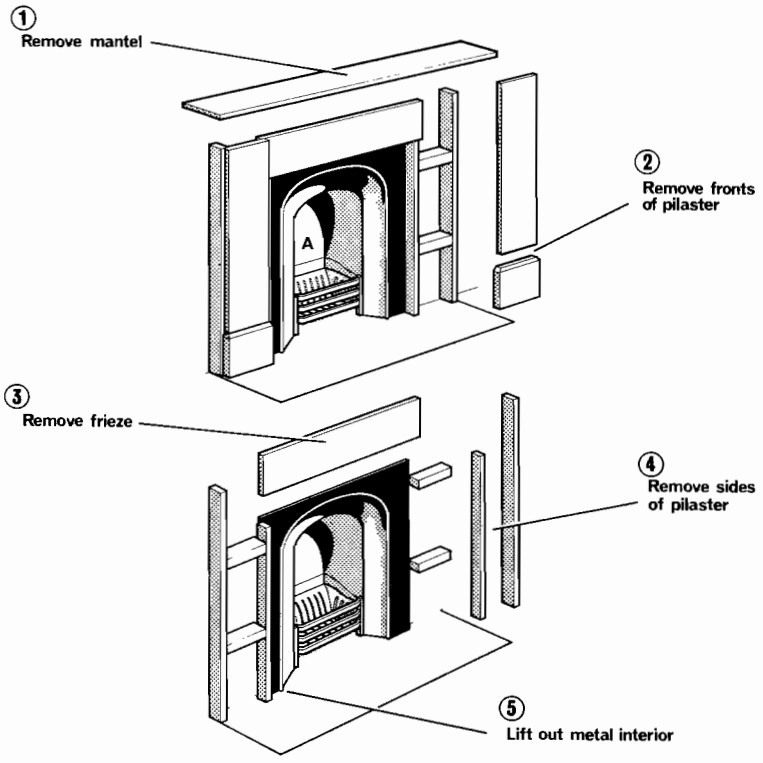

Fig. 5.7 The various stages in removing an older type of mantelpiece and surround to free the grate. Note the register plate marked 'A'

(3) Removing the surround

Sometimes, even though the hearth has been removed, it will still be impossible to reach all the affected woodwork or, owing to the surround having been badly fitted, pockets of soot have accumulated over the years and have become ignited. It may become necessary to remove the entire fireplace, and constructions differ considerably.

The older type of fireplace is shown in Fig. 5.7, and the general rule should be first remove the mantelpiece, second the fronts of the pilaster, then the frieze or lintel and finally the sides of the pilaster. These are usually secured to the wall by some simple fastener, such as an ear plate, a rag bolt or other form of metal clasp. Running the blade of the bricklayer's bolster or cold chisel down behind the surround will find them. In some cases the mantelpiece and the side members are made in one piece and can be

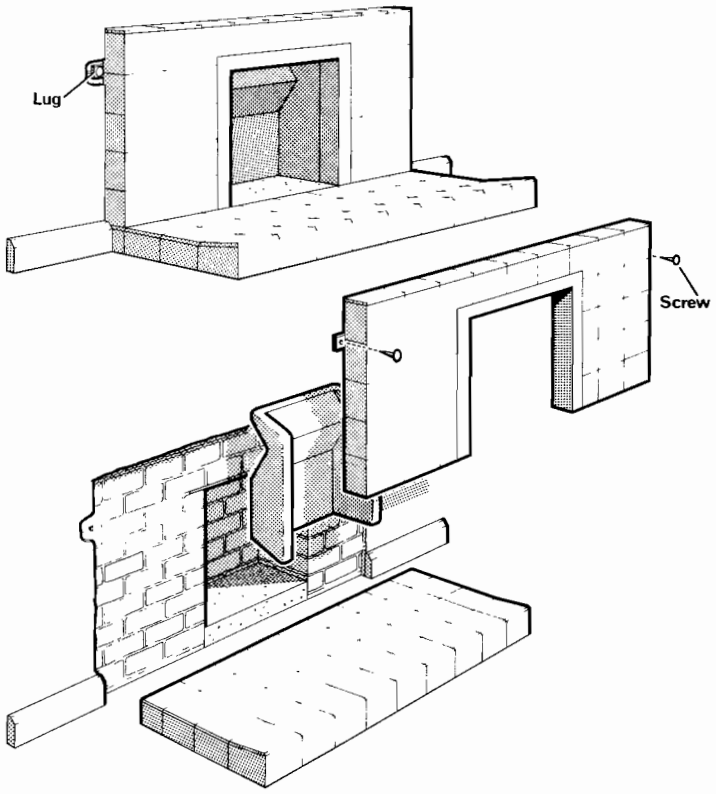

Fig. 5.8 A modern tiled fireplace showing below, the method of fixing.

removed intact. Marble and other stone mantelpieces are sometimes laid separately on brackets secured to the lintel and may be set into the brickwork.

In modern tiled fireplaces, the surround is generally cast in one solid piece of concrete, on which the tiles are fixed, and this stands upon a separate tiled hearth (Fig. 5.8 *above*). It should not be necessary to break such a fireplace, which is often quite expensive. The surround is merely held in position by two screws which anchor the surround to the brickwork via two lugs and these lugs are usually to be found about one tile down from the top of the surround. Chip away the plaster at the side to expose the lugs, and remove the screws. The surround is also sealed to the fireback by fire cement, which will easily break away to release the surround. Take care when lifting the surround off the hearth as it is very heavy. The tiled hearth can now be levered up as it is only lightly grouted in with cement and should come away without damage to

the tiles. If it is necessary to get under the fireback, this will have to be broken, as it is firmly cemented in to the flue brickwork.

(4) Attacking from below

It may very occasionally be necessary to tackle a hearth fire from below, but there are many disadvantages to this method:

(i) It is difficult to make certain, from below, that all the affected woodwork has been removed;

(ii) It is uncomfortable and dangerous to work in this position, since not only may hot embers and sparks fall into the fireman's eyes, but there is a serious danger that the entire hearth may fall. If it is apparent from the discolouration of the ceiling that considerable burning has taken place, shore up the ceiling under the hearth before commencing work;

(iii) Since woodwork supporting the hearthstone may have been weakened by the fire, it may give way if people walk on it or go near it after the fire brigade have left. It may fall into the room below and injure people there;

(iv) The hearthstone will have to come up for repairs to be effected, and double expense caused, since the ceiling will also have to be repaired. This method should, therefore, only be employed in very exceptional circumstances.

d. Clearing up

When the fire is extinguished remaining debris should be cleared up and removed and the room carefully swept. Extra help in replacing furniture and tidying up generally is always greatly appreciated by the occupier. Finally, before the fire brigade leave the premises, the occupiers should be contacted and the supposed cause of the fire carefully explained to them, so that they clearly understand the need for having a properly constructed hearth installed when the repairs are done.

4 Fires in skirtings, etc.

Fires sometimes occur in skirting boards near the hearth through incorrect methods of building, usually by the heat in the flue igniting the timber plugs used to hold the skirting in position (Fig. 5.9). This is liable to occur when the inside lining of the chimney falls away, if the plug has been driven in too far.

There are frequent examples of woodwork in close proximity to flues. Any fault in the lining of the flue, or in the mortar, allows heat to reach the woodwork and, in time, to ignite it. Plate 11 shows an example of a fire caused in this way.

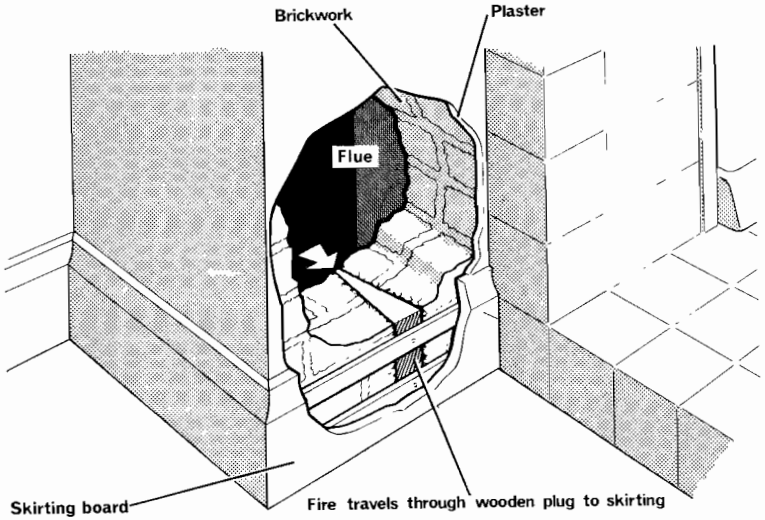

Fig. 5.9 Poor building construction which allows heat from the chimney to ignite the wooden plug which in turn transmits fire to the skirting board.

5 Fires in fume ducts

Restaurant kitchens, fish-frying shops, etc., often have ventilating shafts with large hoods over cooking stoves to allow the fumes from cooking to escape.

These shafts are usually made of sheet iron but are sometimes of brick and may be large. They are sometimes constructed with a total disregard for fire protection, passing through wooden floors and in proximity to lath and plaster partitions. They either continue through the whole height of the building to the roof or to some convenient external ventilator, or run into brick flues. The draught caused by the heat of the kitchen stoves draws fine particles of grease up and deposits them along the sides. Inspection covers are sometimes fitted at intervals, but, frequently, no attempt is made to clean the ducts, so that a lot of combustible material accumulates after some years' use. If a spark escapes from the fire and passes up the shaft, or a pan of fat suddenly flares up, this deposit may easily ignite, and burn with great intensity because of the considerable draught.

Fires in ducts are potentially serious owing to the possible spread up the building. The prime necessity is to inspect woodwork adjacent to the flue on every floor and at roof level, frequently, to

make sure the fire is not spreading. If the flues are above coal-fired ranges, and provided that, for any reason, cooking cannot be interrupted, it may be possible to extinguish a small fire by splashing with water to generate steam. This, combined with subsequently shutting off the bottom of the flue, may prove effective. Any mechanical extractor system fitted should be immediately shut down.

Such a fire can generally be extinguished by chemical extinguishers, hand pumps or hose reel equipment. If there are no openings in the shaft, they must be cut in order that the whole of the interior can be inspected and the burning surface extinguished. If the duct is rectangular and of sheet metal, cut on the corner; this will ensure that all parts of the interior can be reached with the jet.

Shafts are often tortuous through the building without sufficient inspection covers. They may have to be cut at several places to reach all the burning areas. Always visit the scene after allowing time for the shaft to cool. Any areas still hot can then easily be found.

6 Roof fires

Roof fires present a number of different hazards, since construction of roofs varies greatly, and access to the fire is often difficult. The general principle is that roof fires should always be attacked from inside, for, owing to the construction of all roofs, water applied to the outside will run off without doing any good. It may, however, be helpful to separate these fires under the following principal headings:

(a) small dwelling-houses, cottages, etc., which, when in terrace, often have a common roof void;

(b) public buildings and large houses, such as country mansions, with the roof spaces over wings leading off a common roof void;

(c) industrial buildings having special types of roof, such as saw-tooth roofs, Belfast roofs, diamond grid roofs, etc.;

(d) churches, theatres, cinemas, etc., in which the roof is high above ground level and often has a large roof void.

a. Small dwelling houses

In old, small terraced houses the roof void is sometimes continuous throughout the terrace although this is no longer allowed under *Building Regulations*. Fire, unless it is correctly handled, may spread rapidly throughout the length of the terrace. Access to the roof should be gained through a trap-door, if fitted, but if there is no such opening, part of the ceiling should be cut away, or entry

made by removing part of the roof cover. Entry should be carefully surveyed, so that access is obtained to both sides of the fire to prevent it spreading.

Other things being equal, when entering a roof void from inside, cut away the ceiling on the landing at the head of the stairs. This is a much smaller area to make good and repairs will not be so obvious as in a large expanse of ceiling in a room.

b. Public buildings and large houses

There will usually be means of access to the roof space in buildings of this type but, if not, the officer in charge should consider whether to go through the roof rather than cut away part of a ceiling. Ceilings in such houses may be of considerble value because of their decoration or moulded construction. Remember, however, entry by opening up the roof may vent the fire, and make it more difficult to extinguish. Water should, therefore, be available to deal with any resultant increase in the fire.

c. Industrial buildings

Roof construction in industrial buildings varies so widely that it is impossible to lay down any general rules. Firemen are advised to visit new industrial premises to check on the various types. Some sawtooth factory roofs may still exist with an inner lining of combustible building board although, due to the provisions of the *Thermal Insulation (Industrial Buildings) Regulations, 1972*, conditions in this respect are improving. To check the spread of fire, pull away portions of the combustible material to form a break and have branches in strategic positions to cover it. Roofs are often lined with matchboarding and sometime covered with bituminous material along which fire can spread rapidly. Remember matchboarding can easily be removed as it is usually secured very lightly to the joists and can be freed by tapping it lightly with the head of an axe near the joists.

d. Churches, theatres, cinemas

Roof fires in churches, etc., are often very difficult to deal with, due to the height above ground level and to difficult access. Position branches as close to the burning portion as possible, and use large nozzles with relatively high pump pressure to obtain the maximum vertical throw of water. Access to the roof is sometimes possible via internal stairways, particularly in cathedrals, and the verger should be contacted to provide a guide.

Roofs of cinemas, although often having a large roof void, can usually be entered by means of special doors (See Book 8 of the *Manual*, Chapter 5). Since much of the ventilating trunking is carried in the roof, this may tend to spread fire and make it difficult to reach certain parts with jets.

e. General

The following are some practical hints for dealing with roof fires:

(1) Roof fires frequently appear considerably more serious than they actually are. Large quantities of smoke are often emitted even when the fire is confined to birds' nests or small quantities of soot;

(2) If fire is through the roof, a turntable ladder or hydraulic platform monitor should be considered to prevent the spread of fire to other buildings. Guard against water damage on lower floors;

(3) Monitors directed from above tend to drive the fire laterally and make it harder to extinguish. Attack a roof fire from inside, if this is at all possible, as jets can strike the burning beams and rafters which are still screened by the roof coverings from water applied from outside;

(4) If a roof is opened up ahead of a fire to form a break, allow sufficient distance from the fire to ensure that the break can be completed before the fire reaches this point;

(5) Roofs are sometimes found constructed of a proprietary roofing material consisting of corrugated sheet iron coated on each side with bitumastic composition. Here it may be necessary to use water on each side;

(6) Take care to see that fire does not travel undetected beneath lead or zinc valleys or similar hidden spots. Investigate thoroughly to ensure no fire remains and, remember, in roof voids there is often an accumulation of dust which will help spread the fire;

(7) If it is necessary to attack the fire by removing roof coverings, do it, if possible, from a part of the roof that will allow the jet to reach the whole of the interior;

(8) A man should be stationed outside the premises to warn passers-by of the danger of falling slates, tiles, etc.;

(9) With roof fires there is a great possibility of damage to the contents of the building by water, and salvage operations should be started at the earliest possible moment;

(10) Unless a very long throw is essential, jets inside the roof void should be kept working at a relatively low pressure, otherwise slates and tiles may be displaced by the impact. If tiles or slates have been displaced, salvage sheets should be used to provide temporary protection from the weather;

(11) For fires in thatched roofs see Part 6B of the *Manual,* Chapter 40, 'Fires in rural areas'.

7 Basement and underground building fires

Fires in basements or underground buildings present special hazards due, amongst other things, to the following characteristics which many underground fires have in common:

(1) A marked absence of adequate means of ventilating the heat, smoke and toxic products of combustion;

(2) difficulty of access and finding the way about;

(3) difficulty of making any appraisal of the fire conditions, or of the whereabouts of the fire itself, without risking firemen in dangerous places;

(4) difficulty of communication between personnel below ground;

(5) difficulty of communication between personnel on the surface and those below ground;

(6) difficulty in effectively applying extinguishing media; and

(7) in many instances, unusual congestion and restriction of movement in the interior of the underground space.

These difficulties apply, to a greater or lesser degree, in all types of accommodation which is below ground and to accommodation which, although above ground, is not provided with any form of window or other means by which a fire can 'vent' itself to the open air when a certain stage has been reached in its development. The conditions produced not only make the prospects of controlling the fire at any stage a problem, but are liable to give rise to severe danger to life, not only to the occupants, but also to those engaged in firefighting. A fire in underground or similar premises calls for the closest possible attention to the safety of fire brigade personnel and to any other units of firefighting personnel who may be involved e.g. M.O.D. units.

a. Local knowledge

The task will be greatly eased if fireman have good knowledge, including the general layout, contents and any special features, of the underground buildings or those with large basements, in their area. Firemen should be familiar with all fire prevention provisions and any fire risk which could constitute a special danger, such as high voltage electricity or chemicals. Men at stations likely to attend the premises should have the opportunity of visiting them and it is essential that a good liaison should be established with the occupiers. Visits give a general idea of the layout of the premises and what they may contain. These should be followed, if possible, by exercises carrried out wearing breathing apparatus in darkness in order that the men may gain confidence in finding their way

Plate 1. High expansion foam being used to extinguish a particularly deep seated fire in stacked materials.
Photo: London Fire Brigade

Plate 2. An enclosed mall in a typical shopping precinct. Compare with plates 3 and 4.
Photo: Merseyside Fire Brigade

Plate 3. Part of the same precinct (see Plate 2) after a large fire. Asbestos panels have fallen away exposing the suspended ceiling framework and mechanical ventilation trunking. This trunking was externally clad with expanded polystyrene insulation which promoted fire spread and evolved toxic fumes.
Photo: Merseyside Fire Brigade

Plate 4 The intense fire in this shopping mall (see Plates 2 and 3) caused a general collapse of the suspended ceiling and mechanical trunking which hindered firefighting
Photo Merseyside Fire Brigade

Plate 5 Bulk CO_2 tankers pumping into a ship's hold which contained jute Note the ship's ventilators have been blanked off and the hatch covers kept tightly battened down
Photo Tayside Fire Brigade

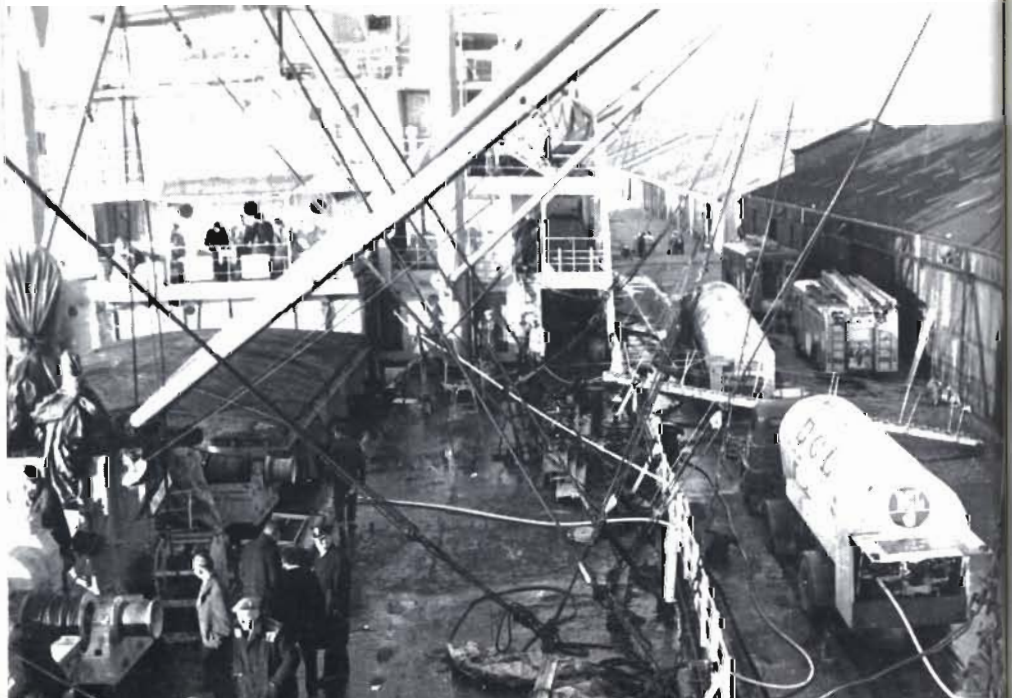

Plate 6 Heat from a relatively small fire in a house has melted the plastic conduit screwed to the wall This allowed the damaged live cable to hang down in the path of the firemen tackling the fire.
Photo: Lothian and Borders Fire Brigade

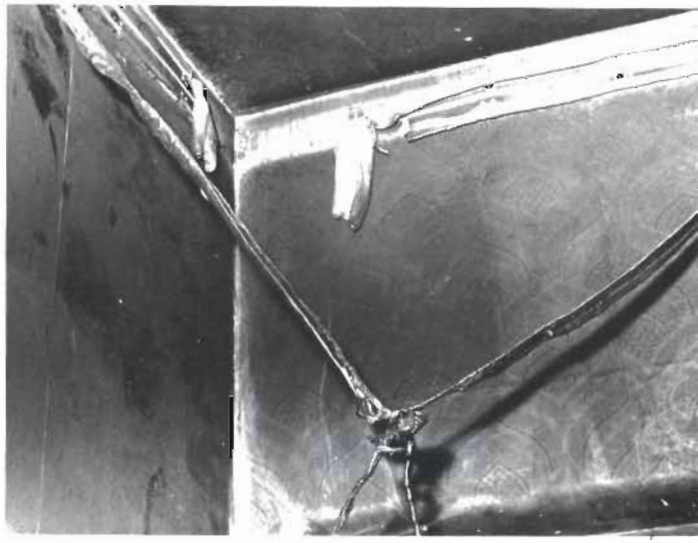

Plate 7 Remains of a hotel wooden central staircase. The disused small lift shaft (centre) acted as a flue causing almost complete destruction of the staircase and difficulty of access for the Brigade
Photo: East Sussex Fire Brigade

Plate 8. In this fire in a private house the central heating flue pipe was uninsulated throughout its entire length. There was no separation at all where it passed through the airing cupboard.

Plate 9. At this fire the fire-resisting sliding door on the right operated and effectively contained the fire. Unfortunately the sliding shutter, although operating successfully, jammed in the position shown allowing some spread. *Photo: Bedfordshire Fire Service*

Plate 10. Construction in a modern terrace of houses where the tile battens were taken across the separating wall. The unfirestopped gaps between wall and tiles allowed fire to spread into the adjoining roof. *Photo: Fire Research Station*

Plate 11. In this example of bad building construction the timbers have been set into the brickwork of the chimney flue which can be seen in the centre. Defective mortar allowed heat to reach the rafter which subsequently ignited. The resulting fire destroyed the top of the building

Plate 12 Various stages of collapse at a large fire in a general warehouse Note the bent cast-iron columns in the back wall Other cast-iron columns in the foreground have been snapped off short

Plate 13 The effect of a severe fire on a stone staircase in a hotel *Photo London Fire Brigade*

Plate 14 A severe fire in this bus garage caused considerable movement in the brickwork Note the cracking even continues across the buttress.
Photo Dorset Fire Brigade

Plate 15 An almost explosive collapse of a warehouse wall which has, obviously, not given much warning.
Photo Daily Express, Manchester

Plate 16. Covered market within a shopping precinct. In the foreground, left and hanging down from the roof, are panels of sprayed concrete on wire mesh. These became detached from their metal hangers and collapsed during the fire.
Photo. Merseyside Fire Brigade

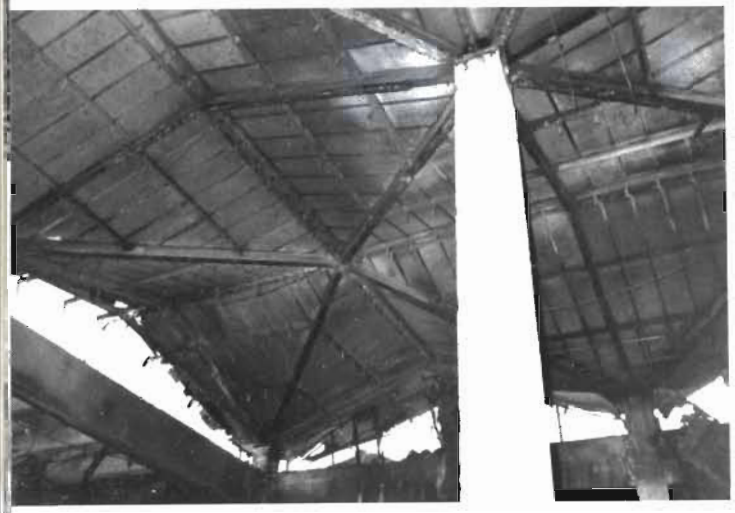

Plate 17. Example of modern light roof design. Wood wool panels covered externally by a layer of bituminous felt and copper cladding. The framework for them is of steel joists on reinforced concrete columns. The steelwork was protected by panels of sprayed concrete (see Plate 16) before their collapse.
Photo: Merseyside Fire Brigade

Plate 18. A mechanical saw being used to remove bars from a window at a large departmental store. Several women were rescued after being cut off by the fire.
Photo: Daily Express, Manchester

about in the premises when they are unable to see. These exercises will also enable breathing apparatus control points, communications and guide line arrangements (see Book 6, 'Breathing apparatus and resuscitation' of the *Manual*) to be predetermined and save time should a fire occur. The exercises will also give personnel an opportunity to make themselves familiar with the position of hydrants and other water supplies and, where necessary, to include relays from any available open water.

b. Locating the fire

The first step in dealing with a basement or underground building fire should be to find out how many basements there are. Many buildings have both basement and sub-basements, and it is not unusual to find that basements are common to, or communicate with, more than one of the adjacent buildings.

Locating the fire can be the most difficult problem facing firemen. There may be an indicator system forming part of a fixed detector installation which will show, within certain limits, where the fire is to be found, but the fire itself has to be located by firemen. There are experimental instruments at present to assist them in this task. Portable infra-red detectors have been tried for this purpose as their functioning is unaffected by dense smoke. The apparatus developed so far, using the pyroelectric videcon system, gives encouraging results in the tests carried out by selected Brigades. However, in the majority of cases, for now, firemen will still have to rely on their experience and skill to locate fires.

In many multi-storied buildings a plan or plans of the building will be provided for the guidance of firefighting personnel, both during visits and at the time of a fire. The plan should incorporate any information required by the fire brigade and, under arrangements made beforehand, be prominently posted in a position which should not become untenable in the course of a fire. If, for security reasons, plans cannot be displayed, they should be available to the fire brigade on request. The action to be taken by the occupier in the event of a fire will generally include an arrangement whereby a member of the staff has the duty of meeting the fire brigade on arrival and giving any available information as to the location of the fire, any persons not accounted for, etc.

c. The effects of heat

Firemen are used to smoke, and smoky conditions in underground premises are in themselves not likely to create any exceptional hazards although, because of lack of ventilation, the smoke may be denser than at other fires. Because of lack of ventilation, however, temperatures may rise to a higher level than would otherwise be encountered and hazards could arise to firemen from an abnormal build up of heat. The special problems of high temperature

conditions and the effect of heat on the human body are dealt with in detail in Book 6, Chapter 9 of the *Manual.*

The atmosphere at the entrance to a basement fire is nearly always far hotter than the air at floor level in the basement, and if a fireman can once force his way down past the heat, he will find conditions there more bearable.

d. Fighting the fire

Immediately branches are in position to cover any possible spread, efforts should be made to ventilate the fire by opening up pavement lights, etc. Basements in large buildings may have several entrances (see Fig. 6.30), and though it is obvious that every possible entry should be used to get at and attack the fire, it is generally preferable to attack the fire from one opening and allow the heat and smoke to escape from the others. Opening up will greatly assist in venting the smoke and heat, but adequate precautions must be taken against the spread of fire to upper floors.

Remove pavement or stallboard lights or, if this is impossible, break them open. In many old premises used for storage, entrance may be gained through the cellar flaps which open up on to the pavement.

e. Covered openings

A basement fire, unless it is skilfully handled, may spread with great rapidity up the building via lift shafts, staircases and other openings in horizontal surfaces. Branches should always be arranged at ground floor level or at openings leading from the basement to cover any shafts up which the fire may spread.

When a fire is being fought in upper floors, remember that burning debris may fall down lift shafts, light wells or other vertical openings and start fires in the basement. Take precautions, therefore, and lay out hose lines to cover the foot of any such openings, so that incipient fires can be dealt with immediately. Once all openings have been protected in this way, it is essential to open all windows on the floors above the fire, to prevent the building from becoming smokelogged, and to begin a regular patrol to deal with any outbreak which may develop on upper floors.

f. Fighting from above

If it is not possible to get into the basement, even when using breathing apparatus, it will be necessary to consider other methods of fighting the fire. In fires of this type, the revolving nozzle, cellar pipe, basement spray, elbow-for-nozzle, and similar equipment (see Book 2 of the *Manual*, Part 2, 'Hose fittings') may help. Estimate the approximate position of the fire and cut a hole in the floor

through which to introduce the nozzle, so that the jet or spray will strike the fire.

If such equipment is not available, it may be possible to use a branch directed by means of a line (see Part 7 of the *Manual,* Chapter 3, 'Fires in ships'), or to improvise some form of cellar branch by using a double or single outlet standpipe head into which ordinary branches with the appropriate size nozzles have been connected. Alternatively, a hand-controlled branch adjusted, before being lowered into the basement, to give a spray at a suitable angle, may be employed. The floor from which the fire is being fought should be ventilated by opening up all windows and doors, and the hole which has been made should be covered with the necessary branches.

g. Special firefighting measures

Many underground premises contain goods or equipment on which it is undesirable to use water and the use of alternative fire extinguishing media needs to be considered. Even in premises for which water is suitable, circumstances can arise where fireman are unable to enter the premises at all, and must make their extinguishing efforts from outside. If, as a last resort, flooding has to be considered, water could be the least suitable medium.

(1) High expansion foam

Although high expansion foam does contain water the amount is small compared with the total volume of high expansion foam required to fill the compartment on fire. When conditions are too bad to allow the use of normal procedures to locate the fire, it may be necessary to use high expansion foam to try to get extinguishment (see Plate 1). Remember that high expansion foam has to displace the air and smoke present in order to flow, so make provision for the escape of the atmosphere diametrically opposite to the point of entry of the foam.

Full details of the operational use of high expansion foam are given in Book 3, Part 3 of the *Manual.*

(2) Carbon dioxide gas

In underground premises where carbon dioxide apparatus has been installed, make use of the installation. Firemen with breathing apparatus will still have to penetrate into the building to ensure complete extinction of the fire. The use of bulk CO_2 from tankers is dealt with in Chapter 3, Section 8.

(3) Flooding

The officer in charge dealing with a basement fire may occasionally find it necessary to resort to flooding. This should only be done when it is impossible to reach the seat of the fire and other means

have proved unsuccessful, also when it is obvious that the stock is irretrievably damaged and after the most careful inspection of adjoining premises. Bear in mind separating walls between basements may not be strong enough to resist the pressure of the water and could collapse. They may be sufficiently porous (due to poor mortar or cracked joints) to allow water to percolate through them and cause damage in adjoining premises.

Flooding will only be practicable in certain types of building and when the basement is of reasonable size. Basements in large buildings of modern construction are usually very extensive and flooding would be difficult owing to the volume of water required. Certain types of warehouse, also, are provided with extra large drains which would carry away the water and, if lavatories are installed, water may escape through them. The best prospects for successful flooding are old buildings, which are often divided into relatively small compartments separated by load-bearing walls.

When flooding, use maximum speed with every available pump using open deliveries. Watch the rate at which the basement fills up carefully to check that water is not escaping and adjoining premises are not being flooded. A rough measurement of basement size will make it possible to calculate the rate at which it should fill with the capacity of the pumps in use. Stop flooding immediately the fire is out, though it may be necessary to flood to the underside of a basement ceiling if this is on fire and then pump out the basement *with as little delay as possible.*

(4) Smoke extracts

Some basements and sub-basements of modern buildings can be ventilated by smoke extracts, which are shafts or openings leading from the basement or sub-basement to the open air. Remember that smoke extracts are of limited capacity, and the rate of smoke production at a fire is generally in excess of the capacity.

Where smoke extracts are fitted, whether consisting of a shaft or not, the opening is protected at ground level, usually by a pavement or stallboard light which can be either cast metal or concrete with glass lenses (see Fig. 6.19). In an emergency either type can be broken with a sledge hammer or large axe. When smoke extracts are fitted to both basement and sub-basement, those from the latter pass through the basement without communicating with it. Smoke extracts are marked by means of small plates placed usually just above or on them with the words SMOKE EXTRACT TO BASEMENT or SMOKE EXTRACT TO SUB-BASEMENT.

(5) Small fires

Save-all trays are sometimes fitted beneath pavement lights or escalators. Smoke emerging from a basement or escalator may be

due to dust or rubbish on the trays being ignited by a discarded cigarette or lighted match.

8 Fires in high rise buildings and complex areas

Large scale redevelopment of city centres, and the increasing tendency towards high rise building*, pose new problems for the Fire Service. Modern building methods of construction have produced tower blocks over 130 m in height, and complexes that cover many acres. The latter may comprise buildings for shopping, office and housing accommodation, built at a number of different levels and interlinked by escalators, lifts and passageways to provide access from one level to another.

Because these buildings are of modern construction, they conform to accepted good practice and statutory requirements at the time of building, so they are invariably of fire-resisting construction. It is in the contents of such buildings that fires start, and can, in theory, spread through a variety of horizontal and vertical openings. In practice, experience shows that, in the majority of cases, the fire brigade, if it is called in reasonable time, succeeds in confining this type of fire to the floor, if not to the room, of origin.

a. Access

Planners of high rise buildings and complexes are inevitably faced with the problem of providing access for vehicular traffic to the centre of the area without restriction and without creating congestion. This often involves a primary road system to keep traffic flowing to and around the centre with an internal access road system for public and service transport and the provision of adequate car parking facilities for local residents and visitors. Normally, this internal road system is limited to one or two levels in a complex, most commonly the lowest level only, and serves only as access to goods lifts for commercial buildings, to car parks and to road transport terminals. There is seldom any access for vehicles on the upper levels, and structural considerations will usually make this difficult, if not impossible. In high rise buildings, though vehicle access may be available on all faces of the building at ground level, the height of the building could make firefighting from outside the building impossible on the upper two-thirds of its height (see Book 8, Chapter 12).

It is now an accepted principle that escape and firefighting facilities must be incorporated within the building itself so that

*NOTE: Although there is no official classification of buildings, *'low rise'* is generally taken to mean buildings of up to 4 floors, *'medium rise'* as buildings of from 5 to 7 floors, and *'high rise'* as buildings of 8 floors and above.

ladder access to windows, etc., and to upper levels is unnecessary. These modern high rise buildings and complexes are provided with comprehensive means of escape including sufficient alternative routes to ensure that rescue by ladder should never be necessary. Means of fighting fire are also provided on a scale which ensures that vehicle access is only necessary at one level. From here appliances can pump into rising mains (if dry) and firemen can readily reach all parts of the building.

Whatever layout may be adopted, there must always be adequate pre-planning for the attendance of fire appliances at key access points. With large complexes, or even with one tower block, there may be a number of entrances, and there will usually be a number of different blocks in the complex. Arrangements should ensure that attendance is made at the correct point according to the location of the fire. It should also be remembered that inhabitants or users of such complexes often get into the habit of referring to the address locally under one general title. If such a call is received, make every effort to get the correct block or road entrance.

b. Dry and wet risers

Dry or wet risers are always included when high rise buildings are constructed: the present tendency, reinforced by *British Standard Codes of Practice*, is for buildings of up to 60 m in height to be given the choice of wet or dry risers, but in those of over 60 m the risers are wet. Because of the height, there will be storage tanks at various levels, and instantaneous female outlets should be provided on each storey above the first, in a staircase enclosure or in a ventilated lobby. The outlet may be placed in a glazed cupboard clearly marked FIRE BRIGADE WET HYDRANT or FIRE BRIGADE DRY HYDRANT (see Book 9, Chapter 7).

The first action of the officer in charge upon arrival at a high building fitted with dry risers should be to instruct one crew to set in and charge the dry riser while the whereabouts of the fire is being located.

c. Fire lifts

Lifts, and sometimes escalators, are to be found in all high rise buildings, and it would be almost impossible for firemen to carry their equipment to the upper floors of a tall building without the use of lifts. In buildings of more than 20 m in height, the *British Standard Codes of Practice* stipulate that a normal passenger lift or lifts should be capable of being commandeered for the exclusive use of firemen in emergency. A switch in a glass-fronted box marked FIRE/FIREMAN'S SWITCH should be found at ground level and this should operate a control whereby firemen can obtain the use of the lift without interference from landing call points. The fire lift

should either be within a staircase enclosure or in a ventilated lobby.

There may be many lifts or escalators in high rise buildings—and as a matter of interest, one modern complex in the Midlands has seven escalators and forty-seven lifts, one bank of five lifts at one entrance being controlled electronically. Firemen are able to control one of the five lifts immediately by operating an emergency key. It is important, therefore, to ensure that all local fire brigade personnel are familiar with the arrangements for attendance, and for the operation of the fire lifts at high rise buildings. All personnel should also know to what entrances attendance should be made.

d. Heating and air conditioning

Some high rise buildings are designed in the form of a fully-glazed office tower block with no openable windows. The heating, ventilating and air-conditioning systems are extremely complicated, involving miles of ducting and the movement of millions of cubic feet of air per hour. Adjoining the tower is often a reinforced concrete, windowless tower accommodating the services, ducts, lifts, staircases, etc., with approach lobbies to each floor level.

In one particular building over 120 m high, it has been considered necessary to establish a fire control room within the building itself with facilities to control and direct the operation of the air-conditioning system and to initiate partial or total evacuation of the building as appropriate. There is an operational procedure for the officer in charge to follow for gaining access to the various levels and establishing communication with the internal fire control.

Heating systems generally have oil or gas-fired boilers, which supply the whole complex, and, although the boilers are often found in the basement, this is not always the case. Storage tanks, too, may be found at various levels. Foam inlets should be provided where boiler rooms or storage chambers are below ground level and/or are difficult of access for the fire brigade. Separate inlets and pipe runs should be provided in each room or chamber. Individual inlets should be marked FOAM INLET TO BOILER ROOM or FOAM INLET TO FUEL STORE, as appropriate (see Book 9, Chapter 8).

Air-conditioning systems normally have shutters, which may be automatic or manual or both in operation, to prevent the fire being spread through ducting. Knowledge of the operation of the systems in particular buildings is essential to firemen (see Book 8, Chapter 11).

Cable-carrying ducts should be sealed and bushed at every floor level to prevent spread of fire through the ducts, or else fully enclosed within fire-resisting shafts extending the full height of the building.

e. Plans for fire brigade use

In large buildings, especially those having extensive accommodation below ground level, a plan for the use of the fire brigade should be found displayed at the main reception office and at ground level of the staircase leading to the below ground accommodation. The plan should indicate positions of any special fire risks, hose reels, hydrant outlets, sprinkler valves and ventilation controls, main gas or electricity controls, fusible-linked operated shutters and doors and should show (usually coloured) exits, staircases and through corridors available for attack on a fire.

f. The effects of wind

It has been found that high rise buildings cause complicated wind patterns to build up, and the Department of the Environment carried out a number of tests at their Building Research Establishment using model buildings. This report showed the wind patterns can be extremely complex, especially between high blocks, slab blocks and low buildings, with the result that quite a small breeze can be magnified and channelled into fast-moving eddies and currents by the resistance of the building blocks. Intense up-currents, down draughts and vortices can be produced, and these could be aggravated by the intense convection currents set up by a large fire, leading to serious fire spread and danger to firemen.

The tests at the Building Research Establishment revealed:

(1) that with a simple rectangular building, one type of air flow upstream and another downstream happens when the wind is perpendicular to the face of the building;

(2) the speeds measured near ground level increase with the increased height of the building;

(3) an isolated high building generates some wind speeds which are higher than the free air speed;

(4) a high slab building with a low building to windward has the effect of increasing the speed of the wind near to the ground in front of the slab and reducing the wind speed at the sides. The increase in wind speed is as much as 20 to 30 per cent above the free air speed;

(5) where a building is raised off the ground, the wind speed beneath the building becomes very high.

This problem is not yet solved but is probably a matter of design, with blocks angled towards the wind or screened by some form of baffle. For the Fire Service at present, it is an aggravation of a hazard and one that must be remembered by an officer in charge. Branches should be placed outside the building, or arranged from

adjacent blocks, to cover the risk of fire spread being accelerated by these phenomena.

9 Fires involving radioactive substances

There are no inherent fire hazards associated with radioactive substances as such. Some are themselves flammable or combustible in varying degrees and, to this extent, they have a fire hazard attached to them, but this hazard is no greater because of their radioactive properties. The method of fighting a fire involving radioactive substances, also, is no different because of the radioactivity. The hazard that does arise is that there is a danger of radioactivity being radiated and, if the substance is volatilised, the danger is greater in that the radioactive vapours could be ingested with more serious consequences. It is therefore necessary to impose a rigid control procedure, and this procedure is dealt with in detail in Part 3, 'Control at a fire'. The properties, hazards and operational procedures, when radioactive substances are involved, are detailed in Part 6C of the *Manual,* Chapter 45, Section 11.

10 Fires on Motorways

The actual technique of dealing with fires on motorways is similar to that on any other major or trunk road, but the main difficulties are:

(1) the necessity for provision to be made for the safety of crews from other road users;

(2) the limitation of access points to a motorway;

(3) the difficulty of moving over to the opposite carriageway, which can only be done at access points or at emergency crossovers;

(4) the provision of water for firefighting is subject to certain restrictions.

The problems outlined in (1), (2) and (3) above will be dealt with in full details in Book 12, Part 1 of the *Manual* (at present Part 6a) and so the following paragraphs dealing with firefighting on motorways should be studied in conjunction with those sections.

a. Topography

Once a motorway is open to traffic, the study of actual physical topography is severely restricted. Specially prepared maps to a scale of 1:10 000 are generally carried on each appliance at stations which have a motorway commitment, and these prove useful. The maps should show points of entry, location of emergency

numbered telephones, location of water supplies within reasonable distance of the motorway, and details of cattle creeps, over and under passes, etc.

b. Water for firefighting

The provision of water for firefighting on motorways falls broadly into two categories.

(1) Water supplies adjacent to motorways

These consist of all open water supplies—streams, canals, ponds, etc.—which are located in the immediate vicinity along the motorway and from which water can be pumped on to the motorway from a portable pump carried from the scene of the fire, or from a mobile pump ordered specifically to the water supply.

In addition, hydrants may be located on water mains in roads which pass over or are adjacent to the motorway.

(2) Water supplies on motorways

The installation of fire hydrants on the actual verges of motorways can only be carried out with the prior approval of the Department of Transport or, in some cases, the Divisional Road Engineer of the area. Hydrants will normally be located at points where water mains cross over or under a motorway, and a hydrant will generally be found on each side of the motorway, housed underground at the back of the motorway verge.

In some rural areas through which motorways pass, water mains which cross over or under the motorway may be widely separated. Where the distance between existing mains is such as to cause delay in the replenishment of water tanks, a spur main may be laid to a point on the motorway where an additional fire hydrant is thought necessary.

The Department of Transport do not allow hydrants to be installed on the central reservation of a motorway. Hydrant indicator plates, whether referring to hydrants on, or near to, a motorway, are normally placed in the motorway verge behind the hard shoulder. The plates may be found erected in pairs at an angle of 90 degrees on a suitable post. Where indicator plates relating to hydrants at ground level are installed on elevated sections of motorways, the precise location of the hydrant may be shown either on or beneath the plate. The use of motorway surface water drainage systems as a source of water for firefighting should not be overlooked especially in wet weather.

c. Firefighting on Motorways

As has already been stated, there is not usually any special problem in extinguishing the fire, but the fact that the fire has occurred on a

motorway presents other difficulties to the officer in charge. His main concern is the safety of his crews, who must be protected from drivers of vehicles using the motorway, some of whom will disregard warning signs and will approach and pass a fire or accident with little or no reduction in speed. The methods of protecting firefighting personnel will be dealt with in Book 12, Part 1 of the *Manual* (currently Part 6a).

It is almost certain that the police will already be in attendance as the majority of calls to incidents on motorways will be made via the emegency telephones which terminate at Police Control Rooms, or incidents may be reported direct by drivers of the police motorway patrol cars. The police will therefore attend to the question of traffic control and will, if necessary, shut the carriageway completely.

Most fires on motorways can be extinguished with the water carried on the water tenders on the initial attendance. Should further supplies be required, the following methods of obtaining water should be considered, bearing in mind the time factor involved:

(1) Ordering on additional water tenders;

(2) Portable pumps which can be got to work from ponds, streams or canals adjacent to the motorway, to relay water direct on to the fire or into the tank of a water tender;

(3) Water may be obtained from hydrants at interchanges or other points on or adjacent to the motorway where the distance from the hydrant to the fire is not excessive;

(4) A shuttle service of water tenders might be used, filled from the nearest hydrant or other water supply;

(5) Water from surface water drainage systems.

The use of cattle creeps or under and over passes will sometimes enable a water supply on the other side of the motorway to be used without crossing the carriageway.

If it is apparent that smoke from a fire on or off the motorway is likely to obstruct the vision of drivers, the police should be requested to contact their control so that the warning signs on the motorway can be operated.

Part 2
Methods of entry into buildings

The powers of a member of a local authority fire brigade to break into premises in the course of firefighting are covered by Section 30 (1) of the *Fire Services Act, 1947,* which states:

> 'Any member of a fire brigade maintained in pursuance of this Act who is on duty, any member of any other fire brigade who is acting in pursuance of any arrangements made under this Act, or any constable, may enter and if necessary break into any premises or place in which a fire has or is reasonably believed to have broken out, or any premises or place which it is necessary to enter for the purpose of extinguishing a fire or of protecting the premises or place from acts done for fire-fighting purposes, without the consent of the owner or occupier thereof, and may do all such things as he may deem necessary for extinguishing the fire or for protecting from fire, or from acts done as aforesaid, any such premises or place or for rescuing any person or property therein.'

If possible, always enter a building by a door or a window, if these can be opened without damage; failing this, enter by the method which will cause least damage. Thus, with certain exceptions listed below, when force must be used, preferably break glass rather than wood.

A fairly extensive list of 'means of entry' is given below, but it must be emphasised this is for information only and you do not necessarily make entry in this order. Where difficulty in breaking in is found try to find the easiest way. Remember that the methods described below will not be used solely to gain initial access to a building. It is often necessary, during firefighting operations, to open locked doors inside a building to get to other parts of the premises or to take hose or other equipment through. Similarly, such operations as cutting away woodwork are more commonly used during the actual firefighting than to provide a means of entry. As they may have to be used on occasions for the latter purpose, all operations of this kind have been included in this chapter.

The saving of life is the first consideration of the fireman, and if lives are at stake, irrespective of any other factors, the quickest way in should always be chosen. The same applies when the fire can be

seen to have secured a hold on the premises, for damage by failing to attack the fire quickly would usually exceed the damage due to entry. Methods described are those used when it is necessary to enter to investigate.

Almost all buildings have at least one secondary entrance, this may be at a back door or tradesman's entrance in private houses, or a goods entrance in commercial or industrial premises. Often the side or rear doors are not kept in such good condition as the front door. If there is no side entrance, the quickest way to the rear of the building will usually be by way of adjoining property, through which a short ladder can be carried for scaling walls, reaching first floor windows, etc. A fireman sent in by an alternative entrance to open up a door from inside can be helped to find his way to the correct place if those waiting for him to open up knock or bang on the door.

Chapter 6
Forcible entry

1 Doors

When seeking entry to a building, first try the principal entrance, unless there are definite reasons against it, since this usually gives access to the hall, stairs or foyer and then the rest of the building. If a door is shut, try the handle to see if it is fastened, for doors have been broken open when thought to be locked. Always call out or knock loudly before effecting an entrance, as there may be people in the building who are unaware of the fire. Front doors have been broken open when firemen have already entered from the rear. Doors may be found which are of considerable value because of special features such as stained or plate glass, special woods, etc. Rather than break down these doors, an alternative means of entry should be sought if time permits.

Doors, shutters and gates are of seven principal types and each requires special treatment in order to force it with the minimum of damage: (see Book 8, Chapter 5 of the *Manual*).

(a) Hinged doors:
  (1) ledged
  (2) panel } (framed types)
  (3) flush
  (4) steel covered
  (5) barred.

(b) Swing doors.

(c) Revolving doors.

(d) Sliding doors.
  (1) solid type.
  (2) steel lattice type.

(e) Folding doors.

(f) Cantilever doors.

(g) Roller shutters.

In many gates and doors of industrial premises a small door, often referred to as a *wicket gate,* may be inset; e.g., a hinged door set in a sliding gate. Always try this small door first.

a. Hinged doors

Hinged doors closing against a rebate on the door jamb are by far the most common. They may open either towards, or away from, the operator.

(1) Ledged

This is the cheapest type of door to construct and, except when installed in well-built houses because of its antique appearance, is usually of flimsy construction. These doors are usually fastened by very light fittings and will generally yield to a push from the shoulder or a stout kick from the fireboot. A good method of kicking a door open is shown in Fig. 6.1.

Fig. 6.1 One method of kicking in a door.

The body should be poised so that the sole of the boot meets the door either flat or with the heel slightly in advance.

(2) Panel

Panel doors usually have a wooden frame with wooden or, sometimes in the upper half, glass panels. The glass panel should be broken first and an endeavour should be made to unlock the door by passing the hand through to the inside. If the panels are all of wood, then a bottom panel should be selected because when the panel has been forced if it is still impossible to open the door from the inside, the fireman will not be injured as he climbs in and will be

less punished by heat and smoke. Moreover, if hose has to be taken into the building, it will not be kinked and possibly damaged as it might be if it were suspended halfway up the door. The panel may be broken with a large axe.

When getting through an opening made in this way, it will be wiser for a fireman to remove his belt and axe (if carried), for it is easy to become jammed in a narrow panel opening. Even though an axe is temporarily removed in this way, never leave it behind. It has many uses and could be required for further breaking in or cutting away.

If it is suspected that somebody is lying behind the door (as, for example, if the door has been opened a few inches but, though a chain is not fitted, it will not go further), then break the *top* panel otherwise efforts to break in may injure the person behind the door.

(3) Flush

This type of door may be either hollow or solid; if the former it may be strengthened by a number of cross-members. Cutting through a solid flush door is difficult so try to lever the bolt of the lock out of the lock plate. If this is impossible, try an alternative means of entry before attempting to cut away.

(4) Steel-covered

This type (Fig. 6.2) presents more difficulty than the flush door since it is impossible to cut through a steel-covered door with an axe. Doors of this type are sometimes steel lined with wooden

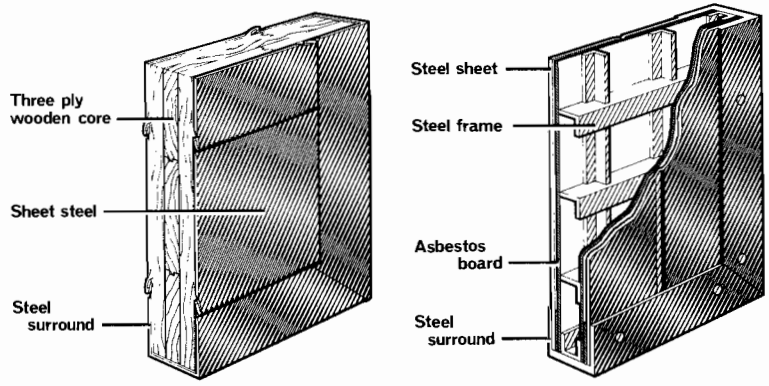

Fig. 6.2 Two types of steel door. Left: steel-covered on wooden core. Right steel-covered on steel frame lined with asbestos.

facings so that the steel work is concealed until the door is attacked. To force such a door, attack on the hinge side. Steel doors are sometimes fitted with a cast-iron plate close to the lock, so break the plate and insert the hand to release the fastenings on the far side.

With certain types of steel-covered door it may be possible, if no other means of entry is available, to cut away a section of plating with cutting plant, or with a mechanical cutter.

(5) Barred

Getting through barred doors will depend largely on their construction. If the bars are of relatively light construction, it may be possible to cut a sufficient number to give an opening, using heavy bolt cutters or shears, or failing this, a hacksaw. Alternatively, cutting plant can be used, or possibly a railing spreader or a heavy jack to force the bars apart sufficiently to provide ingress. If the bars are heavy, other entrances should be tried before time and effort are directed towards them.

b. Swing doors

A general description of swing doors is to be found in Book 8, Chapter 5, Section 5.

This type of door is expensive to replace and it should only be broken as a last resort if it is locked and the lock cannot be forced. Where toughened glass is found it can be broken by a smart blow in one corner with a sharp instrument such as a ceiling hook.

Swing leaf doors, especially those used as smoke-stop doors opening on to staircases, should not be fastened in any way, but some may still be found secured by padlocks with hasp and staple in the same way as a normal door. They may occasionally be found secured with drop or swing bars. Double leaf swing doors can be found locked by a bolt on one leaf, which is fastened first, and a mortice or other lock on the second leaf to secure it to the bolted leaf. If the lock is on the nearside it may be dealt with as described later; if the lock is of the mortice type, or is on the far side, and no glass panel is fitted, the door should be cut away sufficiently for the fireman to reach the bolt, or crawl through. The half of the door containing the lock should be attacked if it can be identified (this will usually be indicated by the keyhole).

c. Revolving doors

Revolving doors present an obstruction to the fireman since, unless they are first collapsed, or broken in, they do not permit the passage of any bulky object or lines of hose. The doors revolve on central pivots at the top and bottom, and usually have four wings arranged at right angles to one another. In some types of door only

two wings may be found, each of which has a curved extension piece.

These doors are rarely locked, but may become jammed. They are usually fitted with glass panels in the upper half. If the catch cannot be released from outside (see later), entrance may be obtained by breaking the glass and climbing in. The wings on the doors are generally constructed to collapse and move to one side so as to give a relatively clear opening. Two methods of securing the wings are usually employed, and these are illustrated in Fig. 5.25., Book 8, Chapter 5 of the *Manual.*

In the first of these the wings are held in place by a bracket or solid stretcher bar suituated usually at the top of the door across the angle formed by the leaves where they join the newel post. One end of each bar is permanently connected to one leaf of the door and the other end engages with some form of catch on the adjacent leaf. The wings are collapsed by releasing the stretcher bars either by undoing the wing nuts or by unfastening the catches which hold them in place.

In the second type the two opposing wings are hinged to the single leaf formed by the other two and are kept in position by a chain which runs through them and which is held by a catch on each of the hinged leaves. If this catch is released, the wings can be folded back to give a clear opening. This operation is shown diagrammatically in Fig. 6.3.

Both types of door may also be constructed so that, after the wings have been collapsed, the whole door can slide bodily sideways to give a clear opening. This is effected by releasing a catch fixed close to the newel post in one of the compartments and pushing sideways (Fig. 6.3, *right*). A track, either in the floor or ceiling, will show whether the door slides to the right or left.

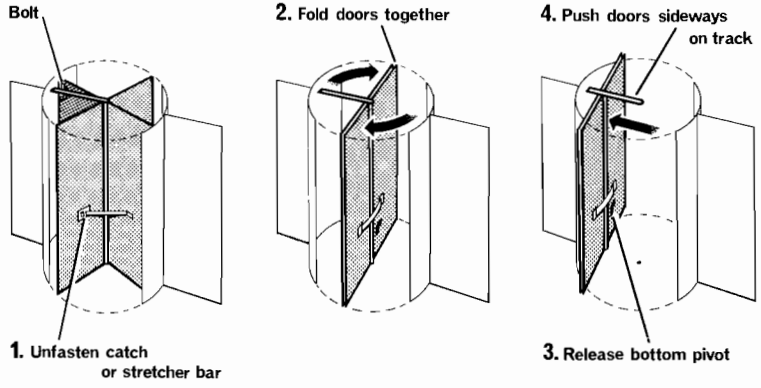

Fig. 6.3 Diagrams showing one method of collapsing a revolving door.

d. Sliding doors

These doors may be either of solid construction, or in the form of a lattice which collapses into a relatively small space when opened.

(1) Solid type

Sliding doors may run in tracks above and below the door (see Fig. 5.27, Book 8, Chapter 5). They are not often found in domestic property, except possibly in garages, but are widely used in commercial premises, especially as fire-resisting doors for isolating sections of a building. These doors may either slide on one or both sides of the opening, or may alternatively move into a central recess in the wall. Some of the more common arrangements are shown in Fig. 6.4. They may not always be seen, immediately, to be of the sliding pattern but the design of the handle and the recess in the side to which the door slides may be a guide.

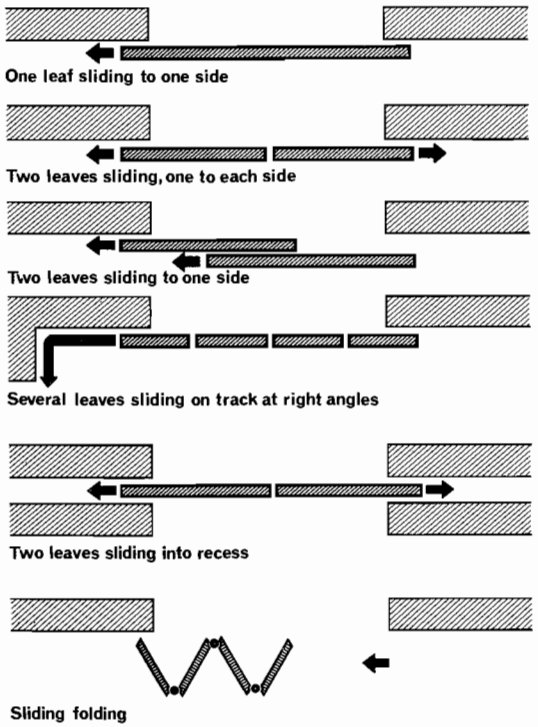

Fig. 6.4 Diagrams showing plans of principal types of sliding door.

If the fastenings are accessible, they should be dealt with as described below. Otherwise, sliding doors can be attacked by levering them away from the jamb on the side from which they would move with a crowbar. If possible, do not distort this type of door as they may not then slide into the recess which is provided for them. Alternatively, depending on the type of rail they run on, such doors may be lifted off the top rail by levering them upwards with a couple of crowbars (Fig. 6.5). They will usually then come off the tracks and fall away from the wall.

In large premises sliding doors will be found in pairs, with halves sliding towards the centre. These may be locked to one another either on the inside or the outside. The usual method of securing them is by a substantial hook and eye, drop bar, or hasp and staple. Pairs of doors can usually be parted sufficiently by driving the blade of an axe between them to see what sort of fastening is employed. The blade of an axe or a flat spade knocked upwards will usually dislodge a drop bar, but it may only be possible to deal with a hasp and staple by cutting away part of the door and then dealing with it through the hole so made. Ordinarily, when looking at a twin leaf sliding door *from the side on which it is fastened,* the padlock is on the right-hand leaf and, consequently, is on the left-hand leaf when approached from the other side.

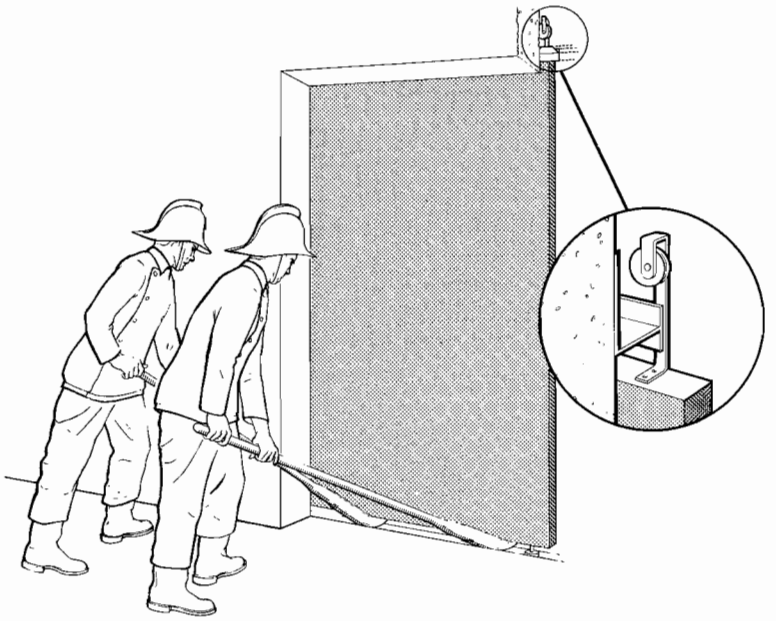

Fig. 6.5 Method of lifting a sliding door off its track by the use of crowbars.

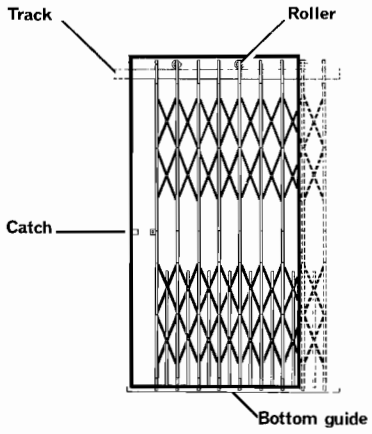

Fig. 6.6 Typical steel lattice gate.

(2) Steel lattice type

This type (Fig. 6.6) is widely used to protect property where weatherproofness is unimportant. The gate usually runs on two sets of tracks, one above and one beneath, but may sometimes be found with a bottom track only. Any distortion of the steelwork will result in jamming, so instead, try to force the lock, and a careful examination will show how this may best be done. Lift gates of this type have an automatic locking device, which is usually at the top, but may sometimes be incorporated in the latch. This lock must freed, in addition to any manual locking device, before the gate can be opened. Locking devices on lift gates will be dealt with in detail in Book 12, Part 1, of the *Manual* 'Methods of rescue' (currently Part 6a). Alternatively it may be possible to cut away parts of the gate with a hacksaw or cutting plant.

e. Folding doors

Folding doors are usually of fairly light construction and will often give way to a vigorous push with the shoulder. Exceptionally, they may be very large and of robust construction, in which case the only course will be to try to force the lock or, for doors of panelled construction, to cut away a panel and obtain access to the inside. Certain types of folding door have bolts on each leaf, and all must be freed before the door can be fully opened.

f. Cantilever doors

This door is counterbalanced and pivoted so that the whole door rises and, when open, lies horizontally. Cantilever doors are usually

found on garages but steel-plated versions are also found on boiler houses and are generally a flush fit. (See Book 8, Chapter 5).

g. Roller shutters

Roller shutters are nearly always made of steel, but may sometimes be made of wood. Those of steel are very difficult to deal with and alternative means of entry should always be sought before any attempt is made to break through such a shutter. If there is no external locking device, this usually indicates that there is an alternative entrance.

Small roller shutters up to about 2.5 m by 1.8 m can generally be raised by a direct lift with the hands, but larger sizes are almost invariably operated by means of gearing (see Book 8, Chapter 5) and some form of handle or chain block on the inside. Very occasionally, shutters fitted with chain gearing may have a cast-iron panel installed in the brickwork close to the chain, which can be broken so that a hand can be inserted from the outside to operate the chain. Roller shutters secured from the outside will usually be fastened with a lock or padlock which can be dealt with as described later. When the shutter is fastened from the inside, the bottom end is sometimes secured by a bolt, the head of which protrudes on the outside. The head may be struck off with a cold chisel and the bolt pushed through the hole to free the catch. Sometimes, however, the head of this bolt is flush set into the bracket and cannot be struck off. Two crowbars inserted under the bottom edge may lever the shutter up sufficiently to part the lock. The crowbars should be inserted one on either side of the fastening and the leverage applied equally. Care must always be taken, however, for should the shutter be distorted, it will be impossible to open.

On some roller shutters (more usually those of wood), it may be possible to lever one end out of the guides and pull out sections until an opening of sufficient size has been made. A hole of suitable size may, of course, be cut in steel shutters with cutting plant, if available. If the shutter has been opened and men are working on the far side, it must always be wedged open so that it cannot fall and trap them.

2 Methods of securing doors

Doors and gates will ordinarily be found secured by any one or a combination of the following methods:

(i) a lock of the mortice or rim type;

(ii) a padlock used with hasp and staple;

(iii) bolts, which may be screw on or 'blind';

(iv) a swing or drop bar;

(v) panic bolts.

a. Mortice locks

A mortice lock (Fig. 6.7, *left*) is one which is let into the edge of the door so that, when viewed from either side, only the keyhole is visible.

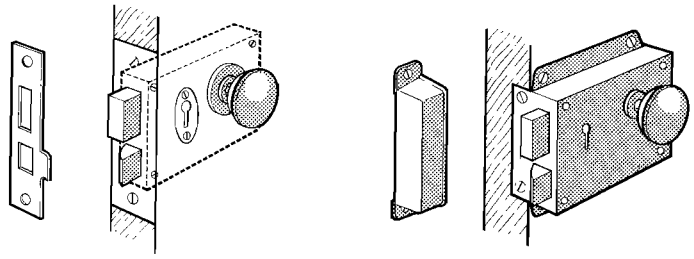

Fig. 6.7 Sketches showing (left) mortice and (right) rim locks.

One of the following methods of forcing a door fastened with a mortice lock may be successful, according to the construction of the door and the way it opens. Certain of these methods will also apply to doors fitted with rim locks (see below).

(1) The bolt of the lock may be prised out of the lock plate by using a large axe in conjunction with a heavy wedge. The wedge is driven between the door and the jamb, using the back of the axe as a sledge hammer, and the bolt of the lock is forced out of the lock plate by leverage. Alternatively, for doors opening toward the operator, the blade of a large axe may be driven in between the door and the jamb either just above or below the lock. If the handle of the axe is then levered towards the wall, away from the door, the latter will be prised out of its fastenings.

(2) The solid portion of the door beneath the lock can be attacked with the head of a large axe.

(3) If it is believed that the key is in the lock on the far side and if the door is of wood or is part glazed, cut away the panel beneath the lock or break the glazing so that a hand can be inserted to turn the key from the inside.

(4) The lock may be cut out entirely from the woodwork round it. This method is more suitable for the lighter types of framed door.

(5) The lock may be forced with one of the special patterns of lock opener carried by some brigades, or (when the door opens away from the operator) by the use of a door breaker, (see Book 2, Part 4 of the *Manual,* 'Small gear and miscellaneous equipment').

(6) With double swing doors which have no rebate, a hacksaw blade can sometimes be inserted in the gap between the two leaves and the bolt of the lock (which is usually of brass) cut off.

b. Rim locks

These locks (Fig. 6.7. *right*) are usually of light construction and operate into a screwed-on lock plate on the door jamb. If the lock is on the near side it will present no difficulty. Even if the key is missing, the lock plate can be prised off or (if time permits) unscrewed. If the lock is on the far side, a sharp blow will either spring the lock or knock off the lock plate, with very little damage to the woodwork. Another useful method of forcing a rim lock is to drive a tapered wedge under the door with the back of an axe, thereby raising the door slightly and straining the screws securing the lock plate. A sharp blow with the flat of a large axe near the lock will then usually force the door.

c. Padlocks

There are various ways of removing a padlock:

(1) by the use of a padlock remover, persuader or similar device;

(2) by using a bolt cutter or hacksaw to sever either the hasp of the padlock or the staple through which it is secured;

(3) by wedging the hasp of the lock against the door with its hinge downwards and giving the body of the lock a sharp blow with a hammer or with the flat of a large axe (Fig. 6.8, *right, above*).

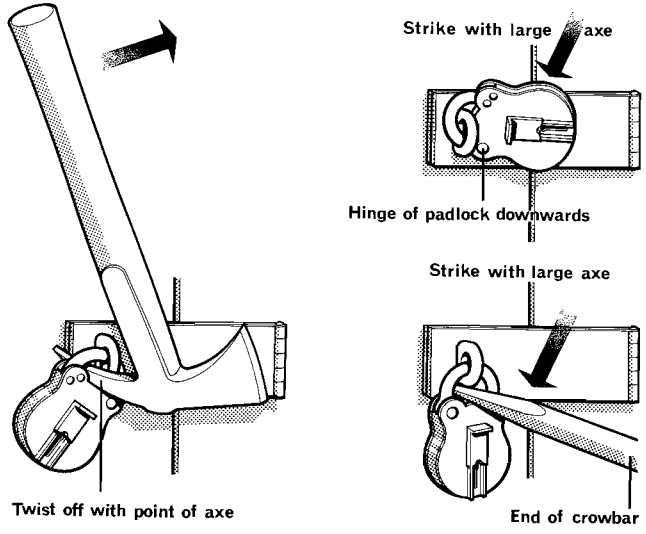

Fig. 6.8 Three methods of breaking open a padlock without using special tools.

(4) by putting the point of a fireman's axe in the loop formed by the hasp of the padlock and twisting the whole until it comes away (Fig. 6.8, *left*);

(5) by knocking off the hasp and staple with an axe, or, if the fastening is on the far side, knocking off the heads of the bolts securing them. The bolts can then be pushed through the hole, releasing the catch;

(6) by inserting the point of a crowbar into the loop formed by the hasp of the padlock, holding the other end and then striking the crowbar close to the padlock (Fig. 6.8, *right, below*). This will often spring the lock.

d. Bolts

Bolts vary greatly in strength of construction. They may be fitted either to the centre or to both top and bottom of a door, on the face of the door or (where appearance is important), on the edge of one leaf of a double swing door.

(1) When the position of a bolt on the far side of the door is known and the socket with which it engages is lightly secured, the latter may be knocked off by a sharp blow from the back of an axe on the door immediately opposite the bolt.

(2) If a bolt is on the far side and the heads of the fastenings securing it project through the door, they may be knocked off with a cold chisel or with an axe.

(3) If the bolt cannot be released by either of the above methods, a hole may be cut in the door and a hand can be inserted to undo it.

One leaf of double swing doors is sometimes fitted with bolts on the edge, and these cannot be reached until the other leaf is first opened. What are known as 'dead bolts' may also be found (in hotel bedrooms and in private houses) as a protection against burglars, since they cannot be detected from the far side. In this event, if it is impossible to cut a hole in the door for the hand to reach the bolt, attack the door from the hinge side.

e. Swing or drop bars

Drop bars (Fig. 6.9) are often used to secure double leaf doors. They can sometimes be removed by springing the door sufficiently to get an axe blade or a spade between and then by knocking up the axe blade to dislodge the bar. On the other hand the swing bar, which is pivoted on one leaf and which drops into a socket and then folds over a hasp and is secured with a padlock, may be virtually impossible to attack from the far side unless part of the door is cut away so that the fastening can be reached.

f. Panic bolts

If the doors are not fitted with a rebate it may be possible to spring the two leaves apart sufficiently to get the blade of a long,

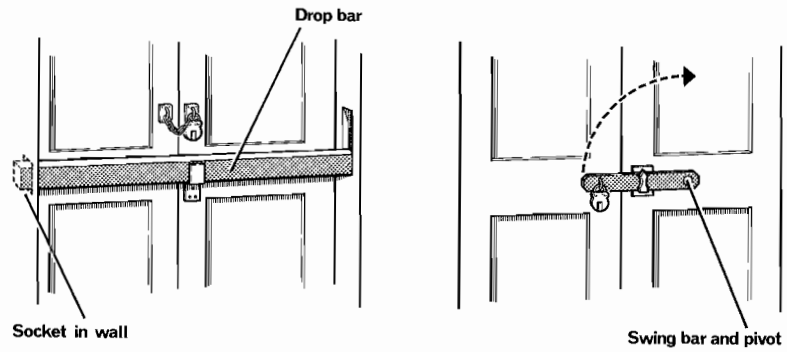

Fig. 6.9 Common types of drop bar. Left: removable type. Right: swing type.

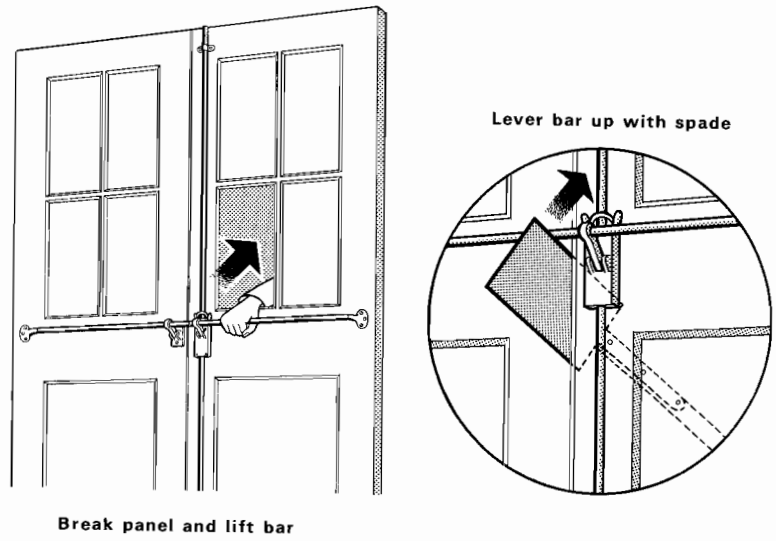

Fig. 6.10 A method of forcing panic bolts with (inset) alternative method which can be employed if no rebate is fitted.

stout knife or other similar thin but rigid object, between them. The blade of a fairly flat spade (Fig. 6.10, *inset*) may serve the purpose. If this is then knocked up it will force the crossbar of the panic bar upwards and will release the catches, enabling the door to be opened. Doors fitted with panic bolts always open outwards, away from the side on which the bolts are fitted.

If it is impossible to get between the leaves in this way, a hole should be cut in a panel *above* the bolt and a hand inserted to lift the bar (Fig. 6.10). In some premises, the two leaves of the door are secured with a chain and padlock once all members of the public have left. These will have to be forced or an alternative means of entry found.

3 Hinges

In some instances, as for example, when the front door of a house is secured by two bolts, top and bottom, two locks, rim and mortice, and a chain, the hinge of the door may be the best part to attack. Some doors, especially those in stables and farm buildings, are hung on strap hinges with pins on the doorposts, and can be lifted off the hinges without damage. One of the following methods of attacking the hinge may be applicable:

(1) It may be possible to remove the pin by putting the axe blade underneath the head of the pin and then twisting it, or knocking it upwards (Fig. 6.11, left), to free the pin, which can then be withdrawn from the top.

(2) If the hinges cannot be seen, and the lock cannot be forced, or the bolts drawn, the door may be driven in by heavy blows with the back of an axe against the points where hinges are likely to be.

(3) Swing doors are sometimes swung on two pin pivots which project into a recess in the floor and in the lintel above. Such pivots are often made of cast iron and a sharp blow with the back of an axe at the two extremities of the door close to the hinges will snap them off, and the door can be removed. It may be possible to lever the door up sufficiently on the hinge side to release the pin of the hinge and allow the door to open.

(4) With doors swung on strap hinges with pins on the doorpost, it may be possible to spring the top of the door out of the rebate.

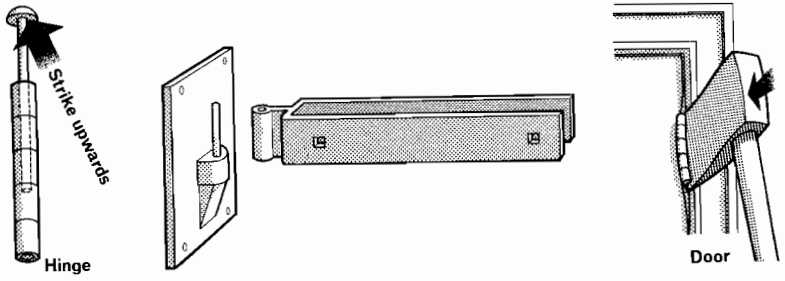

Fig. 6.11 Methods of forcing doors on the hinge side. Left: pin hinge. Centre: strap hinge showing strap lifted off the pin. Right: prising the door away from the hinge.

Then lever up the door from the bottom, to lift the straps off the pins, and free the door without structural damage of any sort. This often applies also to heavy gates (Fig. 6.11, *centre*) used to close the entrances to yards of industrial premises, and to farm gates when these are kept locked.

(5) When the hinges can be seen (Fig. 6.11, *right*), the blade of an axe should be inserted between the door and the hinge plate and the back of the axe should be struck, severing the screws holding the hinge.

4 Fanlights

To avoid the necessity for breaking in a front door, try getting in through the fanlight which is often fitted above it in private houses or in lock-up shop property. If the fanlight is open, force the guides on either side apart so that the fanlight can drop down and leave a clear opening through which to crawl. If the fanlight is carefully lowered, the glass need not be broken. If the catch cannot be released from the outside without breaking the glass, try, after releasing the catch, to lower the fanlight so as to enlarge the opening through which to crawl. This avoids the necessity of having to clear away all the glass. If the fanlight is fixed, the glass should be broken and cleared away completely to avoid injury.

Having made the opening, enter feet first, face downwards, and drop down inside in the same way as when lowering oneself from a window (see Book 12, Part 1 of the *Manual*). Once inside, the door can usually be opened from the inside without damage.

5 Windows

If any windows on the face of the building are open at higher levels, it will usually be found quicker, and less destructive, to pitch a ladder and enter in this way than break a door. Ordinary window glass is cheaper and easier to replace than woodwork so always consider this method first, even though a window is not found open, particularly if the door is solid and obviously costly.

A window above the front door should preferably be chosen as it may lead direct on to the staircase or landing. If not, there should be a door leading out of the room on to the stairs. If the fire situation permits, go down the stairs to the front or to the side door and unlock the door from the inside. When entering through a window above the ground floor, take care that it gives access to a room and not to a stairwell or other drop. Windows are often provided in such places for lighting or for ventilation, and any fireman entering incautiously might suffer serious injury.

If it is necessary to break glass, the jagged edges should be cleared around the frame to prevent injury to men as they enter. It

also prevents damage to equipment, such as hose lines, which may be taken in later. Use a piece of old sacking or a door mat to give protection.

a. Plate glass

Plate glass in windows used in shops is extremely costly. Try every alternative before deciding that such a window should be broken. Never use this method to gain entry, except in an emergency where life is at risk, or where it is obvious that the window will become involved in the fire and will suffer damage. It may become necessary to collapse such a window if it would be dangerous to those working in the vicinity, e.g., where it is severely cracked. When plate glass must be broken, the smallest section of glass should be attacked. There are often small windows flanking the entrance to the doorway of a shop. Choose these for preference.

To break a plate glass window, a ladder may be used as a battering ram, but take care that the end of the ladder which strikes the glass is lower than the other end (Fig. 6.12), so that the broken pieces slide away from the firemen. Alternatively, pitch a ladder alongside, head supported above the window, and then break it near the top, using the flat of an axe. Other members of the crew should stand well clear of the falling glass. A ceiling hook is also useful for pushing in a window. In jewellers' premises shutters are set behind the window, arranged to fall if the window is broken. This will delay entry.

To break toughened or armoured glass, only a sharp tap is needed in one corner with a sharp pointed instrument, such as a ceiling hook or pickaxe, and the whole pane of glass will shatter.

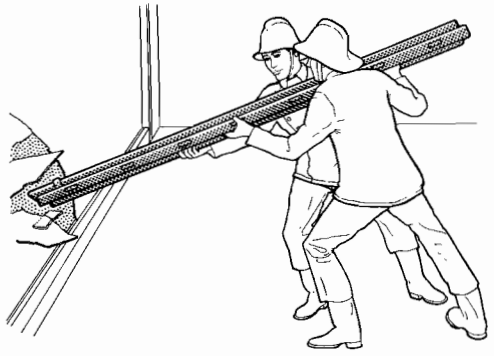

Fig. 6.12 Method of using a ladder as a battering ram to break a plate glass window.

Fig. 6.13 Careless use of an axe near flanking plate glass windows.

This type of glass is even more expensive than plate glass and should only be broken as a last resort.

In many shop premises, the door is set well back from the frontage, the way to it being flanked by plate glass windows (Fig. 6.13). Take great care when working on the door not to strike flank windows accidentally when trying to gain entry through the door. When trying to open a door in shop premises fitted with large plate glass windows held in light metal frames, take care to guard against distorting the framing or breaking the window.

Other windows, such as curved non-reflecting types used in shops, and bow or engraved windows used for decorative purposes, could be very valuable. Break them only when all other means of entry fail. Remember when considering whether to break a plate glass window that the large opening created may vent a fire and result in a very rapid fire spread.

b. Sash windows

The frames of sash type windows are almost invariably made of wood. It may be possible to slip back the catch from the outside using a knife (Fig. 6.14) or the blade of an axe to avoid breaking the glass. If this cannot be done, break the pane of glass opposite the catch and use an axe to unfasten the catch.

If this is impossible, release the catch by hand. Whichever method is used, hold the upper sash with the free hand (Fig. 6.15),

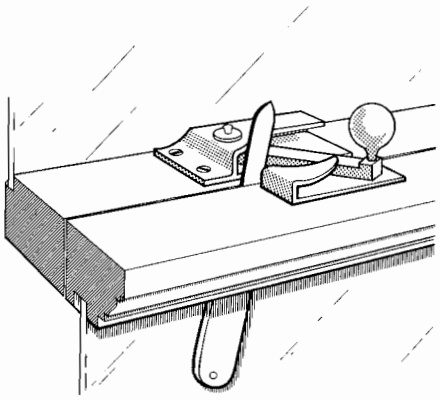

Fig. 6.14 Method of opening a sash window by slipping back the catch with a knife.

Fig. 6.15 Method of opening sash-type window when a pane has been broken. Note the left hand is holding the upper sash to prevent it falling and all jagged edges of glass have been removed from the glazing bars.

to stop it falling should the sash cords be broken. Sash-type windows can also be found where the lower window rises and falls normally but the upper window is pivoted about a horizontal axis and swings open in the same way as the factory type described later.

When breaking a pane of glass, use the flat of a small axe to give a sharp but not a hard blow. The glass will fall into the room and not on those working below. Keep the hand *above* the head of the

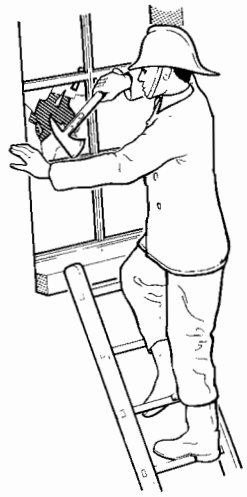

Fig. 6.16 Method of breaking a pane of glass with an axe to effect entry to casement type window. Note that the head of the ladder should only reach to the sill.

axe (Fig. 6.16) to prevent any pieces of glass slipping along the handle and causing cuts. Take care when stepping inside to avoid slipping on the broken glass and push it to one side out of the way immediately the window has been entered.

In certain buildings, such as mental hospitals, it may be found that sash windows are constructed to open only a short distance. In private houses, stops may be found screwed into the upper sash at the sides, to prevent the lower half of the window being opened more than a few inches. These stops can be unscrewed if access is gained by breaking the glass. Some sash windows originally constructed to open may have become stuck through being painted up. The blade of an axe should be inserted at the bottom and the window prised up.

Once a fireman is inside, if a person must be removed from the building, it may be quicker, where windows are small, to remove the entire frame rather than break it up. Prise away the wooden beads, one on either side, with an axe blade. Next cut the two sash cords with the axe and the entire window can be lifted out. Both frames can be removed in this way to give a clear opening the full size of the window.

c. Casement Windows

Both wood and steel are widely used for the frames of casement windows. It is often impossible to release the catch from outside, so

break the pane of glass nearest to, but below, the catch. The locking bar generally fitted to these windows can then be released through the same hole. Remember that casement windows usually open outwards, so that, when pitching a ladder to the window, keep the strings below the sill (Fig. 6.16). It should be obvious from street level whether a window is a sash or casement type. If it is a double leaf casement window, pitch the ladder to the *catch* side if it can be seen from ground level, for that will be the one that opens.

d. Factory windows

Steel framed windows in commercial premises may be found to pivot about a horizontal axis, the upper part opening inwards and the lower part outwards. The catch may be fitted either at the top or the bottom, but more usually the top. Alternatively, a vertical axis may be used. To release the window break the glass close to the catch, which usually has a finger grip and spring. If this is impossible, a crowbar placed between the fixed portion and the open portion should spring the pivots, providing the glazing bars are not horizontal. Factory windows are often secured by thumb screws at the top of the top half and bottom of the bottom half. These screw into the frame and must be undone before the window can be swung open or the frame will come away.

Another type of opening in factory windows may be bottom hung, to open inwards from the top, or top hung to open from the bottom, fastened usually by a spring catch. To enter through these, break the glass, release the spring catch and then release or strike off the chain or quadrants which control the depth of opening of the vent.

Similar to the bottom hung window is the hopper window. This is not hung on hinges but two pins engage in guides in the side members. After releasing the catch, the window may be lifted out of the guides, leaving the whole opening clear.

Examples of casement and factory steel-framed windows are illustrated in Chapter 5, Book 8 of the *Manual.*

e. Fixed windows

Some windows may either have been originally constructed not to open or have been subsequently screwed up and rendered unopenable. If of wood, break the necessary panes of glass to gain entry and cut away the glazing bars. If metal, they may present a problem, but, after breaking the glass, it may be possible to break sufficient glazing bars away from the framework with the back of a large axe, and so make an opening.

f. French windows

These can be treated either as a panel door or as a casement window, as necessary.

g. Barred windows

Bars present a serious problem. If made of very light gauge metal, such as used for nursery windows, they may only be nailed or screwed into place. These can be knocked out or prised away with an axe. If of rather larger size, they may be sheared with bolt cutters or hydraulic shears, or cut with a mechanical saw, if available (Plate 18). If they are of substantial size, as used to protect the lower floors of warehouses or basements, they will probably be set into the brickwork or stonework. Only try to cut them with cutting plant, if such is immediately available. They could be freed either by bending the bars with blows from a large axe, which may shorten and pull them away from the stonework (Fig. 6.17, *right*). Otherwise, break away the stone or brickwork in which they are fastened (Fig. 6.17, *left*) and then pull them clear. The stone can be flaked away by blows from a pick, or from the pick end of a small axe, or by striking it on the edge with the back of a large axe or a sledge hammer.

The bars may then be pulled sufficiently clear to allow entry. Alternatively, the bars may be forced apart by means of a hydraulic spreader or jack. These windows are sometimes unglazed with an inner screen of wire netting to prevent the entry of birds. This will have to be cut away after the bars have been removed.

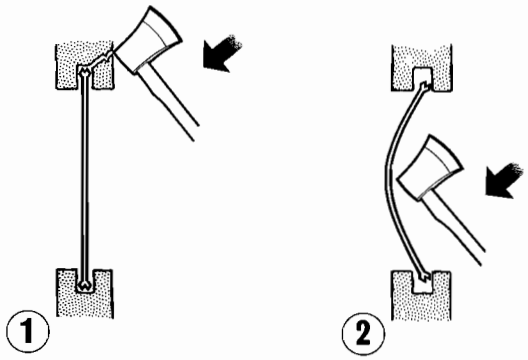

Fig. 6.17 Methods of forcing a barred window. Left: by hacking away stonework. Right: by bending the bars

h. Leaded windows

Leaded windows can sometimes be cut away as a single panel, and placed to one side. The lead is usually sufficiently soft to be cut with a knife, but is sometimes reinforced with steel strip. It may still be possible to lift the lead beading and free the glass. Such

windows, if of coloured glass, may be of considerable value. If possible, take out the whole panel by running a knife or blade of an axe round the outer edge, rather than remove a small section. If impossible, prise a small section out with all possible care. The value of stained glass windows lies in the glass, and not in the leading, which can be replaced. Leaded panes are often held in position by light gauge bars, running from side to side of the opening. These will also have to be removed.

j. Double glazed windows

Double glazed windows will be found in certain types of premises, such as hotels, nursing homes, offices and private houses, where they are installed for sound or heat insulation. Some are complete unopenable units set in metal or wooden frames (see Fig. 5.35, Book 8). Others have normal windows of different types on the outside with sliding panels of glass in metal frames inside in the same window opening. The distances between the two areas of glass, fixed or otherwise, may vary from 5 mm to several centimetres. Another type consists of sealed units of 2 or 3 sheets of glass each spaced at about 5 mm, fixed to the normal glazing bars.

To avoid injury, great care should be taken when dealing with large areas of double glazing, some of which could contain plate glass.

In some cases, if the outer glass can be broken easily, the inside sliding panel can be lifted out from the frame and lowered to the floor inside.

6 Other openings at ground level

In addition to doors and windows, other openings may be available at ground level through which entry can be forced, as for example when attacking a basement fire. Amongst these are:

(a) gratings;

(b) pavement and stallboard lights;

(c) cellar flaps;

(d) chutes for coal or other commodities.

a. Gratings

Basement windows may often be protected by gratings on the pavement. These are often made to lift up without damage but may be set (usually with lead) into the paving stones. A sharp blow with the back of an axe close to the point where the grating is set may free it sufficiently for it to be pulled up. Removable gratings, held down to an eyebolt by a central chain at the bottom of the area they serve,

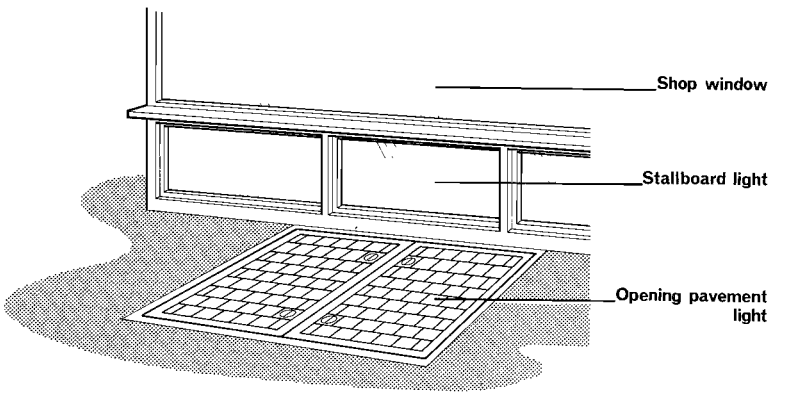

Fig. 6.18 Typical pavement and stallboard lights.

can be levered up sufficiently to gain access. Alternatively, cut the bars through with cutting plant or hydraulic equipment. A self-locking burglar-proof type of grating is sometimes found.

b. Pavements and stallboard lights

Basements in which goods are stored are often fitted with pavement lights or stallboard lights (Fig. 6.18). Pavement lights are horizontal and are sufficiently strong to allow pedestrians to walk over them. They may be constructed solely for lighting, or to open either for ventilation or for the loading of goods.

Pavement lights (Fig. 6.19) are constructed of thick glass panels, often prismatic in shape, set in metal or concrete frames. Lights

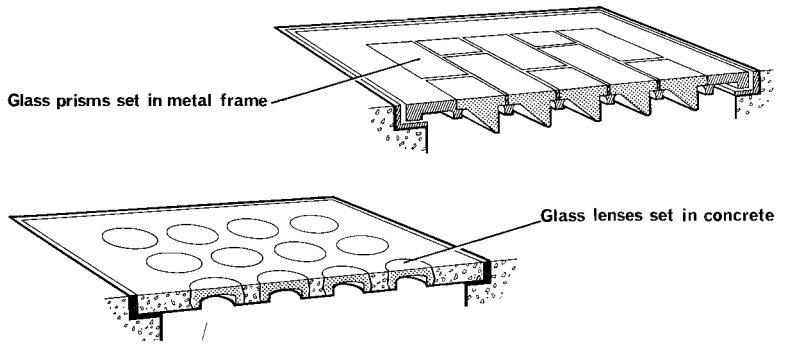

Fig. 6.19 Two principal types of pavement light construction. Above: glass prisms in a metal frame. Below: glass lenses set in concrete.

which can be opened from the inside very often have breakable glass panels set near the catches. Sometimes these panels are made of glass of a different colour. Break them with the back of an axe, put a hand in and release the catch. As goods lifts or hoists are sometimes found beneath such frames, take care on entry. Those which are not hinged may sometimes be prised up out of their settings with the chisel end of a crowbar, but this is usually difficult, for they are heavy and often fixed in position with bitumen or cement grout.

Stallboard lights are similar to a vertical steel window set well down below a shop window, but are seldom of such strong construction as pavement lights. As they resemble a window, attack them as such.

c. Cellar flaps

Many premises in which the basement is used for storage have trapdoors, known as cellar flaps (Fig. 6.20) which open on to the pavement. The doors covering these openings are lifted up when loading or unloading goods, with a staybar or wire mesh grid. This serves to protect the opening and to hold the flaps in position. The doors are often of wood and may be forced by removing one of the boards to get at the fastenings below. Take considerable care in using this type of entrance as lifts or hoists often operate below the doors. These might fall when weight is applied to them such as a ladder pitched down.

d. Chutes

The size and construction of chutes vary greatly. Some are large enough for a fireman, but others may be too small. Iron covers, which can be lifted up, are used for the smaller ones, but the larger chutes will often have trapdoors fastened in a variety of ways. They

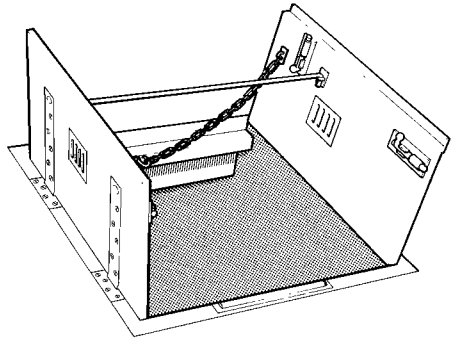

Fig. 6.20 A typical cellar flap.

should normally open upwards or outwards. If it is absolutely necessary for a man to enter premises via a chute, attach a line to him to ensure his safe return should the end of the chute be sealed off or otherwise dangerous.

When a pavement light, cellar flap, or chute, etc., has been opened up, post a man by the opening in order to warn passers-by of the obstruction. Alternatively, guard it adequately to prevent injury to the public or firefighting personnel. At night it should be illuminated.

7 Other openings above ground level

Remember the most suitable method of forcing an entry after the more obvious ones have failed may be more easily achieved above ground level. Windows on upper floors are frequently left open by private householders, and in larger buildings staircases often open on to the roof. Such doors, even if fastened, might be more readily opened.

Where access to a building must be obtained above street level, two methods are possible. First, the use of ladders or hydraulic platforms in their various forms, and second, access from adjoining property. The correct handling of ladders has already been dealt with in Part 1, Chapter 6, of the *Manual,* and in Part 2, Chapters 3 and 4. If hook ladders are necessary and available, manhandle them as far as possible up internally and start the climb from the highest practicable point. Alternatively, it may be possible to reach the roof or a window on a floor above and descend by hook ladder to the required level.

It may be possible to use a dormer window or door on to a flat roof or verandah. Dormer windows are frequently associated with wide parapets and access may be gained from adjoining property. Skylights can be lifted off or broken open, and a short extension ladder used to reach the inside of the building. Many properties, particularly of old construction, have a common roof space. It may be possible to obtain access from adjoining premises via the trapdoors which are often provided. Take care, as skylights very often open direct on to a stairwell and there may be a considerable drop.

a. Loopholes

Loopholes (Fig. 6.21) are loading doors on upper levels from which goods are loaded or unloaded by a crane or pulley block mounted usually on the building itself. In commercial premises loopholes on upper floors may offer a relatively easy way in, but at some floors they may be secured on the inside by heavy drop bars, extremely difficult to displace. They are often fitted with an external drop platform, which can only be lowered by releasing the chains from

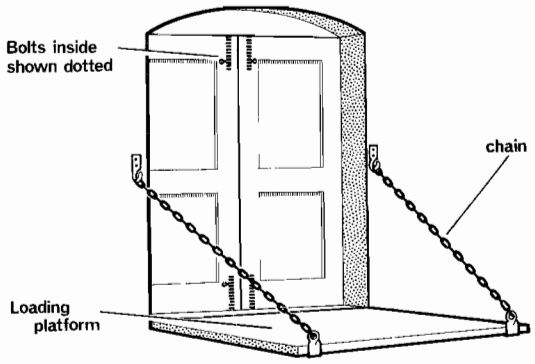

Fig. 6.21 A typical warehouse loophole.

inside the premises. It will be difficult to pitch a ladder in such a way that the platform will not foul it when the platform is lowered. One or other of the methods already described for opening doors should be used depending on the construction found when the loophole is closely inspected.

b. Roof lights

A roof light is a form of window in the plane of the roof and fixed. An opening roof light is referred to as a 'skylight'.

Almost all modern factories and other large single storey buildings are provided with some form of roof lighting. This can take one or more of the following forms:

(1) lantern light

(2) monitor light

(3) dome light

(4) lens light.

(1) Lantern lights (Fig. 6.22) usually consist of vertical glazed sides and a glazed roof. The sides are often arranged to be openable or can be fitted with louvres. This will allow the smoke and hot gases from a fire within the building to escape.

A lantern light without the vertical upstands is strictly speaking a 'skylight' but is often referred to as a 'decklight'.

Where openable, methods vary, but many lights will be found to be either quadrant or gear operated (Fig. 6.23). To get at the operating mechanism a pane of glass will have to be broken and either the quadrant removed or, in the case of gearing, the operating rod turned by a wrench or spanner. In either case it may be easier,

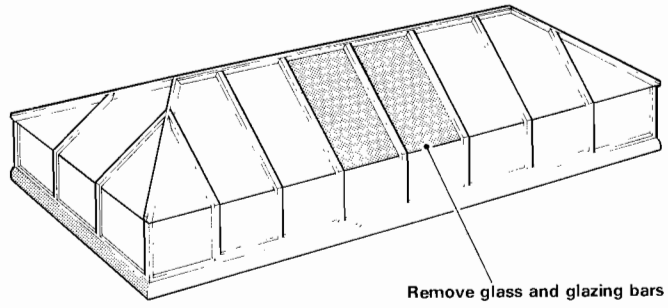

Fig. 6.22 Method of effecting an entrance through a lantern light.

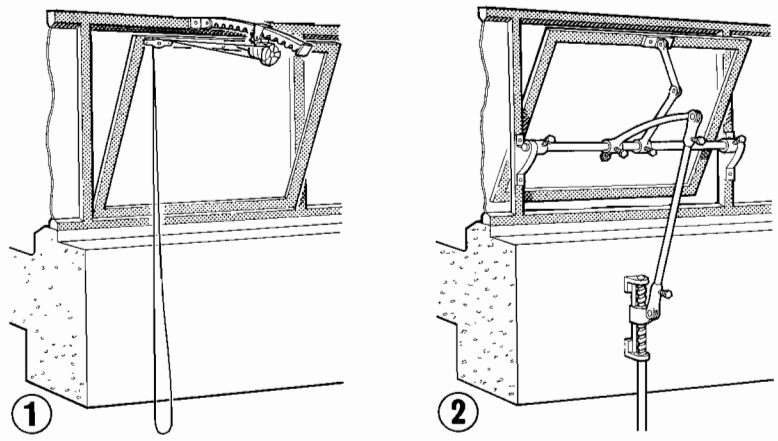

Fig. 6.23 Two forms of lantern light fastening. Left: quadrant-operated. Right: gear-operated.

quicker and less cluttered, to break or remove a pane of glass in a fixed window to get in.

There are still many of the old wooden framed skylights to be found on the roofs of houses, flats and hotels. These are usually hinged at the upper end and can be opened either by levering up the catch with the blade of an axe or breaking a pane of glass to reach the fastening (Fig. 6.24).

A special type of 'light' will be often found on roofs of cinemas or theatres called a haystack lantern light (see Chapter 10, Book 8 of the *Manual*). Remember that, if the fusible link fitted to this type operates, heavy panels of glazing will fall outwards with consequent chance of injury.

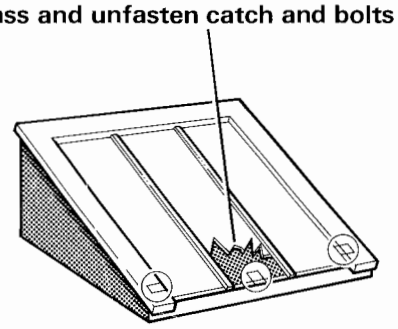

Fig. 6.24 Old type of wooden framed skylight.

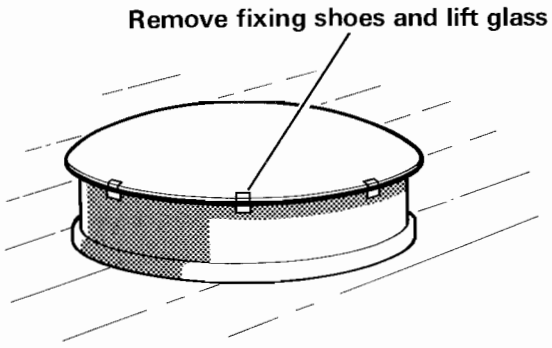

Fig. 6.25 Typical dome light.

(2) Monitor lights take the form of glass 'boxes', each with a flat top on flat or low-pitched roofs. If openable the sides are usually arranged in a similar way to lantern lights.

(3) Dome lights are used in flat roof construction. There is a fairly wide range of standard-sized glass, thermoplastic or fibre-glass types both circular and rectangular. They are usually held down by small fixing 'shoes' which can be easily removed and the dome lifted off. (Fig. 6.25).

(4) Lens lights are square or circular glass blocks of substantial strength cast into the reinforced concrete ribs of flat and barrel type roofs. They are essentially the same as pavement lights but seldom have any method of opening other than by breakage (see Fig. 6.19).

Generally, it will be noted that most types of roof light will fail in heat, venting a fire to the outside air. This stops the fire from spreading laterally within the building. Hazardous conditions can arise from this, however, if the escaping heat and flames can reach

adjacent buildings or flammable materials. The exposure hazard created must be adequately covered in firefighting operations.

In many buildings wired glass is used in roof lights and, while this reduces the risk of glass falling on persons below, it delays the venting of the fire as it will, initially, only crack and become misshapened under fire conditions.

Bear in mind, when gaining access, that many lights are positioned over stairwells.

8 Authorised entry into special premises

a. Authorised forcible entry

Some commercial buildings used for storage have special fittings incorporated to help authorised forcible entry. These include bonded warehouses, furriers, jewellers' shops, banks, explosive stores, cold stores, etc. In many instances Customs and Excise locks may be found in addition to company locks.

The exact method of fixing depends on whether the doors are sliding, folding or hinged, but in most cases the doors are fitted with hinges or with hasps and staples (Fig. 6.26). The hasp consists of a bar bolted to the face of the door and fitted with a hinged end with a slot to fit over the staple. The hasp is secured to the door by cast-iron bolts, and both the bolt heads and the nuts project about

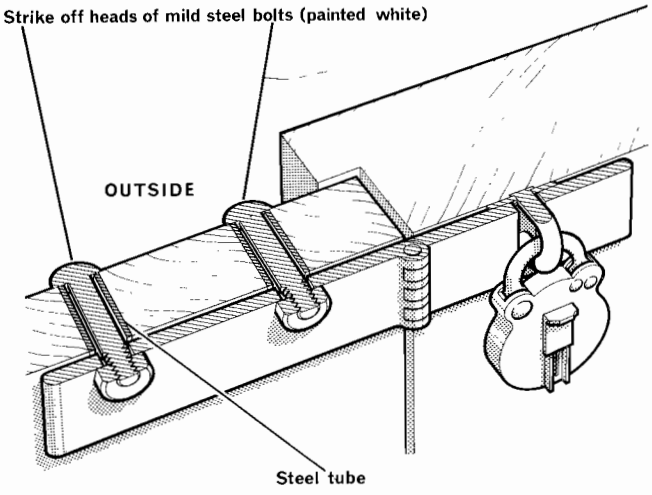

Fig. 6.26 Method of providing authorised forcible entry consisting of hasp and staple secured by cast-iron bolts, the heads of which can be struck off.

12.5 mm from the surface to enable the bolts to be broken from either side of the door. The bolt heads are generally painted white. The mild steel staple may be fixed to the face of the door or to the masonry of the door jamb, depending on the type of door. Once the heads have been struck off, the hinge or staple can be pulled clear, or if it is on the far side of the door, the bolts can be pushed through the door to free the staple. The bolts are often enclosed in mild steel tubes where they pass through the door so that they will not bend when the head is struck off and jam when pushed through.

On some doors rim locks may be fitted and the steel plate holding the rim lock is then fixed to the door by cast-iron bolts. Sometimes cast-iron angle brackets are used on folding, hinged or sliding doors so that, when the doors are shut, they can be secured by a padlock. A sharp blow on the padlock will break the brackets and will allow the door to be opened. This type can be forced from the padlocked side only.

Roller steel shutters are sometimes secured by bolting a steel angle plate with cast-iron bolts to the shutter near ground level and adjacent to the door jamb, and this angle plate lines up with a steel plate projecting from the jamb. The head of the bolts are well clear of the shutter and may easily be struck off. Another type of fastening for roller steel shutters consists of a cast-iron eye bolt (Fig. 6.27), which is usually fitted to the centre of the shutter near

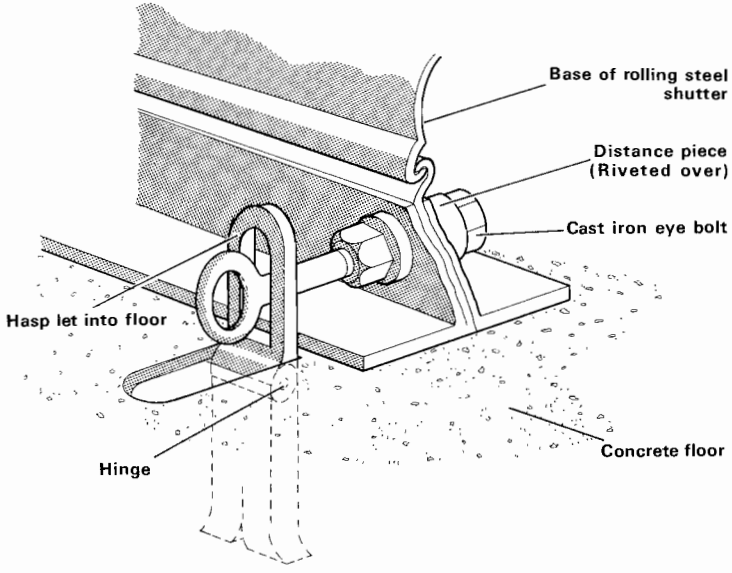

Fig. 6.27 Method of fixing roller steel shutters with a cast-iron eye bolt and hasp let into the floor.

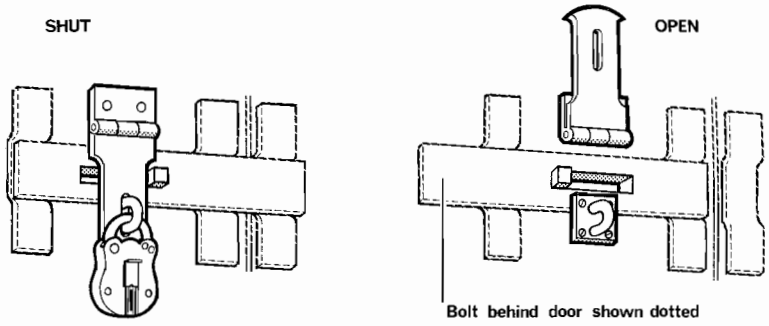

Fig. 6.28 The Liverpool salvage bolt method of providing for authorised forcible entry. Left: the bolt secured. Right: the padlock struck off and the bolt withdrawn.

ground level and engages with a hinged hasp which is let into the floor. The shutter can be released from the lock side of the door by striking the eye bolt sharply with an axe and breaking the shank of the bolt: from the other side strike the nut which is kept well clear of the door by a distance piece to ensure accessibility.

Another type of fixing is the Liverpool salvage bolt (Fig. 6.28). When the padlock is struck off and the hasp raised, the bolt, which is fitted to the far side of the door, can slide back without causing further damage.

An emergency release mechanism incorporating cast-iron bolts is fitted to some London Electricity Board transformer stations (Fig. 6.29). The steel doors of the chamber are secured by a lock operated by a panic bar on the inside and a key on the outside. To ensure rapid forcible entry by fire brigade personnel, an emergency release is fitted. This consists of a 56 mm diameter mild steel plate which is connected to the panic bar by a short length of chain through a 32 mm diameter hole in the door. The plate is held in position by two cast-iron bolts. When the heads of the bolts are struck off, releasing the plate, the door can be opened by means of a sharp pull on the plate which will operate the lock via the chain and internal panic bar.

When it is necessary to gain entry through a door which has no obvious method of opening, check any projecting boltheads. Although cast-iron bolt heads are normally painted white, this is not always so, but they will have projecting heads or nuts, and a sharp blow with an axe should break the bolt. If the bolts do not break after one or two sharp blows, force the door by other means.

In some parts of the country, commercial premises may be found fitted with a cast-iron bulge on the door which can be broken by a blow with a large axe, and a hand inserted to release the key or other fastening.

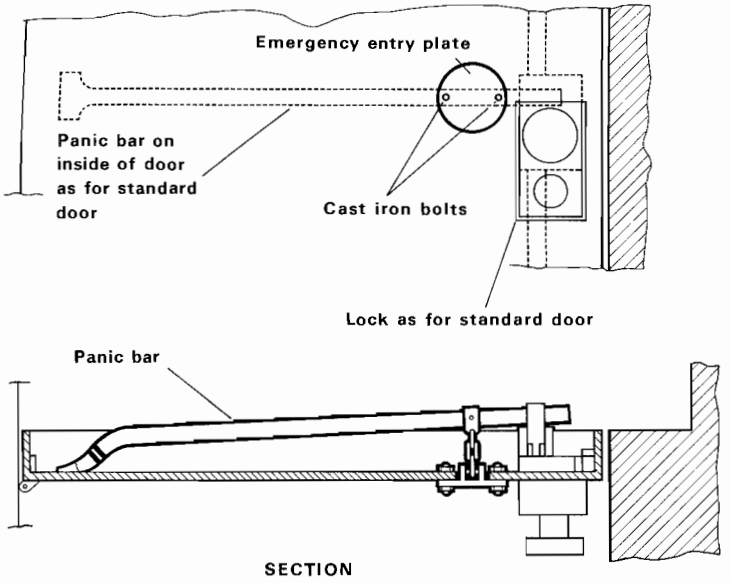

Fig. 6.29 Emergency release to panic bolts fitted to some London Electricity Board transformer chamber doors.

b. Fireman's entrance to basements

Occasionally basements are equipped with a fireman's entrance (Fig. 6.30). This usually consists of a shaft fitted with a cat ladder leading from outside the building into the basement. The top of the shaft is generally covered by a trapdoor, often resembling a pavement light, released from outside by breaking a panel of glass (coloured to distinguish it) and operating a catch below. The bottom of the shaft ends in a lobby having double swing doors. These serve to exclude smoke and heat from the shaft so that, irrespective of conditions in the basement, a fireman can get down to the level of the basement floor without punishment.

c. Keys

Sets of keys for certain premises may, in some localities, be lodged with the police or, occasionally, with the local fire brigade. When keys are held by the police, discussions will have been held to determine which premises on a station's ground can be entered by this means, also the best and quickest way to obtain the keys in an emergency. The method will usually be for the mobilising control to notify the police at the time of the call, and for a policeman to meet the fire brigade officer at the premises with the keys. If there is likely to be any delay in entering, force an entry rather than wait for the arrival of keys.

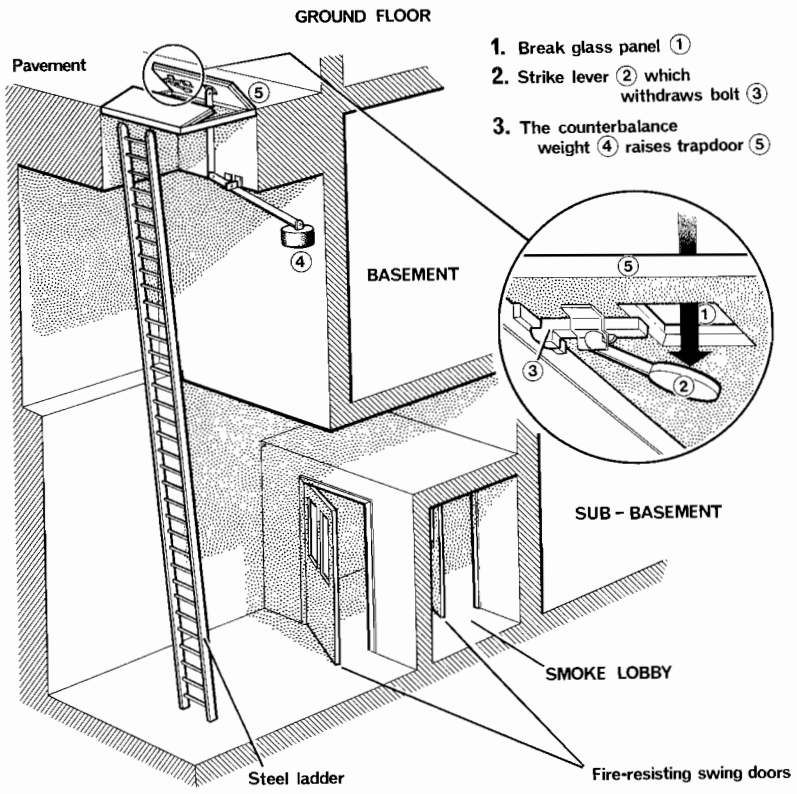

Fig. 6.30 A fireman's entrance to a sub-basement. Inset: method of releasing the catch after breaking the coloured glass panel.

Chapter 7
Cutting away

1 Woodwork

From time to time it is necessary to cut away woodwork, such as flooring, skirting, roofing members and partitions. The most useful tools for such work are a club hammer, a cold chisel with a 50 mm blade, a pad or keyhole saw, a floor saw, a screwdriver, a small crowbar, and two or three wooden wedges 50 to 75 mm long, the thickest part being about 25 mm. Sometimes mechanical saws or cutters may be available, but care is necessary in their use as gas and water pipes and electric cables are to be found in profusion under floorboards. A hand saw is generally the best tool, provided that conditions allow its use. It is quicker and neater than an axe, and timber cut away can often be replaced with very little damage. A floor or cockerel saw is the best type, since a cut can be started on a flat surface. If a floor saw is not available, break one floorboard so that a panel saw can be used on the remainder. One method of breaking a board is to drive the wedge end of a crowbar down into it close to the joist and across the grain.

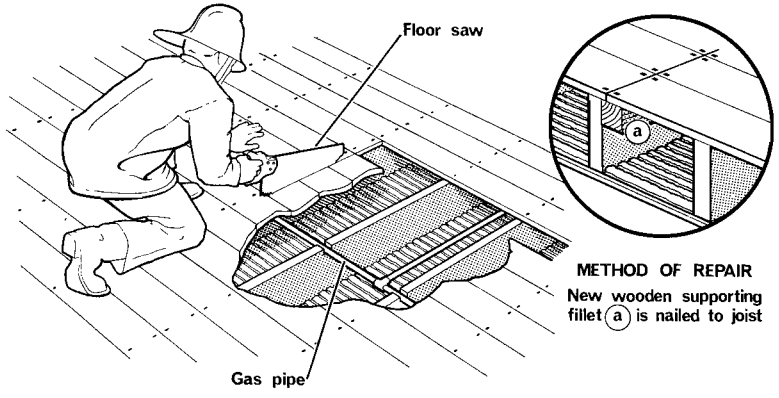

Fig. 7.1 The correct method of cutting a floorboard with a floor saw. Note the danger of cutting concealed pipes. Inset: method of repair which can be used if cutting away has been carried out carefully.

Alternatively, punching the heads of the nails holding the end of a floorboard to the joist down through the board may release it. Prise the end up and lever the board out of position, allowing access to the other boards.

Cut floorboards as close as possible to the edge of the joist. If the cut has been started with a saw, the board can be replaced in position on a fillet nailed to the joist (Fig. 7.1), and no new timber will be necessary. If, when cutting a floor, the saw seems to be striking metal, stop and investigate to see whether there are pipes or cables below. Having removed the first board, always feel below the boards it is proposed to cut next, to verify that the space below is clear. When one or two boards have been cut, it may be quicker to strip up the remainder to clear the necessary space. A crowbar inserted between the floorboard and the joist will prise up the boards without damaging them.

Where the use of a saw is impossible, a large axe is the alternative generally employed. For a right-handed man, the axe should be held as shown in Fig. 7.2. The grip will have to be altered if working in a confined space, since it may sometimes be necessary to cut left-handed. Keep the swing short to give more accurate cutting and less chance of accidents.

Cut timber, irrespective of its size, across the grain, the blade of the axe striking the surface of the wood at an angle to make a wedge-shaped cut, progressively enlarged as the wood is cut into. To cut flooring, select a point as near as possible to a joist (indicated by the line of nails) and make a 'V'-shaped cut across the line of the planks. The support below will reduce the spring in the

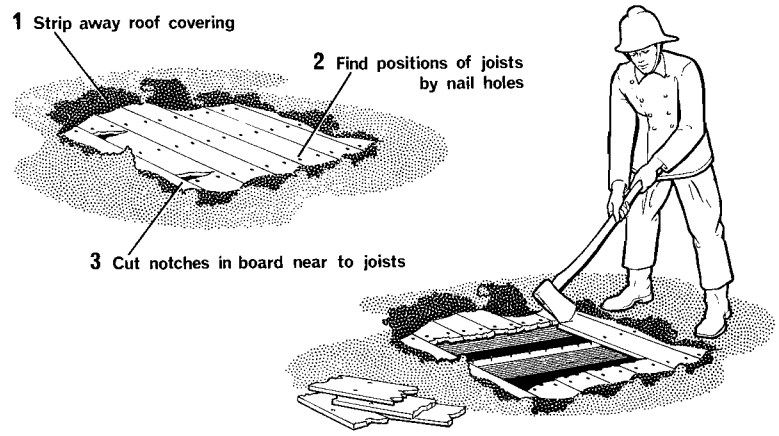

Fig. 7.2 Method of using an axe to cut boarding on a flat roof.

wood and give a cleaner cut. Two men should work together when cutting flooring, each starting at opposite corners of the part to be cut, and working in opposite directions.

Nowadays a great deal of tongue-and-grooved boarding is used. To avoid damage the tongue on one side should be cut before prising up the board. Also there is increasing use of tongue-and-grooved chipboard often in sheets about 2.4 m by 1.2 m. These may be nailed or screwed to the joists and should, if possible, be removed in a complete sheet.

To remove skirtings to look for the spread of fire, it is usually less damaging to clear the whole length of the piece of timber than to cut at any mid-point. This applies to almost all woodwork, since the piece can be replaced as a whole. Skirtings can often be sprung away from the wall near the centre of the run, using the blade of a large axe.

Panelling is generally thin and will indicate to the touch whether there is fire behind. Where possible, remove intact by prising off the beading. This applies particularly in the case of old panelling, which may be extremely valuable. It may be advisable to remove a whole section of the panelling intact rather than attempt to cut out an affected panel. Where the panels themselves are of particular value because of paintings or carvings upon them, the woodwork should be removed to cause least damage to the most valuable part. In other instances, such as the modern type of thin matchboarding, it is better to cut out a section with a floor saw.

Timber work in special risks, such as flour mills, etc., requires special attention, for dust extractors, grain conveyors and chutes, which are often encased in timber, are a frequent cause of fire spread. Sections of these conveyors and chutes should be opened at regular intervals, but obtain the assistance of the engineer in charge, who will be able to point out the whereabouts of inspection covers and suggest methods of opening up to cause minimum damage.

2 Plaster

It is often necessary to pierce or pull down a ceiling, or to cut through a lath and plaster wall.

a. Ceilings

The most useful tool for piercing or pulling down a ceiling is the ceiling hook. Ceilings may have to be holed to get at a fire which is travelling in the laths or woodwork, or to release water from above. Sagging due to weight of water or the presence of beads of moisture will show this. Portions of ceilings may have to be removed because they are liable to fall.

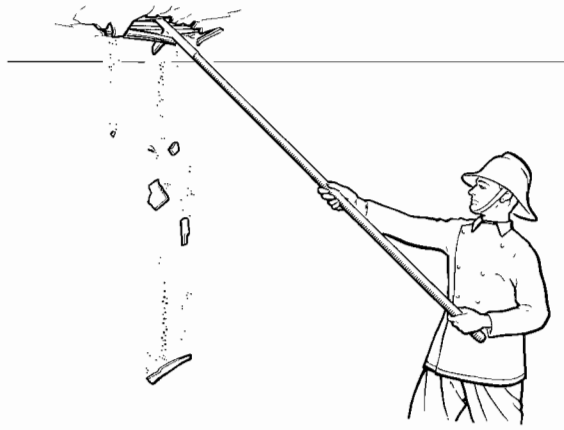

Fig 7.3 The correct position in which to stand when pricking a ceiling.

When pricking a ceiling, choose the position where the opening is to be made, stand well away from beneath it (Fig. 7.3) and remove some of the plaster with the point of the hook with the bill held downwards. This exposes the laths and the direction in which they run becomes obvious. If it is necessary to pull down laths to make a hole for entry or to remove burning material, push the hook up between the laths and rotate through a right angle, so that the bill lies above the laths. A sharp pull will then remove the laths and the operation can be repeated until a hole of sufficient size is made.

When the position of the joists has been found, the sharp upper cutting edge of the ceiling hook bill can be used to cut the laths by forcing them with short, sharp jabs against the joists (Fig. 7.4). This will often result in a neater hole, since it will not pull down long runs of laths. Heavily papered ceilings often bulge and give a false impression of impending collapse, so prick through the ceiling and allow the water to run away. Always use the ceiling hook with care in the first instance. If the ceiling is still safe and it is necessary only to release water, make several small holes in the plaster only by using the point of the ceiling hook corkscrew fashion. There is then less danger of disturbing the lathing and of bringing down the ceiling.

A ceiling should only be pricked after preparations have been made to catch, by buckets, tubs, salvage sheets, etc., the water which will be released. If equal effect can be obtained, prick near a window and arrange to divert the water out by means of a chute.

Certain types of ceiling may be found plastered on metal lathing or on expanded metal work, suspended at intervals from the joisting above. Where this is believed to be the case, stand in a

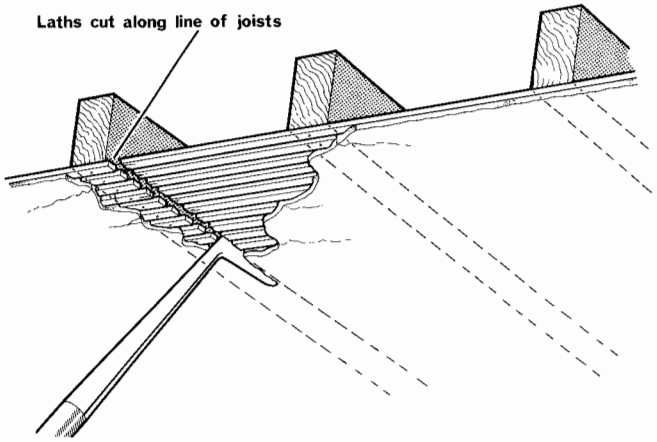

Fig. 7.4 Method of cutting laths with the bill of a ceiling hook.

doorway or at a point from which escape is possible if the whole ceiling begins to come down. If the plaster of a ceiling shows signs of falling and a retreat to safety cannot be made, get in a doorway or under a beam or, if this is impossible, stand upright, so that the ceiling breaks on the helmet.

b. Lath and plaster walls

It is often possible to detect lath and plaster walls by gently tapping them and listening for the alternate hollow and solid sound produced by the spaces between the studding.

Open up between the uprights, locating by tapping on the wall with the shaft of the axe: a stud will usually be found where the wall sounds solid. Outline the outer edge of the portion to be cut away by carefully chipping through the plaster with the blade of the axe. The plaster may then be chipped or levered away from the lath with the point of the axe, and the laths gently hacked or sawn away without damage to surrounding portions of the wall.

3 Brickwork etc.

It may be necessary to cut through brickwork to remove part of a flue or a shaft for inspection, or to reach a fire.

To open up a brick wall, first prise out a brick with a hammer and a cold chisel, and then open out the cavity formed by removing further bricks with a crowbar, working round the circumference of the hole. This method allows the bricks to come out more easily, minimises damage to the rest of the wall and facilitates repair. Deal

with rubble walls, such as those built of flint or random blocks of stone, in much the same manner as a brick wall. When working in a room, provide buckets, etc., for the debris to be removed.

4 Removing roof coverings

It is often necessary to remove roof coverings to reach a fire in the roof or roof void or to ventilate the building and, very occasionally, to obtain entry to the premises. Each type of roof presents a separate problem and the means of access through roofs may be classified under the various types.

a. Pitched roofs

The general construction of these roofs has been dealt with in Book 8 of the *Manual,* Chapter 5, 'Building construction and structural fire protection'. Operations should start at the highest part of the desired opening and should progress downwards.

(1) Tiled roofs

Tiles are usually laid in position (with or without nailing) on battens which, in the better type of construction, are nailed on to close boarding. At the highest point of the proposed opening, lift the first tile with the axe and slide it out. Remove further tiles until a sufficient area has been cleared. As the tiles are removed stack them neatly clear of operations, if the construction of the roof permits. It is often possible to rest them against the guttering (Fig. 7.5). Alternatively, the tiles can sometimes be piled on the chimney stack, where they will be out of the way.

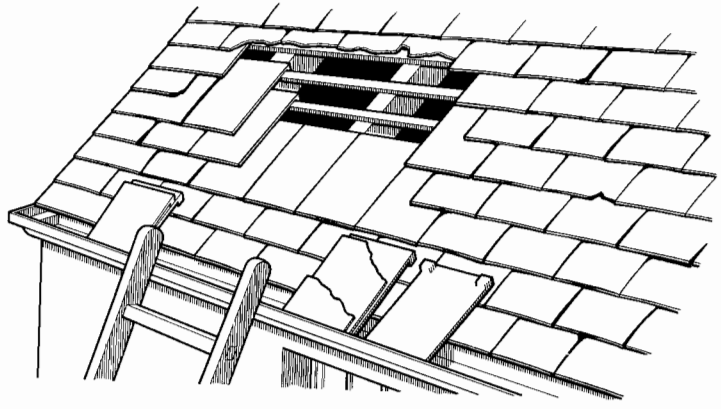

Fig. 7.5 Method of removing roof tiles.

If the roof is close boarded it will be necessary to cut a hole of sufficient size with a saw. The position of the rafters (showing where the boards should be cut) will be obvious from the lines of nail heads. If the tiles rest on battens only, then the number of battens to give the required size hole will have to be cut or chopped away. If the hole is being made to obtain access to the roof space, aim to make a hole some 600—900 mm square and about 1 m to 1.25 m from the base of the roof, but without cutting the rafters. Unnecessary cutting away of woodwork may seriously weaken a roof or even cause collapse. Once the hole is made, the fireman can lower himself through the gap between adjacent rafters (which are at least 350 mm apart) into the roof space. When doing so, however, make sure that feet are placed on the joists and do not go through the plaster of the ceiling which is usually exposed (see Fig. 5.3).

(2) Slated roofs

Slated roofs are constructed and can be opened up in much the same way as tiled roofs by working from the highest point, but slates are nailed in position on to the battens. Break the first few slates until the heads of the securing nails are exposed and it will be possible to prise up the rest of the slates with relatively little damage.

(3) Corrugated iron or asbestos roofs

Corrugated iron sheets should be lifted off whole by knocking off the heads of the bolts securing the sheets with a large axe. If any difficulty is experienced, drive the sheeting in around the bolt holes by means of the pick end of the fireman's axe or with a crowbar, and lift the remainder of the sheet off. If time permits, asbestos sheets can be treated like corrugated iron roofs. Asbestos is brittle, tends to crack and fly and is dangerous to health.

(4) Glazed roofs

The roofs of many factories, office buildings, etc., are fitted with north light glazing (the so-called saw-tooth roof construction). The sheets of glass are often merely laid on metal glazing bars and then flashed with lead. If the lead is lifted with a knife, axe, etc., the glass can be removed whole and without damage (Fig. 7.6). If it cannot be freed in this way, break it away to give the necessary size of entrance. Wired glass will often come out as a single sheet in the same way.

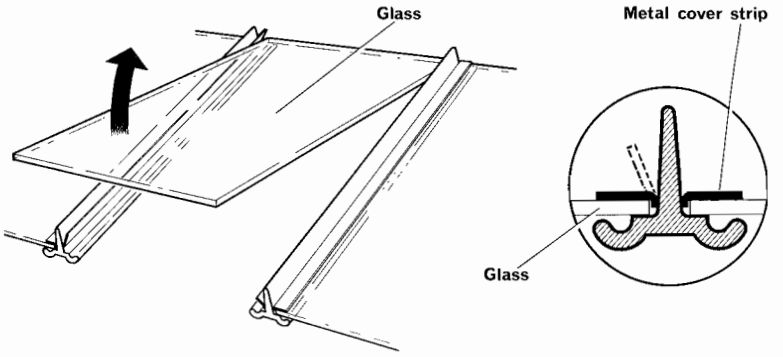

Fig. 7.6 Method of removing panes of glass in a puttyless glazing frame.

b. Flat roofs

Such roofs are usually covered with cement, asphalt, lead, copper or zinc, and may vary greatly in construction. Those in modern buildings are often of hollow tile or concrete below the covering and cannot be opened up.

Lead, copper and zinc are normally laid on close boarding, so that after the metal has been removed the boarding must be cut through. If lead, copper or zinc cannot be removed in sheets, cut it by using the blade of a large axe as a chisel (Fig. 7.7) and draw it along the line of the proposed cut, striking a succession of light blows with a hammer or with the back of another axe.

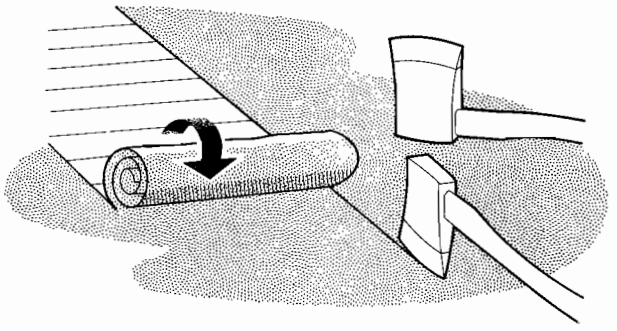

Fig. 7.7 One method of cutting roof material.

(1) Lead roofs

Lift the lead at the gutter and roll back as a sheet, cutting away as necessary the lead dots fastening it to the adjoining sheets.

(2) Copper and zinc roofs

Copper and zinc coverings can usually be removed by lifting the securing nails at the lapped joints, where the sheets are usually arranged over wooden battens to provide the necessary fall for water run off.

c. General precautions

When opening up a roof, have suitable ladders handy for use to reach the inside of the building. If fire is suspected, or known to be present, use caution. There may be a sudden updraught of hot air or smoke from the hole, also the increase in ventilation may cause a rapid spread of fire. If possible, stand to windward, so that rising smoke and fumes will be carried away from you.

5 Working on roofs

Never allow men to work on a pitched roof unless every precaution has been taken for their safety. If it is necessary to work on a sloping roof use a roof ladder, a short extension or a hook ladder to give a foothold. If a ladder is not available and it is necessary, in an emergency, to work on such a roof, make fast a line round a chimney stack (Fig. 7.8) to give a secure hold. Except for flat roofs which have been specially designed for adequate loads, too much weight should not be placed on a roof at one time and only the minimum number of men necessary for the work in hand should be allowed on the roof. Make sure men working on roofs have a long line with them, and they should always work in pairs.

At a roof through which a separating wall projects, pitch the ladder as close as possible to the wall, for the roof is usually stronger close to a separating wall and the wall may be used as a handhold to climb to the ridge. Inspect such handholds before putting any weight on them for the mortar is often old and in poor condition, and the brickwork liable to come away if any sudden strain is placed upon it.

The strongest portions of a roof are the ridges and valleys, but if there is a fire in the roof void the highest part will be the hottest and will also have been most weakened.

Ascend to the ridge of a roof, if possible, in a direct line with a chimney stack or any other object lower down the roof which, if you slipped, would prevent you falling off. When walking on slates or tiles, the foot should be placed on two tiles at once, as in this position the supporting strength is greatest. When working on a

Fig. 7.8 A good position for working on a pitched roof and securing oneself with a line.

roof, always hold an axe in your hand with its point downwards, so that at the start of a slip, the point can be driven through the roof to provide a grip. The time taken to withdraw an axe from its pouch may make all the difference between safety and falling off the roof.

To work on the sloping portion of a roof, one leg should be doubled under the knee of the other, so that as much as possible of the body is in contact with the roof (Fig. 7.8). To ascend a sloping roof without a ladder or other similar hold, it will usually be found best to work backwards in this position until the ridge is reached. With a correct seat on a roof, it should be almost impossible for a man to slip, provided that the roof is of normal pitch and that it is not icy. Any fireman feeling himself slipping and not having his axe in his hand should roll on to his face and press the palms of his hands on to the slates or tiles. When working for any length of time on a roof with a precarious foothold, it will help if a few slates or tiles are removed to expose the battens to provide a good grip.

Roofs formed from asbestos cement sheeting, both plain and corrugated, are particularly dangerous, and the open roof surface should never be trusted to bear any weight. If walking on such a roof is unavoidable in an emergency, the bolt heads protruding through the roof will indicate the position of the purlins supporting it, and hence the strongest part. Skylights may frequently be blackened over either with paint or with smoke, and accidents have occurred, particularly in the dark, through firemen mistaking the glass for solid material. Corrugated iron may frequently be rusty and give way; in winter, snow may mask dangerous conditions.

Exercise care when standing on a close-boarded bitumen covered roof if it is suspected that there is fire or any considerable amount of heat below. Such roofs tend to collapse very suddenly, without warning. When standing on a flat roof which may have been weakened by fire, keep near the edge. A ladder laid down flat to form a duckboard will also help to distribute the load. Never make use of guttering, especially if of plastic, and avoid walking or relying on projecting coping stones, which may be cracked or weak. Ladders should never be pitched against plastic guttering, which is not intended to take any weight.

A catwalk often indicates that the main part of the roof cannot bear a man's weight. This applies in particular to catwalks in the roof voids of cinemas, theatres and other buildings with large false ceilings, which may be of very light construction. When working aloft, slates or tiles should not be dislodged and windows on upper floors should not be broken without warning those below. Slates may fly for considerable distances owing to their thin, flat shape, and the edge can cause fatal injury. If, because of the noise of the fire, those below cannot hear a call to stand from under, then arrangements should be made to ensure all persons are clear before starting to remove slates.

6 Dangers on entry

When entering a building, many pitfalls may be encountered. Also there may be dangers outside the premises to guard against before entry. The yards of industrial premises present innumerable pitfalls to strangers, so take care when negotiating such places in darkness. Open stokeholds, external cooling vats or pits are likely hazards.

When pitching a ladder to the front of certain buildings fitted with luminous discharge tubes, the *'fireman's switch'* (see Part 6B of the *Manual,* Chapter 3 on 'Electricity and the Fire Service') should first be operated to the *'off'* position. Men, having entered a building from a ladder, will be relying on it to make their way out again. Do not, therefore, remove a ladder except with the express permission of the officer in charge, otherwise men may be trapped.

Normal means of entry such as doors and windows may sometimes conceal unsuspected dangers. Doors occasionally open on to a lift shaft and often direct on to stairs, particularly doors leading to basements. Any incautious fireman who opens such a door and steps straight in, runs a serious risk of a fall. When entering a window from a ladder, step carefully and do not jump in. The window may open on to a staircase or well, or the floor may have collapsed. Open an overhead trapdoor in such a way that any hot embers which may be released do not fall down the sleeve of your fire tunic and cause burns.

If it is suspected that there is an explosive mixture of gases present in the building and an intrinsically safe electric handlamp is

not available, the lamp should be switched on before the building is entered and switched off only after the building has been left so that any arcing at the switch will not cause an explosion.

a. Doors

The possible dangers which may be encountered when using external doors have already been mentioned. Danger may also be experienced from internal doors. When opening an internal door behind which fire is suspected, there is a possibility of back-draught or of an explosion due to the accumulation of dangerous gases. Such gases can be recognised sometimes by the nature of the smoke in the compartment, if this can be seen through the window. Thick billowy clouds of yellow smoke are usually an indication of dangerous conditions. The most obvious and best warning of danger is, however, the presence of heat. When opening up a door behind which fire is suspected, touch the handle carefully. If the handle is hot, use the corner of the tunic, or a protective glove, to grasp it. The metal shank connecting the two door knobs is a good conductor of heat, and some idea of the temperature on the other side may be gained from this, provided the knobs are of metal. First test the handle for temperature with the back of the hand in case it may have been electrified by a fallen cable, to avoid gripping

Fig. 7.9 The correct method of opening a door behind which fire is suspected.

the handle and being unable to let go. Where it is suspected that the room which is to be entered is already on fire, do not open the door, except for rescue purposes, without a charged branch being available. Blistering of the paintwork also forms a reliable guide to the heat within, as does the crackling sound of burning woodwork.

If the door swings towards you, place the foot against the bottom and one hand on the door, as shown in Fig. 7.9, and turn the handle gently. There may be considerable pressure in the room due to the expansion of the heated gases, which would otherwise force the door out of your grasp. Keep down low so that any heat or flames released pass overhead.

Beware of mistaking an external door for an internal one when opening up. Certain doors, such as loopholes, may lead into space.

b. Stairs

Stairs present an obvious source of danger when a building is entered and should always be treated with caution until their condition is known. Certain stairs, especially those of stone which are not enclosed and which are supported at one side only, may be very dangerous and collapse if, after having been heated, they are cooled by water from a jet (see Plate 13). It is not necessary for flames to reach them for this to happen.

Stone stairs which are supported at both sides and enclosed in a tower staircase are usually safe and fires can often be fought from them when other parts of the building are untenable. Wooden stairs will seldom collapse without warning, but may become so weakened by charring that portions of them may give way beneath the weight of a man. When ascending or descending stairs, therefore, always keep close to the wall, since the treads will usually bear weight at this point even though their centres may be weakened. If there is any doubt as to their strength, only allow one man on each flight at a time. On spiral stairs, keep to one side to ensure the use of the part of the stairs with the widest tread. Use the balustrade with caution when ascending or descending stairs, since it may have been weakened by charring and may collapse when weight is applied. Cast-iron balustrades may be sufficiently heated to burn the hand and may give way altogether if any strain is put on them.

If a staircase has been seriously damaged by fire, use sections of short extension ladders to improvise a stairway. One way of doing this is shown in Fig. 7.10.

c. Floors

If a building has been seriously affected by fire, floors, particularly those above the fire, may have been weakened sufficiently to become dangerous. Heat which is sufficient to burn through a floor will probably be apparent before entry is effected. Take every care

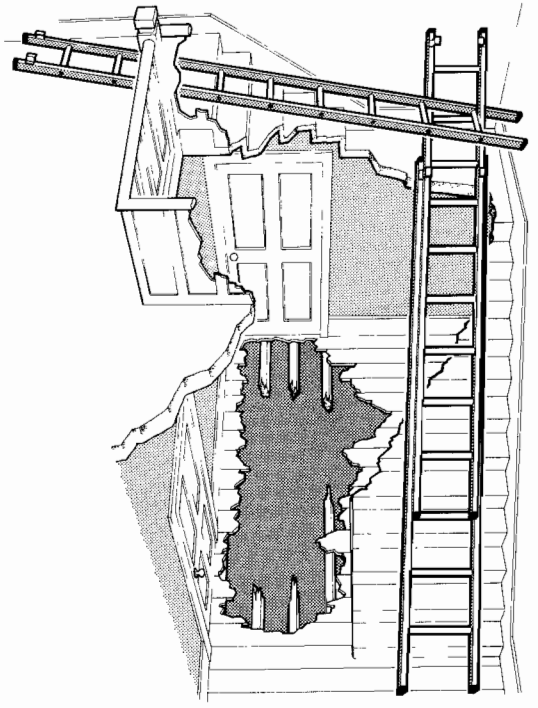

Fig. 7.10 One method of replacing a damaged staircase by means of short extension ladders.

to keep close to the walls in case the structure has been seriously weakened by fire. Floors above a fire tend to be weakest in the centre and above windows (due to the concentration of the escaping heat at the outlet). The usual method of detecting weakening of floors is to inspect for the depth of charring and to see whether or not the floor is level. A floor which is 'live' (i.e., movement is felt when people walk upon it) is always suspect.

A floor with a certain amount of water on it is usually safe because it indicates that there are no holes in it, and, if there is fire below, that the heat is probably not enough to have weakened it below its safe load-bearing capacity. On the other hand, the presence of any considerable depth of water may mean that a floor is excessively loaded and any additional weight might cause it to collapse. If conditions permit, go to the floor below and look at the underside of where it is proposed to work, to see if there are signs of fire, the extent of the charring, the size of the joists, whether joists and columns are in place, and to look for any points of movement in the structure. A floor which has been seriously damaged can be bridged by the use of a ladder (Fig. 7.11).

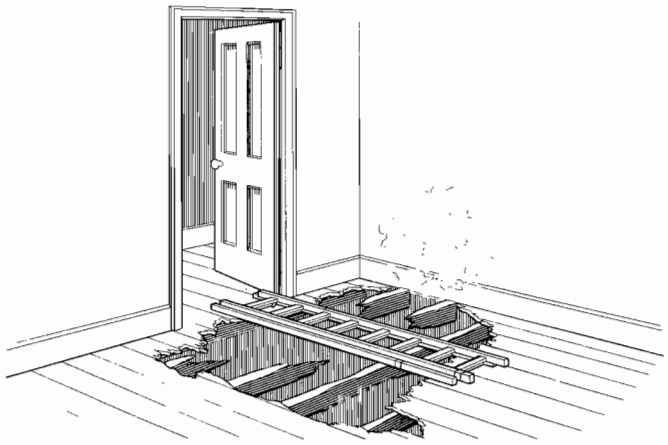

Fig. 7.11 The bridging of a damaged floor by means of a ladder.

In some very old buildings, stone floors may be encountered, and these are dangerous when subjected to heat. Do not use a jet to cool a stone floor in order to walk upon it as this usually causes cracks to appear. Stone, and concrete which is not reinforced, are brittle when subjected to heat and may easily collapse.

It is frequently found in old property which has been converted into a small workshop that floors are excessively loaded with machinery. If time and conditions permit, it is wise to have a quick glance at the floor above that on which men are at work to verify conditions; certain types of floor can be weakened quickly by fire underneath. If in darkness, a torch should be flashed round to see what type of machinery or goods are stored on the floor, to assess their weight and to see whether the ceiling has been strutted as an indication of unusual loading. Keep personnel as near to the walls as possible, especially in rooms such as the spinning rooms of cotton mills, where the centre of the floor carries a very considerable weight of machinery. Finally, remember that the floors in certain buildings, e.g., garages, woollen mills, etc., may be covered with oil and can be very slippery.

d. Special hazards

There are many features which present a hazard in different types of building. It is impossible to catalogue all these as they vary so widely. Those of major importance, however, are discussed below.

(1) Electrical

As a room is entered, a fireman should consider whether, if the current has been left on, the electric light fittings are likely to cause a hazard. The chief risks lie in hanging wiring which has come away from its support (See Plate 6), and all electric fittings should be treated with caution. Switches should be operated with the dry handle of an axe and not with the bare hand. For further details of electrical hazards, see Part 6b of the *Manual,* Chapter 3, 'Electricity and the Fire Service'.

If the current has been left on, the question of firemen using a lift may arise. If the seat of the fire has not been found it may be safer not to use a lift. In high rise buildings, however, it may be virtually impossible to reach an upper floor without the use of a lift, and lifts are specially arranged for the use of firemen (see Chapter 5). Even in smaller buildings at a minor fire the use of lifts may save considerable time (e.g., in bringing up equipment) and the possibility should not be overlooked.

(2) Construction

The importance of a sound knowledge of building construction has been emphasised in Book 8 of the *Manual,* 'Building construction and structural fire protection'. Some of the more obvious dangers resulting from particular types of construction are mentioned below, but it will be apparent that this list is by no means exhaustive, and a fireman should always be on guard against possible dangers resulting from the use of new or unusual materials in the construction of a building. Lightweight steel trussed roofs with exposed steelwork can fail rapidly under the influence of fire, and unprotected cast-iron columns present a danger if subjected to great heat and suddenly cooled. This may cause collapse with very little warning, bringing down the joists and possibly the building with them.

Certain roofing materials present serious danger to firemen. Asbestos cement sheeting may break into fragments with almost explosive force, whilst molten bitumen can fall and cause serious burns. Some of the modern plastics used for ceiling and wall decoration are highly flammable and fall in fiery molten drops. When working in the vicinity of a flat roof there is always a possibility of falling molten lead or glass. Fragments of broken glass always present a danger, and large pieces of stonework may spall off under the influence of heat.

If remaining for any length of time in one place inside a building seriously affected by fire, if possible stand under a weight-carrying beam or girder.

(3) Industrial

Particular caution should be exercised when entering industrial premises. Hazards associated with the various processes carried on will be found, e.g., plating baths, oil quenching baths, open shafts, vats, moving belts and machinery. Private and public garages often have one or more inspection pits, sometimes inadequately covered, cylinders of various gases and large hoists. Old warehouses may be found with trapdoors which, if not properly secured by bolts underneath, could collapse if trodden on by an unwary fireman. A study of Part 6c of the *Manual* will guide a fireman on the types of risks to be found in particular industries. However, due to the vast number of new processes coming into use almost daily, only a thorough local knowledge gained by visits to premises, coupled with commonsense and wide experience will help a fireman to avoid unnecessary injury in a building on fire.

Part 3
Control at a fire

Introduction

The knowledge required of the individual member of a crew of an appliance attending a fire call has been dealt with in the early chapters of this Book. In this Part it is proposed to deal with the work of the officer in charge, and to indicate some of the more important points to which attention should be paid when bringing a fire under control.

Procedure will vary from brigade to brigade according to whether the attendance is composed of whole-time personnel from a large brigade with ample resources of manpower, or whether it is composed of part-time retained personnel where men and appliances have much greater areas to cover. The initial attendance, whether of one pump or several, will generally be under the command of the local officer, or in his absence the next senior, whatever his rank. When the first attendance is made up of several appliances and includes officers of equal rank, the officer on whose ground the fire occurs generally takes command, as he will have the better local knowledge and he will have to make out the fire report. The subject of control at a fire will, therefore, be considered according to whether the officer is in charge of the first appliance, whether he is in charge of the first attendance, or whether he is a senior officer who takes over as the result of a make-up.

Chapter 8
Control at a fire

1 Officership

The officer in charge of a fire must never overlook the fact that his bearing will influence the crews working under him. He should at all times appear imperturbable, and any orders which he gives should be given clearly and simply, without shouting or signs of excitement. It is a tradition of the Fire Service that firemen work without unnecessary noise.

The duty of the officer in charge at a fire is to size up the situation as a whole and to issue the necessary orders. Self-confidence, experience and the ability to make quick decisions are therefore essential. An officer should never send men into a position in which he would not go himself and, in fact, when it is necessary to station men in a potentially dangerous position, a good officer should go with them and remain with them until he is confident that it is safe for them to be stationed there. The function of an officer is to lead and to control, and he should not become involved in manual work, for this is the role of his men.

Every care must be taken by officers of all ranks to ensure the safety of the men engaged in firefighting operations under their particular command. If a crew is working as a team, the officer in charge of the crew should be in a position to note immediately whether any member of his crew is missing. Similarly, a senior officer to whom responsibility has been delegated for a section of a fire should know who are the officers in charge of crews working under his direction, so that, if a roll call becomes necessary, he can ascertain quickly whether any member of the crews in his section is missing.

All officers on the fireground should be correctly dressed in fire kit and should insist that all crews are dressed likewise. Men cannot be expected to keep neat and tidy when firefighting, but slovenliness should never be countenanced at any time. It tends to bring the Fire Service into disrepute at a time when not only the eyes of the public are focused on the Fire Service, but often television and film cameras as well.

2 Officer in charge of the first appliance

a. Before the fire

The better the knowledge an officer has of the ground covered by his station, the better he will be able to deal with fires occurring in that area. The value of local knowledge has already been discussed in Part 1, and cannot be over-emphasised. If there are any unusual risks in his area, such as an oil refinery, an aircraft factory, a chemical works or premises where radioactive isotopes are used, he should have made every effort to familiarise himself and his men with their layout and contents. In co-operation with the occupiers, exercises should be held on such premises.

As far as practicable, the crew of an appliance should work together as a team and should continue under the command of their own officer. Any member of a crew ordered to carry out a task at a fire which separates him from the other members of the crew should, when the task is completed, report to the officer who gave him the instruction and request permission to rejoin his crew.

A well-trained crew know their individual duties thoroughly, so that, on arrival on the fireground, it should only be necessary for the officer in charge to issue general orders. Men are trained on the drill ground to carry out a particular operation in a certain way, but should be able, instinctively, to adapt drill routine to the requirements of the particular situation.

b. On arrival

On arrival at most fires the fire brigade officer will be confronted with a number of things which will need his immediate attention. These will include:

(i) making an appreciation of the situation and deciding whether the appliances and equipment he has, or will shortly have, are sufficient to control the fire;

(ii) effecting any necessary rescues and searching the building;

(iii) finding the fire, and tackling it with the appropriate extinguishing medium;

(iv) surrounding the fire and preventing it spreading.

He will also have to consider the need for ventilating the fire and for carrying out salvage operations.

A first step will be to enquire from the police or from onlookers whether any people are believed to be in the building, but never accept information obtained in this way without question. All likely premises should be searched in order to ensure that no people remain to be rescued. The various methods of rescue are outlined in Book 12, Part 1 of the *Manual* (currently Part 6a).

3 Officer in charge of the first attendance

a. General considerations

The general principles of handling a fire situation are much the same irrespective of the size of the building, but there are many differences in detail in their application to small and large fires. The degree of organisation and planning required to control successfully both small and large outbreaks of fire will be considered in the following sections.

One of the first attendance appliances will arrive slightly in advance of the others, unless the attendance comprises only one appliance. Officers in charge of the later appliances to arrive should be guided in their actions by the position as it appears on arrival. If there are obviously a number of urgent rescues to be effected, they should immediately get their crews to work without reference to the officer in charge of the first appliance, who will be fully occupied. On the other hand, if the fire is a small one and they are not immediately required, or if the job to be undertaken is not obvious, then they should contact him first and ascertain if anything is required of them.

Riding on one of these later appliances there may be an officer senior in rank to the officer in charge of the first appliance to arrive. He will take charge of operations until he, in turn, is relieved by an officer senior to himself. Whenever one officer relieves another there should always be a definite handing over of command at the fire (see Para. 4a below).

The officer in charge is responsible for deciding whether or not the initial attendance is sufficient for the purpose, or whether additional assistance is required. If there is any doubt, no chances should be taken and further assistance should be requested.

b. Estimating assistance

Making an estimate of what additional help is needed calls for rapid assessment of the position—generally known as 'sizing up'. This sizing up must take into account the following principal factors:

(i) How far the fire is likely to spread before a suitable stop can be effected;

(ii) How many and what type of jets are likely to be required to subdue the fire, and consequently the number of pumps required to feed them;

(iii) Whether any special appliances are required, e.g., extension or turntable ladders for rescue purposes or to gain access to high windows; turntable ladders for use as water towers; breathing apparatus or foam to deal with particular types of fire, and so on;

(iv) The nature of the exposures surrounding the building and the threat to them;

(v) Whether or not the water supplies available are close at hand and adequate, or whether a water relay will be required;

(vi) The nature of the goods stored or manufactured in the premises, and the influence the type of construction of the building could have on operations. The degree of flammability of the contents and the construction of the building give a good indication whether the outbreak is likely to develop fiercely and quickly or could be readily extinguished;

(vii) Whether the fire is on the top storey of a tall building, for this might require a larger attendance than one at a lower level. Far more hose may be required unless risers are installed in the building and it takes longer to get the hose into position and to get messages to and from the pumps. Extra men may be required to man firemen's lifts, radio sets, etc. For top storey or roof fires the ordering on of a turntable ladder or hydraulic platform (if one is not included in the initial attendance), since water can be got on to the fire more quickly with its aid. A turntable ladder can often make it easier to get men rapidly into positions which would otherwise be difficult to reach;

(viii) How far salvage work will be able to protect property. A fire on an upper floor often calls for a great deal of salvage work, so there may be need to order on additional salvage equipment;

(ix) The greatest danger of fire spread in the initial stages is by ways of internal areas, lift shafts and staircases. The width of the street usually stops a fire from spreading at the front, and the separating walls divide it off from adjoining buildings and should check lateral spread; the rear of a building, however, is often vulnerable, and it is important to provide adequate cover here;

(x) Dwellings fronted by projecting shops sometimes present considerable rescue difficulties and may require the use of short extension ladders and lines because the projecting part often makes it difficult to pitch an extension ladder direct to the front windows. In such circumstances a ladder must be raised to the roof of the projecting portion and pitched from there. Fire escapes and exits from this type of building frequently open out on to the roof of the main building, sometimes making rescue problems far from easy;

(xi) Finally, the assessment must take into account manpower. Men may be required at a fire for many purposes apart from

manning branches, and the make-up may have to include a number of pumps specifically to supply manpower.

When calculating the attendance required, too many appliances are far better than too few, within reason, for it is unforgivable to run risks with public property. If the requirements are underestimated in the early stages, there is a serious risk of the fire spreading and developing into a major outbreak when this could have been avoided. If too many appliances arrive, the surplus can always be returned to their stations. On the other hand, the officer in charge should not get nervous every time he sees an unusually large burst of smoke or flame and order on additional appliances when those already asked for have not yet arrived. When asking for special appliances, particularly in the less densely inhabited localities, remember the distance they will have to travel. To ask for an appliance which will take so long to arrive that all need for it will almost certainly have passed by the time it reaches the fireground is pointless.

Before a request for assistance is made, therefore, an officer must have considered these various factors and decided on a plan for attacking the fire. This appreciation of the situation will be made almost automatically and in a matter of seconds. An experienced officer drawing up at a fire will grasp the situation and, perhaps from the size of the building alone, will see whether the job is one which can be handled by the first attendance. If not, he will send back an *'assistance'* message which can subsequently be varied if further investigation shows this to be necessary.

If people are believed to be in the building, order an ambulance in case medical attention is necessary. This will ensure that any people who may be rescued from the building can be removed to hospital without delay. Another advantage in having an ambulance on the fireground when a considerable number of men are at work is that there are often minor injuries which can then receive immediate attention.

c. Messages

Messages should be originated only by, or with the authority of, the officer in charge of the fire, and should be sent by the quickest available means, e.g., by radio, telephone, vehicle, messenger, etc., as appropriate. The officer in charge should not transmit messages himself, but should detail a responsible member of his brigade. When a Control Unit is in operation, all messages originated by the officer in charge should be passed to it for transmission and recording. Where practicable, messages should be written out before despatch and should be checked by the originating officer. Abbreviations should only be used in written messages, e.g., 'WT' should be transmitted as 'water tender'.

As soon as a message has been sent, the sender *must* report back to the originating officer, informing him that the message has been sent, and should repeat the actual wording of the message sent. If the delivery of a message is not reported to him within a reasonable time, the originating officer should send a duplicate message. The necessity of this was once illustrated at a serious fire when a messenger on his way to deliver an *'assistance'* message was injured, and the officer was, for some time, unaware that the message had never been delivered. All duplicate messages should be prefixed with the word 'duplicate'.

Examples of the various types of message will be found in the *Fire Service Drill Book*, and it is important that standard wording is used. This will ensure that a messenger, who has been trained in standard messages, will have no difficulty in remembering it if it is given verbally. Also the message will be correctly interpreted by those receiving it, so that the necessary action will be taken without confusion or delay.

Whenever lives are known or thought to be endangered at a fire, a *'person reported'* message should be sent. This is a type of *'informative'* message which is normally combined with an *'assistance'* message: it is used to indicate that people are reported to be trapped in the building and that fire brigade personnel and appliances are needed for rescue purposes.

A copy of all messages passed through a control point (see Section 4) should be retained. It is then possible to check what orders have been sent previously, the time of despatch, and so on.

Messages have dual function, for they not only serve to ask for assistance, but also give senior officers at their headquarters some indication of the size and nature of the fire. Even if further assistance is not required, an *'informative'* message should be sent as early as practicable. This serves to tell senior officers the nature of the fire and whether it has been surrounded. Occasionally it may be some time before the seat of the fire is located, and an interim message will inform them of the position and enable them to consider whether or not they need to attend.

Fires in some types of premises, especially those involving unusual commodities, may provide features of technical interest. Most fire brigades have arrangements to notify certain departments of particular fires, e.g., the Engineer's Department of the Local Authority. Any such particular fires, or premises involved in fire, should be indicated by an early message, so that specialist officers, or organisations such as the Fire Research Station, can be informed and attend, if necessary.

After the fire is under control with the appliances and men available, the *'stop'* message should be sent to the mobilising control. This will indicate that no further mobilising is necessary, except perhaps for relief crews if the situation requires prolonged work.

Obviously it indicates a serious lack of judgment or undue haste in appraising the situation if, after the *'stop'* has been sent, further assistance has to be requested. If the facts required to enable the officer in charge to send back an informative message are obvious (e.g., a room on fire in a private house, or a car on fire in the road), then this can be included as part of the *'stop'* message. Where the details for the *'stop'* message are not immediately available, then the *'stop'* message should not be delayed. The phrase *'details to follow'* can, in such cases, be added. Notwithstanding the receipt of a *'stop'* message, a senior officer may be in doubt as to whether to go on to a fire, and the receipt of the details will then enable him to make up his mind. Alternatively, the information given may make him decide to attend, e.g., to a small fire where there has been loss of life.

d. Covering the rear of a building for rescue work

On arrival at a fire, if it is apparent that there are people to be rescued, or if information is received that there are persons trapped in the building, send a crew, or two men if a second appliance is not in attendance, to the rear of the building, to cover the back of the premises for rescue purposes. If the rear of the building is not accessible to an appliance, the men should take a ladder and lines through the adjoining premises if necessary.

e. Getting water onto the fire

At the same time as any necessary rescues are being made, the main consideration is to get water on to the fire. One appliance should, therefore, be set in to the nearest available water supply, even if only the hose reel or 45 mm hose is got to work at the outset. Any appliances which follow can then be employed in supplementing the supplies if these are inadequate. At every rescue job, it is essential to get water on to the fire as quickly as possible, for the success of the operations will frequently depend on the speed with which this is done. The task of men rescuing with ladders can be made much easier if a cooling spray or jet is used to keep heat and flames away from them.

Although water damage is at all times to be carefully avoided, this assumes particular importance at small fires where even a relatively slight excess of water can cause damage out of all proportion to the size of the fire. When standard hose lines are in use, hand-controlled branches, which permit the water to be shut off as required, will reduce water damage. To also obviate water damage, use non-percolating hose for all lengths inside the building.

Unless life could thereby be saved, a building should never be opened up until water is available and branches are in position to contain the violent increase in the severity of the fire which generally results from the inrush of air. Whenever it is safe to do so,

tackle fires from inside the building. It may not be practicable to get into a building in the early stages of a fierce fire, but an effort should be made to enter at the earliest possible moment. It is universally accepted that jets at work in the street are not as effective as those used at close quarters, which will almost always be inside the building.

f. Positioning of appliances

Crews in charge of pumps should be instructed to set in to hydrants causing the minimum of obstruction, and pumps setting in to open water must leave room for other appliances which may follow them (Fig. 8.1).

Do not obstruct the gateways to industrial premises and prevent appliances moving in and out as necessary. If a pump must be kept at work outside a house for a considerable period, warn the occupants to shut doors and windows on that side and open those on the far side of the building, for exhaust fumes can be irritating and dangerous. Do not position appliances where they can be endangered by falling walls, or place them in situations from which they cannot easily be extricated should the fire spread unexpectedly.

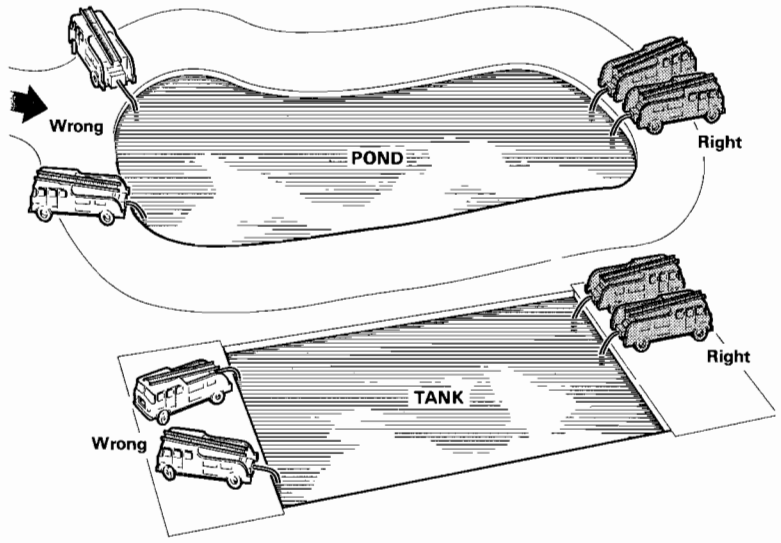

Fig. 8.1 Pumps incorrectly set into an open water supply can block the approach of other pumps which follow on later. Left: incorrect positioning. Right: correct positioning.

Remember that, when a number of appliances are working from hydrants, the size of the mains and the general interconnection of the mains system must be considered. Most Brigades carry water maps on to large fires but the attendance of a turncock will enable water diversions to be made to provide more water to the fireground.

If a turntable ladder is required, leave sufficient space for it to get to work efficiently (see Part 2 of the *Manual,* Chapter 4, Section IV). If the turntable ladder is not fitted with a pump, provide a pump specifically to feed the turntable ladder.

In order to minimise congestion and to reduce the length of hose lines, the pumps closest to the fire should, as far as practicable, be used to their full capacity. Many modern pumps have up to six deliveries, and when an additional line of hose is required, consider (provided the water supply is adequate) whether it can be connected to a pump which is already at work and has one or more deliveries spare. Branches can be got to work more rapidly this way plus the economy in the use of hose. The pump operator should know the capacity of his pump, the number of branches and the size of nozzles which are in use, and should be able to calculate whether it is possible to provide more branches (see Part 2 of the *Manual,* Chapter 2, 'Practical pump operation').

g. Shutting off services

Once entry has been made into a building, it will be necessary to decide whether or not is is advisable to shut off certain of the services.

(i) *Gas.* Gas should be shut off at the control cock (see Part 6b of the *Manual,* Chapter 2, 'The Gas Industry and fires in gasworks'), except where, exceptionally, the building is lit by gas and people are still present. Cutting off the light might lead to panic;

(ii) *Electricity.* This has been discussed in Part 6b, Chapter 3. At fires involving an electrical authority's equipment, a message should be sent to the appropriate undertaking via the mobilising control so that they may attend if necessary;

(iii) *Sprinklers.* Whether or not a sprinkler system is installed will be known immediately on arrival, and a fireman should be stationed at the main stop valve with specific orders that it is only to be closed on the direct instructions of the officer in charge. Sprinklers can hold a fire in check, and may even extinguish it. Any premature shutting off on the water supply could allow the fire to get out of hand (see Book 9, Part 1 of the *Manual,* 'Fire protection of buildings').

Nevertheless, remember that sprinkler heads operating can discharge a lot of water. When the fire is out, the officer in charge should have the main stop valve closed to prevent further water damage.

h. Use of breathing apparatus

Breathing apparatus should only be used on the express instructions of the officer in charge of the fire, and when it is used, the standard operational procedures must be followed (see the *Fire Service Drill Book*).

The whole subject of the use of breathing apparatus, including the control and recording procedures, tables of working duration of breathing apparatus sets, communications, the use of guide lines, the 'entrapped' procedure, the use of air line equipment and working in pressurised atmospheres, is dealt with in detail in Book 6, Part 2 of the *Manual.*

j. Refrigeration

When refrigeration is used in a building, a decision will have to be made whether to shut this off, in whole or in part, and the manager of the premises will be able to advise on this. Ammonia, sulphur dioxide, methyl chloride, carbon dioxide and 'freon' are used as refrigerants, and the escape of any of these will make conditions difficult for firemen. Additional breathing apparatus and protective clothing should be requested, if necessary.

When closing down refrigerating plant, remember that the goods protected are perishable and could be spoiled. Do not take this action unless it is essential to the safe and efficient conduct of firefighting operations. In a large installation, dangerous conditions may result from incorrect manipulation of the valves; if it is necessary to operate the plant controls, ask the engineer to carry out the adjustments (see Part 6C of the *Manual,* Section 12, 'Refrigeration plant risks').

k. Ventilation systems

Certain buildings are fitted with ventilating systems and, in some, the occupants rely on them entirely to maintain a respirable atmosphere. Whether or not a ventilating system should be shut down or, if this is possible, operated in reverse, will depend very largely on its design and layout, the nature of the building and the type of fire. Part of the system only may require to be shut down so ask advice from the maintenance engineer, who should know the degree of control over the plant.

When operations permit, bear in mind any buildings adjacent to that on fire which may be fitted with a mechanical ventilating system. Instances have been known where a system has drawn in

smoke from a neighbouring building on fire, resulting in a false alarm with serious consequences.

4 Setting up a control point

At a fire requiring a first attendance only, contact with the officer in charge presents little difficulty, since the fireground is of limited size and the appliance or appliances outside the building will indicate his approximate whereabouts. At fires of any greater size the officer in charge should, as soon as possible, set up a control point in the vicinity of the fire. This can be a radio-equipped appliance, or perhaps an officer's radio-equipped car, but it should, if possible, be clearly indicated by means of a red and white chequered flag or flashing beacon. The control point should be set up clear of smoke and heat, where it can easily be seen and reached by officers in charge of appliances which subsequently arrive, and where it will be within convenient reach of the officer in charge. The control point must continue to function until it is relieved by a Control Unit. A complete account of the action taken and the messages sent should be passed to the officer in charge of the Control Unit.

It may be necessary to position the control point where reinforcing appliances reporting will not cause congestion. Also, at a major incident, consideration should be given to the need for Control Units from other services to be adjacent. If required, instructions can be added to assistance messages for appliances to report to specific places other than the address of the fire.

a. Arrival of a senior officer

When an officer senior in rank to that of the officer in charge arrives on the fireground, he should contact the control point or the officer in charge. If he does not go to the control point personally, he should send a staff officer or other messenger to notify the Control of his presence on the fireground.

It is the duty of the officer who is being relieved to give the senior officer all relevant information which he may possess concerning the fire, the action being taken to deal with it, and any other details which will assist the senior officer to bring the fire under control.

At large fires, the officer in charge will normally allocate to each senior officer present the responsibility for firefighting operations in a sector of the fire. Instructions to be carried out within a particular sector should be given through the officer who has been allocated responsibility for that sector.

After taking over at a fire, the senior officer in charge should give attention to the following points:

(i) verifying that a thorough search of the building has been made;

(ii) seeing that the fire is adequately surrounded;

(iii) checking that sufficient appliances and specialised equipment are in attendance or have been ordered;

(iv) ensuring that the appropriate messages have been transmitted;

(v) checking that adequate safety procedures have been initiated.

Once he has satisfied himself that the situation is being adequately handled, he may decide to allow the officer already in charge to carry on. If, however, he decides to take charge, he must indicate clearly to his subordinate that he is doing so by some such phrase as *'I am taking over'*. It cannot be too strongly emphasised that a senior officer's presence on the fireground does not indicate his assumption of authority at the fire. Nevertheless, if he is present on the fireground, the ultimate responsibility for the satisfactory conduct of operations must be borne by him. Senior officers will often wish to attend, primarily to see for themselves that the organisation which they have built up and for which they are held responsible is functioning efficiently. Before taking over they should consider carefully whether the size of the fire warrants their doing so. It is disappointing to a junior, and damping to his enthusiasm, if he feels that his senior will invariably take charge merely by virtue of his rank.

b. Use of junior and specialist officers

In order to ensure adequate control of operations at a large fire, junior officers should be freely employed both on specialist duties and to look after groups of branches, or to take charge of one or more sides of the fire. Poor jets, which are doing no useful work should be shut down to provide more water for branches in better positions, or steps taken to improve them. In particular, an officer should, in suitable instances, be detailed with the sole function of seeing that adequate water is available and that the pumps at work make the best use of supplies.

The officer in charge will often instruct a junior officer to take his place at the control point, while he enters the building or tours the fireground to see how operations are proceeding. Alternatively, he may employ one or two juniors to act as staff officers to tour the fireground and bring back reports from the officers in charge of various sectors as to how operations are progressing. Officers giving orders at fires should remember the possibility of conflicting orders being issued by other officers, and should be careful to ensure that all orders are passed through the appropriate junior officers, who will then give them to the crews to whom they apply. Nothing is more irritating to men on the job than to have orders reversed needlessly.

At large fires, fire prevention officers can often be employed as Safety Officers to inspect the building with particular reference to the state of walls, floors, contents, etc., to obtain as much information as possible about the construction of the building (e.g., whether walls are load bearing, whether steelwork is protected or unprotected, etc.), and generally to keep the officer in charge of the fire informed as to the behaviour of the building as the fire progresses, especially if any part of it shows signs of collapse. Fire prevention officers can also check that devices such as fire-resisting shutters or self-closing doors are functioning to the best advantage.

c. Main and advance control points

It is essential for the efficient control of operations at a large fire that the officer in charge has, close to the fireground, a temporary operational headquarters. When the Control Unit arrives, a control point will already have been set up and the officer in charge of the Control Unit should inform the officer in charge of the fire that he is taking over from the officer in charge of the control point.

Good communications are essential, and radio telephony is used by fire brigades to maintain contact with the mobilising control at fire brigade headquarters. Radio transmitters/receivers (see Book 10, of the *Manual,* Part 4, 'Radio') are installed in all Control Units, and, where such a Unit is in attendance, radio can be used for the transmission of messages to the mobilising control.

The main control for a large fire, where a considerable number of appliances are in attendance, or where the streets surrounding the fire are narrow, should be placed well clear of the fire. It should be sited in a wide street, or, better still, in a square where there is ample space in which vehicles or appliances can park awaiting their turn to be sent on to the fire (Fig. 8.2). Reinforcing appliances ordered to a fire must not approach too closely causing congestion on the fireground and making it difficult to put appliances into the best positions. Where the main control is sited at a distance from the fire, an advance control point should be established in a conspicuous position in relation to the fire. The officer in charge, or his representative, should always be at this advance control point, the position of which will be known to the main control. The various sketch plans of the fire which are prepared to assist firefighting should be brought to the advance control point and placed, if necessary, in a radio-equipped vehicle. Communications between the two control points will normally be by radio.

d. Crews in reserve

At large fires one or more crews should be retained near to the Control Unit (or Main Control) for use in emergencies. If, for example, the fire should break out in some unexpected place, or a wall collapse and men have to be rescued, these crews will be

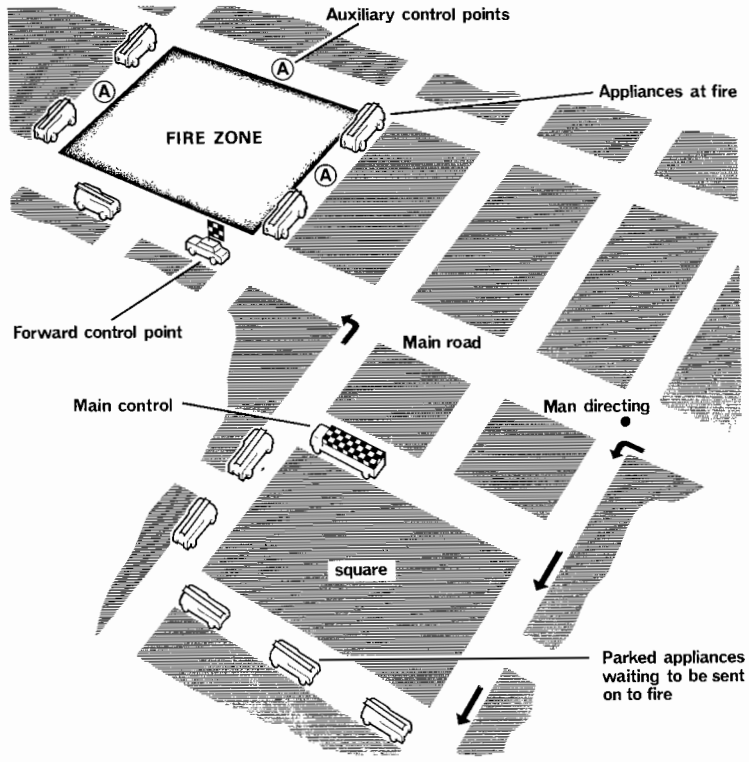

Fig. 8.2 Diagram showing the location of the Main Control, the advance control point and auxiliary control points at a large fire.

immediately available. If any additional appliances are in attendance but the crews are not at work, the officer in charge of each appliance should be kept in attendance at the main control while the crew remain with their appliance. The crews will then be quickly available to take orders from the officer in charge of the fire to get to work.

e. Auxiliary control points

At exceptionally large fires or where the fireground is intersected by a barrier such as a canal, the officer in charge of each sector may find it more practical to have his own control point, which can then be known as an *'auxiliary control'.*

This again would probably be the officer's own radio-equipped car where he, or his staff officer, will be found. These auxiliary control points will again be linked by radio to the main control.

Alternatively, portable radio sets may be used, a staff officer or fireman wearing a set and accompanying the senior officer in charge of the sector as he directs operations. In this way, the officer in charge of the sector is in immediate touch with the officer in charge of the fire.

f. Use of control points

The more important considerations to which attention should be given when using a control point are:

(i) Its location should be notified to the mobilising control, and to all officers on the fireground;

(ii) A sketch plan of the building involved and of the surrounding area should be prepared, showing the building on fire, the position of the appliances at work, and availability of water supplies. The plan, which should be drawn on or fastened to a board and should be placed in the most convenient position, will provide the officer in charge of the fire with a general picture which will help him to decide on the tactics to be employed;

(iii) Records should be kept of messages sent and received, the times of arrival of appliances, the attendance of officers, and of operations generally in connection with the fire. Copies should be made of any rough plans which are chalked on blackboards, and which would otherwise be lost when erased, so that they are available later when reporting on the fire.

If an advance control is in use, a log of operations should be maintained there also. This is of great help when it is subsequently necessary to prepare reports, for records can be kept of the progress of the fire, e.g., the times at which the various sectors were brought under control, the collapse of walls, details of the setting-in of appliances, etc.;

(iv) The control point forms the intelligence and administrative centre of the fireground and acts as a liaison centre for all officers. Unless otherwise instructed, all officers in charge of appliances arriving at the fire should report to the control point. Senior officers arriving will be able to ascertain who is in charge and to obtain information on the progress of the fire, the disposition of appliances, the state of the water supplies, arrangements made for reliefs, and so on. Equally, the control point, through the mobilising system, will be able to keep senior officers on the fireground informed of what is happening elsewhere in the area for which they are responsible.

(v) The control point can provide the officers responsible for catering, transport and arranging reliefs, etc., with the necessary information, and can be used to give representatives of the Press, radio, television and other interested parties, such details of the fire as are authorised.

(vi) The control point will also enable adequate communications to be maintained with the mobilising control of the appropriate brigade.

Once the control point has been set up and a sketch plan has been prepared of the fire together with the surrounding risks and water supplies, a clear overall picture of the situation can be obtained. A meeting of supervising officers should then be held to explain the tactics to be used and they, in their turn, will tell their juniors of the measures it is proposed to take, who will then pass the necessary information to their crews.

5 Other control matters

a. Assistance from non-Brigade personnel

If the police are not in attendance on the fireground and are likely to be required, send a message to the mobilising control asking for the attendance of the police.

If a fire occurs in commercial or industrial premises during working hours, contact a responsible representative of the management early in the operations. At night or when the premises are closed, this will not normally be possible, but the police should have details of the key holder and will notify him. The key holder will know how to contact the works manager, who will have full information about the work carried out in the premises and the type of goods to be found and where. If they are of an unusual or hazardous type, he will probably be able to indicate whether any special precautions are necessary in tackling the fire. The use of water may be inadvisable, and the works manager could be able to suggest alternative methods to be adopted. Sometimes a fire prevention officer will have a good knowledge of the premises and of the risks involved.

The works manager may also indicate whether or not certain parts of the premises are more important than others, e.g., the drawing office or pattern shop may contain material which is virtually irreplaceable and subject to other overriding considerations, an officer should try to concentrate attention on those parts of the premises which the management regard as specially important (see Part 1, Chapter 4, Section 7).

In addition to advice on the contents of the building, information can also be obtained: on its construction and on any features which might lead to unusual fire spread; whether or not there are heavy loads on any particular floor; on alternative means of entry or exit; on the position of internal protective equipment such as hydrants, risers and special types of extinguisher; on the location of separating walls or the whereabouts of fire-resisting

doors. These, and many other details may materially assist the officer in charge in his attack on the fire. It is always extremely helpful to have available an employee of the firm who is well acquainted with the premises, who can act as a guide to officers on the fireground.

The occupier may, on the grounds of safety, advise against entry into the building. The officer in charge must then weigh up the position and decide whether to follow such advice. It sometimes occurs at a large fire that an official of the firm greatly exaggerates the possible dangers to be encountered. The officer in charge, therefore, must listen to all the information he is given, but if he is not absolutely satisfied that it is accurate, he must investigate for himself.

b. Dealing with crowds

It will usually be found that the police will provide, without asking, adequate assistance in dealing with crowds. If they are not available quickly, send back a message asking for this assistance. Where sufficient police are not available, rig up a long line to act as a barrier to keep the crowd at a reasonable distance. Apart from firemen and salvagemen, no one should be allowed to enter premises which are on fire except with the express permission of the officer in charge. Obstruction of members of a fire brigade while at a fire is an offence under the *Fire Services Act, 1947*, and the police should be asked to cope with any particularly difficult persons.

c. Consequential fires

Instances have occurred of flying brands causing fires in buildings at some distance from the main fire. In such circumstances, send back a message treating the outbreak as an entirely separate fire. It can then be dealt with by appliances sent for the purpose. Where all pumps are in use on the fireground, this is usually quicker than to detach pumps which are already at work, unless the distance involved in sending on other appliances is too far.

d. Reliefs

If it is obvious that the fire is going to last for a considerable time, make arrangements for the provision of reliefs for both crews and officers. Records of the times of arrival and departure of appliances will be available at the control point, so that requests for reliefs can be made well in advance of when they will be required to arrive. This will enable them to have a meal before coming on to the fireground. Priority should be given to those crews who have been longest on the fireground. Reliefs generally take the form of crews with their appliances, but sometimes personnel who can be brought on by suitable transport can take over appliances and equipment already at work.

When there is difficulty in detaching a pump from the fireground, owing to the congestion of hose or other vehicles around it, or because much of its gear is in use, then the outgoing crew should take over the pump of the incoming crew and go back to their station on it, leaving their pump at work with the relief crew. Although often possible in large towns where appliances have only a relatively short distance to travel to the fire, this is not always convenient in rural areas.

e. Supplies

At a large fire, thought must be given at an early stage to requesting additional supplies of appliance fuel, oil and any other consumable stores which are likely to be needed. A transport officer usually attends large fires to see that supplies of diesel and oil are adequate and appliances are maintained in good running order. Knowing the number and type of appliances at work, a brief calculation will show approximately how much diesel fuel and lubricating oil will be required.

Be sure that men employed for some hours at a fire are supplied with hot drinks and light refreshments. An officer should supervise the arrangements and should tour the fireground informing the officers in charge of the various sections of the fire of the arrival of refreshments and should arrange for them to send a few of their men at a time to the refreshment point. It is their responsibility to ensure that men on the branches are relieved one or two at a time and that no one is forgotten.

6 Bringing the fire under control

a. Surrounding the fire

The first task is to surround the fire so that it cannot spread. This will normally involve getting a number of branches to work and the simplest example of surrounding a fire is shown in Fig. 8.3, in which a long shed is on fire in the middle. Discounting the wind, the first branch would be got to work as shown, to stop the fire spreading one way down the shed. The second branch would be sited on the other flank to prevent spread in that direction, and, if necessary, a third would be used to work into the seat of the fire. On this plan there is no danger of uncontrolled spread, as would be the case if the first branch were got to work on the seat of the fire, thus allowing it to spread to either flank. When deciding on the number, size and position of jets, always take account of the need to reach the heart of the fire and apply water to the material which is actually burning.

One way to stop a fire crossing the street and entering windows on the opposite side is to place men with branches at some of those windows. If the fire is likely to 'jump' the street, any exposed

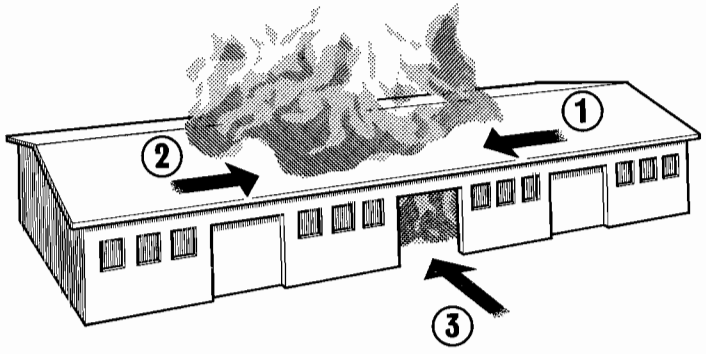

Fig. 8.3 Diagram showing how necessary it is to prevent a fire from spreading to the flanks before attacking the heart.

windows may be covered temporarily by branches in the street, on turntable ladders or hydraulic platforms.

Outside branches, whether from turntable ladder, hydraulic platform or street, are a handicap to those working inside the building, tending to impede the movement of firemen in the building and on staircases and landings, and making working conditions inside difficult. Shut them down at the first possible moment and leave the firefighting to the crews inside.

Sometimes a staircase will be found to be burnt away and an outside branch will have to be kept at work while ladders are pitched or an improvised internal staircase of extension ladders is constructed (see Fig. 7.10). The officer in charge of an inside branch should never hesitate to have an outside branch or jet from a turntable ladder knocked off if it will help operations within. He should communicate from a window or from the roof with the man at the head of the ladder, who will ask for his jet to be shut down.

b. Large jets

Where there is a large area of fire, anything but a large jet is useless and it may be necessary to replace several smaller size jets with larger ones, such as 28 mm or even 40 mm. When ordering large diameter jets to be got to work, consider the part of the premises they are going to strike. Large jets make it difficult, if not impossible, for men to work inside in some restricted parts of the building. Unless carefully handled, they can bring down walls and other parts of a building, especially if the structure has been weakened by fire.

If large jets are to be used for any length of time, monitors or radial branches should be used, to conserve manpower and to prevent strain. As soon as practicable, however, revert to smaller jets

to get inside the building for the complete extinguishment of the fire.

c. Use of dams

Most large fires, especially those occurring in large cities, can be fought by using water from the street mains. In certain circumstances, all available water may be relayed to a portable dam erected close to the fire, and pumps feeding branches can then be set into this.

The advantages are relatively short hose lines to the branches can be used (thus reducing frictional loss), less hose is required, and message-carrying between branch and pump is considerably easier. The outstanding advantage is that all the water is pooled and there is no risk of one pump having a surplus while another is short. The water situation at all times is under immediate observation, and the officer in charge can see whether there is sufficient water for pumps already in use and if additional pumps can be got to work.

d. Influence of the wind

Whilst the wind direction will not be of great consequence in fires which are confined, it can become an important factor in fires in the open, e.g., in timber yards, open sheds, etc. Under such conditions, the first branches should be so placed as to prevent the fire spreading to leeward before assistance can be obtained. Despite the heat and smoke, branches must be placed in the probable path and on the flanks of the fire, to protect any adjacent property and to prevent the fire travelling with the wind (Fig. 8.4). It is a feature of all very large fires that the wind drives in from all sides on account of the uprush of the column of heated air immediately above the fire. Remember, also, the peculiar effect sometimes experienced when high-rise buildings are adjacent to podium, mall or street levels. Even without fire conditions, air movements can be of high velocity and contrary to the expected flow. The build-up of a relatively small intense fire at low level could have a disproportionate effect, especially on smoke movement and flying brands (see Chapter 5, Section 8(f.)).

e. Preventing fire spread

Some of the various factors which lead to the spread of fire have been dealt with in Part 1 and the following points are suggested as requiring the attention of the officer in charge. Consider the position of separating walls and other firebreaks which could help in checking the spread of fire. In modern buildings with fire-resisting floors, horizontal fire travel is more usual, whilst in older buildings, the spread of fire tends more to a vertical direction. If a separating wall is being relied upon to check the spread of fire, detail crews to patrol and inspect the adjoining compartment or

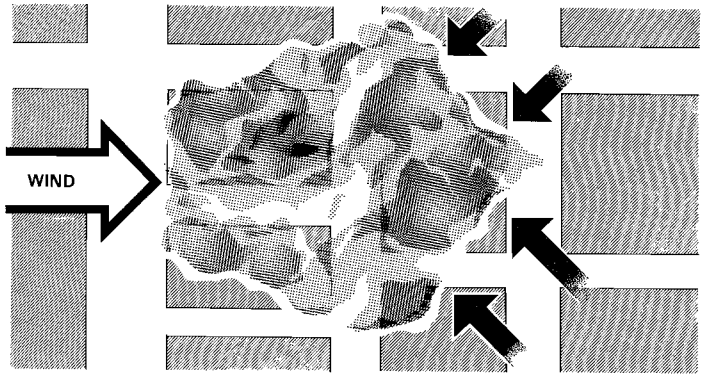

Fig. 8.4 Diagram showing the possible location of branches used to check the spread of fire when wind is an important factor, e.g., at a fire in a timber yard.

premises to make sure that the fire has not broken through because of some constructional defect. Where there is compartmentation designed to prevent the spread of fire, detail crews to work rapidly through the building checking that all fire-resisting doors are closed (see Plate 9) first ensuring that no one can be cut off in the premises. Where unprotected openings occur in an otherwise good fire break, position jets or covering spray branches.

Unless firefighting considerations require otherwise, keep doors in the building on fire closed. The normal 20 mm deal panel door is sufficient to hold back a relatively intense fire for several minutes. Doors of more solid construction will prove effective for correspondingly longer. Close windows in buildings adjacent to, and threatened by the fire to reduce the possibility of fire spread by brands entering rooms and igniting combustibles.

Except in conditions of unusually high wind, a wide street or other open space should form an effective fire break. Inside buildings separating walls should prove effective, particularly where they extend above roof level. If they do not, there is a danger of fire spreading along the roof timbers. Keep a close watch on the possibility of fire spread to lower floors by burning debris falling down lift shaft openings, light wells, etc.

Once there is no danger of a fire in a lower floor spreading to those above, ventilate.

One cause of fire spread is failure to prevent the fire 'driving before' the water. For example, in Fig. 8.5 a fire is shown on the upper floor of a large building which, it will be assumed, is showing at a window (1). The fire should be attacked by suitable equipment taken up the staircase (2), allowing the heat and smoke to escape

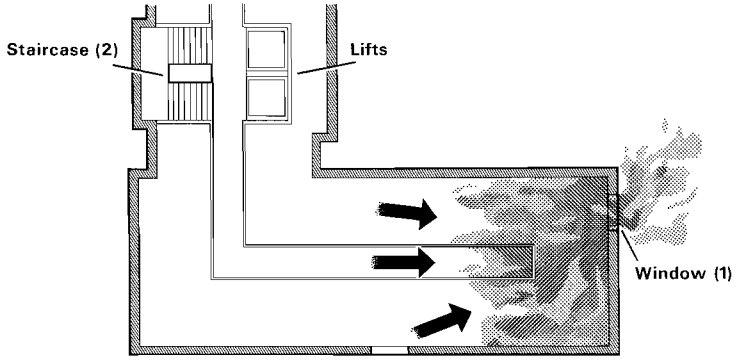

Fig. 8.5 The correct way of tackling a fire in the wing of a building by hose lines taken up the staircase.

through the window at (1). A branch got to work from a ladder pitched to the window at (1) will allow the fire to spread away from the water and involve the whole floor.

Nowhere is this danger more obvious than in projecting shops. The first appliance will usually arrive at the front door and a branch will be got to work from the front of the premises. It can be seen from Fig. 8.6 that, if the fire spreads away from the water, it will force its way into the main part of the building. A branch got to work at the rear of the premises will check the progress of the fire. Events happening at the front of a building on fire are always obvious; those at the rear are less so and tend to be overlooked.

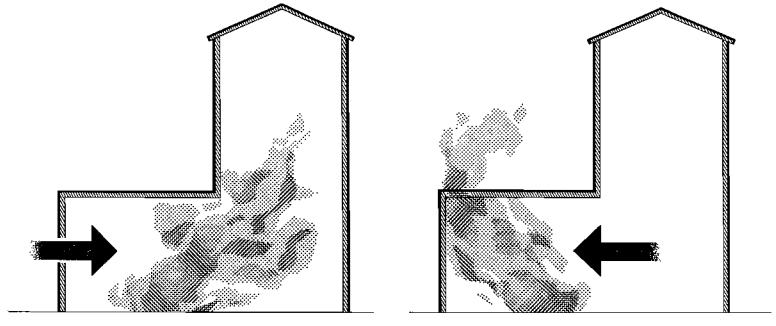

Fig. 8.6 Tackling a fire in a projecting shop. Left: showing how the fire can be 'driven before' the water and can involve the whole premises. Right: attacking from the rear and so preventing spread.

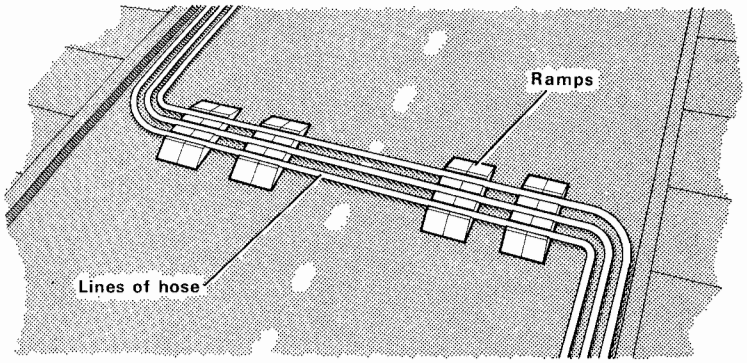

Fig. 8.7 Method of laying hose lines across a road so that hose ramps are correctly placed to take traffic passing over them. The ramps are shown in diagrammatic form only.

f. Ramps and bridges

Try to keep hose lines well to the side of the road. When hose has to be taken across a road, run it at right angles to the flow of the traffic, so that ramps can be correctly set for the vehicles which must use the road (Fig. 8.7). Where several hose lines must cross a road on which traffic must continue to flow, order ramps on where there are insufficient number of ramps available at the fire. At large fires, the police will generally assist in the regulation of traffic. If the police are not available, a man should be stationed at the more important crossings to warn approaching traffic and to replace displaced ramps. It will be necessary at night to provide lighting to illuminate the ramps.

A couple of ramps are quite inadequate for a busy crossing, and whenever practicable, the ramps should form a continuous bridge. Where railway lines must be crossed, it is sometimes possible to remove part of the ballast between the sleepers and pass the hose *beneath* the rails.

As an alternative to hose ramps, some brigades have bridging units which are often manufactured to their own design, to allow the passage of water over major roads with the minimum traffic disruption. One type of bridge is shown in Fig. 8.8, and consists of a length of alloy piping with couplings at each end to accommodate two lines of delivery hose. The piping is raised by means of tripod legs to a height to permit a double-decker bus to pass underneath, and is of sufficient width to allow two-way traffic to flow unimpeded.

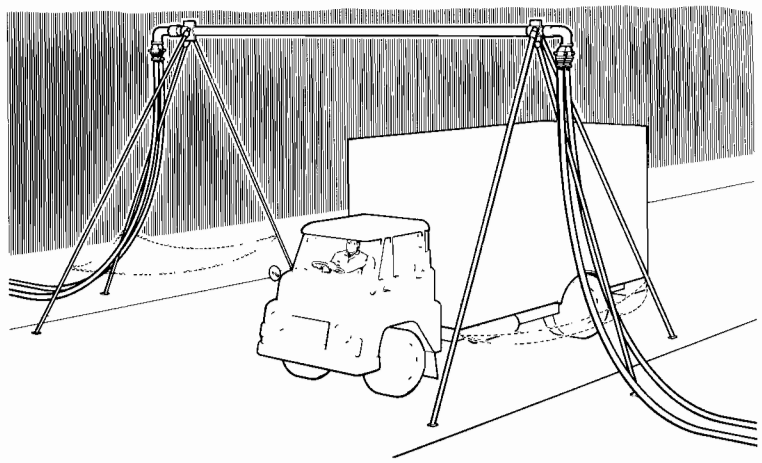

Fig. 8.8 An example of one type of alloy pipe bridge.

g. Moving in branches

During firefighting, providing it is safe to do so, branches should move in as the fire comes under control. A reduction in flame and heat, steam and a lightening of smoke colour are some of the usual indications. Where lengths of hose have to be added, ensure that other branches can cover adequately and take the opportunity to substitute hand controlled or smaller nozzles if conditions permit. If it is obvious that the number of jets can be reduced, this should also be done to conserve water and lessen water damage.

h. Persons injured

Ambulances are usually ordered on automatically by a mobilising control to all very large fires as a precautionary measure. Whenever a person injured at a fire requires hospital treatment, and an ambulance is not in attendance, the officer in charge should order one to attend. It is generally helpful to the mobilising control if the message ordering the ambulance states whether it is for a civilian or for a member of the fire brigade.

Whenever firemen are injured at fires or other incidents and are removed to hospital, a telephone message should be sent back giving details of the man, i.e., his name, rank, station, the nature of his injuries and the hospital to which he has been conveyed. Messages giving these personal details should not be transmitted by radio which can be intercepted by unauthorised persons prior to the next-of-kin being informed. A Brigade will have its own arrangements for ensuring the information reaches next-of-kin as quickly

as possible. The officer in charge should also endeavour to obtain the particulars of all civilians who are injured at fires, although this information need not generally be passed on to the mobilising control until later. The police, if in attendance, can generally be of assistance in this respect, as they will, as a matter of routine, obtain all the relevant information relating to civilian casualties at fires.

j. Leaving the fireground

In normal circumstances, the senior officer will be the first to leave the fireground and, as the fire diminishes in size and intensity and crews are sent back to their stations, so will officers, progressively junior in rank, leave. The rank of the officer in charge should, however, always be kept in proportion to current responsibility.

Before the officer in charge of the fire, whatever his rank, leaves the fireground, he should hand over to his subordinate, making it clear that he is doing so. He should mention any particular features to which attention should be paid and should give him any definite instructions that may be necessary. The transference of authority should be just as positive as when taking over control.

It is the duty of the officer in charge of each appliance to see that none of his gear is left behind, or, where this is unavoidable, to make a list of such gear, so that arrangements can be made to recover it after the fire.

The last officer to leave should, if the occupiers are not present, ensure that the premises are secure. If this is not possible, the premises should be handed over to the police.

Manual of Firemanship
Structure and publishing history

The *Manual of Firemanship* was first published in a series of nine 'Parts' (1–5, 6a, 6b, 6c, and 7) between 1943 and 1962.

In 1974, it was decided that these nine Parts should be gradually replaced by 18 'Books' and a revised format for the *Manual* was drawn up. The new Books were to up-date the information given and arrange the subjects covered in more compact and coherent groups, each group occupying one of the new Books. The following pages show the original plan, *as amended to date.* Book 12 is the tenth of these Books to be published.

Since 1974 there have been many developments in Fire Brigade practice and equipment and in the problems which firemen may have to face. To remain an authoritative and up-to-date survey of the science of firefighting the *Manual* must take these developments into account. Not all the necessary changes can be accommodated within the format announced in 1974. The reader should therefore be aware that the structure of unpublished Books of the Manual, as set out on the following pages is subject to change. Such changes will be publicised as far in advance as possible.

The next Book planned for publication is Book 4 'Incidents involving aircraft, shipping and railways'. This should appear in the form described.

Book 1 Elements of combustion and extinction (published in 1974)	*Formerly*	
Part	*Part*	*Chapter*
1 Physics of combustion	*1*	*1*
2 Chemistry of combustion	*1*	*1*
3 Methods of extinguishing fire	*1 and 6a*	*2 32(111)*

Book 2 Fire Brigade equipment (published in 1974)	*Formerly*	
Part	*Part*	*Chapter*
1 Hose	*1*	*4*
2 Hose fittings	*1*	*5*
3 Ropes and lines, knots, slings, etc.	*1 and 6a*	*7 39*
4 Small gear	*1*	*13*

Book 3 Fire extinguishing equipment (published in 1976)

Part	*Formerly Part*	*Chapter*
1 Hand and stirrup pumps	*1*	*8*
2 Portable chemical extinguishers	*1*	*9*
3 Foam and foam making equipment	*1*	*10*

Book 4 Incidents involving aircraft shipping and railways (not yet published)

Part	*Information available in Part*	*Chapter*	*Last edition*
1 Incidents involving aircraft	*6b*	*4*	*1973*
2 Incidents involving shipping	*7*	*1–3*	*1972*
3 Incidents involving railways	*6b*	*3*	*1973*

Book 5 Ladders and appliances (published in 1984)

Part	*Formerly Part*	*Chapter*
1 Extension ladders, hook ladders and roof ladders	*1*	*6*
2 Escapes	*2*	*3*
3 Turntable ladders	*2*	*4*
4 Hydraulic platforms	*2*	*5*
5 Special appliances	*2*	*6*
6 Pumping appliances	*2*	*1*

Book 6 Breathing apparatus and resuscitation (published in 1974)

Part	*Formerly Part*	*Chapter*
1 Breathing apparatus	*1*	*11*
2 Operational procedure	*6a*	*32(V)*
3 Resuscitation	*1*	*12*

Book 7 (first edition) Hydraulics and water supplies (published in 1975)

Part	*Formerly Part*	*Chapter*
1 Hydraulics	*3*	*19*
2 Hydrants and water supplies	*3*	*20*
3 Water relaying	*3*	*21*
Appendices		

Book 7 (second edition) (not yet published)

As above, plus	*Information available in Part*	*Chapter*
4 Pumps, primers and pump operation	*2*	*1–2*

Book 8 Building construction and structural fire protection (published in 1975)

Part	*Formerly Part*	*Chapter*
1 Materials	*4*	*23*
2 Elements of structure	*4*	*23*
3 Building design	*4*	*23*

Book 9 Fire protection of buildings (published in 1977)

Part	*Formerly Part*	*Chapter*
1 Fire extinguishing systems	*4*	*24/26*
2 Fire alarm systems	*5*	*28*
3 Fire venting systems	*4*	*23*

Book 10 Fire Brigade communications (published in 1978)

Part	*Formerly Part*	*Chapter*
1 The public telephone system and its relationship to the Fire Service	*5*	*27*
2 Mobilising arrangements	*5*	*29*
3 Call-out and remote control systems	*5*	*30*
4 Radio	*5*	*31*
5 Automatic fire alarm signalling systems	*5*	*28*

Book 11 Practical firemanship I (published in 1981)

Part	*Formerly Part*	*Chapter*
1 Practical firefighting	*6a*	*32*
2 Methods of entry into buildings	*6a*	*35*
3 Control at a fire	*6a*	*33*

Book 12 Practical firemanship II (published in 1983)

Part	*Formerly Part*	*Chapter*
1 Fire Service rescues	*6a*	*36*
2 Decontamination	—	—
3 Ventilation at fires	*6a*	*37*
4 Salvage	*6a*	*38*
5 After the incident	*6a*	*34*

Book 13
Contents not yet decided

Book 14 Special fires I (not yet published)

Part	*Information available in Part*	*Chapter*	*Last edition*
1 Fires in animal and vegetable oils	*6c*	*45(8)*	*1970*
2 Fires in fats and waxes	*6c*	*45(3)*	*1970*
3 Fires in resins and gums	*6c*	*45(13)*	*1970*
4 Fires in grain, hops, etc.	*6c*	*45(6)*	*1970*
5 Fires in fibrous materials	*6c*	*45(4)*	*1970*
6 Fires in sugar	*6c*	*45(15)*	*1970*
7 Fires in paint and varnishes	*6c*	*45(9)*	*1970*

Book 15 Special fires II (not yet published)	*Information available in*		
Part	*Part*	*Chapter*	*Last edition*
1 Fires in dusts	*6c*	*45(1)*	*1970*
2 Fires in explosives	*6c*	*45(2)*	*1970*
3 Fires in metals	*6c*	*45(7)*	*1970*
4 Fires in plastics	*6c*	*45(10)*	*1970*
5 Fires involving radioactive materials	*6c and 6a*	*45(11) 33(VI)*	*1970 1971*
6 Fires in refrigeration plant	*6c*	*45(12)*	*1970*
7 Fires in rubber	*6c*	*45(14)*	*1970*

Book 16 Special fires III (not yet published)	*Information available in*		
Part	*Part*	*Chapter*	*Last edition*
1 Fires in rural areas	*6b*	*1*	*1973*
2 Fires in electricity undertakings	*6b*	*3*	*1973*

Book 17 Special fires IV (not yet published)	*Information available in*		
Part	*Part*	*Chapter*	*Last edition*
1 Fires in fuels	*6c*	*45(5)*	*1970*
2 Fires in oil refineries	*6b*	*5*	*1973*
3 Fires in gas works	*6b*	*2*	*1973*

Book 18 Dangerous substances (not yet published)	*Information available in*		
	Part	*Chapter*	*Last edition*
Alphabetical list of dangerous substances	*6c*	*45(16)*	*1970*

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