NATIONAL BUREAU OF STANDARDS
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safety

FOR THE HOUSEHOLD

U. S. DEPARTMENT OF COMMERCE
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1. INTRODUCTION

The purpose of this circular is (*a*) to emphasize the seriousness of certain risks to life and property frequently occurring in or about the home, (*b*) to give simple methods of care and caution against such hazards, and (*c*) to stimulate interest in public measures directed toward safety for household and community. The aim is not to cause undue anxiety but rather to suggest means of removing causes for alarm. Caution alone is not enough, because many of the dangers are not commonly known. Few know, for example, that to turn on an electric lamp with one hand while the other is on a water faucet may result in death from electric shock under certain conditions. Some knowledge of the more common hazards in the home is essential to their removal, and proper care along the lines suggested in this circular will greatly reduce the dangers incidental to these hazards.

1. STATISTICS OF ACCIDENT

Few people realize what an enormous toll is levied each year by accidents as measured by lives lost and serious injuries. In the United States the average yearly number of fatalities due to accidents is nearly 100,000 and the average yearly number of injuries (fatal and nonfatal) is approximately 9,500,000 (table 1, p. 181).

It may be a jolt to our national pride to know that the number of accidental deaths per 100,000 of population is higher in the United States than in most foreign countries (table 2, p. 182).

Some people concede the possibility of injury while engaged in industry and yet overlook the frightful toll taken by accidents in the home (tables 3, p. 183 and 4, p. 184). Few realize that the fatalities among children up to and including 4 years of age and among older people, 65 years and over, comprise nearly 72 percent of all fatalities in the home (table 5, p. 185). In these days when so much is said about economic losses, the average yearly loss due simply to accidents in the home is over $600,000,000 (table 6, p. 186).

2. INSTRUCTION OF CHILDREN

Physical conditions should be such that children are not invited to incur active hazards. While matches, poisons, and sharp tools should not be put in their way, sole dependence should not be placed upon the inaccessibility of such objects. All children should be instructed as to the proper handling of objects and materials which are dangerous, and the child should be encouraged to cultivate good habits in taking proper precautions and in keeping hazardous materials where they belong.

If the individual can be made hazard-conscious during his growing years, he will probably remain so in later life and will not take unnecessary chances or tolerate hazardous conditions. Instruction in school reaches more children than instruction in the home can hope to do. Communities which have not as yet started such work in schools are subjected to a serious disadvantage.

Not only children but adults as well should have their attention called to existing hazards and their cooperation sought in eliminating those hazards or in using the care necessary to prevent a possible accident. For example, in case fire should occur, every member of the household should know how to send in a fire alarm in those communities where a fire company is maintained. Small children should be instructed to get out immediately and avoid smoke.

3. ORGANIZED SAFETY

Because conditions in the household appear to be determined largely by the attitude and practices of the housewife, it is natural

that activities to organize safety should be taken up by the women's clubs. In many communities the women's club has constituted a safety committee to look into local conditions and to take steps to diminish the tolls levied by fires and accidents. Parent-teacher associations can perform a similar service.

The advantage of organized safety is found partly in the interest which can be developed in a cooperative movement, partly in the additional accomplishments which can be brought about by organized activity, and partly in the community standards which can be created by organized action. The organization of a local safety council in any community will do much to promote safety in the home if a proper program is adopted and everyone in the community does his part. In a mid-west city one of the first things done to bring city-wide attention to the home safety program movement was to have the common council pass a resolution calling upon all residents and every branch of municipal government to cooperate in a home safety movement. Then a home safety board, composed of outstanding civic and public agencies, was organized. A home safety portfolio was devised, copies of which were distributed to the representative of each organization. The portfolio contained a large assortment of safety material, and such material was made available in quantities for judicious distribution. Each of the representatives on the home safety board was given a specific territory to cover, after being told of its particular problem, and each was urged to work this out in whatever manner best suited his organization. Full and complete information on the organization of an effective local safety council may be obtained from the National Safety Council, 20 North Wacker Drive, Chicago, Ill. The American Red Cross of Washington, D. C., also furnishes data helpful in the development of an effective community home safety program.

In many localities a community survey conducted under the auspices of the local women's club has been helpful. Such a survey will bring to light the prevailing hazards in the neighborhood and may result in community accomplishment which no housewife could bring about unassisted. One method for eliciting interest and securing safety information is to have club members report all accidents which have occurred to members of their own household and the means adopted to prevent their repetition. It is also valuable to have each club member inspect and report upon conditions found in her home and surroundings. As an aid in such inspection the following questionnaire has been prepared.

Name..... Address.....

1. Are all stairs provided with railings?
2. Is there sufficient headroom on all stairs?
3. Are stairs adequately lighted?
4. Are there any loose rugs at foot of stairs or at places where sharp turns are frequently made?
5. Are floors or steps too highly waxed or polished?
6. Are steps cluttered with loose material or articles?
7. Is bathtub provided with handhold?
8. Are porches provided with railings?
9. Are chairs or unsafe substitutes used in place of ladders?
10. Are sharp tools left where children may handle them?
11. Is there a fire extinguisher in the home? What kind?
12. What type of matches are used?
13. Are children permitted to play with matches?
14. Are incombustible ash trays provided for smokers?
15. Is kerosine ever used to light fires?
16. Are kerosine lamps ever filled while lighted?
17. Is gasoline used in the home for dry cleaning, etc.?
18. Is stove polish used? What kind?
19. Are combustible materials kept away from stoves and out of contact with stove pipes?
20. Is there a screen for the open fireplace?
21. What disposition is made of wastepaper?
22. Is rubbish allowed to accumulate in attic, basement, or elsewhere?
23. Are gas pipes or fixtures used to support clothes lines, clothing, or utensils?
24. Are gas cocks adjusted to turn smoothly but not too easily?
25. Are gas connections made with tubing? Does it leak?
26. Where are poisonous drugs kept? Are all bottles properly labeled?
27. Are any of the electrical circuits improperly fused by pennies, etc.?
28. Is the frame of the electrical washing machine grounded?
29. Is portable cord for electrical appliances or lamps badly worn?
30. Is portable cord of an approved type?
31. Is a stand provided for the electric iron?
32. Are there any metal pull-chains without insulating links?
33. Are electric lights in bathroom controlled by wall switches?
34. Are portable electric heaters or other portable electric appliances used in the bathroom?
35. Is the outdoor radio antenna equipped with a lightning arrester?
36. Is the automobile engine ever run in the garage with the garage doors and windows closed?
37. Are first-aid materials at hand?
38. Are porches, walks, and sidewalks kept in good repair and free of ice, snow, etc.?
39. Are cooking utensils on the stove kept and so used that a person will not be burned by steam or hot liquids?
40. Are the toys of the children maintained and used in a safe manner?
41. Are firearms kept in the home? If so, are they kept where children cannot readily have access to them?

42. Do you keep tubs or other containers filled with hot water where a child will not fall or stumble into them?
43. Are the laundry appliances so guarded that no one will be injured in their use?
44. Do you from time to time instruct the children in the prevention of injuries to themselves or their playmates?

The above list of 44 questions covers many of the more common hazards that occur in the home. The answers to these and similar questions will give a good idea of prevailing safety conditions in or about the home.

The subject of home safety can also be stressed by teachers in the local schools. More and more of the schools are initiating instruction in accident prevention, and where this has been done the results are apparent in the statistics dealing with local accidents. Definite assistance may be secured by school authorities from the School and College Division of the National Safety Council. This organization issues a monthly magazine devoted to the subject of accident prevention, called *Safety Education*.

4. PUBLICATIONS FOR THE HOUSEHOLDER

The titles of many publications containing information of interest to the householder, together with the names and addresses of the publishers, will be found in the following National Bureau of Standards Letter Circulars: List of Published Material Relating to Home Building and Maintenance, LC830; List of Commercial Standards (Revised to January 1, 1947), LC842; Publications Relating to Building Codes and Construction Practice Home Building — Building Material Specifications — Home Maintenance, LC843.

The above Letter Circulars are issued in mimeographed form only. Copies may be obtained upon request to the National Bureau of Standards, Washington 25, D. C.

2. CHEMICAL HAZARDS

The hazards in the household from the use of chemicals are the possibilities of burns, poisoning, fire and explosion. Possibility of burn or poisoning may be prevented by careful handling of the container, marking the container with a label bearing the name of the contents of the container, proper storage of the chemicals and by following the recommendations below for acids, caustics and other chemicals. Recommendations for the prevention of fire and explosions due to chemicals are contained in chapter 4, Fire Hazards.

1. ACIDS AND CAUSTICS

In general injuries by acids and caustics may be caused by one of four ways: (*a*) burning, when in direct contact with the skin, eyes or clothing; (*b*) fume poisoning, when noxious fumes or vapors are inhaled; (*c*) poisoning or burning when taken internally; and (*d*) fires or explosions resulting from improper handling of the acids or caustics.

One cannot be too careful in avoiding accidental splashes of and direct contact with acids and caustics. Careful handling of the container, the wearing of rubber gloves, rubber aprons, and tight-fitting goggles with rubber frames will prevent many injuries.

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Persons handling acids or caustics should carefully wash their hands before handling food. The action of acids and caustics on the eyes and other parts of the body is very rapid and may cause blindness or serious burns unless immediate action is taken to neutralize them. In case of accidents with alkali, use weak acidic materials such as dilute lemon juice or vinegar, and in case of accidents with acids, use weak ammonia liquor, limewater, or solutions of baking soda followed by extensive washing with water. Extreme care should be exercised in mixing acids or caustics or bringing one into contact with another. For example, in diluting acids, the acid should *always* be added to the water, *not* the water to the acid. (See also recommendations for polishing and cleansing materials.)

Care should be taken to avoid exposure to acid or caustic fumes. Do *not* under any circumstance place the container near your nose and inhale the vapor or fumes in an attempt to determine the nature of the contents of the container. If the container does not bear a label with the name of the contents, dispose of the container and its contents without delay.

If a strong acid, alkali, or other poisonous or corrosive material is swallowed, vomiting should be induced immediately by drinking a large volume of warm water in which common salt has been dissolved. Then consult a physician.

2. COSMETICS, DRUGS, AND MEDICINES

Cosmetics

Among the materials used for cosmetic purposes there are a few which present some hazard. Rouge for cheeks or lips has been the cause of serious mercury poisoning, owing to the presence of vermillion (mercury sulfide). Hair removers are in general corrosive in character (such as calcium hydrosulfide with calcium hydroxide) and sometimes poisonous (as calcium hydroxide with arsenic trisulfide). Dyes used in blackening gray hair generally contain one or more of the salts of silver, lead, copper, iron, or bismuth and can

cause serious poisoning if taken internally. It is well to treat all materials of this character as poisonous. Liquid nail polishes and removers contain volatile flammable solvents and should not be used in the presence of flames or while the user is smoking.

Drugs and Medicines

Every home contains drugs, medicines, and proprietary compounds of various kinds, some of which if improperly used are likely to cause serious illness, injury, or death. Sometimes poisons in the form of tablets or pills are removed from their original packages and are left lying about or are mistakenly placed in other containers improperly labeled. Medicinal preparations in the form of pills, tablets, powders, and liquids are often left in easily accessible places or are stored indiscriminately in medicine cabinets, closets, cupboards, and even in pantries. In many cases children have eaten poisonous pills and tablets, thinking they were candy. Mature persons also often suffer as the result of careless or improper disposal or use of various kinds of drugs or medicines in the home. Liniments intended for external use only have been taken internally, and other poisons have been taken for tonics, cough medicine, and home remedies in general.

Accidents such as the above can be eliminated if simple precautions are taken. *First,* see that all containers of drugs and medicines are properly labeled. For poisonous substances, bottles of special shapes or bottles with roughened surfaces or stoppers may be used. Small bells attached to the necks of bottles by light-weight chains have been used in some cases to distinguish poison-containing bottles. Pins thrust into ordinary cork stoppers will give effective warning to careless and absent-minded persons. *Second,* store all drugs and medicines in a special cabinet out of the reach of children, putting poisons in the least accessible place. *Third,* when special medicine has been prescribed by a physician for temporary use, destroy any that remains unused. It would probably not be of benefit later, and it might be harmful. *Fourth,* never take any medicine in the dark or before you have read the name and directions on the label.

3. FOOD AND WATER

The food supply for the ordinary household should be subject to scrutiny from the following standpoints: the presence of harmful preservatives introduced either to render bad food palatable or to preserve food which is preserved with difficulty; the presence of specific poisonous material from food containers, wrappers, or utensils used in cooking; and danger from food contamination by bacteria and parasites. In order to avoid contamination of foodstuffs by lead from containers used in preserving, from wrappers such as tinfoil, or from cooking utensils, metals coming directly in contact with food should contain less than one percent of lead.

Some foods such as poultry, fresh meats, butter, and many garden vegetables spoil quickly. They should not be allowed to remain in the kitchen but should be kept in a refrigerator at a temperature of 40 degrees Fahrenheit.

Before a can or jar of food is opened it should be inspected. A bulging lid or rubber ring, gas bubbles, or leakage are often signs of spoiled food.

All fruits and vegetables should be thoroughly washed before they are eaten in order to prevent possible poisoning because they may have been contaminated by insecticides applied during the growing period.

The purity of the water supply for a household has long been recognized as of vital importance. In thickly settled regions where dangers from contamination are likely to be greatest, water purification becomes a public-service function. In places where the householder must provide his own water supply, it is sometimes necessary to filter the water through sand or charcoal, to boil, or in some cases to distill the water. Where water from wells, springs, or cisterns is used as a domestic water supply, it should be checked periodically (at least once a year) by a competent laboratory to determine its purity. Many state universities perform this service gratuitously or for a small fee. Water for drinking or cooking

purposes should never be run through lead pipes or stored in lead-lined containers, as the accumulative effects of small quantities of lead taken into the system are often disastrous. Tin or any alloy used for such pipes or containers should not contain more than one per cent of lead.

For detailed information on the importance of pure water and food, including milk, the reader is referred to the publications of the United States Public Health Service and of the United States Department of Agriculture. Lists of such publications may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

4. FUMIGANTS, DISINFECTANTS, AND INSECTICIDES

A fumigant is a gaseous product used for the destruction of insect or germ life; a disinfectant is a powder, liquid, or gas that destroys disease germs or renders them harmless; an insecticide is a gas, powder, or liquid used for the destruction of insects, rodents, etc. A disinfectant is not necessarily an insecticide, as some powerful disinfectants are relatively harmless for insects, and good insecticides may be of little value as disinfectants. Formaldehyde is a powerful disinfectant, but it is a very weak insecticide; and, conversely, hydrocyanic acid is deadly for insects and all forms of animal life, but it has little power as a disinfectant.

Hydrocyanic acid gas

Fumigation with hydrocyanic acid gas is one of the most effective methods of destroying household insects. This gas is, however, extremely poisonous to human beings and should not be used without knowledge of the dangers involved and of the precautions to be taken. Fatal accidents have occurred from such a careless act as going into a room or house while the place was being fumigated with hydrocyanic acid gas. The pot method, which consists of placing sodium cyanide in a mixture of sulfuric acid and water in an earthenware crock or in a barrel, is the most common method of

fumigation by hydrocyanic acid gas. Other methods used involve the use of various forms of calcium cyanide or liquid hydrocyanic acid either pure or combined with some absorbent material. Any method of fumigation with hydrocyanic gas should be performed under expert direction and with full observance of the instructions contained in Government publications.

Formaldehyde

Solution of formaldehyde is an excellent and reliable disinfectant. It is an excellent deodorant as well as a disinfectant and may be usefully employed for disinfecting small areas about the house and for disinfecting discharges from the sickroom. While relatively not very poisonous, it does have a very penetrating odor and the gas is irritating to the eyes and respiratory organs.

Carbolic acid

The term "carbolic acid" is rather loosely employed to designate a variety of substances which, though related chemically, are very different in their disinfecting properties. In a pure state true carbolic acid or phenol is solid at ordinary temperatures and when freed of water crystallizes in long white needles. Because of their property of absorbing water from the air, the crystals are likely to form a solid cake in bottles and other containers. For this reason, drug stores usually dispense carbolic acid in a liquid form prepared by adding one part of water to nine parts of crystals. Carbolic acid is not as powerful as other cheaper disinfectants. It is very poisonous and is also objectionable because its strong odor is absorbed by foods. It should be kept in clearly labeled or special shaped containers and stored in cabinets provided for such chemicals.

Cresol

Cresol is found on the market in varying degrees of purity. It is also known under a variety of names such as tricresol, cresylic acid, liquid carbolic acid, etc. It has a strong odor resembling that of pure carbolic acid and, like carbolic acid, is very poisonous and corrosive. Cresol may be used in the same way as pure carbolic acid, though it is considerably more powerful as a disinfectant and is therefore employed in a weaker solution. Because of its odor, it should not be used in or near compartments where foods are kept.

Chlorinated lime

Bleaching powder (chlorinated lime) is a white powder that gives

off the disagreeable odor of chlorine. It should be kept in hermetically sealed containers because exposure to the air causes it to deteriorate rapidly. The efficiency of chlorinated lime is largely dependent upon the quantity of available chlorine it contains. Although chlorinated lime is a very powerful disinfectant, its potency is immediately and greatly reduced when it is brought into contact with organic matter. For general household use 6 ounces of chlorinated lime are mixed with 1 gallon of water.

Besides chlorinated lime, other similar chlorine compounds such as sodium hypochlorite are in more or less common use as disinfectants. The uses to which chlorine disinfectants may be put are restricted because of their corrosive action and their odor. They are powerful bleaching agents and corrode metal. The odor of chlorine disinfectants is likely to be absorbed by foods, and for this reason such disinfectants should not be used in or near food compartments. Chlorine disinfectants are not effective against the germs of tuberculosis.

Corrosive sublimate

Corrosive sublimate (mercuric chloride) is very poisonous, and its use about the household is not recommended. The United States Department of Agriculture states that corrosive sublimate is not nearly so effective or satisfactory for household use as other disinfectants, such as formaldehyde. Corrosive sublimate tablets include ammonium chloride, which facilitates solution in water. Care in handling and storing corrosive sublimate cannot be too forcefully insisted upon. It should never be readily accessible to anyone. The bottles containing it should be plainly labeled, have their stoppers tied or wired in, and should be in a place where they cannot be mistaken for containers of harmless materials. As safety measures, it is sold in bottles of a special shape and the tablets are colored blue or made in the shape of a coffin.

In addition to fumigants and disinfectants, which may also be used for killing insects and rodents, certain other dangerous chemicals may be used for this or other specific household purposes. White arsenic (arsenious oxide) is used as a poison for flies and rodents. It is an essential constituent of Paris green and London purple which are extensively used as insecticides in vegetable gardens. These insecticides also contain copper, which is poisonous. They should be handled with considerable care. Barium carbonate,

also used as a constituent of rodent poison, presents the same sort of hazard as arsenious oxide but in a less degree.

Phosphorus, sometimes used as a rodent poison, should not be used because of its double hazard of fire and poison. Alkaloids, such as strychnine, should not be used for rodent poison because of the extreme dangers involved in careless or mistaken use. Carbon bisulfide, frequently used as a constituent of rubber cement and for killing ants, is not extremely poisonous, but its use involves a fire hazard because its vapor can be ignited by contact with a steam pipe or other object at a temperature far below red heat.

DDT

DDT (dichlorodiphenyl-trichloroethane), a white, crystalline powder, very insoluble in water but soluble in oils and in certain organic solvents, is rather extensively used as an insecticide. It is tasteless and, when pure, practically odorless. Applied in solutions, in emulsions, or as a powder, DDT adheres to any surface with which it comes in contact, and for this reason it is not very likely to form a dust upon agitation of the air. Because of the relatively small amount of DDT present in insecticidal mixtures necessary to destroy insects, the actual concentration of DDT in the air is relatively small. However, there is considerable contamination from the solvents used. Therefore, in many instances the major exposure by different routes is the solvent. Any suitable solvent for DDT has physico-chemical properties which are likely to cause irritation of the skin. These solvents also cause irritation of the mucous membranes and, in sufficient concentrations, may cause systematic effects such as nausea, vomiting, fatigue, headache, and other manifestations. Chlorinated hydrocarbons such as carbon tetrachloride and especially tetrachloroethane should not be used as solvents for DDT. Pure DDT does not cause irritations of the skin in either animals or man, nor is there definite evidence of a sensitizing effect on the skin or of production of other allergic reactions such as asthma. DDT is definitely less toxic than Paris green or sodium fluoride. Nevertheless, DDT has toxic properties which require certain precautions in its use. DDT is absorbed from the gastro-intestinal tract after ingestion and through the lungs after inhalation, whereas the dry powder is not absorbed through the skin. It has, however, been shown that when dissolved in oil DDT is more readily absorbed from the gastro-intestinal tract and is also

absorbed through the skin. Contamination of skin and garments with concentrated solutions of DDT in oily solvents should be avoided, and any spills should be removed as soon as possible by washing with soap and water. While it is unlikely that food contaminated through home use of DDT insecticides will cause toxic effects in man, it is well to remove food from a room or to cover it with paper before spraying.

The National Institute of Health has been studying the toxicity and potential dangers of DDT for some time. The foregoing information on DDT is based on reports made by the Institute, but it is strongly recommended that whenever DDT insecticides are used the latest directions furnished by the Institute be followed.

Nicotine sulfate

Nicotine sulfate is sometimes used as an insecticide, and instances are known where persons have been severely injured by inhalation or by absorption by the skin of the fog or spray. Therefore, when using nicotine sulfate or other nicotine insecticides, one should not stand on the windward side of the spray. Other precautions recommended by the National Institute of Health and by the United States Department of Agriculture should be observed.

5. PAINTS, VARNISHES, LACQUERS, AND ENAMELS

The use of paints, varnishes, lacquers, and enamels present both a fire hazard (discussed in chapter 4) and a poison hazard. Pigments containing lead, mercury, and chromates are among the most dangerous constituents of paints, etc. Although a rather large quantity of soluble lead salts is necessary for acute poisoning, chronic poisoning may be caused by pigments containing lead when in contact with the skin for considerable periods of time or introduced into the system in other ways such as ingestion. Methyl alcohol, also called methanol, is a particularly dangerous substance because of its peculiar paralyzing effect upon the optic nerve, causing temporary and sometimes permanent blindness.

It is possible for babies and other small children to be poisoned by chewing off the paint of toys, cribs, high-chairs, play-pens, etc. Care should be taken to make sure that the ingredients of paints, etc., used for such articles are nonpoisonous. (The ingredients are usually listed on the label.) A list of safe paints for such articles can be obtained from the National Safety Council, Inc., Chicago, Ill.

The various volatile thinners and solvents, such as turpentine, naphtha, benzol, amyl acetate, and ethyl acetate, used in paints, varnishes, enamels, and lacquers, are toxic in varying degrees and for that reason adequate ventilation (open windows, etc.) should be maintained while paint and related materials are being applied indoors.

The repeated use of chemicals to remove paints from the hands may cause dermatitis. Any tendency to dryness and chapping of the skin may be overcome by rubbing an ointment or skin lotion into the skin. Substances used to remove paint from painted objects or surfaces may contain benzol and other solvents which are harmful when the fumes are inhaled. For that reason, places where they are used should be well ventilated.

Metallic pigments similar to those used in paints and metallic salts for fixing dyes in textiles present a certain hazard when used in the coloring of wallpapers, tapestries, artificial flowers, and certain types of colored cloth goods. For example, antimony mordants in cloth irritate the skin, and chromium mordants give rise to an occupational disease among dressmakers who continually handle the dyed cloth.

The use of green arsenic pigments in wallpaper has practically disappeared, owing to the agitation against their use. The danger in such use was more acute than with nonarsenic compounds, because of the dust particles containing arsenic and the formation of very poisonous and disagreeable organic arsenic compounds and arsine from the action of yeast and bacteria on the wallpaper, especially under damp conditions.

Persons using paints, lacquers, enamels, etc., or their constituents should make sure that the hands have been thoroughly cleaned not only with suitable solvents but also with plenty of warm water and soap before partaking of food or liquids. The wearing of suitable respirators will do much to prevent poisoning by inhalation when spraying with paints, enamels, lacquers, etc.

6. POLISHING AND CLEANSING MATERIALS

Some household polishing and cleansing materials contain substances which are injurious to the body, are a fire hazard, or are both a health and a fire hazard. Therefore, such materials should be used with precaution. They should be kept out of the reach of children, segregated from other items, their containers properly labeled, and directions on those labels noted and followed.

Oxalic acid and certain of its salts used in some shoe polishes are poisonous and corrosive. Oxalic acid is commonly used for renovating straw goods and as a metal polish. With disastrous results it is sometimes mistaken for the harmless Epsom salts. Floor polishes and shoe polishes sometimes contain small amounts of nitrobenzene to disguise other odors. That chemical is poisonous when inhaled, even in small quantities. Benzaldehyde, of much the same odor, may be used for the same purpose and is less objectionable. Many polishes contain flammable liquids and on that account present the same fire risks and should be used with the same precautions as gasoline and other flammable liquids (see chapter 4). Some special mixtures of furniture polish contain antimony trichloride (butter of antimony) which is very poisonous and for that reason should not be used.

Ammonia

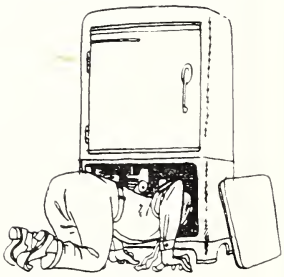
Ammonia water, as purchased and used for household purposes rarely contains more than 5 percent of ammonia and presents few risks. However if the bottle becomes heated and is opened while in a heated condition, the pressure developed in the bottle may cause a spray of the solution to be thrown into the face. When a bottle of ammonia water is opened, it should be opened in a well-ventilated place and with the bottle held well away from the face to prevent the escaping fumes from coming into contact with the membranes of the eyes, nose, or mouth and irritating them.

Strong solutions of ammonia are sometimes used by the householder to darken oak and other woods. Great care should be taken to avoid inhaling the vapors of the solution or spilling the solution on the skin (see also recommendations for acids and caustics.)

Sodium hydroxide

Sodium hydroxide (caustic soda, lye) and potassium hydroxide (caustic potash, lye) are sometimes used in paint removers, drain pipe cleaners, or solvents. Both of those chemicals are caustic poisons and great care is necessary in their use. The wearing of suitable goggles, rubber gloves, protective aprons and footwear will prevent many injuries ordinarily received in the use of those chemicals. The Federal Caustic Poison Act requires that products containing caustic soda or caustic potash be labeled "Poison", with directions for treatment of external and internal injuries caused by those chemicals. These labels and directions should be carefully read before any such product is used. A copy of the Act which gives much useful information may be obtained from the Federal Drug and Food Administration, Washington 25, D. C.

7. REFRIGERANTS



The chief refrigerants, other than ice used for domestic refrigeration, are ammonia, dichlorodifluoromethane (Freon-12), dichlorotetrafluoroethane (Freon-114), ethyl chloride, methyl chloride, and sulphur dioxide. The refrigerant, which is a necessary part of the refrigeration unit, may be considered safe as long as it remains in its proper place within the refrigerating system. Leaks are not common but they sometimes occur. If the refrigerant escapes from the system, either by a slow leak or rapidly, the hazards will depend upon the amount of refrigerant escaping, the speed with which it escapes, and its characteristics (see table 7, p. 187). Possible hazards include: (*a*) fire or explosion, if the refrigerant is one that will

burn; (*b*) personal injury, if the refrigerant is suddenly released or if it is breathed in sufficient quantity for a sufficiently long time; and (*c*) incidental damage to foods, fabrics, or furnishings.

Only those refrigerants which will burn or propagate a flame in air present a fire or explosion hazard. Refrigerants which will burn include isobutane which is similar to gasoline or fuel gas, ethyl chloride and methyl chloride which burn less readily, and ammonia which burns with difficulty. If a refrigerant which will burn escapes in sufficient quantity into a confined space and is ignited, a fire or even an explosion may result.

The danger of personal injury from breathing the vapor of the refrigerant is limited by the fact that the amount of refrigerant in a domestic unit is comparatively small, usually not over 3 pounds. Even if the entire amount were released into a poorly ventilated room containing only one thousand cubic feet, there would be little or no danger from breathing the resultant mixture of refrigerant and air except in the case of ammonia or sulphur dioxide, which would be so irritating that no one would remain in the room if able to escape.

Most persons are familiar with the odor of ammonia and with that of sulphur dioxide which is produced by sulphur matches and the sulfur candles used in fumigation. A small amount of either causes only temporary discomfort; however, the amount in a refrigerating system is large enough to cause serious injury if released into a confined space and breathed for any considerable length of time, as might be the case if occupants were unable to escape.

Some refrigerants which produce little or no effect if breathed in the amounts which could result from leakage from a domestic unit are decomposed by heat, for example, by passing through the flame of a gas burner, and the products of decomposition are distinctly irritating and poisonous. Refrigerants which are decomposed in this way include Freon-12 and Freon-114, ethyl chloride, and methyl chloride. It is not probable, in a domestic installation, that dangerous conditions would be produced in this way.

In the case of leakage of the refrigerant, food which has been exposed is probably fit for use unless spoilage is indicated by appearance, odor, or taste. If there is any doubt, it is safest to throw the food away. The damage to fabrics and furnishings is usually minor, except when no ventilation is provided as in cases where the household is closed and unoccupied.

Although the hazards resulting from leakage of refrigerant are not great, there is a very distinct trend among manufacturers toward the use of those refrigerants which will not burn and which can be breathed in moderate amounts without producing irritation or distress. The safety rules in some of the larger cities tend to encourage this trend. The hazards will be minimized if the following simple precautions are followed:

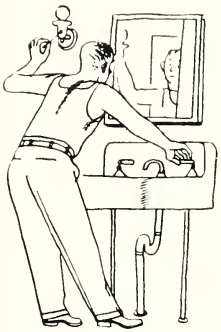
(*a*) Before buying a mechanical refrigerator make sure that it has been approved by a competent disinterested organization such as the Underwriters' Laboratories, Inc., or the Good Housekeeping Institute. Make sure that it uses a refrigerant having a pronounced odor, so that a leak will be promptly detected.

(*b*) When buying a machine keep in mind the desirability of the local company for servicing that particular make of machine.

(*c*) Have the machine installed by a competent and reliable person so that proper connections will be made.

(*d*) In case repair or adjustment is necessary, call a serviceman. Never tamper with the machine or any parts of the system.

(*e*) If a leak of refrigerant is detected, ventilate the room at once, shut off the machine, call the serviceman to make the necessary repairs and continue ventilation until safe to discontinue it.



3. ELECTRICAL HAZARDS

Electricity is one of the most convenient forms of energy for household use. It lights the home, supplies power for various motor-driven appliances, supplies heat for cooking and heating appliances, and operates electric and signaling equipment. In addition to its convenience, electricity when properly used is safer than such substances as oil and gasoline for lighting, power, and cooking. It does away with the use of matches and the need for materials like kerosene and gasoline which involve fire hazard if stored within the home.

Improperly safeguarded and used, electricity presents certain hazards to both life and property. Fires can start and shocks are possible if electrical equipment or circuits are not properly installed or used.

1. TYPES OF ELECTRICAL ACCIDENTS

Accidents of electrical origin may be classified in three groups—shocks to persons, burns to persons, and fires.

Shock

Electrical shock results when a perceptible electric current passes through a part of the body. If the current is very small, it may produce only a slight tingling sensation. If somewhat larger, the

current may produce involuntary muscular contractions which may become decidedly painful. If a dangerous current passes through the body, in addition to causing violent muscular contractions, it may prove fatal by interrupting the breathing process or by causing ventricular fibrillation of the heart.

On commercial frequencies, values of current not to exceed 9 milliamperes may be considered safe for normal adult men, and 6 milliamperes for normal adult women. Somewhat lower values of current are indicated for children. These values of current are not expected to cause fatal injury to normal healthy persons and will permit persons to release themselves from a circuit. However, they can cause muscular contractions which may startle persons into jumping and possibly injuring themselves.

The amount of current which may flow through the body from electrical circuits of 125 or 250 volts and the consequent severity of the shock depends upon several conditions, the most important of which is the electrical resistance of the skin at the points of contact with the circuit. Dry thick skin offers a high resistance to electric current, whereas the resistance is low if the skin is thin and moist. It is the current and not the voltage which causes electric shock. The voltage is important only to the extent that together with the resistance it determines the amount of current which will flow through the body under a given set of conditions.

Most electrical circuits installed in residences have one of the conductors grounded, and consequently a shock may be received by touching a single conductor when a person is in electrical contact with the ground. This contact with the ground may be direct (as when standing upon soil, wet concrete, etc.) or it may be made by touching pipes, radiators, water faucets, and other metal objects which have a direct connection to ground. It may also result from standing upon a wet floor. Many of the worst electrical accidents, especially the fatalities at low voltage, occur to persons who make contact with an electrical circuit under wet conditions.

Burns

If the current passing through the body is large enough, it may actually sear the tissue, especially at the point of contact with the skin. This seldom happens except on circuits of high voltage. It is most likely to happen when the voltage is high enough for the electricity to spark or arc to the skin before actual contact is made with the electrical conductor.

Burns are also caused at times from immediate proximity to an electric arc which has formed between two conductors so that the current does not flow through the person's body. Such arcs may result from a short-circuit or an electrical circuit, through which current is flowing, that is broken at the switch.

Fires

The fire hazards of electricity usually consist of the overheating of conductors which are carrying too large a current or of an electric arc in the presence of combustible material. An overheated conductor may set fire to its insulating covering. An electric arc, in addition to producing a large quantity of localized heat, may spatter molten metal about and thus set fire to surrounding combustible material.

The overheating of electrical conductors may be brought about by trying to operate lamps, motors, or appliances which take too much current for the circuit to which they are connected. This can result from connecting too many appliances to one circuit, or it may arise from some fault in the insulation.

It is important from a fire-prevention standpoint that all joints and connections in electrical circuits be tight and permanent. To prevent trouble when they are not, it is best that joints be made inside a metallic enclosure such as an outlet box or switch box. When an electrical installation includes loose or improperly made joints in wires or connections to devices, such as switches and sockets, dangerous heating or sparking may occur at these joints or connections even when the currents are not excessive.

Prevention of hazards

The design of electrical circuits should be, and usually is, such as to make it improbable that these hazards will exist in buildings of residential occupancy. All wiring should be installed in accordance with the regulations set forth in the National Electrical Code and the National Electrical Safety Code. To avoid contact with live parts, electrical conductors are covered with insulating material and are not exposed to contact. Excessive voltages may occur from contact of outdoor high voltage wires with the wires supplying the premises. To prevent this hazard, the wires of the house circuit are usually grounded. To prevent the exposed metal covers of electrical equipment and the metal coverings of wires from present-

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ing a hazard in case of insulation failure resulting in contact with the electrical conductors, these metal parts are usually grounded when the electrical equipment is installed.

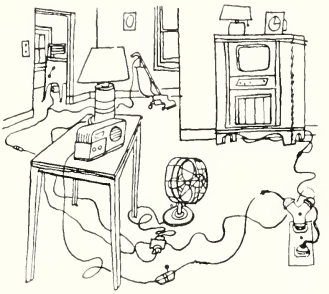
The use of electrical appliances should be avoided when the hands are wet or when standing upon a wet floor or ground, for an electric shock under these conditions may be expected to be fatal. If the use of a portable appliance under such conditions seems unavoidable, then all exposed metal parts on the appliance should be connected to ground. Insulation is especially subject to breakdown when exposed to moisture, and the current may consequently leak from the electrical conductors or the motor winding to the frame of an appliance such as a washing machine. Grounding the frame of the machine will prevent such leakage from giving a shock to the operator. This may be done by use of a separate wire connecting the exposed metal directly to a cold water pipe or by use of a three conductor cord where one conductor is used for grounding the exposed metal parts of the appliance. A polarized plug and receptacle are needed to insure that improper connection of the grounding conductor will not occur.

To avoid overloading the electrical wiring, automatic overcurrent protective devices are provided in branch circuits. These protective devices consist of a fuse or circuit-breaker designed to open the circuit if for any reason the current becomes too high. The rating of the fuse or circuit-breaker is selected to correspond to that of the wire. If a fuse or circuit-breaker of too high rating is used, the wiring may become overheated to the extent of causing a short circuit and starting a fire.

The blowing of a fuse is a warning that some fault has occurred or that a circuit is overloaded. Before a blown fuse is replaced, the fault should be ascertained and remedied. A fuse of the proper rating may then be inserted in place of the blown fuse. To replace a blown fuse by one of larger rating or to replace the fuse by other metal which will not give the intended protection is to remove a very necessary safeguard. In order that fuses may give the intended protection, it is necessary that their integrity be rigidly maintained. The fuse is to the electrical installation what the safety valve is to a steam boiler. To render a fuse inoperative is taking a chance with life and property which is similar to tying down the safety valve of a steam boiler.

Fuse plugs of 15-amperes, the rating suitable for ordinary branch circuits, may be easily distinguished from those of higher rating by

their hexagonal shape. This may be a hexagonal opening in the cap through which the window of mica or other material shows, a hexagonal-shaped recess in the cap, or hexagonal impression raised or depressed on the (metal) cap. Fuses of ratings larger than 15 amperes do not carry such a hexagonal design.



2. HOUSEHOLD ELECTRICAL APPLIANCES

Portable cords

Cords to portable electrical appliances such as lamps, pressing irons, and fans, cannot, of course, be either out of reach or guarded by exterior metal covers. For this reason the insulation of such cords is more subject to deterioration by mechanical injury and moisture than fixed wires. These cords in general impose a greater shock hazard than other parts of the electrical installation. The use of such cords is one of the principal reasons for the grounding of circuits. Their use likewise makes the relatively low voltages for interior wiring essential. The manufacture of portable appliances for domestic use operating at more than 120 volts is negligible. For these appliances satisfactory protection is provided by the use of heavy fibrous or tough-rubber covers over the insulation.

These cords are adversely affected by moisture, oil, heat, and handling. Where any abrasion of the protective covering is noted, the condition should be promptly corrected. If the cord is kinked or sharply bent in handling, some of the cord strands may break and later pierce the insulating covering. Persons contacting these exposed strands may receive a shock. Cords should be made as short as convenient and where practicable located and used away from radiators or set tubs, kitchen ranges or sinks, bathroom fittings, cement basement floors, or other objects well connected with the ground, whereby a person touching the cord may become a part of an electric circuit and receive a shock. Where the surfaces are very damp and especially where the air may be moist with steam, as in bathrooms, kitchens, and laundries, the conditions are especially bad for the cord and permit more severe shock if the cord

is abraded or otherwise injured. For this reason, cords used in laundries, bathrooms, and similar places should have special waterproof coverings. A special type of cord is supplied for heating appliances. In general, in such places, the floor on which users stand should be covered with dry wood, rubber, or other insulating material, and caution should be observed in handling the cord. The National Electrical Code gives types and uses of flexible cord.

Lamps and appliances

The same general considerations that apply to the use of cords in various locations apply to the use of portable appliances in the same locations.

Members of the household using portable appliances should keep away from grounded objects. The use of such appliances by persons while in bathtubs or when likely to touch faucets, laundry tubs, kitchen ranges, or other grounded objects is particularly dangerous. The danger is greater for persons in bathtubs because the skin is wet and a large surface of the body may be in contact with the conducting water. Accidents involving electric shock under these circumstances may be expected to be fatal.

In nearly all cases where an electrical accident has occurred in the bathroom, the victim's body was wet. In most cases the person was in a bathtub. Under this condition he may have attempted to turn the switch of an electric light or appliance. In these instances the part of the switch, appliance, or socket that he touched was uninsulated and in contact with the ungrounded part of the electric circuit.

Electric fixtures in the bathroom should be controlled by a wall switch near the entrance door. Key sockets should not be used; ceiling fixtures are best. No electrical appliances which require handling should be used in the bathroom. To permit accessibility for aid in case of accident, bathroom doors should preferably remain unlocked.

Brass-shell sockets should not be installed in the basement or places liable to have damp floors if key sockets are used. Only porcelain or composition sockets should be employed under such circumstances.

Portable extension lamps are often put together by inexperienced persons, and records show them to be frequently involved in severe accidents or fires. Extension lamps should not be made up of twisted lamp cord and brass-shell sockets. They should be equipped

with a socket of nonabsorptive insulating material and the insulated conductors should be inclosed within an outer protective covering.

Electric-lamp bulbs become very hot when free ventilation is interrupted. Where these lamps come in contact with curtains, carpets, woodwork, or bedding, the use of suitable inclosing wire basket guards is essential. Such guards also protect the bulbs against breakage. Paper or cloth articles should never be placed in contact with lamp bulbs, and such materials should be used for lamp shades only if very liberal ventilating space is left between the shade and the lamp bulb.

Where it is necessary to make use of portable lamps or appliances in such places as a garage having a cement or earth floor, use a special type of portable cord containing an additional wire for grounding the frame or case of the appliance. Special types of plug and receptacle are necessary for the use of this cord which prevent insertion of the plug in the ordinary type of receptacle. The appliance or lamp may, therefore, be used only where the special receptacles are installed. Such receptacles are not usually installed in residences but are becoming common for use in factories. In some states they are now required for certain industrial installations.

A rather common hazard is the overloading of lighting fixtures by the attachment of portable appliances. Large numbers of electrical appliances are coming into use because of their convenience and intrinsic safety as compared with heating and power appliances depending on other forms of energy. Lighting fixtures are generally designed for supplying current to lamps, but not for supplying some of the larger appliances or several of the smaller ones. A single lamp socket rated 660 watts cannot be used with safety to supply a flatiron or toaster rated 1,000 watts. Use of a multiple outlet plug or similar device in a lamp socket provides an even greater opportunity for overloading.

Water heaters

There have been offered for sale portable immersion water heaters in which the current-carrying parts come into direct contact with the water to be heated. Ordinarily part of the current will flow through the water to the containing vessel and is a shock hazard to anyone placing his hands in the water or touching the container. The use of such types of water heater is not recommended.

To get quick results in heating water, a larger current is usually

needed than can be supplied by the ordinary branch circuit. Water heaters intended to be plugged in on such circuits should consequently be viewed with suspicion and should not be employed if rated at more than 15 amperes. Any appliance which does not have the rated current or wattage and voltage plainly marked should not be used.

Satisfactory water heaters of both the storage and instantaneous types are available for permanent installation, but these usually require a separate circuit to supply the needed high value of current.

Radio and television receiving equipment

In erecting an antenna, care should be taken to avoid contact with or crossing over or under electric power, light, telephone, or telegraph conductors. Contact between antenna wires and power conductors has often caused fatal shock.

During a lightning storm it is a good plan to disconnect outdoor antennas from the radio or television set and connect them to an effective ground. Information on grounding is contained in the National Electrical Safety Code. It is always necessary to have a lightning arrester connected to the lead-in wire from an outside antenna.

Before attempting to replace tubes or pilot lights in a radio set make sure the set is disconnected from the supply circuit by pulling out the plug supplying the set. Because of the high voltage circuits present in television equipment, repair or servicing should be performed only by competent persons.

Radio transmitting stations

Installations of amateur transmitting stations should be made only by competent persons familiar with local regulations and the rules of the National Electrical Safety Code. As therein required, radio transmitting equipment should be kept disconnected from the antenna system when not in use and the antenna effectively grounded. This can be done by use of a double-throw, single-pole switch outside the building. The antenna should not be attached to the radio apparatus inside the house during severe lightning storms.

Antennas used for transmitting should be carefully erected with poles or towers guyed in such a manner that they cannot fall even if the antenna wire should be accidentally broken. The following situations should be avoided in erecting antennas and guy wires:

(*a*) attachments to electric power, light, telephone or telegraph poles; (*b*) crossing over railroad tracks or public roads; and (*c*) crossing over or under electric power, light, telephone, or telegraph wires.

As some of the circuits in radio transmitting equipment present a serious shock hazard, construction or arrangement should be such as to prevent contact with these circuits during operation of the equipment.

Laundry appliances

Electrical appliances and machinery used in laundry work, such as washing machines, involve a special hazard, since they are frequently used in a damp place, such as a basement. Even when the laundry room is not permanently damp, water is likely to be spilled on the floor. A person standing upon a damp floor is especially liable to a severe electrical shock from contact with a live wire or machine frame, because a good conducting path to ground is thereby provided.

It is obvious that in laundries and places equally subject to dampness, exposed metal parts of motors or machines should not be permitted to become alive through any failure of insulation. There is an easy way to prevent this, and it is by making a positive connection to ground. Motors permanently installed are regularly grounded, but with portable machines this is not customary. If the portable laundry appliance is not provided with a grounding conductor in the cord (it will be marked with a green color), grounding should be provided by using a separate wire not smaller than No. 10 AWG, connecting one end to the frame of the washing machine and the other end to the nearest cold water pipe. A ground clamp is used for this purpose. If a grounding conductor is provided in the flexible cord, the receptacle used for its connection should be of the type to receive the attachment properly and should provide a reliable ground connection for the grounding conductor.

A motor-operated wringer should be equipped with a guard or with a device which will stop the motor or release the wringer in case one's hand gets caught in the wringer.

Electric toys

There are many electrical toys on the market, in the purchase and us of which certain precaution is necessary. These toys are most in evidence during the Christmas holidays. Their increasing use has brought about the development of devices for use on house-

wiring circuits to reduce the voltage of the house wiring to a safe voltage for use with toys and to avoid use of dry batteries. With alternating-current service small transformers are obtainable for accomplishing both purposes. With direct-current service it is impracticable to secure a truly safe supply for electrical toys. The dangers of shock and fire are always present. Before purchasing electrical toys, therefore, it is well for persons to ascertain whether their electrical service is alternating or direct current.

If alternating-current service is supplied, selection should be made of a transformer which is entirely inclosed in an iron or insulating case. Some now on the market have openings in the case for ventilation, through which fire originating in the windings may be communicated to combustible objects. The transformer should always be provided with a permanently attached, heavily insulated cord and an attachment plug for connection to receptacles. The transformer arrangement should be such that the high-voltage terminals are entirely inaccessible, and it is very important that the higher and lower voltage windings should be entirely separate, with no connection. If the purchaser is in doubt as to the safety of the device, it is always better to ask advice of the local electrical inspector than to run the risk of accident to one's family or home.

The purpose of the toy transformer with alternating-current service is to produce a voltage of 10 to 25 volts, suitable for toy operating, in place of the 115 volts used on the house wiring. If the transformer is properly constructed and connected, persons operating the toys will come in contact only with 25 volts while handling the secondary terminals of the transformer or the toys and their wire connections. Even though such a voltage is ordinarily harmless as regards shock, the current produced may be large. For this reason the transformer selected should preferably have a circuit-breaker in the secondary circuit which will prevent an excessive current in the toys or the transformer.

Temporary display lighting

Temporary display wiring, such as that for Christmas-tree lighting and other temporary decorative illumination in or about the house, should be confined to materials that are specially suited to such uses. Flexible cords with miniature or other sockets distributed along their length and festooned over trees or about rooms are particularly likely to suffer injury to their insulating coverings, and in some cases where the fittings are improperly designed the live

parts of the lamps or sockets are exposed to contact. Only cords having substantial protective coverings over the insulation proper and with both the insulating and the protective covering in good condition should be put into use, and careful inspection should be made from time to time during use to make sure that no injury has occurred that will be likely to cause either fire or life hazard. Some of the Christmas-tree lighting outfits now on the market, arranged with plug connectors to fit the sockets in the house wiring, have only a very thin insulating covering and are suitable for use only with low-voltage batteries, and not on house circuits. Outfits having thicker insulation and suitable for connection to house wiring are on the market and are listed by Underwriters' Laboratories, Inc.

Display wiring should, of course, be connected to the house circuits in a proper manner. For the larger displays this frequently requires the provision of special means of connection, which should be installed by a competent electrician. As soon as the display is permanently discontinued, it should be removed so that it cannot later be accidentally connected after it may have dangerously deteriorated.

The presence of decorations in the immediate vicinity of lamps and fuses is to be avoided. Cotton batting or other highly flammable material is dangerous because of high temperature when touching incandescent lamp bulbs. Tinsel and other metallic decorations frequently give rise to hazards by working their way into the live parts of the sockets. Insulating washers furnished around the base of the lamp serve to prevent this and should be retained when changing lamps. It is desirable that conducting metal decorations be kept away from electrical wiring and fixtures. If the electrical decorations are at all extensive, it may be advisable to have the installation inspected.

3. INTERIOR WIRING

The electric wiring of residences is usually designed for use at 110 or 120 volts on the branch circuits, but frequently twice this value of the voltage is supplied over the service conductors entering the premises. There is an economy in the supply of double voltage over three conductors which need not be gone into here but which makes this a common method of supply. A transformer is used to convert the high voltage distributed from the power plant to a low

value suitable for bringing into the premises. Since the insulation of a transformer may fail or the high-voltage wires in the street may come in contact with the low-voltage wires entering the building, it is necessary to protect the occupants of the building from the resulting high voltage. This is done by connecting one of the low-voltage circuit wires to the ground. Where water pipes are available, the grounding of the conductor is carried out by making a connection to the water pipe. In localities where there are no water supply pipes, a connection to ground is usually made by driving a pipe or rod into the soil and connecting the wire to it.

In cities which are supplied with direct current, the ground connection is not made upon the consumer's premises but is made at the power station where the current is generated. The requirements for the proper method of making grounding connections are given in both the National Electrical Safety Code and the National Electrical Code.

The wires used for electric circuits in buildings are provided with an insulating covering in order to confine the current to its proper course. In some methods of wiring, the insulated wire is enclosed in rigid metal conduit, flexible conduit, armored cable, metal molding, or metallic tubing. In other cases the wires are incorporated into a cable having a covering of material which provides mechanical protection and electrical insulation. In still other cases the wires are not provided with further mechanical protection but are carefully mounted upon insulators, either exposed or concealed in the wall spaces, to keep the wiring out of contact with other materials.

House-wiring installations will have the circuits made up of white wires and black wires. The white wire, which is the grounded conductor, is thus identified so that its polarity may be maintained throughout the installation past joints, switches, lamp sockets, etc., since it is important that single-pole switches be inserted in the black wire and that the shells of sockets be connected to the white wire. The grounded circuit conductor which is white should not be confused with the conductor used for grounding the frames of equipment which is green and which normally does not carry current. Fuses are not provided in the white grounded conductor nor the green grounding conductor.

The conductors within the building are connected to the service conductors through a main switch and fuses, and each branch circuit has, in addition, its individual fuse. The switches for operat-

ing lamps, motors, and other appliances are usually provided at the point of use.

Hazards in handling fuses

Before replacing fuses where any metal part used for carrying current can be touched, the switch in the fuse box should be opened to cut off the current. In many of the older house-wiring installations the disconnection of the circuit to make safe the changing of fuses can be accomplished only at the main switch to the building. This means that the entire building must be put out of service when only one circuit out of many needs attention. A more convenient arrangement is to have each fuse arranged with a separate switch, whose operation will disconnect it. Devices are now generally available which will accomplish the purposes of safety by inclosing both switch and fuse in a cabinet so arranged that the switch can be operated without opening the cabinet and the fuses are inaccessible until the switch has been opened. It is especially desirable that cabinets including fuses have no live conductors or parts of the fuse holders exposed to accidental contact when changing fuses.

Hazards of switches

Next to portable appliances, switches are the most handled portion of electrical equipment, and the live parts should consequently not be exposed to contact. In modern installations this is accomplished by the inclosure of switches under the flush plates of metal wall boxes with only handles or push buttons projecting, or by the use of snap switches with fiber-lined metal enclosures. Where snap switches are used in damp locations, and particularly in bathrooms, the covers should be of porcelain or other material not so likely to fail under damp conditions as is a fiber lining.

Switches should be placed in convenient locations. This is especially true of the main or service switch which is installed for the purpose of cutting off the building wiring from the source of electrical supply. This switch should be accessible at all times and stored material should not be placed so as to block access to it. When a house is to be left unoccupied for long periods, it is well to open this switch.

Making repairs and changes

It may be presumed that the original house-wiring installation has

been installed by responsible and competent persons and has been inspected to assure against defects which might cause life or fire hazard. Later changes or additions to wiring should be installed only by a competent electrician and should receive proper inspection. Householders unacquainted with proper electrical construction methods should never make such changes. Additions to the circuits may overload them seriously and involve the use of larger fuses than are safe. Changes may be made in such a way as to lower the insulation of the circuit and so encourage arcing or complete break-down of the insulation.

4. LIGHTING THE HOME

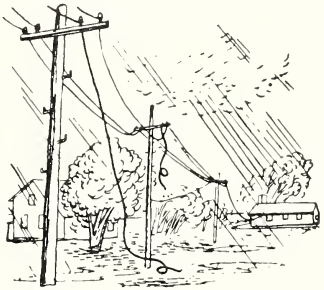
Good lighting in the home promotes safety; inadequate illumination may contribute to accidents on stairs, in working spaces, or elsewhere. Poor lighting may permanently injure the eyes, especially the eyes of children. It has been found that the majority of the homes in this country are not provided with adequate artificial lighting. Use of the eyes under poor conditions of lighting leads to eye fatigue, which can lead to eye strain and permanent injury to the eyes.

The essentials of good lighting consist of a sufficient intensity of illumination, a suitable distribution of the light, and freedom from glare. A sufficient intensity of illumination will be provided in the case of electric lighting by using the proper size and number of lamps. A proper distribution of the light will be determined by the location of the lamps and the reflecting character of walls and ceiling. To avoid glare bare lamps of high intensity should not be used nor should lamp filaments be exposed in the direct field of vision. The best way to obviate glare is to provide lamps with suitable diffusing shades. Glare is sometimes caused by the use of glossy paper, polished desk tops, and similar reflecting surfaces. Children should be cautioned against working where direct reflections are thrown into the eye.

Details of the planning of electric light installations can not be

gone into here. Suggestions as to the proper design may be found in "Recommended Practice of Home Lighting," published by the Illuminating Engineering Society, 51 Madison Avenue, New York 10, N. Y. (25 cents a copy). A reprint of this appears in the June 1945 issue of *Illuminating Engineering,* volume 40, pp. 339-372. Additional information can be secured from the leading lamp manufacturers.

5. OUTDOOR ELECTRICAL HAZARDS



Electrical wiring outside of buildings is either placed underground or is mounted upon overhead structures, such as wood poles or steel towers with suitable clearance from buildings, trees, and other objects and suitable separations of the several conductors.

Every householder can help eliminate a serious hazard by reporting to the electric-light company, or other proper authority, any wires which have fallen in the street or which have broken or sagged down so as to be within reach of pedestrians or vehicles. Contacts of conductors with trees are not so serious but even this should not be permitted to continue. Broken or sagging wires are most likely to be observed after heavy storms.

The reduction in the safe clearances of overhead wires constitutes the only danger to the public from such wires. They are responsible for a considerable number of fatalities annually. These occur from contact with fallen or broken wires, from unauthorized climbing of poles, from contact of other wires with the electric-power wires, and occasionally from some tall object such as a derrick being moved in the street where there is insufficient clearance.

The covering of high-voltage wires cannot be depended upon to supply sufficient insulation for safety, and no one should touch a high-voltage wire even though it is covered with such insulation.

The flying of kites near overhead wires has been responsible for a number of accidents, particularly where wire has been used as a kite string or where cotton string has become wet. Children should

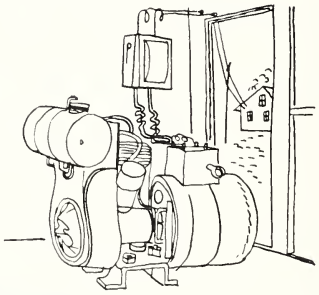
be instructed not to fly kites near overhead wires or to throw strings or pieces of wire over the power wires. They should also be warned against climbing of poles or trees near which electric wires pass.

Another frequent cause of injury has been the attempt to erect radio-antenna conductors in locations where it was necessary to carry them over electric light or power wires. Contact with the power wire by an antenna wire held in the hand subjects the victim to a severe and probably fatal electrical shock. Antenna wires should never be erected in the immediate vicinity of electric light or power wires.

Electric light companies usually trim trees near which their wires pass so as to avoid contact. With later growth of the trees such contacts frequently develop, and trees should be kept trimmed so as to avoid these contacts. Such a contact may rub the insulating covering of a wire until it is bare, and the wet surface of a tree during a rainstorm may be sufficiently conducting so that it becomes hazardous to touch the tree at any point.

Persons should also avoid touching wet poles that carry electric light or power wires. Such wires are usually mounted upon insulators, but during a storm the wire may come in contact with the pole or cross arm and if the pole is wet the current may be conducted to a person touching it near the ground. Contact with the guy wires which support poles should also be avoided, since live wires may also sag against them during a storm.

6. PRIVATE ELECTRIC LIGHTING PLANTS



Household generators and batteries

Electric energy for use in the household or on the farm is usually obtained from the distribution circuits of electric-lighting companies where these circuits are available. However, farmers and others to whom energy from the distribution circuits of lighting companies is not available frequently install isolated power plants. It is desirable to locate these plants in a separate building or inclosure rather

than in the house, barn, or other principal building, because they involve the use of a gasoline or oil engine together with an electric generator.

Where oil or kerosine engines are used for private plants the hazard may be less than with gasoline engines of similar capacity. The mixture of gasoline vapor with air is very explosive and may be ignited easily by lanterns, matches, or flashes caused by open electrical switches used with a power plant. If a private plant is placed in the home or other main building, the character, amount, and storage of fuel deserve very careful consideration.

Power plants of this type installed by persons on their own premises have increased in number very rapidly in recent years. The fact that such plants are scattered and are seldom within any regular inspection jurisdiction may tend to encourage careless installation. It is consequently necessary that careful attention should be given to secure proper equipment and proper installation.

When the proper precautions are followed, an electric plant is much safer than an acetylene or gasoline lighting plant. The use of electricity also permits the application of electric power to operate washing machines, churns, water pumps, etc. A water system within the house provides means for extinguishing a fire before it gains much headway. Power available for pumping is thus an added element of safety.

It is customary to provide small electric lighting plants with storage batteries. Frequently storage batteries are used only as a means of starting the engine. Where storage batteries are used, a few precautions should be observed. Metal objects should not be placed on the shelves or over a storage battery where they are likely to fall across the connections and cause a spark or a large local current. Batteries should be placed in a light place where they are easy of access and where they will be well ventilated. It would be preferable to have all cells inclosed were it not for the fact shown by experience that inclosed cells do not receive proper attention.

115-volt systems

When a 115-volt private power plant is used, the wiring will not be different from that ordinarily installed for use of 115-volt public utility service.

30-volt systems

It is not uncommon for small lighting plants to operate at about

30 volts, chosen because a storage battery having only 16 cells is sufficient. A system using this low voltage requires wiring especially suited to it. Since the wiring in the ordinary city house is installed for a system using 115 or 120 volts, the rural owner must make sure that the electrical contractor who does the work is informed as to the voltage and kilowatt capacity of the plant and proper methods of installation. He must not permit the fact that it is possible to use cheaper materials to lead to an inadequate wiring system. The owner should require that the completed job pass inspection by a regular electrical inspector.

The 30-volt system, in contrast to 115-volt system, involves little danger from electrical shock in case of accidental contact with the wires. The low-voltage system has the disadvantage, however, that in order to supply the same amount of power to lamps, motors, or other current-consuming appliances, a larger current is required than for a 115-volt system. There is a fire hazard connected with both which may be reduced to a minimum by proper installation by competent persons supplemented by inspection.

The 30-volt system can be made safe if certain precautions are followed. Since larger currents are employed when the voltage is smaller, the conductors must be larger to carry this larger current. A system for 115 volts uses smaller current and smaller wires, and such wires would not be satisfactory for a 30-volt system. Larger wires and accessories mean a more expensive wiring installation.

It must be remembered also that while the low-voltage system will be satisfactory for operating lamps and motors which are properly installed and connected, it is not safe to connect heating appliances, such as electric toasters, coffee percolators, and flatirons, to the sockets which have been installed for lamp connections. If it is desired to use such heating appliances in the house, it will be necessary to install special separate circuits using a size of wire and outlet fittings capable of handling the desired current.

Lighting fixtures should be obtained which are wired with a size of wire not smaller than No. 16. Except in fixtures, no wire smaller than No. 12 should be used with a 30-volt system. If the equipment, including switches, sockets, and ordinary lighting fixtures, is of the kind which would be installed for a 115-volt system, there will be a serious fire hazard if appliances are connected to the fixtures.

In view of the conditions just outlined, installers of private plants should give serious consideration to the advisability of in-

stalling 115-volt plants. This will permit the installation of less expensive wiring and equipment in the building. It will also have the advantage that if commercial service later becomes available such service may be utilized without change in lamps or heating appliances. With a 30-volt system, it will be necessary to secure new lamps, etc., suited to the higher voltage.

Since the lines of most electric lighting companies are supplied with alternating current, it will be necessary to secure new motors regardless of voltage, unless the motors are of the universal type.

The fact that farm houses are usually isolated so that they do not have the benefit of public fire protection makes the minimizing of the fire hazard a prime consideration. The lack also in such locations of regular inspection service throws a greater responsibility upon the householder for making a selection of equipment which will be least likely to involve any fire hazard.

When the power plant is finished, the owner should have an inspector check it. The owner should also require that the conductors be properly fused with respect to their carrying capacity.

7. SUMMARY OF PRECAUTIONS

Each year people are killed or injured or fires are started by improper use of electrical equipment. The following list of precautions should serve to prevent many of these electrical accidents.

1. Never touch interior live metal parts of sockets, plugs, or receptacles used to carry current. In handling electrical devices use insulating handles provided for that purpose.

2. While in damp locations such as bathrooms, toilet rooms, kitchens, laundries, or any place with damp floors and where there are stoves, heaters, steam or hot-water radiators, or pipes which may be touched, avoid touching any metal part of a lamp socket, fixture, or other electrical device because it may accidentally be alive. While in a bathtub never touch any part of an electric appliance cord or fixture.

3. Avoid touching bare or abraded spots on flexible cords attached to electric lamps, pressing irons, or other portable appliances. Handle all cords carefully in order to avoid injury to their insulation. Do not hang them on nails or over fixed wires. Always have them replaced when any injury to insulation is observed. Where toasters, fans, pressing irons, or other appliances are moved about so that cords receive more or less hard usage, use only cords

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with heavily reinforced coverings to protect the insulation. In damp places use only cords having a heavy waterproof outer or insulating covering.

4. In buying any cord or portable appliance, inquire whether it has been inspected and approved by the proper authority.

5. After using portable heating appliances, especially pressing irons, turn off the current before leaving them.

6. If combustible materials are used for lamp shades, be sure they are not in contact with the bulb. Provide portable hand lamps with substantial wire guards.

7. Open the circuit before attempting to replace fuses. Lighting circuits should be protected by fuses rated at not over 15 amperes.

8. Do not touch a wire which has fallen in the street, but warn others to keep away and notify the city electrical department, the power company, telephone company, or other owner. Overhead wires with a protective covering should be treated like bare wires because the covering soon deteriorates.

9. Avoid touching the guy wires used to anchor poles to the ground or the ground wire run down wood poles. During and after storms do not touch wet poles.

10. Avoid contact with overhead electric wires. Never climb a pole or tree near which electric wires pass. Never raise a metal pole or other conducting object so that it comes in contact with electric wires. Warn children against flying kites near overhead electric wires.

11. Never touch a person who has been shocked while he is still in contact with the electric circuit unless you know how to remove him from the wire, or the wire from him, without danger to yourself. Have someone immediately call the nearest doctor and the lighting company.

Use a long dry board, a dry wooden-handled rake, or broom to draw the person away from the wire or the wire from him. Never use metal or moist objects.

12. When a person, unconscious from electrical shock, is entirely clear of the live wire which caused the injury, do not delay an instant in attempting to revive him. Use the method of prone-pressure resuscitation explained in chapter 11, section 4.

4. FIRE HAZARDS

Fire under control is man's best servant. Uncontrolled, it can in a short time not only destroy property values that will require years to replace, but also take a toll in lives and cause injuries and damage beyond evaluation or restoration. According to the estimates of the National Fire Protection Association, fires in the United States take an average annual toll of nearly 13,000 lives. Such terrible deaths are unnecessary.

Table 8, p. 188, lists the causes of the loss of life in fires in which 18,592 lives were lost during a 15 year period. That tabulation includes only fires in the United States reported to the National Fire Protection Association's Department of Fire Record and is a typical sample representing about 10 percent of the estimated total fire casualties. The volume of data, however, is sufficient to draw conclusions as to the relative importance of the various causes of loss of life in fires. The table showing the loss of life by fire has been prepared to show the actual cause of the loss of life; which is not necessarily the same as the cause of the fire. In many fires the cause of the loss of life is not immediately related to the original cause of the fire; in the case of people trapped in a burning building the result may be the same irrespective of whether the fire

started from careless smoking, from a defective heater, or from spontaneous ignition of oily rags.

Table 9, p. 189, lists by occupancies, the estimated distribution of fire losses in the United States for a 5-year period. Attention is called that the number of fires in dwellings during that period is about 56 percent of the stated estimated number of fires and that the loss because of such fires is about 28 percent of the total estimated fire loss.

Table 10, p. 190, lists by causes the estimated distribution of the fire losses in the United States as given in table 9, p. 189. Attention is called that most of the fire causes given in table 10, p. 190, are those which undoubtedly are responsible for many fires in dwellings.

The estimates given in tables 9, p. 189, and 10, p. 190, show clearly that the hazard of injury or death by a fire in the home is as great or greater than that in a public building, a mercantile establishment or in a manufacturing plant. Every individual should realize that death, injury, and loss of property by fire are wholly unnecessary and can be prevented by control of fire hazards, by provisions for prompt detection of fire, and for escape from burning buildings, and by the exercise of elementary precautions which may be observed if everyone would keep the danger of fire constantly in mind and never forget to take reasonable precautions for personal safety.

1. BONFIRES

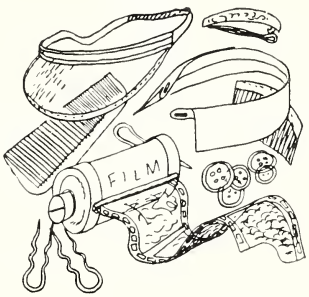
It is common practice to dispose of combustible rubbish, such as discarded papers, dry grass, etc., by burning it. It is also a common practice which should be prohibited for children to burn wood and other combustibles for the fun of seeing the blaze. Children are attracted by the flames of bonfires and often do not realize the hazards of them; and they may become too venturesome, fall into the fire, and be fatally burned; or their clothing may be ignited with serious results. Great care should be exercised when adding fresh fuel to a bonfire or when stirring up the fire.

Rubbish, waste paper, and other combustible materials should be burned in open metal containers placed on bare ground at a safe distance (50 feet if possible) from buildings and combustible materials. Bonfires should not be started on a windy day. They should be kept under careful supervision in order to reduce the hazard of

flying sparks which may settle on dry grass, leaves, etc., and ignite them. Bonfires should never be left to "burn themselves out" nor should they be left unattended. Care should always be taken to make sure before leaving the scene of a bonfire that the last spark has been extinguished and that the area surrounding that of the bonfire has been thoroughly soaked with water.

Dried grass, brush, or leaves should not be permitted near the house or other buildings, particularly where there is danger from grass or brush fires. A clear space of 50 feet will afford reasonable protection where the hazard is not great. Firing the grass or brush outside of a fire break in the path of an oncoming fire will increase the protection afforded by the fire break. When a house is exposed to fire in a neighboring brush, woods, or building, a close watch should be kept to prevent flying firebrands from igniting combustible roof coverings.

2. CELLULOID AND SIMILAR MATERIALS



Pyroxylin plastic consists chiefly of nitrocellulose and camphor and is used in the manufacture of numerous household objects such as combs, hairpins, eyeshades, buttons, toilet articles, photographic film, toys, ornaments, and decorations of various kinds. One common trade name of this material is celluloid. Others are pyralin, xylonite, fiberoid, fiberloid, and viscoloid. Some are colored and others are nearly transparent.

These materials differ from guncotton and similar explosives in degree rather than in kind and under suitable conditions readily burn and may give rise to mild explosions. If heated somewhat above the boiling point of water, decomposition takes place so rapidly that ignition occurs. A hot curling iron or even the heat of a steam radiator, may be sufficient to cause ignition of these materials. Many persons have been seriously burned while wearing celluloid articles such as combs, eyeshades, etc., when lighting matches, smoking, or working about open fires. Therefore, celluloid

and other pyroxylin plastic articles should never be worn where there is a possibility of their being ignited.

The low ignition point of the above articles and their rapid rate of burning make them more hazardous than wood or paper. Also the products of decomposition contain highly toxic gases (oxide of nitrogen and carbon monoxide) that have caused many deaths.

Motion-picture, X-ray, and other photographic films on a nitrocellulose base have the same general composition as the materials mentioned above, and municipalities have enacted ordinances to regulate the use of such materials so as to minimize the fire hazard.

Acetate-cellulose motion picture and X-ray films present no greater hazard than wood or paper. The same is true of a number of cellulose, acetate-cellulose, and casein-base products, such as cellophane, cellit, cellon (charmoid), transol, erinold, and karolith.

3. CHIMNEYS, FLUES, AND FIREPLACES

Regular cleaning of chimneys, flues, and fireplaces, especially where wood or bituminous coal is burned, is essential to safety. The burning out of accumulated soot is dangerous, chiefly because sparks may ignite nearby combustible roofs, and the high heat of the burning soot may crack the flue lining or damage the chimney. Where the services of an expert chimney-sweep are not available for removal of the soot, some mechanical means in preference to chemical means is recommended. One mechanical means is by the use of a rope to lower down through the chimney, a brick wrapped in an old piece of carpet. Reliability of chemical cleaning has been questioned because so far no reliable authority has been found willing to vouch for the claims that salt, scrap zinc, and zinc compounds when thrown on a hot fire will produce fumes which will disintegrate the soot.

Chimneys and flues should be inspected at least once a year to make sure there are no defects such as falling out of mortar from

between the bricks, cracks, etc. Any defects observed should be corrected without delay. One method of test to detect cracks in chimneys or flues is to build a smudge fire in the furnace, boiler or fireplace and when the smoke is flowing freely from the chimney, close it tightly at the top. If smoke escapes at any place in the wall the chimney should be repointed or rebuilt as conditions warrant.

Quantities of paper, excelsior, and other light flammable material should never be thrown onto the flames in a fireplace because of the danger of the flames flaring out into the room. A close-mesh wire screen which completely encloses the front of the opening should be provided at all fireplaces to prevent sparks from flying out into the room onto rugs and other combustible materials and also to prevent such sparks striking persons or their clothing (see also chapter 10, section 3).

4. CHRISTMAS TREES

Fire is probably the most serious hazard associated with Christmas celebrations, because of the presence of so much combustible material in comparatively limited spaces, and of the numerous possible sources of ignition that are at hand. The Christmas tree itself, as well as the tissue paper and other flammable material with which the tree is often decorated and the larger quantities of tissue paper and ordinary wrapping paper that are usually strewn about the room after opening the presents furnish fuel for a sudden and intense blaze. The tree should be set up well away from the fireplace or any other heating device, and be firmly secured so that it will not be toppled over. Freshly cut Christmas trees, sawed off at an angle at least one inch above the original cut and stood in water will absorb a sufficient amount of water or reduce their extreme flammability for the few days the tree will be indoors. The water level should be kept above the cut surface during that time.

In selecting trimmings for the tree, ornaments made of celluloid, cotton, paper, or other highly flammable material should be avoided.

Attractive and highly colored ornaments are now made of glass or thin metal and decorations of this type can be used without fear of fire. Flake asbestos and powdered mica make an extremely natural looking snow, and these materials will not burn.

Lighted candles should never be used on Christmas trees. When lighted candles are arranged for decorative illumination, or are carried around the tree by children wearing highly flammable clothing, combinations are effected which often bring a sad ending to an otherwise joyous occasion. Removing a present from a candle-lighted tree may precipitate something else into the flame of a lighted candle. Drafts of air may cause ornaments or portions of the tree to sway directly into the flame of a lighted candle. A lighted candle dropped onto a floor covered with cotton may cause a very serious flash fire which will set the whole room ablaze within a few minutes. For safety's sake, if illumination is to be used on the tree, miniature electric lamps should be employed. The electric wiring on Christmas trees should be carefully installed by someone familiar with the hazards incurred (see also chapter 3, sections 2 and 3).

5. CIGARS, CIGARETTES, AND PIPES

The discarding of lighted cigars, cigarettes, and lighted tobacco from pipes without regard for flammable materials which may be set on fire has given origin to the expression that "every smoker is a fire hazard." Every smoker should exercise reasonable care in regard to sparks from lighted cigars, cigarettes, or pipes and to the disposal of such articles.

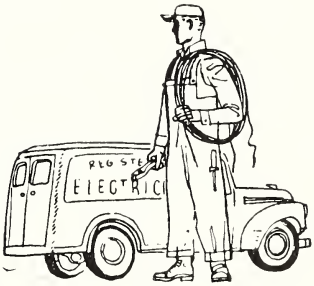
It is generally admitted that the ordinary cigarette is a greater fire hazard than is a cigar or pipe, because if it is laid down after being lighted, it usually will continue to burn until it is consumed, whereas, under the same conditions, a lighted cigar or pipe will "go out." However, lighted cigars are often carelessly thrown onto combustible material, and burning tobacco is frequently emptied into waste-paper baskets and other unsuitable places, with the result

that fires are started. The careless handling and disposal of smoking materials is one of the leading causes of fires in the United States.

Table 10 shows that during the five year period 1940-1944 the estimated loss because of fires due to smoking and matches was $128,350,000. The hazard is particularly serious in the home because so much burnable material is there and, though ash receivers are usually provided, they are not always used and as a result considerable sums are spent for repairing and replacing expensive rugs, stair and floor carpets, draperies, table linen, furniture, and other household articles because of the careless handling or disposal of lighted smoking materials.

There are certain places about the home where smoking should not be permitted under any conditions. These include barns, garages, and other places where there are materials which flash or burn readily. Smoking in bed is a decidedly unsafe practice. Attention is called to the fact that 293 or more than 20 percent of the 1,440 fatalities recorded in table 8, p. 188 as due to ignition of clothing or bedding, etc., were persons whose clothing or bedding was ignited by lighted smoking materials when those persons fell asleep while smoking.

6. ELECTRICITY



Electricity is one of the safest means of producing light, heat and power in the home when the appliances for its use are properly installed and handled with reasonable care. When a building is wired for electricity the work should be done by a competent electrician and in addition the work should be inspected by the local authority having jurisdiction. Inspection is also necessary when changes are made in wiring. Additions to circuits may overload the circuits dangerously.

The average person knows comparatively little about the dangers of electricity and too often takes chances which result in personal injury, damage to property, or both. The hazards will be greatly reduced if the householder will use only electrical equipment ap-

proved by competent authorities, will have it inspected from time to time, and will see that all electrical installation work, including repairs and alterations, is done by a competent electrician. Full and complete recommendations setting forth the precautions to be observed in the wiring of the home, and the use therein of electrical appliances will be found in chapter 3.

7. FIRE-FIGHTING EQUIPMENT

Fire-fighting equipment for the ordinary dwelling will usually be limited, by practical considerations, to portable hand apparatus. Principal reliance for extinguishing fires which have gained any appreciable headway must, of course, be placed on outside aid. When a fire occurs, the fire department, if one is available, should always be summoned without delay. It is, however, true that most household fires start from a small beginning and can in the majority of cases be readily extinguished before they have gained headway and before any considerable damage has been done or risk of personal injury has developed, if the proper means is right at hand and can be promptly applied. The prompt application of a little water or the use of blankets may readily extinguish a small blaze which might later have developed into a disastrous blaze. A partially filled pail of water may often be used effectively. A broom can be used to apply the water in a finely divided state, which is often satisfactory for extinguishing a fire and also may be used to bring within reach burning draperies or to beat out a small blaze. An ordinary garden hose with nozzle, kept where it can be quickly attached to a water faucet, is also an effective fire-extinguishing device for the area over which its length will permit its application. Attention is called that water should not be used to combat oil, grease, or electrical fires (see also section 12 of this chapter).

Portable Extinguishers

There are on the market portable hand extinguishers which are specially designed for first-aid fire-fighting, the effectiveness of

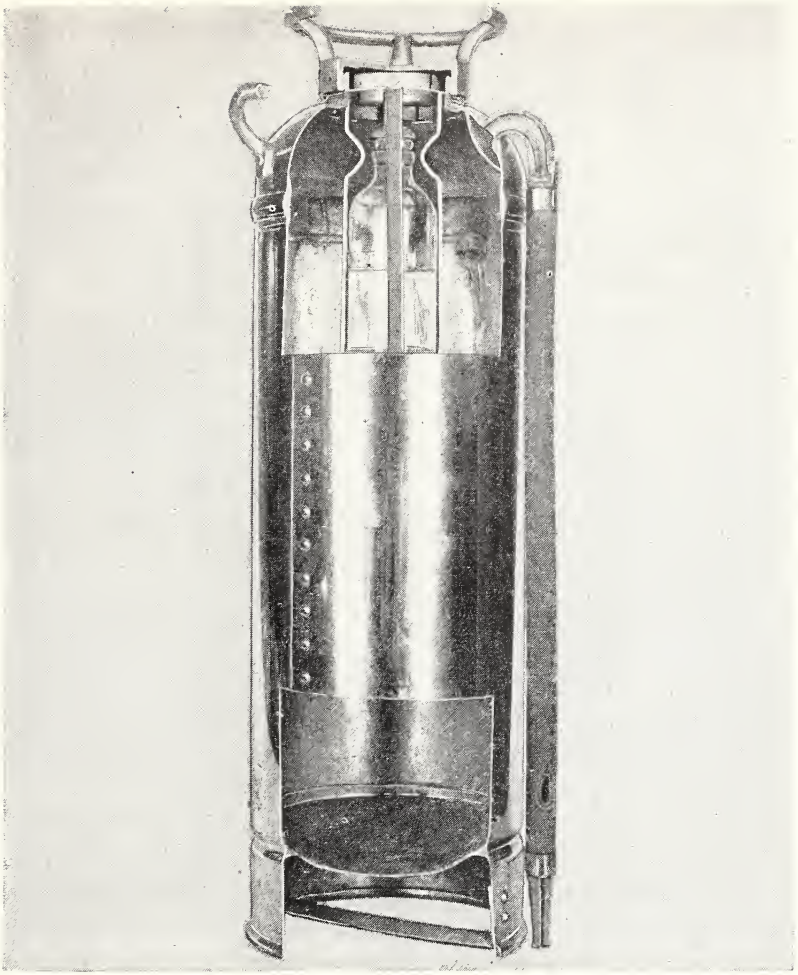


FIGURE 1.—*Cutaway view of a soda-and-acid fire extinguisher.*

which has been demonstrated by years of experience. They are much more effective than improvised means, as, for example, water thrown from a pail, blankets, or similar expedients, and have the added advantage that since they are intended for one purpose only these can be permanently kept in assigned places where they will be available when needed. It is, therefore, distinctly worth while to have one or more good portable fire extinguishers in every household.

In providing first-aid fire-fighting devices for the protection of the household it is of prime importance that the devices purchased

be reliable and be designed and constructed in accordance with recognized standards with regard to safety and performance, such as are defined in Federal specifications or those set up by the Underwriters' Laboratories, or other recognized authorities. Since it is usually not feasible for the householder to make adequate examination and tests, he will generally have to rely on the results of tests and approval made by others, as evidenced by inspection labels, certifications, or other forms of guaranty. In the case of Underwriters' Laboratories each extinguisher of a type which has been approved is marked with a distinctive inspection label. This label is usually in the form of a small brass plate attached to the extinguisher near the name plate or forming a part of the name plate itself. It is not intended to state that all fire-fighting devices which do not bear the Underwriters' Laboratories label are improperly designed and constructed, but that the presence of this label provides the purchaser with a simple means of assuring that a given extinguisher has been built in accordance with recognized standards.

Portable fire extinguishers are suitable for combating three classes of incipient fires in the home. According to "Standards of the National Board of Fire Underwriters for the Installation, Maintenance and Use of First Aid Fire Appliances, as recommended by the National Fire Protection Association" those classes of fires are as follows:

(*a*) *Class "A" fires.*—Those fires in ordinary combustible materials (such as wood, paper, textiles, rubbish, etc.) where the quenching and cooling effects of quantities of water or solutions containing large percentages of water is of first importance.

(*b*) *Class "B" fires.*—Those fires in flammable liquids, greases, etc., where a blanketing effect is essential.

(*c*) *Class "C" fires.*—Those fires in electrical equipment where the use of a nonconducting extinguishing agent is of first importance.

The chart "Characteristics of Underwriters' Laboratories and Factory Mutual Laboratories Approved Hand Fire Extinguishers" (table 11, facing p. 190) gives in a concise manner essential information relative to approved hand fire extinguishers suitable for home use.

There has been a good deal of controversy about the toxic effect of the carbon tetrachloride used in the vaporizing liquid type of hand fire extinguishers. It is recognized that carbon tetrachloride

vapor has an anaesthetic effect and if subjected to high temperatures decomposes to some extent, forming toxic gases, including hydrochloric acid and phosgene. The National Board of Fire Underwriters standards named above contain the following caution:

"In using extinguishers of this type, especially in unventilated spaces, such as small rooms, closets, or confined spaces, operators and others should take precautions to avoid the effects which may be caused by breathing the vapors or gases liberated or produced."

8. FIRE-RETARDANT TREATMENTS

The safety of the household against fire may be improved by chemical treatments or coatings which reduce the susceptibility to ignition and the rate of burning of ordinary combustibles such as wood, clothing, curtains, and other textiles. However, it must be recognized that no chemical treatment or coating can make combustible materials the equivalent of noncombustible materials.

Treatments for Fabrics

Curtains, draperies, decorations and like fabrics for indoor use can be given a fair degree of flameproofness by immersing them in or spraying on a cold or lukewarm solution of 1 pound borax, 13 ounces boric acid in 2 gallons of water. The salts are soluble and the treatment should be repeated after every washing. To prevent scorching, the iron for smoothing the treated fabrics should be several degrees cooler than ordinarily used on cotton fabrics.

The above formula has been used with success on theater scenery and decorations, and on work clothing. Few colors are affected by it and the treatment has little effect on the appearance or feel of fabrics properly treated. The treatment may be slowly dissipated, however, through the effects of wear and volatility of the chemicals, and exposure of the treated fabrics to sunlight deteriorates both the strength of the fabric and the effectiveness of the treatment. For such clothing and household fabrics as receive only brief or infrequent exposure to direct sunlight and for which

flame protection is especially desirable, this treatment provides an effective measure, simple, and easily applied at home. It may be applied to any fabric easily wet with water and not damaged by the wetting. However, the treatment will have little value for coated fabrics which do not absorb water readily, and home application to many of the long-napped fabrics is not feasible because of the difficulty of restoring the nap. Many of the extremely flammable fabrics which have appeared in recent years fall in one or the other of these two groups. Cotton and rayon fabrics carrying unusually long or fine nap fibers are especially hazardous: the large surface area of the fibers, freely exposed to air, afford conditions ideal for rapid ignition and spread of flame. The chaps of certain cowboy playsuits, some brushed rayon and chenille housecoats, and certain combed rayon sweaters have been made of materials of this type. The extreme flammability of clothing made of certain coated fabrics has also caused serious accidents, and some of the light weight rayon nets used for veils, dresses, and trimmings burn with hazardous rapidity. Articles made of fur, wool, nylon, or weighted silk fabrics present little hazard.

Some degree of flameproofness or flame retardance can be given to starched goods by mixing suitable chemicals with the starch. One formula for flameproof starch requires 3 parts sodium tungstate, 2 parts borax to 6 parts dry starch. Other formulas will be found in the 1946 edition of National Bureau of Standards Circular C455, "Flameproofing of Textiles."

Of the more permanent treatments suitable for finer fabrics, the Perkin process is the oldest and most widely known. Cottons properly treated by this process retain much of their flameproof characteristics after a number of launderings, with little, if any, loss in strength. However, the process is rather complicated and difficult to apply and has not come into general commercial application in this country. Recently, several new processes have been developed for which very attractive claims of permanence and effectiveness are made. These were restricted to the use of the armed forces during the war and while their value for civilian fabrics is not yet well established, some of them show considerable promise. It is hoped that inclusion of reasonably permanent flameproofing in the regular commercial finishing of cotton and rayon fabrics may soon prove possible.

Reasonably successful fire- and weather-resistant treatments for duck and canvas to be used in awnings, tents, and similar arti-

cles which must withstand outdoor exposure, have been developed. Such preparations are well established and are available on the market. Some of these incorporate materials to improve the weathering properties of these goods and to make them resistant to mildew. Goods of this character which have been given treatment at the fabric finishing works will usually give better service than those which are treated after fabrication. These goods are fire, water, weather and mildew resistant. At least two producers make chemically treated flameproofed fabrics which have been approved by the Underwriters' Laboratories.

Treatments for Wood

According to publications of the National Fire Protection Association, the natural combustibility of wood may be decreased by impregnation with fire retardant chemicals or with fire-retardant coatings. Wood that is impregnated with an adequate quantity of fire-retardant chemicals will not usually support combustion. For interior work, combinations of ammonium phosfate and ammonium sulfate have been used as fire retardants. Other chemicals that have been used are ammonium chloride, sodium borate and zinc chloride. Most of these chemicals are soluble and would be washed out where exposed to the weather or when used on floors cleaned by washing. Certain materials when applied as coatings over wood provide some protection against ignition of the wood and spread of flame. The customary finishing materials for wood, such as ordinary stains, oil paints, varnishes, shellacs, and lacquers are of no particular value in protecting wood against fire and may even increase its combustibility. From a series of tests conducted at the National Bureau of Standards it was concluded that for inside use as much fire retardant effect can be obtained with flat wall paints, whitewash and sodium silicate as with a proprietary paint.

The most effective fire retardant coatings are themselves nonflammable and form a protective film over the wood that persists even at high temperatures or emits noncombustible gases that dilute the flammable gases from the wood. Their principal value from the standpoint of fire safety is that they check the starting of fires originating from small sources. They are not suitable for protecting against high temperatures for a long time.

Sodium silicate in its usual form is not permanent in effect. Sodium silicate solution is one of the most effective fire-retarding

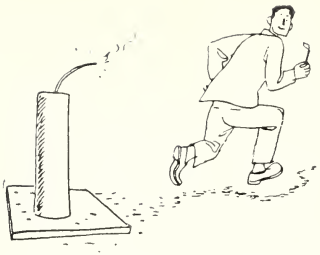
materials when applied as a coating but is not durable when exposed to damp conditions. Even in dry places it requires rather frequent renewal or application to maintain a good fire-retarding effect. Sodium silicate solution is made by diluting 1 volume of commercial water-glass solution (1.39 specific gravity) with 2 volumes of water.

Ordinary whitewash has fire retardant properties when first applied, but tends to flake off with age and frequent renewals are necessary. It withstands damp conditions somewhat better than sodium silicate. Different formulas vary somewhat, particularly with reference to their durability under damp conditions. In Bulletin 304b of the National Lime Association the following formulas for whitewash are recommended for wood surfaces exposed to the weather:

(*a*) Dissolve 12 pounds of salt and 6 ounces of powdered alum in about 4 gallons of hot water. Add one quart of molasses. Make a thick cream by thoroughly mixing 50 pounds (1 sack) of hydrated lime with about 7 gallons of hot water. Add the clear solution to the lime, stirring vigorously. Thin to desired consistency. Thirty-eight pounds (one-halfbushel) of fresh quicklime may be substituted for the hydrated lime. The quicklime must be carefully slaked and screened before use.

(*b*) Soak 5 pounds casein in about 2 gallons of water (preferably hot) until thoroughly softened (about 2 hours). Dissolve 3 pounds of trisodium phosfate in about 1 gallon of water and add this solution to the casein. Allow this mixture to dissolve. Prepare a thick cream by mixing 50 pounds (1 sack) of hydrated lime in about 7 gallons of hot water, stirring vigorously. Dissolve 3 pints of formaldehyde in about 3 gallons of water. When the lime paste and the casein solution are both thoroughly cool, slowly add the casein solution to the lime, stirring constantly. Just before using, slowly add the formaldehyde to the batch, stirring constantly and vigorously. Care must be taken not to add the formaldehyde too rapidly as that may cause the casein to jell, thus spoiling the batch. A cold lime paste produced by carefully slaking and screening 38 pounds (one-half bushel) of quicklime may be substituted for the hydrated lime. Do not make up more of this formula than can be used in one day.

9. FIREWORKS



Many kinds of injuries and fatalities are caused by the improper use of fireworks. Fingers and sometimes an entire hand are blown off by exploding firecrackers; toy powder-using cannon explode and pieces fly and destroy eyes; clothing is set on fire causing serious and often fatal burns. Skyrockets, bombs, roman candles, fire balloons, and many other kinds of fireworks that are chiefly used for display purposes have many possibilities for harm to both life and property. Even sparklers, which are commonly supposed to be harmless, have caused many serious injuries. Gunpowder, dynamite, chlorate of potash, and many other dangerous substances used in fireworks are unsafe for children to handle under any circumstances. As a safety measure it is a good plan to never allow children to handle or use fireworks unless it is done under the direct supervision of a mature and careful person.

After fireworks have exploded they sometimes smolder for a considerable period and are allowed to remain where combustible materials may come into contact with them and be ignited. Firecrackers are sometimes thrown onto wooden roofs, or into corners or other places containing combustible materials, and fires are started which may gain considerable headway before they are discovered. Many matches and glowing punk are used for lighting fireworks, and are sources of hazard. A child may light a firecracker with a match or glowing punk, and being startled by the rapid "sizzling" of the powder train or fuse, may quickly throw aside the burning firecracker, match, or punk in order to get rid of them. It is largely a matter of chance whether or not the burning match, firecracker, or punk burns the child's fingers, ignites his clothing, or sets fire to nearby combustible material.

Because of their explosive nature it is dangerous to leave fireworks either packed or unpacked, in a room with an open light or to strike matches or to smoke in a room containing fireworks. It is well to remember that powder grains sometimes shake out of fireworks packages during shipment and scatter around in the

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packing box. Such a box until it has been cleaned out is similar to an open powder bag. Care should be taken to unpack fireworks only in a place where they will not be exposed to accidental ignition for any reason. It is also well to remember that, when setting off fireworks, a few buckets of water at hand, or a nearby garden hose connected to a water pipe may serve to prevent a disastrous fire (see also section 7 of this chapter).

Although many cities and towns have adopted and endeavor to enforce regulations governing the sale and use of fireworks the final responsibility for the prevention of fireworks accidents to children rests upon parents as individuals and as members of a community. They should keep a careful watch over children when fireworks are being set off to make sure that every possible precaution is being taken to prevent an accident. Often parents can provide for their children safer forms of amusement and entertainment on the Fourth of July than the dangerous and ear-splitting firecrackers, powder-using toy cannon, and other explosive agencies. They can use their influence to secure public fireworks displays under safe conditions and they can work for the adoption and enforcement of State and local laws and ordinances which will effectively prevent the indiscriminate sale of fireworks and their use by children and other irresponsible persons and under unsafe conditions.

10. FLAMMABLE LIQUIDS

The improper use and handling of flammable liquids have resulted in serious and often fatal burns as well as large property losses. Strictly speaking, flammable liquids are not a fire cause, although often referred to as such. The hazards lie in the gases or vapors given off when flammable liquids are exposed to the air or subjected to heat. Those gases or vapors are combustible and when mixed with air in certain proportions are explosive. A spark or other minor source of ignition, which might otherwise be harmless, may cause a fire in the presence of flammable liquids. The hazards of flammable liquids may be avoided altogether in some instances by the substitution of nonhazardous liquids. For example, carbon tetra-

chloride, a noncombustible liquid with solvent properties similar to and, for some uses, superior to gasoline, can be used in many cleaning operations.

As combustible gases or vapors are formed when flammable liquids are exposed to the air, such liquids should not be used where there is a possibility of ignition for any reason. Also the places where such liquids are used should be ventilated by open windows or other means. Fires in combustible liquids may be extinguished by a chemical fire extinguisher or the flames may be smothered by the use of a rug or a heavy woolen garment, or by throwing dry sand or earth on the flames (see also sections 7 and 17 of this chapter).

Petroleum products such as fuel oil, gasoline and kerosene, paints and varnishes, and the oils, thinners, solvents, paint remover liquids, etc., are some of the common flammable liquids used in the average household. Classifications of the properties of flammable liquids and their gases or vapors will be found in the publications of the National Board of Fire Underwriters and the Underwriters' Laboratories, Inc.

Fuel Oil

Oil for fuel oil burners used in furnaces and boilers for heating dwellings should be of a grade which has a flash point of not less than 100 degrees Fahrenheit. The oil should also be a hydrocarbon oil free from acid, grit, fiber, or other matter likely to clog or injure the burners or the valves. The fuel oil should be one which tests and experience have shown to be suitable for use in the particular burner employed. A list of inspected oil burners issued by the Underwriters' Laboratories, Inc., gives for each burner listed, the minimum grade of fuel oil for which that burner is suitable.

Fuel oil supply tanks should be of metal and should preferably be located underground outside of the dwelling. The top of the tank should be below the level of the piping to which the tank is connected, to prevent discharge of oil by siphoning through a broken pipe or connection. The storage of fuel oil in tanks in buildings is permitted under certain conditions, such as that the tank be of metal, that a capacity of the tank not exceed 275 gallons, that the tank not be located above the lowest story, cellar or basement and not within 7 feet horizontally of any fire or flame. All supply tanks should be vented to the outside air and should be equipped with reliable liquid level indicators. The piping should be main-

tained in good condition, and be free of leaks and other defects (see also section 13 of this chapter).

Gasoline

The three terms, *gasoline, benzine,* and *naphtha* are applied to hydrocarbon liquids that from a fire and explosion standpoint differ only slightly. At low temperatures they give off highly combustible vapors or gases which form mixtures with air that are decidedly explosive. They are the most hazardous flammable liquids used about the home.

Washing garments, rugs, or other articles by immersing them in gasoline should never be done in the house under any circumstances because the gases or vapors may be readily ignited by a nearby stove or other source of ignition and because the friction of the garments being cleaned may produce a static spark sufficient to ignite the vapors or gases with serious, sometimes fatal, results. If gasoline is used for such cleaning, it should be used out of doors in a place where fresh air is circulating freely. It is less hazardous to use a nonflammable cleaning liquid such as carbon tetrachloride or, better yet, to send the articles to be cleaned to a dry-cleaning establishment where the hazards of any cleaning are clearly understood and where they are avoided by the use of special apparatus.

Using gasoline for starting fires is an all too common practice in some homes and is one which if persisted in will surely result in a serious if not fatal burn and perhaps a high property loss. A handful of small splinters of wood, a few wood shavings, or a few pieces of charcoal will start a fire equally well, and while they may not be so convenient nor so quick as gasoline, in obtaining results, the assurance of safety outweighs those objections. If local regulations permit the keeping of gasoline in the house the amount should be limited to one quart and it should be stored in a safety can located away from heat or other possible sources of fire.

Another common use of gasoline by members of a household is operation of the family automobile. Running the engine in a closed garage is decidedly hazardous because the carbon monoxide gas generated by the operation of the engine will eventually result in sufficient contamination of the air to cause severe illness or possibly death. Such contamination may not be noticed until it is too late because carbon monoxide gas is tasteless, odorless, and colorless. Therefore, it should be a hard and fast rule in all households that under no circumstances is the engine of the family automobile to

be run in the garage unless the windows and doors of the garage are open wide. What has been said about the danger from carbon monoxide poisoning from an automobile engine in a closed garage or room applies also to the operation of any device using gasoline as a fuel. For resuscitation of persons overcome by carbon monoxide gas, (see section 4, chapter 11).

Kerosine

Kerosine is used to some extent in homes for heating, lighting, and cooking. Although it is somewhat less hazardous than gasoline, the improper use and handling of kerosine has resulted in numerous fatalities and many disastrous fires. The supply of kerosine in the house should, if possible, not exceed 1 day's supply and should never exceed 5 gallons. The supply should be kept in a metal safety can in a cool place where it will not be a fire hazard.

The pouring of kerosine into a stove to start a fire or to rebuild a smoldering fire, or into the reservoir of an oil stove, lamp or lantern while the wick is lighted or the reservoir is hot, or while there is an open fire or flame in the room, is a hazardous practice which cannot be condemned too strongly. Too many persons have been fatally burned and too many homes have been destroyed by fire because of those unsafe practices.

Be sure that all parts of an oil stove, lamp, or lantern are in good repair and in proper working order before using them. Broken chimneys of oil lamps and lanterns are particularly hazardous. The wick should be of such size that it properly fits the wick holder. If the wick is too small, vapor in the reservoir may pass through the wick holder, be ignited by the burning wick and result in a fire or explosion. Care should be taken to make sure that lighted oil stoves, lamps, and lanterns rest on fixed supports in such a way that they cannot be easily knocked or tipped over. Care should also be taken to see that such lighted devices are not located near combustible materials. It is also important that lighted lamps and lanterns be located out of the reach of children, especially small children. Lighted oil stoves should not be carried from one room to another because of the possibility of stumbling, or of upsetting or dropping the lighted stove, thereby spilling oil which may be ignited by the burning wick. Lighted oil stoves, lamps, or lanterns should always be attended by a person who is both mature and reliable.

Paints, Varnishes, etc.

The spraying of quick-drying enamels, lacquers, paints, and similar finishes in the home has become a common practice and has created new home fire and explosion hazards. Pyroxylin lacquers, brushing lacquers and in fact most materials sold under the designation of quick-drying finishes contain amyl acetate, alcohol and similar liquids. These liquids give off vapors which are flammable and which when mixed with air in the proper proportions form mixtures which will readily ignite in the presence of a source of ignition such as a lighted pipe, cigar, or cigarette or a static spark. These vapors may even flash back to the person using the liquids at what seems to be a safe distance from a flame. This hazard may be guarded against by adequate ventilation. The application of these quick-drying finishes either by sprayers operated by hand or by those attached to vacuum sweepers should, therefore, be carried on out of doors if possible, so that the vapors will be quickly dissipated and carried away in the open air. If of necessity these liquids are used indoors, every precaution should be taken that no open flames, lights, sparks, or other sources of ignition are present and that all windows and doors are open. Smoking should be strictly prohibited at all times.

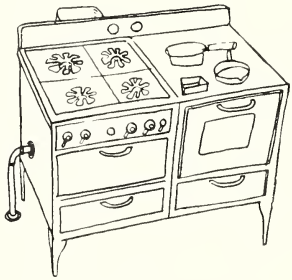
Liquids used for the removal of paint, varnish, etc., as well as all thinners used in connection with such articles also give off vapors which are flammable and explosive when mixed with air in proper proportions. What has been said above in regard to the presence of a possible source of ignition in the presence of paint, varnish, lacquer, and other flammable liquid finishes also applies to the liquids used in connection with them.

Since paints, varnishes, etc., their thinners and solvents are fire hazards, these liquids should be kept in closed containers well away from any source of heat or ignition. All rags, cloths, or other materials used in wiping up these liquids should never be allowed to accumulate but should be disposed of by burning out of doors well away from any combustible materials (see also section 16 of this chapter).

Miscellaneous Liquids

The majority of liquids used about the home for killing flies, moths, and other insects and for waxing floors, polishing furniture, stoves, etc., are flammable. Therefore, these liquids should not be used in the presence of a possible source of ignition such as an open flame,

lighted cigar, pipe, or cigarette, etc. Particular attention is called to the fact that stove polishes should not be usd on a stove that is not entirely cool. All of these liquids should be kept in closed containers located well away from heat or ignition. Cloths used in the application of floor waxes, furniture polishes, etc., should be disposed of by burning as recommended above for wiping rags and cloths for paint, varnish, etc.



11. GAS

The causes of fires that result from the use of gas are very similar to those that occur with other fuels. Gas appliances, in general, are so designed that if properly installed no danger of fire need result. Nevertheless the householder should remember that the gas flame is extremely hot and that the products of combustion carry away a large quantity of heat which may produce dangerous conditions if proper protection is not afforded, either by heat insulation or adequate spacing of appliances, flues, etc., away from wood, lath and plaster, and other combustible construction. Such protection is usually not expensive and there is no excuse for neglect of suitable precautions.

If gas be unmixed with air, it cannot under any circumstances be caused to explode. Therefore, the only danger of explosion comes with permitting mixtures of gas with air in such proportions that an explosive product results. Even when such explosive mixture is formed there is no danger of explosion unless a flame, electric spark, or some highly heated substance comes in contact with the mixture. However, the only safe practice is never to allow such a mixture to be formed (see also chapter 5).

12. GREASE

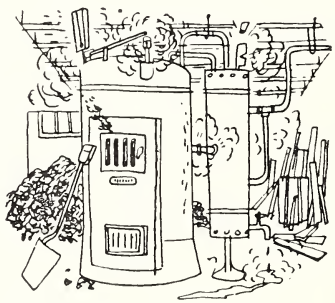
The combination in the kitchen of fire, grease, and flimsy garments worn by members of a household, constitutes one of the most serious household fire and injury hazards. Great care must be exercised when using grease and fat for cooking. Kettles of hot fat

used in deep frying should be watched closely, to see that the fat does not boil over. If the grease or fat in a frying pan catches fire, the flames often may be smothered by placing a metal cover over the container; or they may be extinguished with a fire extinguisher of a suitable type. If burning grease is spilled on the floor, probably the best way to put out the fire (if no suitable fire extinguisher is at hand) is to throw a heavy rug over the fire. Water should not be used in small quantities to combat a grease or fat fire because the water may cause the fire to spread or it may cause the burning grease or fat to spatter and seriously burn someone nearby.

Sometimes cookstoves and ranges are equipped with hoods and ducts for carrying off greasy vapors and heat. Such hoods and ducts should be substantially built of metal, with tight riveted joints, and well separated from all combustible material. Grease has a tendency to collect in such hoods and ducts. Therefore, as a fire prevention measure, those hoods and ducts should be cleaned out frequently.

It is advisable to keep a suitable fire extinguisher in the kitchen, for use in combating grease and fat fires (see also section 7, of this chapter).

13. HEATING AND COOKING APPLIANCES



Hot-air furnaces, hot-water heaters, steam boilers, and coal and wood stoves for heating and cooking are included in this classification. (Gas stoves and appliances are discussed in chapter 5. Electric stoves and heaters are discussed in chapter 3).

Providing proper insulation for heating appliances and allowing adequate clearance about them and about heating pipes and smoke-flues are important fire precautions. Furnaces and heating pipes should be completely covered with cellular asbestos or magnesia covering or other equally effective insulating material. Wooden joists over furnaces and boilers if close to such heating appliances should be protected by metal lath and plaster.

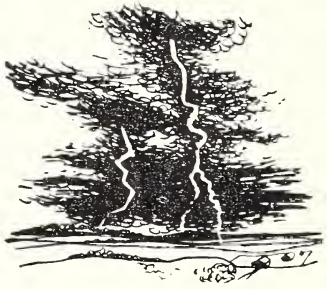
Many fires may be avoided by observing the following precau-

tions: Selecting stoves which have legs or supports providing air spaces of at least 4 inches if the stoves are to be placed on combustible floors; locating such appliances well away from combustible partitions or woodwork, and, where this cannot be done, placing screens to protect the adjacent woodwork; placing sheet metal or other noncombustible materials under stoves set on wood floors with the metal extending beyond the stoves at the front; having fireplaces and flues properly constructed and properly lined and pointed to prevent sparks from communicating fire to woodwork outside the flues; running stovepipes as far as possible from unprotected walls, floors, and other woodwork; and where pipes necessarily pass through combustible partitions, surrounding them with thimbles which provide air spaces about the pipes; where pipes pass into chimneys, surrounding the pipes with suitable flanges; frequently inspecting stovepipes to detect rust holes and open joints, and regularly cleaning out the pipes.

Modern heating appliances are usually provided with appropriate safety devices. These are highly effective but will not operate indefinitely without attention. Investigations made after explosions or fires have occurred often disclose that controls and other safety devices had become inoperative merely because of neglect, no attempt having been made to keep them in proper working condition. This proves the necessity for frequent inspections and for proper care and maintenance of all parts of the equipment. Regardless of the kind of fuel used and in addition to the mechanical and electrical safety devices that are provided with automatically controlled equipment, every steam boiler should have a safety valve and every hot-water boiler should have a relief valve. Such valves should be of the correct size and when accessible they should be raised from their seats frequently to make sure that they are not stuck and that they will operate as intended if the pressure in the boiler rises above that at which the valves are set.

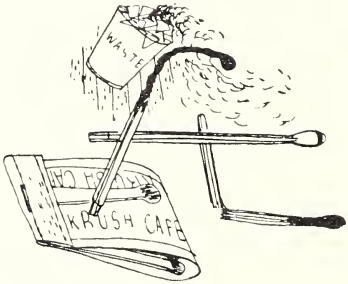
All solid fuels used in heating and cooking appliances should be kept stored in a neat orderly manner well away from the appliances. Housekeeping must also be considered, because even though the heating and cooking devices are set properly with relation to flammable floors, ceilings, and partition walls, careless persons often allow firewood, wooden boxes, paper, rubbish, and discarded combustible materials of various other kinds to accumulate where they may be ignited by live coals, hot ashes, radiated heat, or actual contact with the heating or cooking appliances. Metal ash con-

tainers should always be used. Many fires have resulted from the too common practice of depositing hot ashes and possibly live coals in wooden boxes and barrels, and in paper and other flammable containers. Fires are sometimes caused by depositing hot ashes close to wooden buildings (see also section 10 of this chapter and section 3 of chapter 10).



14. LIGHTNING

The hazards to life and property due to lightning and the methods of protection are considered in a separate publication entitled "Code for Protection Against Lightning," National Bureau of Standards Handbook H40. The percentage of fires due to lightning is very much less in rodded than in nonrodded buildings. Whether the rods are of copper or iron makes little difference; the important point is proper installation including location and grounding. The lightning protection system should be inspected at least once a year and particular attention should be given to the rods at the points where they enter the ground. It is there that corrosion of the down conductors is most likely to occur. Mechanical injury to the rods also most frequently occurs at or near the ground (see also chapter 6, and chapter 10).



15. MATCHES, OPEN FIRES, AND LIGHTS

Matches

Like oil, fireworks, and many other highly flammable substances, matches cause disasters and deaths through incautious handling. Every year many children are burned to death because they play

with matches, and set fire to their clothing or to household furnishings.

Two varieties of matches are in common use. These are the so-called "safety" matches which can be ignited easily by striking them on the specially treated surface on the box or folder containing the matches, and the "strike-anywhere" or parlor matches, which can be ignited by rubbing the heads against almost any dry object or material. Safety matches are safer than parlor matches, but care must be taken in their use. If the box or book is left open while striking a match a spark may easily ignite the matches in the box or book. Many painful experiences and scars result from handling those matches in this manner. Always strike any match away from the body instead of towards it.

Numerous fires have been caused by throwing burning or glowing matches into combustible wastebaskets or other containers in which there are flammable materials. Care should always be taken to completely extinguish matches after using them. A good practice to follow is to break a match in half after using it. A match cool enough to handle will not start a fire.

Matches should be kept in covered fireproof containers out of the reach of small children. Matches should not be carried loose in the pockets of one's clothing, because they may fall out and become ignited. Instances are known of where persons have been seriously burned because they carried loose parlor matches in a pocket and the matches have been ignited by friction when the carrier has accidentally struck the pocket against an object. Pocket match-safes of incombustible material are recommended for strike-anywhere matches; and to prevent the boxes from being crushed and allowing the contents to spill, covers of similar material should be used when boxes of safety matches are carried in the pocket.

In purchasing matches for household use, care should be exercised to secure a good quality. Many offered for sale have properties which render them undesirable. Among these properties are a tendency for the head to fly off, and afterglow following extinguishment of the flame. Well-made safety matches are recommended for household use. If this type is not obtainable, a parlor match whose head can be ignited only by friction of the extreme tip against any kind of surface should be chosen. Parlor matches and safety matches with strong splints and which have been treated to prevent afterglow are now obtainable and matches with these qualities should be insisted upon.

Open Fires and Lights

Sparks from fireplaces, stoves, bonfires and other open fires often set fire to nearby combustible materials. Every fireplace, Franklin stove, or other open fire in the home should be guarded by a metal screen. This is especially important when wood is used for fuel, because of the danger of flying sparks, and the likelihood of the logs or sticks of wood toppling over as those beneath them are burned through. Some kinds of wood, such as poplar, are much more likely to snap or pop and throw off sparks than others, and the use of such wood for open fires should be avoided as far as possible. Quantities of paper, excelsior, and other light flammable material should never be thrown onto open fires, because of the danger of the flames flaring out into the room or starting chimney fires. All flammable materials should be kept well away from open fires, and persons working about such fires should use every precaution to avoid contact with the flames or burning material. Children should never be allowed to play about an open fire (see also section 1 of this chapter).

Although, even in rural districts, electrical devices are rapidly replacing gas-lighting fixtures and appliances, portable gas lamps, ordinary candles, and kerosine lamps and lanterns, enough of those portable gas lamps, ordinary candles, etc., are still in use to produce an annual home fire loss of considerable amount. Proper installation and approved equipment are essential for safety where gas of any kind is used for illumination (see chapter 5).

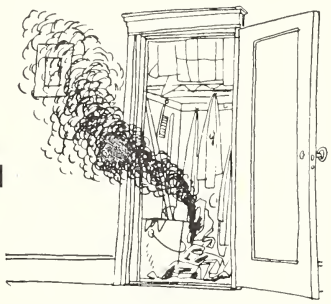
Candles are used principally for decorative purposes, and for emergency lighting when the electric-current is cut off. Great care should be taken to insert the candles securely in suitable holders or candlesticks, and to avoid placing them where there are drafts of air, or near flammable objects and materials. Never place lighted candles on window sills near shades and/or on Christmas trees.

Kerosine lamps should preferably be set low so that they will not be likely to tip over with ordinary handling, and they should have metal oil containers.

Lanterns should be of the best quality obtainable, their chimneys should be protected by wire guards, and they should be carefully handled. When using them where flammable materials are stored, they should be set down in safe positions or hung from suitable hooks.

Electric hand lamps (flashlights) should be used in preference

to candles, or ordinary lamps or lanterns, whenever it is necessary to carry lights about the home. Lighted kerosine lamps or lanterns or ordinary candles should never be left unattended or attended only by children.



16. RAGS AND RUBBISH, SPONTANEOUS IGNITION

Rags and Rubbish

Newspapers, paper boxes, packing cases filled with excelsior, and wrapping paper, discarded rags, etc., are sometimes placed in basements, attics and closets with little regard for the fire hazard but with the intention to remove them later. However, as time passes they are not removed and the condition becomes even worse as members of the household deposit more such things in the basement, attic, or closets. All such articles, because of the fire hazard, should be removed and disposed of in a safe manner. If the articles are disposed of by burning, this should be done in containers which are constructed of open metal work and which are placed out of doors well away from buildings, fences and combustible material (see also section 1 of this chapter).

Fires sometimes occur in households because of the spontaneous ignition of cotton waste, rags, etc., that have been used in wiping up linseed oil, or paint. Painting materials, if stored in the household, should be stored in closed containers in metal cabinets located away from stairways, combustible materials, and heat. (See also Spontaneous Ignition below.)

Vacant lots are sometimes allowed to become covered with accumulations of dried grass, weeds, papers and other combustible materials. Such accumulations should not be permitted since a fire started in them by children or in any other manner is likely to spread and get out of control or sparks from the fire may ignite nearby buildings.

Spontaneous Ignition

Spontaneous ignition, often erroneously called "spontaneous combustion", is a danger which is generally considered difficult to avoid.

However, in most instances ordinary care and good housekeeping will eliminate this cause of fires.

Oily clothing, rags, or waste thrown on the floor or put into closets may cause a fire from spontaneous ignition. Oily and greasy rags, particularly those which have been used with furniture polish or floor oil, or in wiping up linseed oil or paint, should either be kept in closed metal containers away from heat, or they should be immediately destroyed. Animal and vegetable oils are most likely to cause spontaneous ignition. Mineral oils are almost free from this hazard as they do not readily oxidize at ordinary temperatures.

Newly cut hay is a frequent source of fire and many barns have unnecessarily burned because the owners cut the hay too early or did not cure it properly before putting it into the barns. In the barn ventilation will often remove heat which would otherwise continue to increase and result in spontaneous ignition. Hay, as well as rags or clothing, is more likely to cause trouble by spontaneous ignition if in thick layers, especially if the material has been damp.

17. SUMMARY

Fire Cautions

The following suggestions are intended as a general guide for the householder for the prevention of fire in the home.

(*a*) Keep matches out of the reach of young children. Teach children the dangers of playing with fire.

(*b*) Do not throw away cigars, cigarettes, and matches without first making sure they are extinguished.

(*c*) Do not allow accumulations of combustible waste materials in or near the house. Without them fires from carelessly discarded materials would be less frequent.

(*d*) Keep chimneys and stovepipes clean with all joints and connections tight. Provide separate metal cans for ashes and rubbish. Never mix the two.

(*e*) Place substantial fire-resistant guards in front of all woodwork close to sources of heat.

(*f*) Keep greasy and oily rags in tightly closed metal cans provided for the purpose.

(*g*) Avoid the filling of lighted lamps. Avoid the use of kerosine to start fires in stoves, etc.

(*h*) Do not use gasoline, naphtha, or benzine for cleaning. Use

some of the safer solutions now obtainable and these, in any considerable quantity, only out of doors and during the day.

(*i*) Keep all open flames away from gas leaks. Explosive mixtures of gas and air are quickly formed at such places, and they only need a lighted match or taper or a spark to cause disastrous results.

(*j*) Avoid hanging curtains and other draperies near gas jets or other open flames. Remember that the draft from near-by windows may cause fires to spread and make them difficult to extinguish.

(*k*) Avoid toy wax candles. Each year a number of deaths of children and adults are due to placing candles on Christmas trees.

(*l*) Avoid placing articles made of celluloid, pyralin, xylonite, fiberoid, viscoloid, and similar materials, such as collars, combs, toilet articles, etc., upon or near sources of heat, as they are very likely to catch afire. Also remember that articles of the above materials should not be worn in the hair as they may readily catch fire and seriously burn the wearer.

(*m*) Permit only experienced persons to install or repair electrical fittings and appliances.

(*n*) Never leave unattended lighted heating or cooking appliances, particularly kitchen ranges and stoves, flatirons, toasters, waffle irons or other equipment of a similar nature.

(*o*) Make sure that when you burn refuse that you do so out of doors in a metal container well away from any building and also be sure that when you leave you have extinguished all smouldering embers.

What To Do In Case of Fire

Each member of a household should understand how to send in a fire alarm to the fire department. In many cities the fire alarm may be sent in by telephone or from a street fire-alarm box. Some cities require that the alarm be sent in by telephone, and others require that a fire-alarm box be used. Seconds count at the time of a fire, the proper method should be definitely known, and used.

If sending in a fire alarm by telephone is required or permitted, the telephone number of the fire department should occupy a conspicuous and permanent place at each telephone or telephone extension in the home. In giving information about a fire over the telephone one should carefully consider what he is doing. What the fire department wants and should know is (*a*) the number of the house, (*b*) the name of the street or road, (*c*) the nearest street

corner, and (*d*) the number of the telephone from which the call is made. A few seconds lost in doing this are not wasted.

If sending a fire alarm from a fire-alarm box is required or permitted, the location and method of use of the nearest fire-alarm box should be definitely known. Also if such a method is employed, some one should be stationed in the vicinity of the fire-alarm box or along the route of the responding fire department company to direct it to the fire.

Saving the lives of the occupants of a building on fire should receive first consideration. Many lives have been lost in attempts to put out fires or to save personal belongings.

In case of fire:

First: Collect your thoughts. Keep your mind on what you are doing. Act quickly.

Second: Unless you are *very sure* that you can handle the fire without help, notify the fire department or have someone else do this. Many have been sure until *too late.*

Third: Summon help if anyone is within calling distance.

Fourth: If the blaze is small and you think you can put it out by devices which are available, either

(*a*) use a suitable fire extinguisher, or

(*b*) use a woolen blanket or rug to smother the fire. Keep the air from the fire. Or

(*c*) throw water from a garden hose on the fire if such a hose is available. If it is not, throw water from a pail using a dipper or a broom. *Do not use water on an oil or grease fire;* use sand or earth from flower pots. Water, especially in small amounts, will cause spattering of burning grease.

(*d*) Beat down any draperies, curtains, or light materials causing the blaze, using a wet broom or a long pole. Using the bare hands may result in serious burns.

Fifth: Tie a wet towel or any other material (preferably of wool) over the mouth and nose if you are fighting the fire and are exposed to smoke or flames. More people lose their lives by suffocation than through burning.

Sixth: Place yourself so that you can retreat in the direction of a safe exit without passing through the burning area. Unless you can do something worth while, get out of the building.

Seventh: If necessary to go through a room full of smoke, keep close to the floor and crawl on the hands and knees, having covered the mouth and nose with a wet cloth. The drafts and currents

cause the smoke to rise and the air nearest the floor is usually the purest.

Eighth: If you have to retreat and all occupants are out of the building or burning portion thereof, cut off the draft by closing doors and windows.

Ninth: Do not jump from a high window unless into a life net. To use a rope or life line twist the rope or life line around one leg and, holding the feet together, regulate the speed of descent. Otherwise the hands may be painfully injured by friction with the rope or life line, especially if the height is great. Sheets and other articles of bedding will often provide a life line if knots are carefully made so that they will not slip. An extra loop in the knot may avoid this danger. Tie the rope or life line to a bed or other article of furniture which will not pull through the window. The rope or life line should not be thrown out of the window until the instant it is needed. Getting out from an upper story onto a porch or veranda has saved many lives. Such action also affords temporary relief from smoke and heat and also attracts rescuers.

Persons with clothing afire.—When a person's clothing catches fire, the first consideration is that the flame or hot gases should not be inhaled.

If your clothing is on fire do not run, as running fans the flames and makes conditions worse. Smother the flames by wrapping yourself in a rug, blanket, portiere, or woolen coat and roll on the floor. While rolling on the floor call for help. If the article of clothing which is on fire can be easily stripped off, this should, of course, be done. If a shower bath or pail of water is handy, use it and then roll in the spilled water.

If the clothing of another person takes fire use measures given just above for when one's own clothing is afire. If the person is excited because of fear caused by the blazing clothing, it may be necessary to trip him to make him lie down. Then if water or a fire extinguisher is handy, apply it at once, being careful not to direct the stream from the extinguisher on the face.

After the flames of a person's burning clothing are extinguished and the clothing has been drenched with water, do not remove the clothing from burnt skin until an ointment is available to apply to the burn. Avoid tearing the skin.

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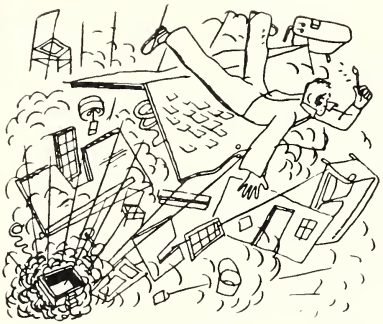


5. GAS HAZARDS

Like many other sources of energy, gas must be used carefully, for in careless hands it is a possible source of great danger. However, nearly all accidents with it are readily preventable by the observance of simple precautions. In fact, the householder should realize that gas when carefully and properly used is perfectly safe and that the user is almost invariably responsible for any fire or accident which may occur.

Several types of gas are used in American households. The more important of these are commonly classified in the gas industry as manufactured gas, natural gas, mixed gas (natural and manufactured), and liquefied petroleum gases (also popularly referred to as bottled gas) which are mainly propane, butane, or their mixtures.

1. TYPES OF GAS ACCIDENTS

In the utilization of gas in the household five kinds of accidents may happen: (*a*) Asphyxiation by unburned gas; (*b*) asphyxiation by the gas resulting from incomplete combustion; (*c*) burns to persons; (*d*) destruction of property by fire; and (*e*) explosions, which may or may not be accompanied by fire or injury to persons.

Asphyxiation by unburned gas, occurs only when manufactured or mixed gas is used, Natural gas and liquefied petroleum gas are

almost always practically free from poisonous constituents and are not likely to be breathed in sufficient quantity to cause asphyxiation by depriving one of oxygen. Asphyxiation by the products of incomplete combustion is equally serious in households using either natural or manufactured gas, and is by no means limited to gas-burning appliances. Wherever fuel is burned this hazard may exist. It will, therefore, be discussed with reference to the use of all fuels, liquid and solid as well as gaseous, in the last section of this chapter, which deals with carbon-monoxide poisoning and its treatment.

Many of the precautions given in the following sections are already familiar to nearly every user of gas, but the frequent recurrence of accidents from well-known causes shows warning is needed.

It is necessary that the householder not only carefully observe the precautions himself, but that he should also give careful instructions to all members of the household, including the servants and children, so that the fullest measure of protection may be offered.

Many hazards would be avoided if gas users would more frequently seek the advice and assistance which every gas company is glad to render. The employees of a gas company have vastly greater experience with the numerous problems which arise in service than does anyone else likely to be locally available for consultation. Usually the company has special facilities for dealing with every difficulty likely to arise; and it has as great an interest in safe and satisfactory service as the consumers have, for accidents and dissatisfaction seriously affect its business.

In particular, the gas company should be promptly notified in any case of serious trouble and should be consulted before any unusual change is made in the equipment used. No accessory made by one manufacturer for use with an appliance made by another should be purchased without the advice of the gas company.

2. INSTALLATION AND CARE OF GAS PIPING

Accidents from gas may be classified with respect to their origin into those resulting from leakage and those resulting from faulty application.

Much of the danger from leakage may be prevented if the house piping and connections are always maintained in first-class condition. When gas piping is installed see that the best materials are used by a competent workman and that the work is carefully inspected. This is particularly necessary in the case of the liquefied petroleum gases. The pressure under which bottled gas is usually delivered to the appliances is double that for manufactured gas; but in some systems, through design or accident, it is quite possible for the liquid fuel to get into a portion, at least, of the piping in the house, and pressures may then rise to more than a hundred times the usual pressure of city gas supplies. Sealing compounds often used in the joints of piping, particularly, a paste of white lead in linseed oil, are soluble in the liquefied petroleums and must not be depended on for tightness. In addition to the difficulty of retaining the gas, a small leakage of liquefied petroleum gas is much more serious than of manufactured gas because about one-fifth as large a volume is required to produce a flammable mixture and because the vapor is heavier than air, tends to accumulate at floor level, and does not escape readily from the room.

In all cases, but particularly where liquefied petroleum gas is used, piping should be run as directly and with as few fittings as possible.

There are certain details in the installation of the meter and the piping system which require special experience not always possessed by plumbers that do not make a specialty of gasfitting, and it is essential that all of the installation be made in a workmanlike manner and in accordance with the best practice, and that it be thoroughly tested for tightness after being installed.

Since details apparently trivial may be very important in insuring

both safety and satisfaction in the use of gas, the householder should not undertake to do the gasfitting or install appliances himself, unless he is certain that he understands exactly how the work should be done and has available the tools which are necessary for proper work. In many cities, ordinances are in force which forbid such work by anyone except registered or licensed workmen. The householder is especially warned against opening any plugged or capped outlets while the gas is turned on. To do so allows the escape of large quantities of gas, and a person may be overcome before the opening can again be closed, or the gas may become ignited.

If the householder finds any appearance of serious defects in the piping in his house, he may well ask the city plumbing inspector or the gas company to determine if the work is properly done and safe.

Certain defects can be detected readily and if noted should be corrected. For example, the pipe should be securely fastened in place so that the joints cannot be strained by movement of the pipe. The pipe should not sag or be bent in any way to permit a low point in which liquid could collect and partly shut off the gas. Grounding-wires of telephone equipment, electric light circuits, etc., should be connected to cold-water pipes rather than to the gas pipes.

Especially after repairs of leaks have been made, the householder should observe whether the nature of the repair is permanent or not. A permanent repair usually consists of a replacement, by a new part, of the defective portion of the system. Temporary repairs such as wrapping the pipe with tape or cloth bandages or the use of such adhesive materials as soap or wax, may be resorted to in an emergency; but such makeshifts should not be allowed to remain for any length of time, ordinarily not even overnight. The householder should insist that a permanent, first-class job be done without delay. Furthermore, old piping that is nearly rusted through should be promptly replaced before there is any danger of leakage, which usually occurs at the joints first, for it is there that the pipe is weakest and also most subject to rusting.

The gas fitter should be encouraged to use pipe of generous size which will insure an adequate supply of gas for satisfactory operation of present and probable future appliances. It costs very little more at the start to put in the larger pipe during the construction of the building, whereas later it may be very expensive to substitute the larger size needed to serve new appliances or even to give satisfaction with those already installed.

Gas piping should not be placed in outside walls or where stoppages may be caused by ice or liquids condensed from the gas during cold weather. This applies to piping for manufactured or natural gas and particularly for butane from underground storage. Piping for propane from above-ground storage is usually and preferably placed above ground, but it should be safe from damage by falling ice or other mechanical causes.

The house piping in basements is sometimes used as a support for clothes lines, and so severe a strain is put on it that breakage of the piping or leaks in the joints may result. The same results are likely to occur if wood, coal, or other material is piled against piping. Do not place the gas piping under strain by stepping on it; it is even more dangerous to try to change the position of an appliance by forcibly bending the pipe.

Have all cocks and valves so located that there is the least possible danger of opening the wrong one, or of accidentally opening one, as by catching the clothing upon it. Have all connections permanently made with rigid piping, if possible. If flexible tubing must be used, be sure that it is of the best quality and that the connections at the ends are always tight. Never turn the gas off at the outlet end of a piece of flexible rubber or metal tubing, leaving the gas in the tubing under pressure, but rather by a cock in the rigid pipe. Take every reasonable precaution to prevent children from turning on or playing with the gas cocks. Several styles of cocks which latch and cannot be opened without pressing or turning a release are available and can be obtained through the gas company. These are a valuable protection if children play near an appliance.

A gas valve which is fully opened by a quarter turn of the handle and which cannot be turned past the open or closed position is the safest type for general use. Sometimes a valve of this type, through wear or loss of a pin, no longer has a positive stop. See that such a valve is replaced or repaired at once. Valves should be well lubricated so as to turn smoothly, but should not be loose enough to turn without a distinct pull.

A class of valves that is definitely to be avoided is one that controls two burners, e.g., a main burner and a simmering burner of a gas range, if the valve goes through a closed position between the two open positions. Although these valves are commonly used only on appliances equipped with pilot lights, ignition of a partly opened burner through a tube leading to a distant pilot flame is

unreliable. If double burners controlled by a single valve are to be used, there is no reason why gas should not enter one burner before it is entirely shut off from the other.

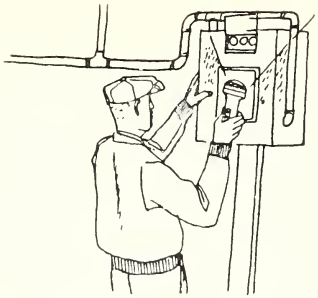
Flammable materials and rubbish should not be placed near the gas meter, since a fire in such material would be likely to melt the soldered seams of the meter or its connections and the flame of the escaping gas might greatly increase the extent of the fire.

The gas meter should never be tampered with or subjected to strains. It is generally one of the weakest parts of the piping system because it is usually constructed of light sheet metal and the breaking of its case will cause the escape of gas. The householder should, therefore, allow the company to install the meter where, in its judgment, it will be safe from mechanical strains, falling objects, and other harmful conditions such as excessive heat, cold, or moisture. Meters are frequently placed on shelves or other supports to take the weight off the connections. Such support should never be removed.

Sheet-metal meters should not be used with liquefied petroleum gases, which are best weighed or measured as liquids unless delivered as vapors to many customers from a central vaporizing station.

The installation of so-called house governors or regulators except those installed on the inlet side of the meter by the gas company, or those supplied as a part of the regular equipment of a house-heating furnace or other appliance requiring unusually accurate control, is seldom justified for residential service. The gas company is responsible for the delivery of gas to the user at pressures suitable for the operation of all ordinary appliances, and the obligation is usually met, often with the aid of governors. If the obligation is not met, the remedy lies in an appeal to the company or, if necessary to the proper public authority rather than in the purchase or rental by the householder of controlling devices which may do more harm than good. When expert service is regularly employed for the care of appliances, the use of regulators will, of course, be left to the judgment of the expert. No device intended to modify the character or control the supply of gas, other than a well-made governor, should ever be installed in the supply line without careful investigation and the approval of the gas company.

3. TURNING ON AND TURNING OFF THE GAS



The practice of some gas users of partially closing the shut-off valve at the meter is not advisable; it rarely or never saves gas and may unfavorably affect the operation of appliances already adjusted to give the most economical and satisfactory service. With adequate piping and open valves, the use of one appliance affects another scarcely at all, but if the meter valve is closed enough to affect appreciably the gas supply to one burner, the operation of another will reduce the supply available to the first, possibly to the extent of introducing a hazard from the flashing back or extinction of the flame. Even if there is only one burner on the line and it burns gas at too high a rate, the remedy is the adjustment or replacement of the burner orifice, not interference with the gas supply.

It is well, however, to know the location of the meter shut-off cock and to have a wrench handy with which to close it in case of necessity; but having once been shut off, the gas should not be turned on again by the householder. The gas company should be notified and requested to turn on the gas. This precaution is so important that in some cities even experienced gas fitters are not allowed to turn on the gas unless actually in the employ of the gas company.

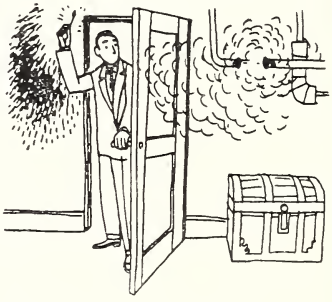
Whenever the gas is to be turned into the house piping, the householder should assist the gas company's representative in making sure that there are no gas burners open in any room before he turns on the gas. In case there are any rooms which can not be entered to make sure of this, he should not be allowed to turn the gas on.

It is a rule among gas companies that before one of their employees turns on the gas he must first examine every outlet to see that it is closed; after turning it on he must observe the meter to see whether any gas is flowing; he must then light a small burner and observe the meter to make sure that it is registering and

would have indicated any flow; and finally he must again visit every outlet to determine that the gas will burn there, and that the outlet is not left open.

One hazard to be particularly guarded against, is an "air pocket" left in the line; this would extinguish a pilot flame and subsequently permit the release of unburned gas from the main burner which depends upon the pilot flame for ignition.

Prepayment meters, once very common in the poorer sections of cities and in resort towns, are now fortunately almost nonexistent in this country. If one must be used and if the flow of gas has stopped, the householder should never put another coin into the meter until absolutely certain that there are no open burners.



4. LEAKS

Any leakage of gas, no matter how small, may be dangerous. Although the quantity of gas escaping may appear to be insufficient to cause asphyxiation or explosion, it is never possible to be sure of this without a chemical analysis of the mixture. Hence, one should never regard an air-gas mixture as safe, and when even a slight escape of gas is noted, shut off any equipment using the gas and immediately provide as much ventilation as possible.

"Manufactured" gases all possess distinctive odors. Strong, unpleasant scents are added to all liquefied petroleum marketed for domestic use, and much of the natural gas, but not all of it, is similarly odorized. Leakage of gas is usually first detected by odor, which is noticeable when the room is first entered even though the amount of gas present is very small. However, if a person for any reason remains in a room containing gas, he soon loses to some extent the ability to judge by the odor whether or not the air is heavily charged with it. Therefore, anyone who persists in staying in the room after the gas is smelled may in a little while not suspect that he is running any risk, even at the moment when he is on the point of losing consciousness. Even at the start it is difficult to

judge from the intensity of the odor how much gas is leaking. Therefore, it is never safe to disregard the odor of gas. The very first thing to do is to ventilate the room and then search for the leak, which will usually be at a gas cock or a joint in the connections. If this is quickly located by odor, sound, or by applying soap solution, and it is evident that the leakage is so small as not to permeate the room, no other precaution need be taken than the temporary use of soap to stop the leak and a notification to the gas company, so that a permanent repair may be made. Tubing that is cracked or that has loose ends, even though leaking very slightly when first noticed, should be put out of use immediately.

Never search for a gas leak with a match, candle, lantern, or with the aid of any other ordinary lighting appliance. Even the switch operating an electric light may cause a spark which will ignite an explosive mixture and thus cause disastrous results. Never try to locate the point of leakage by igniting the escaping gas, for unexpected "pockets" of explosive mixtures may exist, as between joists, beneath stairways, or close to the ceiling, and these explode without warning. It is safer to open the windows or take other precautions—in the dark, if need be—having someone outside the affected room on the watch to render assistance if necessary. Not only is there danger of explosion, but the use of a lighted match near a lead meter connection or at the soldered seams of a meter may cause a tiny unseen flame at a point of leakage, and this tiny flame may melt the lead or solder, causing a larger leak and eventually a serious fire.

If the odor of gas seems to permeate the room, and the actual leak cannot be located quickly, the gas may be coming into the room through the floor or walls, and in the basement or another room it may be even worse than it is in the room where it is first noticed. No time should be lost in extinguishing all flames or fire, in opening the windows, and in seeing that all persons who may be in the room are warned to seek a part of the house where there is no odor, or, if necessary, to leave the house altogether. These precautions should be taken on the bare suspicion that a serious leak may be present and before any investigation of basement or adjoining rooms is undertaken.

Do not wait for a second impression or for confirmation that the odor is not increasing or is dying away. Remember that the nose loses its sensitiveness in a short time in a gas contaminated atmosphere.

If on opening a door into the basement or an adjoining room, the odor there seems stronger, it is safer not to enter. If there is no fire or flame burning in the room, and if it is unoccupied, it is safer to close the door and leave the premises, if necessary, to wait until someone from the company arrives. If it seems important that the basement or room should be entered to extinguish lights or to rescue persons sleeping or unconscious, no light should be carried except an electric flashlight which should be turned on and off only outside the room; and a watcher should be stationed outside to summon aid in case the person who entered first should lose consciousness.

Gas sometimes travels for a considerable distance; it may be found at points far removed from the real source of leakage. Gas in dangerous quantities may pass through the foundation walls of buildings, as from the street under frozen ground into the basement, or from the basement of an adjoining building, and also through party or partition walls, and through floors, as from the basement to first floor rooms.

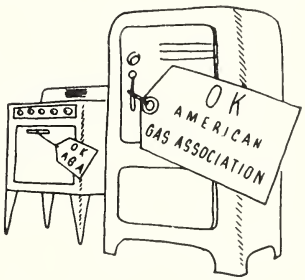
The hazard from gas which has traveled underground is likely to be underestimated for several reasons. The odorous constituents of the gas mixture are strongly absorbed by many soils; the familiar odor is likely to be disguised by the removal of some of its components and by the addition of others; and finally the development of the odor is likely to be so gradual as to escape notice in a familiar environment.

Even the slightest odor of gas, the source of which cannot be definitely located, should be immediately reported to the gas company. Many of the most serious accidents would have been prevented by attention to this rule. One which will serve as an example occurred near the National Bureau of Standards. Two men lost their lives by asphyxiation while sleeping on the second floor of a building unconnected to the gas system. The gas entered the basement of the building through porous earth from a broken main. It was reported that the occupants of neighboring buildings had detected the odor of gas in their basements for several days, and prompt notification of the gas company would certainly have prevented the fatalities.

In another case, a store was destroyed by explosion and fire, and it was subsequently reported that an odor of gas had been noticed for several days, both in the building in which the explosion occurred and in the adjoining basement.

In no other case is attention to the first indication of escaping gas so important as that of a buried reservoir containing liquefied petroleum gases. The fuel is in the dense form of a liquid under high pressure (for a gas distribution system) and can escape at an excessive rate through a very small opening. The escape of gas is likely to be the result of corrosion, and without inspection the extent of the corroded area cannot be estimated. A leaking tank must not be uncovered for inspection while under pressure because the removal of the supporting soil from corroded metal frequently results in opening relatively large areas. Hence, the only thing to do is to notify the company supplying the fuel to remove what is already in the tank and make the necessary inspection and replacement or repair immediately. If the container is corroded through, it should be replaced, of course, not repaired. If expert service is not obtainable at once when leakage is discovered, gas should be burned from the system at a safe place rapidly enough to materially reduce both the temperature of the liquid and the pressure in the reservoir. The leak is not then likely to be enlarged until the fuel supply is exhausted, after which an inspection can be made safely.

5. SELECTION OF APPLIANCES



The selection of the appliances with which gas is used is much more important than is commonly supposed. While the danger of getting an unsafe appliance is not very great, as is shown by the fact that the number of serious accidents is not great compared with the many millions of appliances in daily use, it ranks in importance with the danger of trouble from accidental leakage and is therefore one of the major hazards in the use of gas.

The American Gas Association, a national organization, has established a well-equipped laboratory for the purpose of determining whether appliances offered for sale are so designed that they can be used safely and with satisfaction. Specifications called

"approval requirements," with which an appliance must comply before it can be regarded as safe, have been adopted. To receive the approval of the Association, an appliance must pass a number of careful tests. These tests can be made only in a specially equipped laboratory. An appliance, whether manufactured by a member of the Association or not, may be submitted for test; and the great majority of models of domestic appliances have been tested. Several thousand models have been approved.

It has been clearly shown in recent years that the cost, reputation, and appearance of appliances have little relation to their safety. The judgment of even the best qualified "experts" regarding the safety of an appliance is not a satisfactory substitute for a careful laboratory test. There is, therefore, little reason for the purchase of an appliance which does not have the approval of the Association. All appliances so approved bear the blue approval star of the Association, and this label is the only safe means available to the average purchaser for distinguishing a safe appliance.

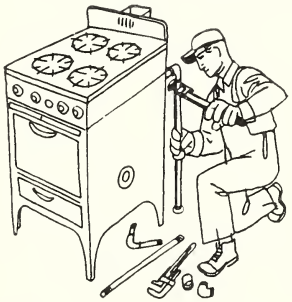
In selecting an appliance for use with propane or butane, make certain that it has been approved for that service. There are important differences between appliances for butane and for manufactured gas, and an appliance made for use with one of them cannot ordinarily be used satisfactorily with the other. In many cases different burners are supplied for manufactured and natural gas. Make sure through the appliance dealer or the manufacturer that you have the right burner.

Usually only one appliance of a given model is tested by the American Gas Association laboratory, and the manufacturer is sure to take care that his appliance is in perfect condition when submitted. Therefore, even among "approved" appliances which are supposed to be duplicates there may be individual differences or defects which can be distinguished by a well-informed purchaser. Consequently, it is desirable before accepting a new appliance to observe it carefully while it is operated under all the conditions likely to exist in service. After studying the discussions given later in this circular of the adjustment and care of appliances, the purchaser should be able to note any one of several possible indications of unsatisfactory operations which may appear. Mention is made here only of difficulties connected with ignition and of the uniformity of size and action of the burner "ports," the openings at which the gas burns. All the ports should be clean cut and, unless obviously intended to be different, they should be of uniform

size and of regular spacing. Any breaking away, even of the surface, of the original casting around a port should subject the burner to rejection. The gas should ignite without delay at all the ports. The flames at all the ports should be of as nearly uniform size and appearance as the eye can detect. When the air shutter is wide open and the flow of gas is varied as much as possible without extinguishing the flame, the flames at the different ports should remain alike in appearance. There should be no noticeable tendency for any flames to flicker, and if the gas rate can be increased until the flames rise from the ports they should all "lift" at about the same rate.

The difficulty of igniting the gas, if any, and the action of pilot lights and accessory controls such as the safety pilots are readily observed. The purchaser of an appliance should make sure that they are fully understood and entirely satisfactory. Uncertain, partial, or delayed ignition of burners followed by explosion or flashback are the conditions to be guarded against, and considerable differences are to be found even among approved appliances.

6. INSTALLATION OF APPLIANCES



The installation of appliances is a matter which should always be given careful attention. In general, this work should be entrusted only to the gas company or a gasfitter of recognized ability. There are certain types of gas-using equipment which require special knowledge for their installation, and a reliable workman will know just how the job should be done to insure safety and satisfaction to the customer.

When installing a gas appliance there are five things to be kept in mind: (*a*) Make sure that the location is suitable for the work intended, (*b*) make gas connections tight and strong, (*c*) place

the appliance so that nothing can take fire from it, (*d*) provide for enough fresh air to completely burn the gas, and (*e*) provide for the proper disposal of the products of combustion.

It would seem that these five things are almost too obvious even for mention, but persistent violation of good practice in these particulars shows that they need be emphasized.

An appliance should be so located that it is easy to use. When the appliance is awkward or difficult to operate, accidents are more likely to occur. Appliances should be so located that they are not subject to excessive drafts which might extinguish the flame, and that there is no danger of bumping into or stumbling over them or their connections even in the dark. Valves should not be placed where they could be opened by catching clothing on them, where they cannot be easily reached when lighting the gas, nor in such a position that a person turning on the gas is forced to stand too near the burner to be safe in case there is a slight explosion. Valves controlling different appliances should be placed far apart if possible. If near together, they should be supplied with handles of such different shapes or material that they can be certainly identified by touch.

Location of appliances in small confined spaces is bad practice; and in extreme cases, for example, where a large water heater is placed in an unventilated closet, the flame may actually be smothered out by exhaustion of the oxygen in the air. It is considered dangerous practice to put water heaters of any kind in bathrooms or bedrooms, or to use appliances which discharge the products of combustion into the room to heat rooms in which people sleep. If a bathroom must be heated by an unvented heater, a window or door should be left partly open for ventilation.

It is desirable, in general, to connect all of the larger appliances to chimneys or other outlets through which a good draft will be assured. Such appliances include "closed-top" gas ranges, water heaters, and generally all room-heating or house-heating appliances. It is not usually regarded as worth while to vent, by a canopy or otherwise, the "cooking top" of a "grate-top" range, lighting fixtures, or gas refrigerators. It is very doubtful whether the advantage to be gained from venting the oven of an ordinary range justifies making a connection to a chimney.

It certainly is not worthwhile to build a chimney for this purpose where one does not exist. Every appliance which is automatically controlled should be connected to a flue, if it uses manu-

factured or natural gas at the rate of 5,000 Btu per hour[1] or more. Automatically controlled appliances which burn less than this should be flue-connected unless equipped with a "safety pilot," which will automatically shut off the gas supply to the main burner or burners if the means of ignition becomes inoperative. The object of the flue connection in this case is to prevent the accumulation of unburned gas should it escape from the appliance. Since propane and butane are heavier than air, flue connection of appliances using them is of no value. It is imperative that a safety pilot be employed with every pilot light when propane or butane is used. The safety-pilot should control the entire gas supply of appliances for these gases so that unburned gas cannot escape even from a pilot.

If a chimney is to be built for use with a gas appliance, as much care should be taken in its construction as though it were to be used for any other fuel. If an appliance is to be connected to an existing flue, make sure that the flue is open and in good condition before making the connection.

The connection between a gas appliance and the chimney should be short and as free as possible from bends and horizontal portions. A "draft diverter" should be installed in the flue connection of each appliance unless one is unnecessary because of the construction of the appliance itself.

The subject of flues and draft diverters is of such importance as to justify further discussion in order that it may be fully understood.

Neither gas nor any other fuel will burn without air. If air does not circulate through a gas appliance in a normal manner, the flame may be extinguished or the gas may be only partially burned, frequently with the production of a large amount of carbon monoxide (in addition to that in the original gas). A gas appliance differs from a stove burning solid fuel in several important respects. If a solid fuel does not burn, it remains harmlessly in the stove; but if a gas appliance is turned on, gas is supplied continuously, and unless it is burned it must escape into the surrounding room if not up the chimney. If there is a down draft in a stove burning solid fuel, the stove "smokes" and the odor of the smoke is so disagreeable that the occupants of the room are warned and usually remedy the condition or escape before they are harmed. Dangerous products of incomplete combustion of gas can and

[1] Btu is the abbreviation for British terminal unit and means the amount of heat which will raise the temperature of 1 pound of water 1°F.

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sometimes do escape unnoticed. Nearly everyone has had enough experience with smoking fires to realize that the use of gas would be prohibitively dangerous if each case of back draft resulted in the extinction of the flame or otherwise caused the escape of large amounts of carbon monoxide. The necessity for installing appliances in such a way that this will not occur is therefore evident.

Fortunately most gas appliances now on the market are so designed that, when not connected to a flue, enough air circulates through the combustion chamber to permit complete combustion. Trouble results if this circulation is disturbed either by a down draft, as we have seen, or by too strong an up draft. If the flue connection forces a strong up draft, an excessive amount of heat is lost and in some cases a small flame, particularly a pilot flame, may be extinguished. It is the purpose of the "draft diverter" to maintain the same pressure at the outlet of an appliance as at the inlet, in order that the quantity of air necessary for the best service may automatically circulate through the combustion chamber when the appliance is in use. Appliances are sometimes so constructed that there is adequate escape for any down draft through passages other than the combustion chamber. In other words, they have the equivalent of a "built-in" draft diverter. Such appliances need no outside diverter.

In the installation of appliances care must always be taken to avoid incurring any danger of fire. Gas appliances are, in general, much more easily installed properly to safeguard wood floors and walls, and other parts of the house or its furnishings than are coal or wood-burning stoves; and this has led to a carelessness with gas appliances that is often serious. The householder should remember that under many circumstances the risk of fire may be greatly increased by neglect of simple and inexpensive precautions.

Wherever heat is produced continuously for a long period of time, the temperature of nearby combustible materials will be raised dangerously unless there is some provision for removing heat from the space between them and the source of heat. This is equally true whether the heating is done with a solid fuel, electricity, or gas. Usually the saving transfer of heat is by convection of the air between the stove or appliance and the floor, partition, or other combustible material, but in recent years many appliances have been designed to be used safely when built into or placed snugly in contact with floors and walls even though they are of wood. In every such case, however, a space has been

provided within the appliance itself through which cold air circulates and isolates the region of higher temperature. No reasonable amount of "insulating material" will take the place of the free air space. Failure to understand this is the usual cause of fires from gas-burning appliances.

All appliances which receive the approval of the American Gas Association must pass a test which demonstrates that when they are set 6 inches from a wooden wall the wall will not be heated to an unsafe temperature. These appliances designed to be built into or set directly against the wall must pass a corresponding test before approval. Unless the appliance is specifically labeled as approved for flush installation, a 6-inch space should be left in every case. This applies to lath-and-plaster walls no less than to wooden partitions. Appliances that do not have the seal of approval must be installed with even greater care, for a 6-inch space may not be adequate. If any appliance must be placed so close to the floor or wall that after long operation wood or plaster become too hot to be comfortably touched with hand, additional precautions should be taken. Interposing a sheet of metal or asbestos is usually effective, the more so if it is near to or against the appliance rather than the wall.

Floor furnaces and wall heaters must be installed in such a way that every provision made for the circulation of air is fully effective. Stopping any of the vent holes or reducing clearances provided for are almost certain to result in disaster.

Wooden shelves should not be placed above a stove or heater; but if this is unavoidable they should be carefully protected on the under side from the heat. Such shelves are particularly dangerous if covered with paper.

Curtains hanging too near gas burners especially gas lighting fixtures have been a frequent cause of fire.

In many households, spaces behind and around the appliances are used for the storage of brooms, mops, buckets, cloths, and such household necessities. This should not be done, since it is extremely easy for these articles to be set afire.

7. ADJUSTMENT OF APPLIANCES

The possible liberation of carbon monoxide from an appliance in which gas is burning presents a problem distinct from that of raw unburned gas which leaks from pipes or burners. In a gas flame to which there is an unrestricted access of fresh air and no sudden chilling, the carbon monoxide is completely burned. When the flame is partially inclosed and brought into contact with an object which takes away some of the heat, the carbon monoxide may be completely burned or it may not.

It is not always easy to tell when an appliance is liberating carbon monoxide through incomplete combustion, but certain things may well be regarded as warnings. Any odor (which does not come from grease, varnish, or other material about the flame to which the odor can be definitely ascribed) is a cause for suspicion. Of course, carbon monoxide has no odor; but when any odorous substance is liberated from the flame it is pretty safe to assume that carbon monoxide is liberated too. The usual odor accompanying the liberation of carbon monoxide is slightly irritating to the membrances of the nose but is not particularly unpleasant when not too strong. Many people will identify the odor at once as that given off by a plumber's or tinner's gasoline torch. It has no resemblance to the odor of the unburned gas. Unfortunately the absence of any odor is not a positive indication that carbon monoxide is not being liberated, even in dangerous quantity.

Another valuable indication is the appearance of the flames. When a flame has a sufficient supply of fresh air its outlines are sharply defined. When, however, the burning gas is surrounded by an atmosphere from which most of the oxygen has already been used, the outlines of the flames are very faint and indefinite and have a wavering or ragged appearance even in the absence of any noticeable air currents. Most appliances, when correctly adjusted, have flames with distinct greenish "inner cones," the

size of which may be a valuable guide to an adjuster familiar with the particular model with which he is concerned; but the inner cones are of little significance, in general, in judging whether combustion is complete, for carbon monoxide may be liberated in dangerous quantities, under certain conditions, from flames with bright, well-formed inner cones; while flames without percepible inner cones may burn the gas completely. It is the size, form, steadiness, and continuity of the pale blue outer boundary of the visible flame which give valuable indications of the safe or unsafe condition of the appliance.

A flame which is depositing carbon (soot) is not necessarily liberating carbon monoxide, but it is to be regarded with suspicion. When the flame flashes back—that is, when the gas burns inside the ports of the burner—carbon monoxide is almost always liberated in dangerous quantity. This condition is usually recognized at once by a roaring noise and a disagreeable odor. Usually there is a distinct pop when flash-back begins.

Whenever any indication of unsatisfactory combustion is observed, notify the gas company, as in a case of leakage. Many gas companies give free service in correcting conditions of this kind and others make only a small charge, since failure to insure satisfactory and safe utilization of gas always results in a loss of business.

All manufacturers of appliances endeavor so to construct their products that they will completely burn the gas needed for the best service; nearly all of them place on the name plate a rating in Btu per hour. In the case of ranges the rating of each burner is usually standard and is understood by adjusters although it does not appear on the name plate. This rating is either the greatest rate at which heat should be supplied to give good service, or it is the maximum amount of heat for which it is safe to adjust the appliance, allowing for probable changes in the pressure of the gas supply and in the condition of the appliance. Usually the safety consideration determines the rating. All appliances have means for changing the size of the opening, called the orifice, through which the gas flows from the supply piping into the burner. This may be done either by means of a threaded part, the turning of which opens or closes the orifice, or by replacing the small block of metal in which the orifice is drilled with another block which is drilled with an opening of a different size.

The orifice should be adjusted to give the manufacturer's rating

when all cocks and valves are wide open, and when the pressure is the maximum which commonly occurs. Suppose, for example, the appliance is rated at 12,000 Btu per hour and is connected to a gas supply of 500 Btu per cubic foot (a common value for many manufactured gas supplies) in a locality where the pressure varies daily from about 4 to about 6 inches of water pressure with occasional minima of 3 and maxima of 7 inches. The orifice should then be so adjusted that 24 cubic feet of gas (24x500=12,000) will flow through the orifice per hour when the pressure back of the orifice is 6 inches of water. This adjustment, and in some cases that of the shutter which controls the amount of air admitted to the burner, can safely be made only by a man who is entirely familiar both with the operation of appliances and with the conditions of gas supply.

If an appliance is moved from one community to another, or if the character of the gas supply is materially changed, for example, from manufactured to natural or the reverse, it is particularly important that the appliance be adjusted for the new conditions by an experienced man who is entirely familiar with the local situation.

After the adjustment is set, it is dangerous to change it, particularly to enlarge the orifice at a time of low pressure. If service is unsatisfactory because not enough heat is supplied, the trouble may be caused by a partial clogging of the house piping, of the service pipe connecting with the street main, or of the valve controlling the appliance itself; it may be caused by mechanical difficulty in the meter; or it may be the result of a temporary condition which causes low pressure in the mains which supply the neighborhood.

In none of these cases is the enlargement of the orifice a correct or safe method of remedying the trouble. The only safe course is to notify the gas company and permit it to locate and remove the cause of the difficulty.

Although a change of orifice should never be attempted by the average user of gas, an adjustment of the air shutter may usually be made with safety in the case of ranges, water heaters, and some other appliances, but the adjustment of room heaters not directly connected to flues should be left to an expert. Generally the small flame at each port on the burner should be distinct, free from yellow, and have a sharply defined inner cone. It is not desirable,

however, to open the air shutter so wide as to make the flame noisy, to permit flashing back of the flame when turned down as much as it is likely ever to be in use, or to cause any tendency for the flames to "lift" away from the ports.

8. OPERATION AND CARE OF APPLIANCES

In lighting an oven, a water heater, or other appliance in which a large amount of gas is burned in a partially inclosed space, a few simple precautions should be taken to assure safety. Several arrangements for lighting and flame-control exist. In the simplest of them a lighted match is merely applied to the main burner. The match may be brought to a touchhole from which the flame is communicated by a row of small ports or by flashing through an open tube to the burner. A pilot light may be ignited, after which the gas is turned onto the main burner and the pilot light turned off. There may be a pilot light which burns continuously but without a safety pilot; or there may be a safety pilot which, when cold, prevents gas from flowing to the main burner only, or to both the pilot light and the main burner.

In every case the doors of the burner box and oven or of whatever large space communicates with the combustion chamber should be opened first. If a match is to be applied directly to the main burner or to a tube leading from it, the match should be lighted, then the valve should be opened fully and the match brought to the lighting position about one second later. If the lighted match is held over the burner before the valve is opened, the flame is likely to flash back into the explosive mixture formed with the air initially in the burner. If flash-back occurs or if the ignition of the main burner does not occur, close the valve immediately, light another match and try again. If a separately controlled pilot light is provided to assist in the lighting operation, it should be lighted first and the main burner valve opened suddenly. It should then be ascertained that the main burner is actually

lighted before turning off the pilot. In case the main burner flashes back when turned on, the gas should be shut off at once and then turned on again before the pilot is extinguished. In case the match flame goes out before the pilot (if any) or the main burner is lighted, the gas should be turned off immediately and another match procured and lighted before the gas is turned on again.

If a safety pilot is provided which controls the supply of gas to the main burner but not to the pilot, simply light the latter and wait for the safety pilot to warm up and then turn on the main gas supply. This operaion should be observed at least once to make sure that it occurs in a normal manner. When the safety-pilot controls the supply of gas to the pilot light as well as to the main burner, instructions as to the lighting of the particular appliance should be obtained from manufacturer or gas company and followed. In general, the main valve should be opened and heat applied with the flame of a match or taper where it will cause the safety-pilot to open and will ignite the pilot flame. One hand should be on the main burner valve, and another match should be within reach. When the safety-pilot opens, if the gas does not ignite immediately and without flashing back, turn it off at once, then promptly turn it on and apply the match or lighted taper to the main burner as directed for lighting a burner without a pilot. The action must be quick or the safety pilot will cool and again interrupt the gas supply. If failure to light the appliance satisfactorily occurs more than once or twice, the gas company should be asked for advice or assistance.

Certain statements may be made which apply to all appliances, whatever the method of ignition. Failure to ignite the gas at all may occur because there is a stoppage in gas piping, valve, or orifice. If flashing back occurs frequently or if a blue flame burns about the match or pilot flame but will not "settle" on the burner, it is an indication that the air-shutter is too wide open, and the trouble may be remedied by closing it slightly. However, it should not be closed far enough to produce a yellow flame or any of the conditions previously described as indicating incomplete combustion. If, as sometimes happens, there is so much delay in igniting the gas that it escapes from the pipe unburned for several seconds, the main burners should be turned off, time allowed for the appliance to become free from gas, and the condition which resulted in delayed lighting remedied, if possible, before lighting

is again attempted. Especially in case of an automatic heater this precaution is very necessary, and if gas has been escaping into the heater unburned for some time, several minutes should be allowed to elapse after closing the main burners before attempting to relight. Special care should be taken to make sure that very little propane or butane escapes during a lighting operation. Whereas natural and manufactured gases pass up the chimney, the heavy petroleum gases are about the operator's feet and may easily set fire to clothing if they become ignited.

After lighting but before leaving a burner, the flame should be observed to make sure that perfect ignition has occurred. This applies to burners under the solid or partly inclosed cooking top of a range and to a radiant space heater as much as to an oven, water heater, or furnace.

It sometimes happens that the gas does not light at every port of a burner and unburned gas escapes from those at which there is no flame. Oven burners are especially subject to this trouble. When the gas is lighted see that there is a flame at every port. If much difficulty is encountered in getting all the ports of the burner to light, something is wrong. Usually the burner needs cleaning, but if cleaning does not remedy the trouble, the burner must be repaired or replaced by an experienced appliance adjuster.

The ignition of flowing sleeves when women reached over front range burners to light the back ones formerly caused many bad burns. This hazard has been pretty well eliminated by changes in both appliances and clothing but should be kept in mind by women working in the kitchen. The use of catalytic or most friction lighters as substitute for matches is to be avoided. With such lighters ignition is usually delayed longer than with a match, frequently much longer. Hence, gas may accumulate before ignition to the extent of causing a dangerous flame. The type of friction lighter in which a wheel, rotated by a spring, definitely directs a shower of sparks forward in a narrow stream is the best of these devices and can usually be relied on. It is probably as safe as, or safer than, matches; but the use of many other forms of mechanical or catalytic lighters introduces a distinct hazard.

Appliances should always be kept clean and in good condition. If any part of the appliance appears to be broken, bent, or out of position, you should have an experienced man correct the condition unless the part can be simply replaced, as in the case of the glowers or radiants of radiant heaters.

In all cases safe combustion requires clean burners and unobstructed flue passages. Obstructions in the burner ports or air shutters and accumulations of dirt or soot in the burners modify the design, interfere with the proper mixture of air and gas, and create dangerous conditions. Burners can be easily cleaned by washing in boiling water and soda; they should be dried before using. After cleaning a burner or displacing it for any other reason, it must be carefully restored to exactly its original position.

Nothing is more dangerous than to close the vent of an appliance either by carelessly placing something over it or by deliberately obstructing it, as is sometimes done by persons ignorant of the dangers, for the purpose of saving heat. The proper way to save heat is to burn the gas only when needed and then at the lowest rate that will accomplish the desired work.

A vessel containing a liquid should be closely watched as boiling begins because the liquid may run over the edge of the utensil, extinguish the flame, and permit unburned gas to escape. The boiling over of cooking foods is the most common cause of clogged burners. As soon as liquids start to boil the gas should be turned down until boiling continues only very gently. There is nothing to be gained by violent boiling, for the temperature of a liquid cannot be raised above the boiling point, and the high flame simply wastes the gas and is a hazard.

When it is desired simply to keep the contents of a utensil hot, it is better to place the vessel over a moderate flame from a small burner than over a low flame from a large burner. It is best always to guard against turning a burner too low, for it may blow out or flash back, and thus cause bad results. Especially after a burner has been turned down, one should be sure the flame is actually burning before turning on more gas.

It is hardly necessary to remind the housewife of the importance of keeping flammable materials away from the gas range. For example, the range should not be used to dry clothing, or other articles if this can be avoided. If it is necessary to use the range or oven for drying clothing, one should be careful that the articles do not become overheated or slip down on the flame and thus become a source of danger for the entire building. They should not be hung on the oven or oven door.

Few housewives need to be warned of the danger of overheating deep fat when making doughnuts, fritters, etc., or the paraffin used for sealing preserving jars; but the great concen-

tration of heat in the gas flame and the rapidity with which materials are heated by gas may catch the cook off her guard, especially if she happens to be accustomed to a coal fire. Paraffin may be safely and conveniently melted in a utensil immersed in or supported above boiling water.

Gas or gasoline is still employed for lighting to some extent in camps and rural homes. The glassware of gas lamps should be maintained in good condition, for not only may glass falling from a broken globe injure some one, but also, if highly heated, it may ignite any combustible material on which it falls. Carbon collecting on the mantle because of dirt in, or improper adjustment of, the lamps is also a serious matter; it decreases the amount of light received and hot pieces of the carbon may fall from the lamp and set fire to furnishings. A lamp or any other appliance showing such carbon deposits should be cleaned and adjusted. Mantles should be replaced as soon as the slightest break appears, because the uneven heating resulting from a broken mantle is the usual cause of broken glassware. It is uneconomical as well as unsafe to neglect broken mantles.

9. ACCESSORIES FOR USE WITH APPLIANCES

Accessories that may alter the character and size of the flame, or the access of air to the burner and the escape of products of combustion from it, should never be purchased. Particularly to be avoided are the "solid tops" or plates to be placed on a stove designed for the use of a grate top, and the miscellaneous devices sold from house to house and alleged to save gas when placed on other appliances. Meritorious solid top stoves, built as such, are in use but they must be particularly well designed to be safe and reasonably economical. Placing a solid cover on a range not designed for it interferes with the admission of air around the flame and with the escape of the products of combustion through the open grates as intended by the designer.

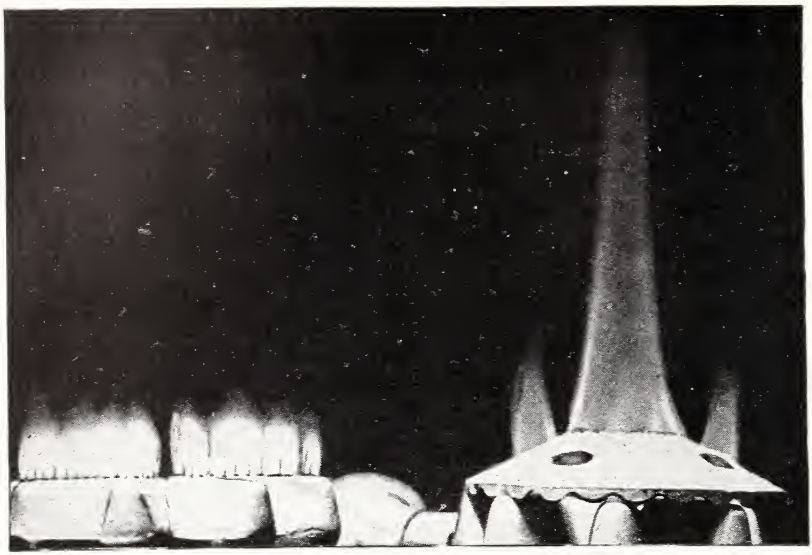


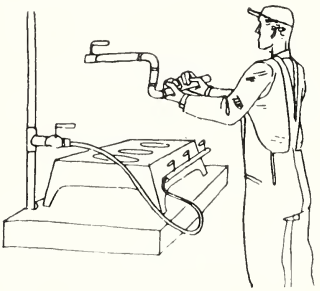
FIGURE 2.—*Effect of "gas saver" on flame.*

If the various devices alleged to save gas when installed on range burners were really valuable, they probably would have been incorporated by the manufacturer of the original appliance. These devices do not, in general, correct any fault which may exist in the consumer's appliance, except that of a burner placed too far below the top of the stove, a condition which is now rarely found. They occupy much of the space between burner and utensil, interfering with the access of air to the flame and the escape of products of combustion.

The effect on the flame of a typical device of this kind is shown in figure 2. On the left is pictured a top burner with all the flames of the same height. When a utensil is placed the proper distance above such a burner the heat is distributed uniformly over the bottom of the utensil. Such a condition results in efficient heating of the utensil, causes no local overheating, and allows the gas to burn completely. Placing a "gas saver" above such a burner produces the effect shown on the right. A utensil placed over this burner is enveloped in flame, the individual cones are no longer distinct as in the preceding case, and it is impossible for the air necessary for completing the combustion to reach all portions of the flame. The result is the formation of considerable quantities of carbon monoxide.

An attachment of another type which should be strictly avoided is one alleged to filter or purify the gases escaping into the room from an oven or space heater and installed on the vent of the appliance. An open elbow turned away from the wall, or other equivalent deflector, is useful to prevent the streaking of the wall behind an appliance, and may prevent local overheating; but the householder should never allow steel wool or other metallic shavings, perforated plates, or porous material of any kind to be introduced into the vent or flue passages of an appliance.

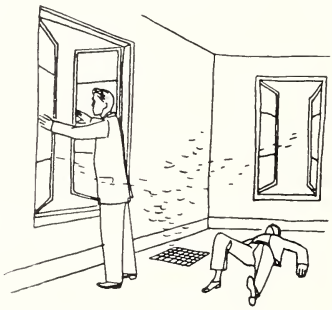
10. FLEXIBLE TUBING



Considering its limited importance and application, flexible tubing has, without doubt, been the cause of a far greater number of serious accidents than anything else for which there is legitimate use in connection with the burning of gas. Several types of accidents have been common: (*a*) Cracking or breaking of the tubing itself, allowing gas to escape; (*b*) the pulling off of the tubing from the appliance or from the gas outlet to which it is connected; (*c*) the separation of the tubing itself from the connectors which attach it to gas outlet or appliance; (*d*) the momentary kinking or collapsing of the tubing (when stepped on, for example) which extinguishes the flame or causes it to flash back; and (*e*) the overheating of the tube or its connectors which results in leakage. Burners at which backfiring has occurred usually get extremely hot, and the rubber connectors sometimes melt or burn off. Even the flexible metal tubing with metal connectors usually depends for tightness on a thread of rubber packing and will leak if overheated. The best precaution against the dangers of flexible tubing is to avoid its use whenever possible. Hot plates, radiant heaters installed in fireplaces, and all other appliances which are to be used in one location for a considerable period of time should always be connected with rigid and permanent piping. There is

little difference in cost, considering the fact that the flexible connection may have to be replaced repeatedly during the life of the appliance. If flexible connections *must* be used, as in the case of a gas iron, the best tubing obtainable should always be secured. The best available evidence that the tubing is safe is the approval of the American Gas Association, which subjects tubing to a series of rigorous tests to determine its safety from each of the more common hazards. Tubing should always have the connectors at both ends permanently attached at the factory. Always take the utmost care in connecting the tubing. See that the ends are as tight as they can be made and that they will not loosen with a strong pull. See that no part of the tubing is left in a position in which it may become overheated. The gas should always be shut off the appliance at the inlet end of the tubing, never at the appliance. For this reason it is unsafe to use a flexible tubing with an appliance which has a shut-off. When tubing which has been in use shows the first sign of leakage or other serious deterioration, throw the piece away and get a complete new tubing. Successful repairs are almost impossible to make. The very best repairs lengthen the life of the tubing so little that the saving effected is negligible. Many deaths have resulted from attempted repairs of this kind.

11. CARBON-MONOXIDE POISONING



The active constituent of gas which causes death when breathed is carbon monoxide. This gas is so active a poison that as little as 1 or 2 parts in 1,000 parts of the air, if breathed continuously for several hours, may cause death. It is not present in natural gas, and varies in amount in manufactured gas from 5 or 6 percent to about 30 percent, depending on the method of manufacture. If either natural or manufactured gas is burned under unfavorable conditions, carbon monoxide is produced in the appliance. It is possible, under the worst conditions, such as those which

may result from closing the vent of an appliance with a damper or cap, to convert practically the entire carbon content of the gas into carbon monoxide. If this is done, the volume of carbon monoxide liberated is actually greater than the volume of gas burned in the case of some natural gases, and almost as great in the case of manufactured gases.

Fortunately, if removed to fresh air while still breathing, one who has breathed air containing carbon monoxide, even to the extent of losing consciousness, will rapidly recover and will generally suffer no permanent injury.

Carbon monoxide is a constituent of all manufactured illuminating or fuel gas. It is formed and then burned during the combustion of all fuels, coal, wood, oil, or gas. A blue flame is, to a large extent, burning carbon monoxide; that is, carbon monoxide in the process of uniting with the oxygen of the air to form the harmless gas, carbon dioxide. Only two requirements must be met, for carbon monoxide to burn readily and completely. These are (1) that the gas have access to enough air to supply the necessary oxygen, and (2) that it be hot enough for the chemical combination of the carbon monoxide and the oxygen to take place.

In the cylinder of an automobile it is possible that neither condition will be met. The oxygen present is limited to that drawn in with the "charge," and the water-cooled cylinder walls may cool the gases before their combustion is complete. Hence, an automobile is a well-recognized source of possible carbon-monoxide poisoning, and it is never safe to run an automobile engine in a small closed garage (see also chapter 9, section 3).

Stoves and furnaces of all kinds are possible sources of carbon monoxide. Hot-air heating systems, in which leaks have developed between the flue passages and the hot-air ducts are the most dangerous of the coal-burning appliances. Any odor of coal gas, especially if it persists day after day, should be traced to its source and its cause eliminated. Appliances burning gasoline or oil are to be regarded with at least as much suspicion as the most nearly equivalent gas-burning appliances. Usually there is no danger of carbon monoxide from a stove or fireplace burning wood because, although the gas is produced under some conditions, it is always accompanied by so much irritating smoke that no one is likely to breathe a dangerous amount of it.

Symptoms of rapid carbon-monoxide poisoning are lassitude and weakness followed by dizziness and, perhaps, nausea and headache.

If such symptoms are noticed in a room in which a gas appliance is burning or in which any odor of gas has been detected, get into fresh air at once.

In cases in which there is a rapid liberation of carbon monoxide, such as a considerable leakage of raw gas, or the operation of an automobile in a closed garage, loss of consciousness may occur so suddenly that the victim has no warning, except the initial odor of gas, until it is too late to escape. If there is any reason for suspecting that carbon monoxide may be present, the only safe course is, therefore, to escape from the contaminated atmosphere as quickly as possible, even though no effects may yet have been noticed. Headache practically always follows some time after breathing even so small an amount of the gas that there is no other noticeable effect. Frequent or persistent headaches of no great severity for which there is no other known cause may be the result of repeated exposure to carbon monoxide from a defective appliance.

When anyone is found helpless, and carbon monoxide is suspected as a possible cause, do the following things: First, provide the patient with fresh air, either by carrying him outdoors or to another part of the house or by thoroughly ventilating the room in which he is found, breaking open doors and windows if necessary. Whichever means will most quickly accomplish the result should be used. Second, call a physician and, if in a city, notify the fire department and the gas company. Many city fire and police departments have special equipment for the resuscitation of partially asphyxiated persons and have men trained in its use, the so-called rescue squad. Telephone calls always go through to them instantly, and there is a minimum of delay in their arrival. Every second is precious. The gas company likewise has trained men and special equipment for dealing with these cases. Until the doctor comes, keep the patient warm and at rest. If breathing has ceased, artificial respiration is to be applied as in cases of drowning or electrical shock (see chapter 11, section 4). If you do not know how to apply the prone-pressure method of artificial respiration, call the nearest boy scout or girl scout, as they have usually been trained.

6. LIGHTNING

The number of fatalities from lightning is shown by Census Bureau reports to be about 400 per year for the entire United States. From the ratio of deaths to injuries where both are known, the number injured is estimated at 1,000 per year. The same reports show that approximately nine-tenths of these casualties occur in rural districts, which, for census purposes, include all towns and villages having 2,500 inhabitants or less. This indicates that the lightning hazard is by far the greatest among persons engaged in outdoor pursuits, an indication which is substantiated by the general run of reports of such casualties.

Data on property losses from lightning are incomplete. Reports of the National Board of Fire Underwriters show losses averaging more than $9,000,000 annually, but this sum does not represent the total loss. Many mutual fire insurance companies pay lightning losses which are not reported as such for tabulation, and there are some losses not covered by insurance. In addition to this there is the destruction of livestock and the damage to buildings where no fire occurs. It is consequently probable that the total loss amounts to double the above value. Lightning, therefore, appears as an important cause of loss of property. To protect all buildings against lightning would lead to excessive expense. Most of the fires, however, occur in a few classes of buildings, and if these were protected, loss would, in large part, be obviated.

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The structures most liable to fire by lightning are those which are, of themselves, combustible or have combustible contents. Oil tanks, barns, and churches head the list as far as fires by lightning are concerned. It may be added that where equal numbers of barns and houses are struck, about four times as many barns as houses are fired.

1. PERSONAL PROTECTION

No large object in the path of a thunderstorm can be assumed to be immune to being struck by lightning. It does not differentiate to any great extent among objects upon which to fall, but strikes whatever is in its way. The only place which may be regarded as absolutely safe is one of such character that, even though a stroke of lightning does fall upon it, no harm will come to the occupants. Rooms entirely surrounded by metal, rooms underground, or in a steel-framed building may be regarded as safe. Here, even though lightning strikes, the chances that its effects would penetrate to the interior are negligible. The next safest place is a well-rodded house. But even in a rodded house some precautions may be observed in order to secure the maximum reduction of danger. For instance, when a thunderstorm is in progress one should keep away from those parts of outside walls near the places where lightning conductors pass into the earth, and also away from electrical wiring, telephones, and large metallic objects.

In unrodded houses not containing pipes or other extensive metallic conductors an appreciable degree of danger exists, and to avoid it as much as possible the same precautions should be observed as in the case of rodded houses. It is essential to safety to keep away from the vicinity of down spouts on the exterior of the house, and metallic masses near the walls on the interior of the house, such as radiators, stoves, and safes. For a stroke of lightning following a down spout, or a lightning rod or any metallic conductor, may jump to metallic objects near by, and a person sitting in the path of the discharge may be injured. Briefly, when one is in the house and a thunderstorm is in progress, take a position as near the middle of the room as practicable but not under an electric lighting fixture, well away from the objects named above, and retain it until the storm is over, or at least until the lightning discharges are appreciably lessened in intensity. This is about all one can do, and even so it seems that unless a house is well protected against lightning there is considerable danger if it is struck.

There is hardly any place in an unprotected house to which lightning will not penetrate, although in modern houses containing water and gas pipes, steam or hot-water heating pipes, and other extensive metallic conductors which are connected to earth, the danger to life is considerably reduced. These conductors act, in a measure at least, as a protection against lightning, since they form more or less of a grounded metallic screen about the occupants.

Small metallic objects within houses, as, for instance, scissors, knives, and other small implements and tools, are not likely to attract a discharge of lightning. One may, therefore, use these during thunderstorms without increasing the danger from lightning.

Moreover, there is no danger in lying on an iron bed during a thunderstorm. The impression is abroad that to occupy an iron or brass bed during a thunderstorm is to invite injury, or even death, but the fact is that these beds are safer than any other. They form a metallic screen on one side of the occupant, the effect of which would be to divert the lightning if it should enter the room.

Outdoors the danger is much greater than in houses, even though the latter are unprotected. It is desirable to keep away from lone trees, barbed-wire fences, long wire clotheslines, and other prominent objects which are likely to be struck by lightning, or, having been struck, may carry the lightning a long distance. Open sheds or small outbuildings away from larger buildings are almost as dangerous as lone trees. When caught outdoors in a thunderstorm, seek shelter in a cave, a depression in the ground, a deep valley or canyon, the foot of a steep or overhanging cliff, in dense woods, or a grove of trees. When near lone trees the temptation is to get under them to obtain protection from rain, but a wetting is a trivial matter compared with a stroke of lightning, and a person who takes refuge under a lone tree invites a serious accident. Thick timber, however, is different. There a person may get under a tree in comparative safety, because it is no more conspicuous than its fellows, and hence not likely to be singled out for a stroke. The tree selected for shelter should not be the tallest one of the group. If, in spite of all precautions, a person has been injured by lightning, the clothing may be torn to ribbons, the flesh may be seared and burned, or even broken and lacerated. In every such case immediate attention should be given to the injured person. As in the case of all other electrical accidents, a physician should be sent for as soon as possible, and in the meantime every effort should be made to restore the patient by artificial respiration and to treat

his burns or wounds in accordance with the principles set forth in another chapter.

It may be stated that if those who have been struck by lightning and given up for dead had had proper restorative measures applied at once, many of them would not have died. This statement is well borne out by authenticated cases of persons being restored who were apparently past recovery.

2. PROTECTION OF BUILDINGS AND LIVESTOCK

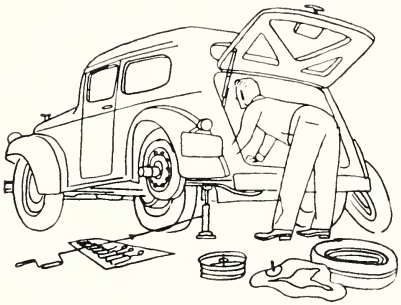
Protection of Buildings

A means of protection against lightning is provided in the lightning rod invented in 1752 by Benjamin Franklin, and which, after 180 years of use, is admirably fulfilling its function. If due care is given to its installation, a lightning rod may be expected to function perfectly in 99 cases out of a hundred on barns and similar buildings where very little metal enters into the construction; and to protect nearly as well houses and other buildings where there are chimneys and metallic masses that may make protection more difficult. In places where thunderstorms occur very infrequently lightning rods may be considered unnecessary. Where one wishes protection against lightning, lightning rods should be installed. Protection should be provided on exposed buildings which are of themselves combustible or have combustible contents or in which large numbers of persons are likely to be congregated during thunderstorms. It should also be provided on structures which are of historical value, or the loss of which would cause secondary losses impossible to cover by insurance.

A few principles to be observed in the installation of lightning rods are given in chapter 10, section 6, Building a Home. Standard specifications should be followed when planning an installation.

Protection of Livestock

To protect livestock from lightning discharges received through wire fences, the fence should be grounded at intervals of 150 to 300 feet. Ground connections can be made by driving ½ inch galvanized-iron pipe into the ground to a depth of 4 or 5 feet and tying it to the fence with wire. The electrical continuity should also be broken up at intervals of 1,000 feet by cutting the wires and inserting short lengths of seasoned wood or other insulating material.



7. MECHANICAL HAZARDS

Hazards of a mechanical nature are quite common in the home and consequently are of great importance. They can be readily dealt with by the householder and can usually be eliminated by personal care and by giving proper attention to physical conditions. Experience has shown that in the home, as well as in the factory, the correction of physical conditions can largely eliminate accidents due to machinery or equipment hazards; whereas, accidents due to handling of materials, to falls, and to the movement of persons are much harder to cope with, and their elimination depends largely upon carefulness and the development of good habits.

1. AUTOMOBILES

Before driving a car out of the garage or driveway, one should make sure that it is safe to do so. Failure to take that precaution may result in a personal injury, or in damage to the car; a child or other person may be struck and perhaps fatally injured, the car may be struck by a passing car whose driver has not observed the car coming out of the garage, or the outcoming car may strike against an obstruction of one kind or another.

Although most automobiles are now equipped with self-starters, there are in use some automobiles that are started by the use of a hand-crank. Many persons have been injured in so starting an

automobile engine. Before trying to crank an automobile engine, be sure that the gear-shift lever *is in* the neutral position. See also that the emergency brakes are set securely particularly if the car is on an incline. If an automatic choke is not installed on the car, set the choke lever so that the air supply to the carburetor will be cut down to its lowest limit. See that the spark lever (unless the spark is automatically controlled) is fully retarded. Turn on the ignition. If the crank is of the detachable type, see that it is securely engaged with the motor shaft so that it will not slip off or come out of mesh until the engine is turned over. Grasp the crank with the *left* hand, with the thumb of that hand extending along the handle of the crank, *not* around it, and pull upward on the crank, making sure that the head, arms, and other parts of the body are well away from the circle that the crank would describe if the engine should start or backfire unexpectedly. If the engine does not start, try again, pulling up the crank as before. Do not rock the flywheel; do not spin the crank; do not push downward on the crank; do not try to work the crank with your foot.

When jacking up a car to remove a tire or for any other purpose, the jack should be placed securely and the car wheels should be blocked to prevent movement of the car. When using a modern bumper jack remember that it must be extended to a considerably greater height than a jack placed under the axle, and consequently is more liable to tip over and allow the car to drop. Greater safety will be secured if an ordinary jack or a strong block of wood is slipped under the axle after the car has been raised with the bumper jack. Jacks should not be depended upon when one is to work underneath a car. In such cases blocks of wood, capable of withstanding not less than four times the load to be placed on them, should be securely placed under the axle before anyone goes underneath the car.

Explosions of tires while being inflated with air have resulted in serious injuries. When inflating a tire stand in such a position that the face, arms, etc., will be protected by the fender in case the tire should burst. Never squat or face a tire directly when it is being inflated There are still in service automobiles equipped with old-style adjustable tire rims. Before inflating such a tire be sure that the rim is locked securely in place.

Painful burns have been caused when attempting to remove a radiator cap to fill the radiator, check or replace the antifreeze solution, or to check the water level. If the water in the radiator is

near the boiling point the hot water often will spurt out and burn the hands when the radiator cap is removed. Also radiator caps are sometimes too hot to be safely handled with the bare hands. It is good practice to wear thick gloves or to use a thick piece of cloth to protect the hands and to wear goggles to protect the eyes when removing a radiator cap.

If denatured alcohol, or other volatile flammable liquid is used to prevent freezing of the water in an automobile cooling system, great care should be exercised to keep lighted matches, cigars, pipes, and cigarettes, or any open flame away from the radiator filler nozzle, when adding the antifreeze or checking its condition. Many persons have been burned because of failure to observe this precaution. If artificial illumination is necessary a pocket flashlamp should be used. Substitute antifreezes, such as kerosene, salt, vinegar, or other makeshift solutions should not be used because they may cause serious damage to the cooling or engine mechanism.

One should not wear a long, loose necktie or any other loose garment when working about an automobile engine. It is always advisable to stop the engine before raising the hood. This precaution is particularly important when one is about to clean some part of the motor, because with the engine running the cleaning cloth or waste may be caught in the fan blades, belt, or pulley with the result that the hand is drawn into contact with those moving parts or thrown against a hot engine or some other part of the car.

Some householders have home chargers for use in giving a partially discharged automobile battery an occasional "boost", which can be done without removing the battery from the car. It is important to make certain that all car switches are turned off so that the current from the charger will not go to the car lights and accessories. It is also necessary to make certain that the positive wire of the charger is connected to the positive post of the battery, otherwise the battery will not be charged. The battery acid known as electrolyte is injurious to practically any substance with which it may come into contact. Even a small amount which may drop from the tube of a hydrometer onto a person's clothing, will eat through the material in a few minutes unless washed off immediately with plenty of water. If the acid is spilled on the hands, it should be washed off immediately and completely with plenty of soap and water, otherwise there may be a rather bad burn of the hands.

When closing the door of an automobile, make sure that no one's hand, finger, or foot are in a position to be caught. Never open the door of a moving automobile. Children and even adults have fallen from a moving automobile and have been severely injured because the door was open while the automobile was in motion.

The hoods of many modern automobiles are of the alligator type. Many a person has been seriously injured because the hood was not securely fastened in place and fell on his head, arms, or shoulders while he was checking the oil, water level, etc. Before working under such a hood one should make sure that it has been raised high enough and is securely fastened in place. Remember also that on a windy day a sudden gust of wind can easily dislodge an insecurely fastened alligator hood and that a person may be severely injured when it falls.

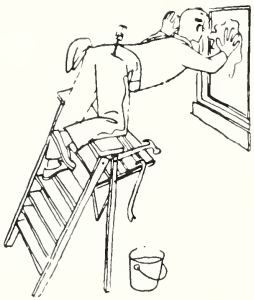
Falling luggage compartment lids are also a source of many injuries. Occasionally one of these lids drops unexpectedly and strikes and injures a person removing or placing articles in the compartment. This hazard has been recognized by automobile manufacturers and some have eliminated it by counterweighting the lid, and incidentally have made it easier to raise the compartment lid. When raising a lid not so equipped make sure that the supporting device is securely latched before letting go of the lid, and, when lowering the lid, let it down gradually and be sure that your fingers or a hand, arm, or head, are not in a position to be caught under the descending lid.

Many householders have skinned their knuckles while working about the family car because a wrench or screw driver slipped. Hand tools should be kept in good condition or thrown away. Wrenches should be of suitable size so that they will closely fit the nuts on which they are to be used. It is advisable to use socket type wrenches whenever practicable. Screw drivers should be of the proper size to make a snug fit in the screw slots and should be kept in good condition so that they will engage the screw slots properly. Heads of hammers should be securely fastened to the hammer handles by suitable wedges. In using a hammer, one should be careful to avoid misdirected blows; otherwise, a mashed thumb or finger may be the result (see also Hand Tools, in section 5 of this chapter).

An accumulation of ice or snow on the running board of a car left out over night may easily cause a painful injury such as a

skinned or wrenched knee or leg when one attempts to step into the car.

Unless they have the proper equipment and know how to use it, householders should not attempt to perform major repairs to their car, such as removal and replacement of a clutch, relining the brakes, removal of a cylinder block, etc. It is far safer, and often more economical, to have such repairs made by a reliable repair shop.



2. FALLS

Statistics of accident fatalities in the home, given in table 4, "Deaths from Home Accidents by Type of Accident," based on National Safety Council data, show that during the eleven year period 1933-43, inclusive, 176,100 (49.6 percent) of all home accident fatalities (355,000) were due to falls. Table 5, Deaths from Accidents in the Home by Type of Accident and Age Group, (p. 185), also based on National Safety Council data, shows that 54,400 (84.5 percent) of the 64,400 home accident fatalities during the four year period 1940-43, inclusive, were due to falls of persons 65 years of age and older. No doubt frailties of age (poor health, failing eyesight and other bodily defects) were contributing factors in the large number of fatalities in the 65 years and older group. Table 5, also shows that 2,650 (4.1 percent) of the 64,400 home accident fatalities during the period 1940-43, inclusive, were due to falls of persons 24 years of age and younger. It may be that many of the last mentioned fatalities were due to reckless practices on the part of individuals, but in fairness it is proper to assume that many of those 2,650 fatalities as well as many of the 54,400 to those in the 65 years and older group were due to a lack of proper facilities or to physical conditions of property, etc.

FIGURE 3.—*Stairways such as this are decided hazards.*

Stairs

Falls on stairs are so numerous that special attention to this hazard is necessary. Back stairs, attic stairs, and cellar stairs are the chief offenders of falls in the home.

Falls down stairs may result from the lack of a handrail, lack of a gate at the head of the stairs (in the case of babies), insufficient illumination, the presence of sharp turns or narrow treads. These are defects or omissions in the design or construction of the house. Again, falls down stairs may be caused by articles left standing on the steps, the presence of water or greasy materials on the steps, or by other evidences of carelessness, negligence, or undesirable habits

of certain members of the household. The only cure in this case is the elimination of the objectionable practices.

Handrails assist materially in lessening falls on stairs. A good rule to follow is to provide one or more handrails on every flight of stairs having four or more risers.

Gates should be provided at the top of all open stairways and porch steps if babies are allowed to crawl around unsupervised, if there are children in the home who cannot yet be trusted to go up and down stairs alone.

Severe accidents have occurred to persons passing through doors that apparently led to other rooms on the same floor level, but which really opened onto stairways. In cases where the head of a stairway has a door opening directly onto it at the top, the hazard may be reduced in large measure by replacing the door with a glazed door or high gate so that the stairs are visible at all times.

Waxed stair treads and loose rugs and slippery floor surfaces at the top or bottom of stairways are likely to cause falls, especially among children, and aged and infirm persons. Small rugs should not be permitted near stairways. All rugs should lie flat. It is desirable to prevent their sliding by the use of fasteners, underlays, or by a special treatment of the under surface.

Cellar stairways are hazardous when such articles as scrub buckets, brooms, ironing boards, piles of old newspapers, extension table leaves, and what-not, are on them. Such storage should not be permitted even for very short periods.

Small objects such as marbles, pencils, and toys, are often left on stairs by children. These objects may cause serious accidents by rolling or sliding when someone happens to step on them. It is bad practice to put small objects on steps even temporarily.

Falls on stairways and in other obscure places can frequently be avoided by providing adequate illumination, since many such falls are often due to failure to see objects in the way or to failure to observe a condition which may favor a fall. In homes provided with gas or electric service there is little excuse for inadequate lighting, since the condition can be remedied by the installation of a suitable lighting fixture. The lighting unit should be controlled from the head of the stairs or other point reached before the light is needed. This can be accomplished by the installation of a wall switch for an electric light, or even by the use of a cord attached to the chain where a pull-chain socket has been installed. Gas lights can be similarly controlled from a distance by the use of automatic

lighters. Where a stairway or dark passage is likely to be approached from more than one direction, a switch should be provided for each point of approach. In homes where neither electric or gas service is available, a flashlight should be kept handy for use on stairways.

Slipping

Falls are also caused by slipping in soapy bathtubs, on polished floors, either bare or covered with small, loose rugs, slipping on wet or icy porches or on outside steps. Rubber heels, often intended to prevent slipping, become accessories to falls when one encounters wet, smooth pavements, unless the heels are of the antislip type. The high heels so common on women's shoes, are a frequent cause of sprained ankles because the heels have caught on stair nosings, or because the wearer has slipped due to the insecure footing afforded even on an ordinary floor surface.

Many persons have been killed by falling in bathtubs, which have become slippery because of soap on the surface. A tub set away from the wall affords a handhold on each side. Where the tub is built in, there should be on the side next to the wall a firm handhold to help one get in and out of the tub with minimum risk. Rubber mats with suction cups are sometimes used to prevent slipping in bathtubs and shower stalls. However, such mats should be placed in the bathtub or on the floor of the shower stall before the water is turned on, otherwise they may not hold but will slide out of place when stepped on.

Ladders

Almost every house has a ladder. It may be a stepladder for indoor or outdoor use, or a ladder made up with rungs or slats for outdoor use. Ladders require frequent inspection for the sake of safety. Examine your ladder frequently and give it a shake or two. Many ladders in daily use are dangerous and would serve better as firewood. A sound, sturdy ladder, appropriate to one's needs, is a good investment in both utility and safety.

The use of ladders calls for care. Many accidents have occurred from tools and other objects falling from ladders, and striking persons below. Walking underneath ladders is hazardous, and should be avoided if possible. Many stepladders are provided with a folding shelf for holding a bucket of water or other working materials. It is very dangerous to try to stand on this shelf, as it is not designed to hold the weight of a person, and too the ladder may be out of balance with such a distribution of weight.

Many jobs outside of the house require the use of stepladders or straight ladders which should be strong and of suitable design. Some important precautions in the use of stepladders are (*a*) open it to its full extent, (*b*) make sure that the spreaders are locked in position, (*c*) set the ladder on a firm level foundation, (*d*) do not stand on the top step, get a straight ladder if the work is such that the job requires one for safety, (*e*) do not reach out far enough to cause the ladder to tip sideways. If a straight ladder is to be used exercise due care in setting it up. When raising such a ladder its lower end should be braced or someone should hold it so that it will not slip. Such a ladder should not be set with its upper end against a windowpane or sash; it should be against the window sill, and be sure that the base of the ladder rests on a firm foundation. Also in working from such a ladder do not reach out so far that the ladder will slip or slide; instead move the ladder as the work requires. When using a straight ladder to pick fruit or to trim trees be sure that the ladder is set at the proper angle and that the ends of the side rails rest against the trunk of the tree or against a strong limb; also watch out for reaching so far out as to cause the ladder to slip or slide.

The straight ladder utilized more for outdoor than for indoor work must be used with care on smooth floors or pavements, as there is danger of the base slipping out. For wooden floors, ladders with metal point bases or lead-coated bases are recommended; for use on iron floors, ladders with bases of carborundum have been satisfactory. For concrete floors, ladders with shoes of carborundum are recommended. For wet floors, ladders with recessed rubber bases have been used with good results. Ladders with cork grip shoes are satisfactory for general use. The cork is inserted in the steel of the shoe and can be renewed when worn out.

Climbing a ladder while carrying something in one or both hands involves the hazard of a fall. The safe way is to go up the ladder carrying a rope over the shoulder or attached to a belt, thus leaving the hands free to grasp the ladder rails and then after the ladder has been climbed, hoist up the desired articles in a bucket or bag.

Climbing

Children frequently experience bad falls not only in climbing ladders but also by climbing outside of porch railings or upon the ledges of mansard roofs. Where opportunities of this kind invite the venturesome child, caution should be voiced from time to time,

or perhaps, good climbing methods taught. Similarly, every child should be given some good hints on proper method of climbing trees. Children should be prohibited from climbing poles supporting electric wires not only because of the danger of falling but also because of the danger from live electric wires.

Miscellaneous

Standing on chairs, especially rockers, on frail boxes, crates, and barrels, and on insecure stepladders is responsible for many falls. Such falls can be entirely avoided, by proper care in selecting a suitable stepladder and seeing that it is steady and secure before using it. Fragile crates and boxes should be avoided, as also should chairs without solid seats. The arm of a chair of any kind is a dangerous place upon which to stand and should not be used for that purpose.

An upturned barrel makes a precarious stool, as frequently there is nothing to hold the head from being forced inward and one may have a severe fall as a result of using such a makeshift. Projecting nails on the inside may also inflict bad scratches or worse.

Serious and even fatal injuries have resulted from falling only 2 or 3 feet, and the hazard is especially great for elderly persons, whose bones are brittle and nerves less able to stand sudden shocks. Serious injuries have resulted to children and even grown-ups from falling out of bed.

3. FIREARMS

According to National Safety Council data, firearms are responsible for more than 1,000 fatalities each year in homes (see tables 4 and 5). Home firearms accidents occur mainly in preparing to clean guns or pistols, in dropping a gun or knocking it off a support, in exhibiting the "unloaded" gun, or in actual foolish play or scuffles.

There are five general classes of small arms: Shotguns, rifles, pistols and revolvers, machine pistols or submachine guns, and machine rifles and machine guns. Weapons in the last two classes

are military weapons having no place in the home. Some veterans have brought these types home as souvenirs. If such weapons are in the home, they should be rendered incapable of firing by removing the firing pin.

Before using any small arms it is necessary to know what size and type of ammunition may be safely used, if all parts of the gun are in good working order, where the "safety" or device for locking the firing mechanism is located and how it works. This information is usually contained in pamphlets which come with the newer models, and may also be obtained from a competent gun dealer, or an experienced shooter familiar with the weapon.

Firearms are kept in many homes for protection against burglars and other criminally minded persons. However, considering all the accidental deaths and serious injuries that have resulted from the mishandling of revolvers and guns, it seems possible that the hazard created to members of the household by the presence of such firearms may outweigh their protective value as defensive weapons. The average burglar is not a killer, and being fully aware of the specially severe punishment that he is likely to receive if he is captured with a revolver in his possession he often prefers to "work" without one. Nevertheless, the chances are that he knows more about the use of a revolver than does the average householder; and if he does carry a gun and is discovered in an attempted robbery, his greater familiarity with the weapon is to his advantage and may enable him to wound or kill his would-be captor and make his escape.

Firearms are kept in many homes for numerous purposes other than for protection against burglars. Sportsmen have them on hand for hunting purposes and for target practice. Farmers keep shotguns in convenient places for use in killing hawks, crows, and other birds and animals that often play havoc with their livestock and growing crops.

The chief hazards from firearms in the home are brought about by keeping the weapons loaded and leaving them in places where they are accessible to everybody, including children. Small children, as a rule, cannot be expected to realize the danger of playing with a loaded gun, or even to know whether it is loaded; but it seems strange that so many adults will attempt to clean or otherwise handle firearms without first taking the elementary precaution of removing the cartridges or making sure that they have been removed. Numerous deaths and injuries have resulted from neglect

of this precaution and (more often in cases where young or irresponsible persons are involved) from fooling with loaded guns and showing off. "I didn't know it was loaded" is the excuse often given for gun accidents that would not have occurred if ordinary care had been exercised.

As far as practicable, firearms—loaded or otherwise—and ammunition should be kept locked up. In any event, they should be made inaccessible to children and should never be kept on bureaus, desks, tables, or closet shelves or in unlocked drawers and cabinets. Children should be strictly forbidden to have anything whatsoever to do with firearms that, inadvertently or otherwise, might be left within their reach.

Firearms of all kind should be kept suspended or otherwise stored in such a way as to preclude the possibility that they may tip over or fall to the floor from an elevation, because in falling they might be discharged with serious consequences.

Before a person is allowed to use firearms alone, he should be taught how to use them on a well-protected range under competent instruction. Backyard target shooting should never be attempted; a stray bullet may cause injury in any populated area. Basement or other in the house shooting should be practiced only if a satisfactory backstop has been constructed. Shooting at hard, horizontal surfaces, or over water should be avoided, because bullets ricochet from such surfaces.

Every gun should be treated as a loaded gun. The first action in handling any gun should be to make sure that the muzzle is pointed in a safe direction, *never* at a person, then examine the breech to make certain that the gun and magazine are empty, and look through the bore to see that it is not obstructed. Never look into the muzzle end of a gun to determine the condition of a barrel, look into the breech end. Then look a second time to be certain that the bore is clear. If the shotgun or rifle is of the type in which the cartridges are contained in a tubular magazine, the tube should be withdrawn and the magazine carefully examined to make sure that a cartridge is not stuck in the tube. Some slight deformity in the tube—grit or excess grease, or a weak magazine spring—may cause a cartridge to remain concealed. A sudden jar later may cause the cartridge to drop into position and be fed into the chamber, from which it could be fired accidentally.

Sometimes gun barrels burst as the result of using special-purpose or extra heavily loaded shells in guns that are not designed to

withstand the higher pressures created when firing such ammunition. Warning notices on shell boxes, containing ammunition made with modern high-pressure powder, caution persons against using those shells in obsolete guns. In recent years the country has been flooded with cheap foreign-made guns and pistols, many of which are poorly made and unsafe to use with any ammunition. Persons have been injured as a result of firing a gun while there is an obstruction of some kind in the barrel—perhaps an oily rag that has been put into the barrel to prevent rusting. Gun barrels have been known to explode when persons attempting to shoot a fish, turtle, etc., have placed the muzzle end of the gun barrel in the water and pulled the trigger.

When buying ammunition, care should be taken to make sure that it is suitable for the gun in which it is to be used. The size of shotgun shells is determined by the gauge of the gun. This gauge is stamped on the gun so that the correct ammunition will be used. In rifles, pistols, and revolvers, the correct size of the cartridge is determined by the caliber and model which are stamped on the barrel. Smaller ammunition than that for which the gun was constructed may slip into the barrel and cause the gun to burst when ammunition of the correct size is later injected.

Before loading a gun, the barrel should always be inspected to make sure that it is clear. An obstruction, such as dirt, snow, mud, or a cleaning patch in the bore of the gun, may cause the gun to blow up when fired, or force burning powder through the breech, either of which is likely to result in serious injury to hands, face, or head. Such inspection should be made only by looking through the barrel from the *breech* end— *never* the muzzle end. In loading a gun, the muzzle should not be pointed toward any part of the body, nor at any other person, nor at any surface which could cause a ricochet.

A gun should be pointed *only* at the object which is to be hit. Horseplay with guns should never be tolerated. If one is not certain of his target, he should *not* fire.

Loaded guns should not be leaned against trees, fences, walls or other objects. It is dangerous to carry loaded guns in an automobile, wagon or similar conveyance. A sudden jar of the vehicle might cause a loaded gun to be discharged with serious consequences. When hunting from a boat, guns should be left unloaded and with their muzzles pointing away from the boat until the boat is in the

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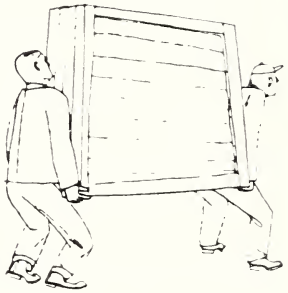
proper location and the hunters are in position for shooting at the game.

When carrying a loaded gun, the gun should be kept on "safety" as a twig or underbrush might hook the trigger. However, it is not safe to trust a "safety" completely, and the gun should be carried in such a way that if the "safety" fails, no injury will result. When climbing with a gun over or through obstacles, such as fallen trees and fences, "break" the gun or open the breech and put the gun over the obstacle first.

A gun should be cared for just as any other piece of fine machinery. A well-kept gun has all corrosive chemical removed from the bore, all dust and dirt removed from the outside parts, no excessive oil left in the action part and that when the gun is put away, that the "safety" or its equivalent is on.

4. HANDLING MATERIALS



The proper handling of materials in the home is of great importance because almost every person in the home at some time or another lifts, carries or lowers material and objects. The following information taken from National Safety Council literature will be of help in the prevention of injuries due to handling of materials.

Strains and sprains or cuts and bruises are the injuries most frequently resulting from handling objects. The hands, the feet, and the back are the three parts of the body most frequently injured. Factors contributing to handling injuries are:

(*a*) Handling loads that are too heavy.

(*b*) Lifting or lowering with the back muscles instead of the leg muscles.

(*c*) Handling load with an insecure grip and failing to watch where hands are placed.

(*d*) Handling without sufficient help or failing to use mechanical equipment.

(*e*) Handling before getting a firm footing.

(*f*) Lifting or lowering with a jerking, twisting movement of the body, or when the body is in an awkward position.

Some of the common activities involved in handling are carrying a tray of dishes; moving luggage boxes, electric fans, etc., from a closet shelf; moving pieces of furniture while cleaning house; and putting up or taking down screens and storm sash.

General

The actual number of pounds a person can handle safely depends upon the person himself. Physical condition, training, and experience in handling will be the criteria for determining how heavy a load any person can handle. A general guide recommended by the United States Department of Labor is: Men should handle no more than 50 pounds; women, no more than 25 pounds. Many persons should not handle this much. The top limit for boys and girls is usually much less.

A person can usually tell when he is handling too much because he feels strain or pull, which serves as a warning to him to secure help or reduce the load and make several trips. When help from one or more persons is necessary, the efforts should be distributed evenly among the persons. One person should call the moves in order that confusion and resulting undue strain may be avoided.

At no time should a person's view be obstructed by the object being lifted or carried. This is especially important when carrying a load up or down stairs, as the probability of falling is increased. Generally, help should be obtained, or the load should be divided.

Persons continually lifting, lowering and carrying heavy objects should rest frequently. This is necessary because a tired person who has been carrying even moderate loads over long distances for a period of time is more subject to strain, sprain, tripping and loss of balance. Sustained strain on muscles, as a result of continued lifting and carrying, may have the same effect on a person as lifting a load with a sudden jerk.

Lifting

Before lifting a load, take a good look at it, estimate its weight, and decide the best way to lift it safely. If it is too heavy or too bulky for your strength, get help. These lifting procedures should be followed:

(*a*) Get a firm footing.

(*b*) Crouch down to the object.

(*c*) Bend knees, but keep back almost vertical.

(*d*) Get a comfortable, secure grip on the object.

(*e*) Straighten knees, rise, keeping load close to body.

To maintain a firm footing, the feet should be far enough apart to provide a broad base for balance. A reasonable distance is the length of the shoe.

Before crouching down to lift the object, be sure the hands, objects to be lifted, and the floor are free from grease or any other slippery substance. This eliminates the possibility of falling or of dropping the object. One should also watch for slivers, jagged edges, nails, and pinch points on the objects to be handled. If there are rough edges, heavy gloves or hand pads should be worn. The edge of the object should be grasped firmly and hands should not slide along the edge. The load should be carried close to the body. The center of gravity of the load should be almost directly over the feet.

When lifting, the weight should be raised gradually by straightening the knees slowly. Lifting in this manner puts the strain on the strong leg and shoulder muscles rather than on the weak back muscles. In rising from the crouching position, it is sometimes helpful to rest the load against one knee. Quick, jerking movements should be avoided because they may cause injury by putting sudden strain on the muscles. Whenever mechanical lifting equipment is available, it should be used.

Lowering

In lowering an object:

(*a*) Estimate the weight of the object. If it would be too heavy for you to *lift,* don't try to *lower* it.

(*b*) Get in a position so that you will be able to hold the load close to your body. The center of gravity of the load should be almost directly over the feet.

(*c*) Turn the object so that you will be able to get a firm hold on it. If you are lowering a box, you might hold it by the two diagonal lower corners, or by an upper and a lower corner.

(*d*) Get a firm footing.

(*e*) Crouch down, keeping the back almost vertical.

(*f*) Put the part of the load that is away from the hands on the floor first and remove one hand at a time from the load to prevent pinching the fingers.

When handling objects from shoulder level or above, the distance should be broken by resting the object on a lower shelf, table, etc. This gives an opportunity for one to get a more advantageous grip before lowering the object to the floor. Moving objects from shoulder to floor level is hazardous as the handler may lose his balance and fall.

Carrying

The method of carrying should be suited to the size, shape, and weight of the object. Objects should be carried so that they do not interfere with vision or with the natural manner of walking.

Objects with handles, such as suitcases, shopping bags, etc., should be carried at one's side. However, if it is necessary to carry such objects for a long period of time, frequent stops for rest are recommended, as the hands, arms, and shoulders may otherwise be strained. Shifting the object from one hand to the other relieves strain. When possible, it is advisable to divide the load into two portions, one for each hand. This balances the weight.

When objects are carried on a tray or in front of the body, the tray or bundle should be held at about waist level. One should always be careful that the objects are not so large or stacked so high that they obstruct vision.

If one carries objects with the load balanced on the hips, the body must be bent to one side to maintain balance. One arm gets all the strain, and sometimes the hip is chafed by the friction. Whenever possible, it is better to use one of the other methods.

5. HAND TOOLS

Almost every home has a hammer, screw driver, a pair of pliers, and perhaps a hand saw and one or more wrenches. However, not every person in the home knows how to use hand tools nor how to take proper care of them. As a result, the misuse of hand tools is the cause of many injuries in the home, sometimes quite serious ones.

The most common unsafe practices in the use of hand tools in the home are:

(*a*) Failure to use the right tool for the job.
(*b*) Failure to use the tool properly.
(*c*) Failure to keep tools in a safe condition.
(*d*) Failure to keep tools in a safe place when they are not in use.

The following information based on data in National Safety Council literature will, if followed, do much to lessen hand-tool injuries in the home.

General

When not in use hand tools should be kept in tool cabinets or in a tool rack on the wall where they are easily accessible. Sorting tools for the right one often causes injuries as well as damage to the tools. An attempt to use a dull or damaged tool often results in an injury. Tools should be kept in good condition. Wood handles should be firm and smooth to eliminate the possibility of injury by slivers and should be made from straight-grained material such as hickory, ash, or maple. The handles should be securely fastened to the heads of tools, such as hammers, mallets, and sledges, to keep the head from flying off the handle when a blow is struck with the tool. Blades of cutting tools should be kept sharp and have the proper angle, because sharp tools are safer and more efficient than dull ones. Dull tools may slip, stick, or slide, and cause injuries to the user and damage to the material being worked. Chisels, punches and similar tools with mushroomed heads are unsafe to use because when struck a blow a piece of the mushroom may break off and fly and injure the worker or someone nearby. Mushroomed tools may be made safe by grinding off the mushroom.

Can openers

The safest can opener is one with a revolving motion that folds under the sharp freshly cut edge of the can top. If it is necessary to use the common pry type of can opener the can should be held firmly, supported on the table. Special care should be exercised so that the can does not slip as jagged edges of the can are turned up by this type of can opener. The hand may be protected by a thick pad held firmly on top of the can when the pry type opener is being used.

Chisels

Cold chisels are used for cutting metal and should be made from tough, high carbon steel. Wood chisels are also of metal and are used for cutting wood, plastics, etc., but unlike the cold chisel are

provided with handles. The head of a cold chisel should be dressed to a curve of about three-sixteenths inch as soon as it begins to check, in order to withstand a maximum amount of pounding. Cold chisels with mushroomed heads should not be used; the mushroom should be ground off before the tool is used. Handles of wood chisels should be strong and substantial. Because it is necessary to use both hands on the handle of a wood chisel to do a good job, the work should be securely braced or clamped. When a mallet is used for striking the end of the handle of a wood chisel, it is good practice to use a chisel having a plastic, leather, or metal band around the end of the handle so that the handle does not slip or spread.

Crowbars

The principal hazard in the use of crowbars is encountered when the bar slips, causing the user to fall or the bar to fall on his foot. This is generally due to not placing the point of the crowbar under the object to be moved or because the point of the crowbar is dull and does not readily grip the object.

Files

The principal hazard in the use of a file is that the user sometimes does not have a handle on the tang end and the file slips and the sharp point of the tang pierces the hand of the user. Files should be kept clean by means of a wire brush known as a file card, otherwise the teeth become clogged and will not take hold of the object to be filed. Files are made of brittle steel and should never be used for any other purpose than filing.

Hammers

Driving or pulling nails is a common practice in the home. For that purpose a claw (carpenter's) hammer should be used. The hammer should be in good condition and the head securely and squarely fastened to the handle by wedges, or other effective means. When striking a blow with a hammer, grip the handle firmly and close to the end to increase the length of the lever arm and make the blow more effective. Whenever possible, strike the object with the full face of the hammer. Striking at an angle may cause chipping or other damage to the material being worked. The user should keep his eyes on the object being hammered and should center attention on striking an accurate blow, otherwise he may strike and mash a finger or thumb. The face of the hammer and the handle

must be clean and free from grease, dirt, etc., otherwise the hammer may slip in an effort to strike a blow. To drive a nail safely hold it between the thumb and forefinger, near the head of the nail; rest the hammer on the head of the nail, then draw the hammer back and give the nail one or two light taps to start it. Then complete the operation by squarely hitting the nail head several blows to drive the nail home, taking care not to strike the surface of the material into which the nail is being driven.

Hand Planes

There is little danger in the use of hand planes if the blades are kept in good condition and are properly used. The chief hazard is a dull blade which may jam and stick. When using a plane, raise the plane slightly on the back stroke to protect the blade from dulling.

Hatchets, Axes

These tools should be kept sharp and the handles should be of good material well secured to the tool head. When using an axe or hatchet, be careful that there is no obstruction in the line of swing and see that no one is standing close enough to be hit by flying chips. The eyes should be kept focused on the object to be hit, and the handle of the tool should be as nearly horizontal as possible when the blade strikes the object to be hit. This class of tools often causes accidents when left lying about where they can be stepped on or struck accidentally. Therefore extra care must always be taken after using these tools to make sure they are placed where they will not be a source of injury to someone. Leather cases should be used for carrying double-edged axes, but if this is not possible, the tool should be carried with the cutting head forward, the handle gripped directly behind the head. Single-edge axes should be carried on the shoulder, the axe head back of and close to the shoulder with the blade turned out away from the carrier.

Knives

The correct size and type of knife should be used for each job—a small knife for paring fruits and vegetables and for carving wood; a large knife for slicing bread, carving meat, etc. Whenever using a knife attention should be focused on the work being done. Sharp knives of all kinds are safer than dull ones; they do not require as much pressure to do their work, and, therefore do not slip as

easily as dull ones when being used. In making a cut with a knife always cut away from yourself; otherwise if the knife slips, a finger or some other part of the body may be injured. Sharp knives should be washed separately, not handled along with other utensils. Each knife should be dried separately, holding the sharp edge away from the hand using the towel.

Knives should not be used for opening jars or cans because they may easily slip on the rounded surface of a jar or can, thereby causing a hand or finger injury. If a knife blade is jabbed into the top of a can, the keen edge of the blade is dulled and sharp edges of tin are left. The blade may also slip or break suddenly because of the pressure required to pierce the tin. A can opener should be used for opening tin cans. The use of a jack-knife for such purposes is even more dangerous because the jack-knife blade may close, catching a finger between the blade and case of the knife. Kitchen or other sharp edged knives should be kept in slotted racks, either on the wall or in drawers, well out of the reach of small children.

Pliers and Wire Cutters

Pliers should not be used to loosen or tighten nuts because the pliers may slip off; use a wrench of the proper size for that purpose. Before attempting to use a pair of pliers on an electric circuit be sure the current is off, otherwise the user may receive a painful or perhaps fatal shock. When cutting wire under tension or when cutting spring wire in coils, always take hold of the wire close to the cutter, stand so that the loose end will not fly into the face, and be sure that cutting is done away from cutter. Pliers and wire cutters, like screw drivers, should not be used as substitutes for hammers, etc.

Saws

The saws commonly used in the home are the hacksaw and the handsaw. The hacksaw is used to cut metal and the handsaw to cut wood. There are two types of handsaws, the ripsaw to cut with the grain and the crosscut to saw across the grain. All saws should be kept sharp. In starting a saw cut, the thumb of the left hand should be used to guide the blade until the cut is started at the desired location. The first stroke of the saw should be in the up direction. Sufficient pressure should be used when starting the cut so that the saw immediately begins to bite into the wood. Whenever possible, a sawhorse, bench, or a vise should be used to support the

work being sawed with a handsaw and a vise should be used to secure work when using a hacksaw.

Scissors

While cutting with scissors, attention should be centered on the fingers of the hand supporting the material and the path of the scissors should be kept clear. Scissors should be handed with the blades closed and the handle towards the person receiving them. Eye accidents and cuts and stabs are caused by running with sharp pointed scissors and by tossing them to other persons. Small children should never be permitted to use sharp pointed scissors. When they use scissors they should use scissors with rounded points. Scissors not in use should be kept closed and in a case or box, or hung securely from wall hooks.

Screw drivers

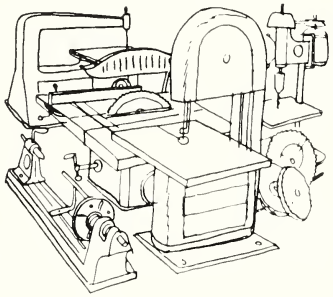
Screw drivers present a hazard when misused or when the user lacks knowledge or skill in using them. All screw drivers should have smooth, firm handles, and the blades should be kept in good condition because the screw driver becomes useless and dangerous if the blade is broken. Always use a screw driver with a blade that fits the screw to be turned. The blade of the screw driver should be seated squarely against the bottom of the screw slot. Never hold the work in one hand and the screw driver in the other, because the screw driver might slip from the screw slot and pierce the hand holding the work. Screw drivers with insulated handles should be used when making electrical repairs or installations and be sure the current is off before attempting such work. Screw drivers should not be used as substitutes for chisels or hammers or for purposes other than to turn screws.

Vises

A vise should be solidly mounted directly over the leg of the workbench on a two inch plank. The solid jaw of the vise should extend at least one-half inch beyond the edge of the plank. The vise should be bolted onto the plank rather than be fastened with wood screws. It is important that the vise be heavy enough for the work that is to be done. Before opening the vise, be sure to have a firm hold on the object in the vise so that the object will not fall or fly off when the grip of the vise is released.

Wrenches

The wrenches most commonly used in the home are the open end type and the adjustable type (or as it is sometimes called, the monkey wrench). If an open end wrench is used to tighten or loosen a nut, be sure that the wrench properly fits the nut, otherwise the wrench may slip and the user may be injured. When using an adjustable wrench to tighten or loosen a nut place the wrench in such a position that the pull on the handle tends to force the jaws further onto the nut, that is, with the open ends of the jaws facing in the direction in which the pull is to be made. Wrenches should not be used as hammers, as this weakens the wrench and eventually may cause an accident.



6. MACHINERY

All kinds of machines, whether motor-driven or not, present hazards when not properly guarded and properly handled. Too great care cannot be exercised when purchasing mechanical equipment to see that all possible protection against accidents has been provided. The small hand-operated meat and food grinders that are used so commonly in the home are a rather frequent cause of finger injuries because in feeding material into such machines, it is a common practice to push the material down into the hopper with one hand while turning the grinder crank with the other, and as a result a finger of the hand feeding the material is caught in the revolving screw of the grinder. Such accidents may be avoided by using a short hardwood stick to push the meat or other food down into the grinder hopper.

General

All machines which have gears should have them so enclosed that fingers and clothing will not be caught in the gears. This applies to washing machines, ice-cream freezers, churns, bread mixers, and many other forms of household appliances. Wringers, especially the motor-driven wringers attached to washing machines, should have

a guard to prevent the fingers from entering between the rolls, and, in addition, should have a release device so that extreme pressure upon the rollers will throw them out of gear. Sewing machines should have a guard to prevent the fingers from getting under the needle. Electric fans should always be provided with a guard over the fan blades. Any machines having blades or other sharp parts should be handled with great care. A lawn mower if turned while being cleaned may easily cut off the fingers.

The power tools used in the home workshop are usually woodworking machines of various kinds. However, in many home workshops will be found metal working machines such as lathes, drill presses, and possibly a tool grinder.

All power tools should be securely mounted on suitable benches, stands or floor. They should be kept well lubricated. They should never be cleaned or oiled while running. When operating a lathe wear snugly fitting short-sleeved shirt or jacket with no loose or torn parts and thus avoid the possibility of being severly injured because your clothing has caught on a moving part. Long neckties offer a similar hazard, as do rings or wrist watches.

Chips and sawdust should never be brushed off a saw, jointer, shaper, or other woodworking machine by hand while the machine is running. A suitable brush should be used for this purpose, preferably after the machine has stopped.

Children should never be permitted to operate any machine, especially a power-driven one unless they have been trained in its use or they are operating the machine under the direction of a person skilled in the safe operation of the machine. Young children should not have access to such machines, as they do not realize the dangerous possibilities involved in trying to operate them.

Band saws

The wheels of a band saw and the blade (except at the point of operation) should be fully enclosed, not only to keep a person from coming into contact with the blade but also to prevent body injury in case the blade should break. The saw-blade guide should be so adjusted that there will be no unnecessary clearance between the guide and the work.

Circular saws

As a rule, circular saws are provided with guards which should be kept in place while the machine is in use, when it is practicable to

do so. If the guard is of the type that is secured to, and forms a unit with the splitter, it may become necessary to remove it when the saw is to be used for grooving or for some other special operation, but it should be replaced before the saw is again employed for normal purposes. The operator should use a push stick when sawing narrow strips to avoid bringing his hands dangerously near the saw blade. Because of the possibility of a kickback he should never stand directly in line with the saw nor push a board with his body. He should hold the work firmly on the saw table and be sure that it does not strike the top or back of the saw. The saw blade should be kept sharp and the teeth of it properly set, because more pressure against the work is required if the saw is dull and this increases the danger of the operation. The height of the saw above the table should be so adjusted that the blade will project above the table slightly more than the thickness of the wood that is to be cut.

Drill presses

When operating a drill press be sure that the work is securely clamped or otherwise secured in position so that it will not turn with the drill. Never attempt to hold a small job in the hands while drilling it as such a practice is certain to result in a serious injury at a time when least expected.

Grinding wheels

In many home workshops there is a motor-operated grinding wheel for sharpening tools and doing other work. Often the user knows little or nothing about the safe speed of the wheel, the proper method of mounting it, or the necessity for keeping it when not in use, where it will be protected against dampness, and damage that might be caused by dropping tools or other objects on it or in other ways.

The extent of personal injuries or property damage that may result in case a grinding wheel bursts, varies in accordance with the speed of the wheel, the weight of the flying pieces, and other conditions. Even a tiny light-weight piece of a small wheel might easily cause the loss of sight, if a person's unprotected eye were struck by the flying piece.

In mounting a grinding wheel, regardless of its size, it is highly important to use properly recessed flanges, to place washers of compressible material (blotting paper or rubber-gasket material)

between the flanges and the sides of the wheel and to avoid drawing up the flanges too tightly. Before a wheel is mounted, it should be carefully examined for cracks and other defects, and tapped lightly with a screw-driver handle or a wooden mallet. This test should be applied only when the wheel is dry, and free from sawdust or other material in which it has been packed, otherwise it will not give a clear ringing tone, even if it has no cracks or flaws.

When using grinding wheels, avoid striking them with tools or other objects because even slight blows are likely to crack or break them.

The safe speed (revolutions per minute) of a grinding wheel varies in accordance with the diameter and types of the wheel and the kind of machine or stand on which it is mounted. Grinding wheels should not be operated in excess of the speed stamped on the label affixed to the wheel by the wheel manufacturer.

Care should be taken to store wheels carefully when they are not in use—they should not be placed in tool boxes or drawers where objects are likely to be dropped on them, nor should they be stored in a damp location.

Many wheel breakages and injuries to home operators of grinding wheels have occurred because the work has become wedged between the work rest and the wheel. Such accidents may be largely prevented if the work rest is substantially constructed and is securely clamped in position at a distance of not to exceed ⅛ inch between the work rest and the wheel.

When operating a grinding wheel wear a pair of goggles which will prevent particles of metal and abrasive from entering the eyes.

Jointers

Circular heads should be used on jointers and the knives should be kept sharp, properly adjusted and securely fastened to the machine arbor. A push block should be used when planing short and thin pieces. Each jointer should have an automatic guard which will cover all the section of the head on the working side of the fence or gauge except that part of the head actually covered by the work being planed. The section of the cutting head back of the fence or gauge should be covered by a guard which will effectively prevent accidental contact with that portion of the head.

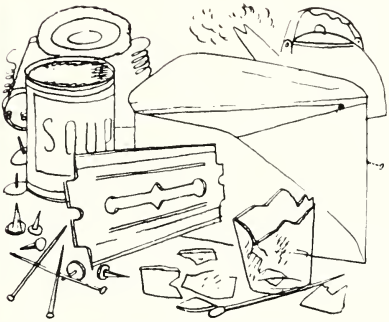
Lathes

Home operators of metal-working lathes are sometimes injured because of displacement or breaking of the tool or of the stock that

is being processed. Insecurely or improperly placed tools often work loose and cause trouble in other ways. They may dig into the work and unless the lathe is stopped immediately the tool is likely to break or be forced out of the tool-post; or the work may be thrown out of the chuck. To prevent such accidents (*a*) select a tool that is suited to the job; (*b*) make sure it is in good condition; (*c*) set it properly in the tool-post; (*d*) secure it firmly; (*e*) see that tool is not set for an excessively deep cut or too rapid feed; and (*f*) if work is performed with the work revolving between head and tail stock centers, see that the centers are properly adjusted to fit the counterbored holes at each end of the piece being cut. When filing revolving work in a lathe, the filing should be done with the file in the left hand, especially when near the lathe dog or chuck; also see that the file is equipped with a handle and that you are standing in such a position that if the file is forced upward, it will go past your body instead of against it.

Shapers

Great care must be exercised to secure shaper cutters firmly on the spindles, because they revolve at high speed and might cause serious injuries if they should work loose and fly off. The cutters should be kept sharp and in balance. A guard should be provided which will keep the operator's hands away from the cutting edges of the blades.



8. MISCELLANEOUS HAZARDS

1. CERTAIN GENERAL HAZARDS

The purpose of this chapter is to bring to the attention of householders and members of their families a number of recommendations for the promotion of safety in the home not discussed elsewhere in this publication. However, it is not intended to include in this chapter all household safety recommendations not elsewhere discussed.

Trash, in the form of broken glass, or old tin cans with ragged edges, is a frequent cause of bad cuts and scratches. Such articles should be handled carefully and should be placed at once in appropriate receptacles for disposal. If such trash is permitted to accumulate on vacant lots, children should never be allowed to run barefoot there as serious cases of blood poisoning have resulted from cuts produced in this way.

Bruises

Bruised fingers frequently result from being caught by doors, windows, screens, etc. Children should be warned against this hazard and especially against being caught behind the hinges of doors. Bruises on the head are often the result of insufficient headroom in cellars, on stairways, etc. This is a matter to be considered when building a house.

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Electric Batteries

Electric batteries for ringing doorbells are frequently placed in very insecure locations, so that a slight pull upon the loose terminal wire may precipitate the battery upon the head of the unwary. If ordinary cells are used they should be placed in a box. It is more satisfactory to operate a bell from a bell-ringing transformer, if electric service is available.

Envelopes

Envelopes and other gummed articles should not be licked for the purpose of sealing them. The tongue may be cut when wiped along the edge of the paper. If the tongue is used for this purpose it should be merely pressed against the gum in several places. This avoids cutting the tongue and also avoids wiping the gum off the paper. The skin on the more tender parts of the fingers is not infrequently cut similarly by being drawn along the edge of stiff paper. Satisfactory and safe moistening of the gum on envelopes and other gummed articles may be accomplished by means of one of the small applicators which have attached to one end a small piece of sponge or other material that may be moistened. Such applicators may be obtained for a few cents in any stationery supply store.

Razor Blades

Safety razor blades present a problem because they are so small that they are overlooked, and because they are so well adapted for various purposes. After they have lost their keen shaving edge they are used by women in the household for ripping seams, by the men for scraping paint and often by the children for sharpening pencils. Special inexpensive holders which completely cover the blades when not in use, have been devised and are available. These holders make the use of the blades considerably safer for the purposes mentioned. Such holders should be obtained and used. The blades should be kept in a covered box or other container out of the reach of children when not actually in use. Discarded blades should be disposed of by placing them in containers provided for that purpose and disposed of afterwards in a safe manner. Such blades should never be left lying about where children and others may accidentally come into contact with them. Serious and painful cuts have been caused by contact with a discarded safety razor blade left on a stand, washbasin or even in a medicine cabinet.

Miscellaneous

Stumbling over objects and bumping into furniture can largely be avoided if upon leaving a room, and especially when putting out lights, care is taken to see that furniture and other objects are in their usual positions and are not in the customary travel paths between doors. This is particularly important if there are in the household persons who are blind or who have defective eyesight.

In stacking objects in closets, in attics, upon shelves, and in other storage places, if the objects are so placed that they will not slide or fall off, accidents may be avoided.

When workmen are doing repair work upon a home, indoors or outside, children should be cautioned against walking or playing beneath the ladders or scaffolds, as tools and other objects are sometimes inadvertently dropped.

The flooding of a floor from an overturned vessel of water, an overflowing plumbing fixture, or from a roof leak frequently results in soaking the plaster of the ceiling below. Such plaster is very likely to fall, and the area below it should be avoided until the plaster is known to be safe or has been replaced.

Pins, tacks, coins, and similar articles having sharp points or edges, or which are small enough to be swallowed, should never be placed in the mouth. Such articles may cause much trouble if swallowed and blood poisoning sometime results from cuts or scratches made inside the mouth.

The careless handling of hot water may result in painful and serious scalds. The lid of a teakettle should not be lifted while the kettle is held by the handle, as the sudden heat of the steam evolved may burn the hand or cause the grip to be released and the kettle dropped. Pots of boiling water near the edge of a stove may be knocked over or be pulled over by children and produce serious scalds. It is dangerous to carry a child and a kettle of hot water upstairs at the same time, as tripping in such a case may cause a serious accident. A washtub or wash boiler full of hot water should rest very securely on the bench or other support, so that it cannot be easily overturned. Sudden pouring of hot water into a tub should be avoided because the water may surge back with sufficient force to overturn the tub towards one. Pails or tubs containing hot water, hot starch, and other hot liquids should never be left standing on the floor, where children might fall into them, nor on tables or chairs where the children might tip them over.

2. TOYS AND PLAYTHINGS

Toys should be built substantially enough to withstand the investigation of their construction by curious children. Surfaces of toys should be smooth and free from sharp edges or points. Edges of metal toys should be rolled or turned in and corners should be rounded. Play tea sets should be made of material which if broken will not produce sharp edges. Children's toys made of lead or colored with lead-base paints should be avoided because of the possibility of lead poisoning. The label affixed to the toy by the manufacturer should be examined to ascertain if vegetable-dye or other nonpoisonous paint has been used in the makeup of the toy.

Horns, whistles, bubble blowers, mouth harps, or any type of toys which require the use of the mouth should be made strong enough to prevent the user sucking parts of it into his throat.

The wheels of wooden toys should be attached to the toy with screws and the pull cord should be fastened to the toy with staples or tied through a neat round hole in the toy. These parts should never be fastened to the toy with thumbtacks, carpet tacks or nails.

Pencils, crayons, paint brushes, or other objects used in construction toys should never be held in the mouth. Serious mouth or throat injuries could result from a fall in such case, or parts of the object may be broken off and swallowed.

The use of fireworks should be prohibited by law at all times, except at public displays, where they are used under the supervision of trained adults (see also chapter 4, section 9).

The eyes of dolls or other stuffed animal toys should be sewed in, not fastened with pins. Eyes of buttons, etc., are not recommended; embroidered or cloth eyes are safest. Dolls with heads of fragile material are not safe for small children. Dolls and stuffed animal toys for such children should be made entirely of cloth or other soft material, free of harmful dye.

Every home should have designated places for keeping toys and play equipment not in actual use. Low shelves are good places for

toys, as they are easily accessible and make it possible for a child to see "his prized possession" without having to dig to the bottom of some box. Toys and other play and sport articles should never be left on the stairs, floor, or sidewalk, where persons may fall over them. Adults and their children should work together in putting away toys, until the user is old enough to do it for himself.

Electric and mechanical toys

Electric toys should never be handled with wet hands. If a youngster has been playing in the snow, he should put on dry clothing before playing with electric toys. A heavy mitten worn by a child when using a play electric iron or stove will help prevent hand burns. All electric toys should be of approved design and construction such as those bearing the label of the Underwriters' Laboratories, Inc. All electric toys should be maintained in a safe condition. At the first sign of a defect, the necessary repairs should be made or the toy discarded (see also chapter 3, section 2).

In the construction of key winding toys, the spring should be strong and enclosed in a cylinder which is adequate to withstand the shock from the spring if it should break. The key should not revolve when the toy is in action, because a finger might be mashed by the revolving key if the child should pick up the toy before it has run down. If the toy has gears, they should be fully enclosed.

The rapidly growing interest in model airplanes, boats, and racing cars has made the toy internal-combustion engine a fairly common article. Most of these use a mixture of high-test gas and lubricating oil in the fuel tanks. The supply of this fuel (other than an ounce or two required for operation) should be kept outside of the house at all times. The continual operation of one of these small motors indoors may in time produce dangerous concentrations of carbon monoxide. While the displacement of such an engine is generally a fraction of a cubic inch, the rotational speeds are high—from 5,500 to 6,500 r. p. m.—so that a relatively large amount of exhaust gas may be produced in a few minutes. When the engine is cold or just being "run in" the exhaust gas would probably contain very appreciable percentages of carbon monoxide. Insist that at least one window in the room or basement be open when such toy motors are being run.

Construction toys, for a person who has not yet learned how to use hand tools, should be of a type to be glued or fitted together.

This would avoid mashing a finger with a hammer while driving in nails or tacks (see also chapter 7, section 5).

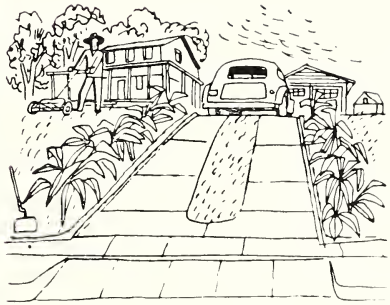
Miscellaneous Toys

All chemical sets are potentially dangerous. If a youngster desires a toy chemical set he should be taught what each substance in the set is, how it reacts under varying temperatures, if it is flammable, and what the reaction is when combined with each of the other substances in the set. *Under no circumstances should he be permitted to mix substances just to see what will happen.*

Toy weapons cause may serious injuries and sometimes fatalities. They are not suitable gifts for small children; and when they are given to older boys and girls, the proper and safe use of them should be explained and demonstrated by trained adults. This caution is important in connection with archery sets, air rifles, and firearms, which must be used correctly and in safe locations if serious accidents are to be avoided (see chapter 7, section 3).

When bow and arrow are used be sure the bow is of suitable wood. Among the best are yew, osage orange, lemonwood, and hickory. Many of the cheap sets for small children are made of wood that will break with considerable splintering if the bow is pulled beyond a certain point. The grain should be parallel with the top and bottom surfaces of the bow. The conical brass cap of the usual arrow can cause a painful injury. Children should be taught to wait until everyone is away from the target before releasing the arrow and to avoid shooting at random into underbrush which may conceal a person. Broadhead or hunting arrows should never be left where children may get at them. Even in the hands of a child using a small weak bow such arrows may produce a serious wound. Crooked or bent arrows should be destroyed since they will not fly true but may dart off at erratic angles. A guard should be worn around the wrist next to the bow as a protection against abrasion by the recoiling bow string. To prevent finger cuts when aiming and shooting, the arrow should lay atop the hand and not be held between the fingers.

Kite strings should be made of nonconducting material. Wire or tinsel string, such as that used for tying Christmas packages, may cause the kite flyer to receive an electric shock if the kite drops across an electric power line. A cotton string is safest, *but* will conduct electricity if it is wet. Kites should never be flown where the strings may come into contact with electric wires.



9. YARDS AND GARDENS

Many injuries occur in the yards and gardens of homes. Most of these injuries are due to unsafe physical conditions of buildings and grounds, to the improper use of equipment such as ladders, hand tools, etc. Others are due to miscellaneous causes such as contact with poisonous plants. Many of the hazards which are found in yards and gardens are due to poor housekeeping. Good housekeeping is just as essential in the yard or garden as it is in the house itself. Many cuts received in the yard or garden result from the presence of broken glass, boards with upturned nails, cans with rough edges and other similar conditions which should never exist. The prompt disposal of rubbish would avoid accidents and prevent many fire hazards. Children's toys and playthings should not be allowed to remain in the yard where someone may stumble over them. Children should be taught to keep these things in a safe place when they are not in use.

1. DRIVEWAYS AND WALKS

Driveways in the yard are used principally for driving the family car to and from the street and garage. They are also used in some instances for the receipt of coal, wood, and household supplies of one kind or another. Where driveways are deeply excavated to give access to basement garages, etc., they offer a serious hazard to

children playing in the vicinity or to adults unfamiliar with the terrain while walking about the yard, especially in the dark. If possible, the banks on the sides of such a driveway should be sloped not steeper than thirty degrees; otherwise the cut should be walled and a substantial guardrail provided on top of each retaining wall.

The grade of the driveway from the garage to the street or alley should be as low as possible, and sharp curves should be avoided. Very steep drives are hazardous particularly in snowy or icy weather; in fact many such driveways render the use of the automobile impossible under bad weather conditions. Where steep approach drives are necessary, adequate drains must be provided at the low point (which should be well outside the garage doors), otherwise the garage itself may be flooded. Where steep grades cannot be avoided, boxes or pails of dry sand should be available during stormy weather and the sand should be used freely when the driveway requires it.

Driveways level with the contour of the ground offer hazards to children playing about the premises, particularly where the driveway is screened by hedges, trees, or clumps of shrubbery. Care should always be exercised in swinging from the street or alley into such a driveway. Service delivery trucks and others may use such driveway, the safe arrangement is to avoid planting trees or shrubs that will mask the driveway and to keep hedges low enough to permit a clear view of the driveway from the street or alley.

Outside approaches to the entrances of houses should receive attention to eliminate the possibility of a person falling or slipping. Persons who are not entirely familiar with the location and entrance steps of a home are likely to fall and be injured, especially at night. If the lighting facilities are inadequate, the steps may be made more clearly visible by applying white paint to the outside edges of the steps and to the handrail. In winter steps that are exposed to snow and ice may become dangerously slippery. If temporary, well secured wooden coverings are provided for the steps, together with a suitable handrail, the danger of falling or slipping will be greatly decreased. Sprinkling salt, ashes, sawdust or sand on these slippery places is also effective in preventing accidents. Outside cellar hatchways should have substantial doors which should be kept closed when the stairs are not in actual use or the hatchways should have substantial handrails.

All driveways and sidewalks should be kept in good condition, smooth, and free of defects which may be a stumbling or tripping

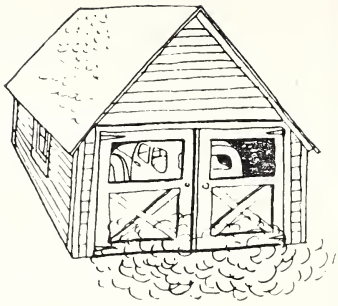
hazard. They should be kept free of bicycles, children's toys or other objects which are tripping hazards. Keeping driveways and sidewalks safe not only prevents accidents but may save the owner from having to pay large sums for personal injuries to those who may have occasion to use the walks or driveways.

2. GAMES AND SPORTS

The discussion of games and sports in this section is limited to those recreational activities usually carried on in the home or in the home yard or garden. Therefore, outdoor recreational activities such as boating, camping, golfing, hiking, skating, swimming, etc., are not discussed.

Children should be required to play all games and sports in accordance with "the rules of the game". Copies of instructions for the proper playing of most any game or sport may be obtained from sporting goods supply dealers, local recreation activity directors, etc. Children should not attempt to perform "stunts", "stump the leader" or other acts which may result in an injury to themselves or their playmates. Children, especially boys, have a great desire to throw marbles, pebbles, and other small objects; but the danger from throwing such things may be very great. Throwing snowballs is a favorite sport with many children. Many children and even adults have been injured when hit by a snowball containing a small stone "to give it weight." Parents should instruct their children in respect to these actions. Playing football or baseball should be allowed only on designated playgrounds or on vacant lots that have been cleared of all hazards. Play apparatus should be kept dry; wet pieces are slippery. Only one person should occupy a swing and he or she should not stand or kneel on the seat or jump off while the swing is moving. Other youngsters should be warned to keep away from moving swings. Before one gets off of a seesaw he should warn the person at the other end. The board of a seesaw should be held as nearly horizontal as possible to allow the other person to get off safely.

3. GARAGES



Asphyxiation by carbon monoxide gas is a rather common cause of fatalities in the home garage. Investigations show that the circumstances surrounding carbon monoxide poisoning are about as follows: The homeowner goes to the garage and without having opened the doors and windows wide, he starts the engine. Perhaps if the morning is very cold he may run the engine a short time to warm it up before he drives out of the garage. Perhaps after starting the engine he stops to change a tire or perform some other work about the car, and does not shut off the engine. Suddenly he falls to the floor unconscious and remains in that condition until death comes or until he is accidentally discovered, which is often too late. Under no circumstances (and no matter what the outside temperature) should one operate an automobile engine in a garage unless the doors or windows are wide open. Symptoms of carbon monoxide poisoning and the treatment of persons overcome by that gas are discussed in chapter 11, section 3.

Carbon monoxide is colorless, odorless, and tasteless. An ordinary automobile running at normal speed in the average private garage may in a few minutes easily produce enough carbon monoxide gas to raise the carbon monoxide content to three-tenths of 1 percent. As little as one-twentieth of 1 percent of carbon monoxide will cause headache and when one-fifth of 1 percent is present collapse of the person in the garage will result. A slightly higher concentration is liable to bring serious results very quickly.

If a person is found unconscious in a car with the motor running in a garage, do the following:

(*a*) Open doors and windows.
(*b*) Shut off motor.
(*c*) Get person into open air.
(*d*) Start artificial respiration (see chapter 11, section 4).
(*e*) Have someone call a physician.

If you hear a motor running continuously in your garage or in that of your neighbor's, check to see that the doors are open and the person in the garage is all right. Many lives have been saved because someone was curious enough to investigate the long-continued operation of an automobile in a closed garage. Conversely, many lives have been lost because no one did investigate.

For the man who prefers to do the service and maintenance work on his own car or who is so located that he is forced to do it, a few warnings may be in order:

(*a*) Never get under a car unless the wheels are chocked front and back. Even on apparently level ground the car may move if someone leans against it.

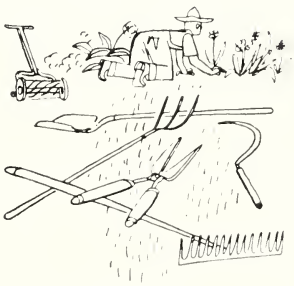
(*b*) Never get under a car that is jacked up unless the wheels are blocked and then be sure that blocks are so placed under the car so that if the car should slip off the jack or if the jack should collapse there will be ample room for you between the car and the ground or floor.

(*c*) See that all tools are maintained in good working condition; go over them periodically to see that:

1. Jaws of wrenches are not worn or sprung out of parallel so that they will slip off a nut.
2. Heads of chisels, drift pins, and center punches are free from burrs.
3. Handles of hammers, etc., are firmly secured.
4. Chipped or battered screw-driver blades are hammered flat and carefully reground.

Where a man does all the work on his car, a pan, tray or box with separate compartments for each tool is a distinct advantage as this makes it possible when working in cramped quarters to locate any tool needed (see also chapter 7, sections 1 and 5).

4. LAWN AND GARDEN TOOLS



Every year many persons, young and old, are injured by common gardening tools and appliances such as spading forks, rakes, hoes,

shovels, sickles, grass shears, pruning shears, and lawn mowers. Many, perhaps the majority of such injuries would be averted if the implements were properly disposed of when not in actual use, even temporarily. For example, when tools are laid on the ground, their points or edges should be turned down. The points of an upturned rake can inflict painful and sometimes serious puncture wounds when stepped on, to say nothing about the possibility of the handle flying up and striking one in the face. Tools should not be left where the edges or points may be hidden by grass, leaves or other materials.

When tools are not in use they should be stored in racks, or hung securely on hooks in a tool shed, basement, or other storage place. It is unsafe to lean tools against a wall or to leave them on the floor because they may not only cause someone to stumble or trip but may invite children to try to use them.

Keep the fingers away from lawn mower blades. Merely striking the hand against a blade while oiling, cleaning, or adjusting the blades, may result in a painful and perhaps serious injury if the fingers are caught between the revolving and stationary blades.

The handles of all tools should be free of cracks and splinters and should be strong enough not to break under ordinary usage. Should the handle break, serious injury may be caused by the head of the tool flying off and hitting someone or by pinching or lacerating the hand or fingers.

Having suitable tools and knowing how to use them will do much to prevent injuries. For example, when spading keeping the legs together will do much to prevent strains. Properly uncoiling a garden hose will prevent tripping or catching the foot in soil (see also chapter 7, section 5).

5. MISCELLANEOUS

Bird baths and fish ponds

In some yards and gardens there are bird baths and fish ponds. Bird baths should have sufficiently large bases and be of such weight that a child cannot pull them over. Fish ponds should not be so deep that a child falling into them will be drowned. To prevent accidents of this character, the edges of any fish pond should be guarded by substantial railings. Sometimes a heavy wire mesh screen is stretched tightly over the top of a fish pond to prevent

children from falling into the pond. As a safety measure children should never be allowed to play about a fish pond in the dark.

Cesspools, cisterns, and wells

The cleaning of cesspools is not exceedingly hazardous provided proper precautions are taken in this work. It is well to know that cesspools are sometimes filled with heavy foul air and harmful gases which must be removed before anyone attempts to work in these places. If a blower is at hand, abundant quantities of fresh air may be discharged into the bottom of the hole, through a section of hose of sufficient length. If no blower is available, and the hole is large enough to permit, an open umbrella can be dropped to the bottom of the pit and alternately raised and lowered by means of a rope fastened to the umbrella handle. This operation produces air currents which remove the poisonous air and replace it by a pure supply from the atmosphere above. A plentiful quantity of fresh, unslacked lime, upon which water has been poured, may be lowered into the hole, and left near the bottom of the space for a sufficient time to absorb the greater part of the carbon dioxide or "black damp" that is present. After these methods of ventilating have been thoroughly tried, the cesspool should not be entered until after the air has been tested and found pure enough to be safe for one to enter the cesspool. Tests may be made by lowering a lighted candle or lantern into the opening, and if the light is extinguished, or burns feebly, the presence of bad air is proved. If foul air is still present, the cesspool should be further ventilated before any person is allowed to enter it.

It may be necessary, at times, for persons to go down into wells and cisterns in order to clean them out or to do repair work of one kind or another. Well-made ladders are necessary for the safety of these persons. Every man who enters a cesspool, well, or cistern should have a rope tied under his arms, or attached to him by means of a belt, and another man should be stationed at the ground level to draw the other man out in case of necessity. Before any well or cistern is entered the same precautions against foul air as recommended above for entry into cesspools should be taken. Wells and cisterns should be provided with strong covers which are properly maintained and fastened in place to prevent anyone falling into the well or cistern. If a well or cistern is to be abandoned it should be filled to ground level with dirt and stones.

Clotheslines

The pulley clothesline is commonly used for hanging out the family wash. A rope is passed over and through two pulleys and the ends of the rope are tied together. One of the pulleys is made fast to a pole in the back yard while the other is secured to one of the posts that support the back porch, or perhaps it is tied to a window sill where the housewife can conveniently reach the rope from the window and draw the clothes in or out as desired. Often these clotheslines are placed so low that there is not sufficient headroom for a person to pass underneath the line and a person walking through the yard may strike against the line and be severely injured. Revolving clothes poles or low multiple rope racks are generally safer than a single clothesline stretched across a yard.

Poisonous plants

In order to avoid possible discomfort and even actual suffering, members of a household should learn to recognize and keep clear of poison ivy, poison oak, and poison sumac. All three belong to the same class, are poisonous to the touch and have fruit, greenish white in color, and arranged in grape-like clusters.

Poison ivy is a plant which is either a low shrub or a creeping vine. The plant leaves, which may be notched or smooth, are arranged in groups of three on short stalks of unequal length. The leaves are shiny, dark green in summer and brilliant orange or scarlet in the fall. In May and June there are tiny white flowers clustered at the base of the leaves. These flowers develop into berries which are green when immature and which turn waxy white when they mature in the fall or winter. The plant may be found in the woods or in the open in dry or moist locations along fence rows, paths, roadways, and in yards on trees and posts.

Poison oak is a variety of poison ivy and should not be confused with the nonpoisonous oak tree. The term poison oak is customarily applied to two plants. One is always a shrub; the other is a shrub but may become a vine in suitable environment. The leaves of the first type of poison oak resemble small oak leaves. They occur in groups of three, are somewhat hairy and are deeply lobed. The second type of poison oak is a shrub which varies in height from four to eight feet but which may also be found as a climbing vine. Its leaves resemble small oak leaves. They appear in groups of three, oval and rounded, and variously lobed. The growing locations

of both varieties are similar to those of poison ivy. The fruit is a whitish, waxlike berry, which is poisonous to the touch.

Poison sumac, also known as white sumac, poison oak, poison dogwood, poison elder, and thunderwood, is a shrub but it may occasionally be found as a tree which reaches a height of from 20 to 30 feet. The sharply pointed, smooth, oily leaves are similar to those of the ash tree or elderbrush. They are arranged in pairs of from seven to thirteen leaves with a single leaf at the end of a slender stem. The poisonous sumac can be distinguished from the nonpoisonous by the way the fruit or berries grow. Common or nonpoisonous (red) sumac has reddish, hairy berries clustered at the *end* of the branch. The poisonous sumac has smooth, cream-colored berries growing in loose clusters along the *side* of the branch or stem.

The poisonous substance of the above three plants is nonvolatile and is believed to be the same substance in all three. The best means of preventing poisoning by them is to learn to recognize the plants and to keep away from them. The effects of poisoning by these plants are similar to a rash which appears on the skin and causes an almost unbearable itching sensation. It takes 15 to 30 minutes for the poison to penetrate the skin. When a person knows that he has brushed against one of these poisonous plants it is recommended that he immediately sponge off the exposed area with alcohol. Afterwards the skin should be washed with soap and water. This prevents after effects. It is not necessary that a person come in direct contact with these plants to be poisoned. Pets may spread the poison by rubbing against the plant and getting the poison on their hair. Occasionally the poison has been transmitted from one person to another through bodily contact.

When a person knows that he is going into an area where he is likely to come in contact with these three plants as much as possible of the body should be covered. Long sleeves tucked in heavy gauntlet gloves, slacks or trousers tucked in boots or leggings, shirt collar turned up or a scarf tied around the neck, will help to prevent body contact with the plant. Particular care should be taken not to touch gloves or clothing, since the irritating oils have been known to remain on those articles for as long as a year. Any clothing which is suspected of having been in contact with these three plants should be dry cleaned; soap and water are not always effective in removing the poison on them.

The above three plants may be eradicated by digging them out.

Another method is spraying them with a solution composed of 3 pounds of salt dissolved in 1 gallon of slightly soapy water. The first spraying should take place as soon as the buds appear on the plant and should be followed by several later sprayings as the new leaves appear. Another spray may be made with crankcase oil diluted with kerosene or ordinary fuel oil. Oil sprays kill the leaves but the roots must be dug out of the ground. Various chlorinated aliphatic acids are available commercially which kill these plants very rapidly. Sodium or potassium chlorate is an effective eradicator but because of its fire producing properties is dangerous to use.

When burning vines or bushes or roots which have been dug out, keep out of the smoke from such fires. The poison is vaporized by the heat of the fire and may produce symptoms over all parts of the body, and breathing the smoke may result in serious irritation of the throat and lungs.

While some persons are apparently immune to the poison in such plants, it is well to observe the above precautions, since it sometimes happens that this immunity disappears with advancing age or for other reasons.

Snow and icicles

Unless steep-pitched roofs are provided with suitable snow guards, the snow is liable to slide off and injure persons or cause damage to property, especially after a heavy snow. Heavy icicles often form on eaves and other parts of the building and overhang building entrances and sidewalks. This is a serious hazard because they may fall and severely injure and possibly kill a person who may be standing under them. Icicles should be removed before they become large enough to endanger a person or persons passing underneath them.

10. SUGGESTIONS FOR BUILDING A HOME

Many of the hazards which are found in residences are the type which can best be eliminated when the building is being designed and constructed, and it is often difficult to remove such hazards after the construction is complete. It is consequently thought to be of value to collect here some suggestions having relation to the prevention of fire and other hazards which might be inherent in a building if consideration were not given to these points in the design of the building and the preparation of specifications. It is mandatory that local requirements relating to dwelling construction, equipment, and maintenance be ascertained and followed. However, many useful suggestions in the design, construction and maintenance of homes will be found in material listed in National Bureau of Standards Letter Circular LC 830, "List of Published Material Relating to Home Building and Maintenance," copies of which are obtainable upon request to the National Bureau of Standards, Washington 25, D. C. The publications listed in LC 830 may be obtained from the sources named, either free or at the prices quoted.

1. FIRE-RESISTIVE CONSTRUCTION

It is possible to provide a wide range of fire resistance in dwellings, depending upon the materials used for the structural members and

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their finish. By the use of incombustible structural members of proper design, collapse of the building in any ordinary fire can be prevented, since the contents will simply burn out without impairing the structural integrity of the building itself. For those who desire the maximum of fire resistance, it is entirely feasible to provide steel, reinforced concrete, masonry, and other incombustible construction such as has been widely used in office buildings and other structures. A reasonable degree of safety is, however, obtainable with other construction. In many cases, fire originates in the contents of the building rather than in the construction itself. Attention to various safeguards intended to reduce the chances of fire being communicated to the construction and spreading subsequently will do much to provide adequate safety (see chapter 4).

2. EXTERIOR STRUCTURAL ELEMENTS

The roof and outside walls or finish of a house may be exposed to burning brands and other modes of fire attack from the outside. In closely built-up localities it is desirable that a fire within a building be so confined therein that a complete burning out will not be hazardous to nearby buildings. Almost all of the incombustible types of roofing, such as slate, clay and concrete tile, cement asbestos, metal sheets, and metal shingles, have sufficient fire resistance to prevent ignition of the boards supporting them from chimney brands or brands from an adjacent burning building. The protection afforded by the metal roofings can be increased by placing asbestos felt between the roofings and the boards. Some prepared asphalt-saturated rag-felt roofings afford fair resistance against brands, the effectiveness depending mainly on the thickness of the roofing and the amount of mineral surfacing present.

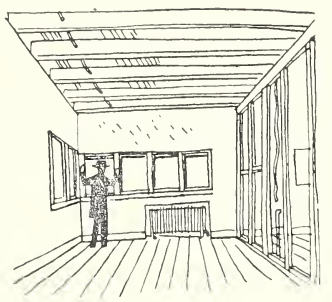
Wood shingles, particularly when of inferior grade, and when weathered, and some asphalt-saturated rag-felt roofing materials, are less resistive to fire brands. Some municipalities permit the use of wood shingles only in less thickly settled areas and when dwellings are well separated. This is intended to guard against spread of fire by burning brands which may be caught up by the wind and

carried considerable distances. When used, wood shingles should be of good quality and properly applied.

Sparks and burning embers from fireplaces, from burning buildings or nearby bonfires, often set fire to combustible roofing material. The chances of this occurring are greater as the roof becomes older and on roofs so designed that brands may find a place to lodge.

As coverings for outside walls, there is a range in fire resistance beginning with board finish, followed in order by stucco on wood lath, stucco on metal lath (both over wood framing and boards), masonry veneer over wood frame, and load-bearing masonry walls. Well-maintained paint coatings will slightly increase the fire resistance of a board finish against an exterior exposed fire. Masonry walls 8 inches or more in thickness will generally give adequate protection against outside fires in residential districts.

3. INTERIOR CONSTRUCTION



Since the greater number of fires originate within buildings, emphasis should be given to the importance of interior structural provisions that will aid in preventing fire origin and spread. Interior fire origins range from sparks and match flames to rapid burning of quantities of flammable liquids.

In the case of detached houses and sometimes with row houses, the modern tendency is to place the garage in the main housing unit, the garage space being located in the basement or at the first floor level. Such a location permits the car to be kept warm, thus enabling quick starts in cold weather, and makes the car easily accessible in stormy weather. These advantanges carry with them certain penalties in the form of additional hazards. The built-in garage brings with it increased fire hazards which must be minimized by proper fire-resistant construction in the sidewalls and ceiling.

The basement, if housing the heating plant and fuel and other storage, gives rise to many fires, and a smoketight and fire-resistive separation from the other stories is desirable. Plasterboard, asbestos board, and plaster on metal or wire lath applied on the basement ceiling joists are effective. A double first floor with incombustible felt between the two board layers adds appreciably to fire resistance and smoketightness. Protecting the floor members for a space of several feet above and around the furnace will help to prevent fires resulting from overheating and defective or fallen smoke pipes. Complete fire separation by means of a fire-resistive and incombustible first-floor construction is advantageous even where the rest of the house is of ordinary construction.

The interior partitions and floor and roof constructions determine the main fire-resistive characteristics of the building. The wall, ceiling, and floor finishes are the first to receive the attack of fire from interior origins. Wood and combustible-fiberboard finishes can be made a little less flammable by application of whitewash, or calcimine. Well-applied whitewash coatings are as effective as any fire-retardant paint. Plasterboards, plaster on wood lath, plaster on plasterboard, and plaster on metal or wire lath give greater protection, the effectiveness being approximately in the order given. For interior work, gypsum plaster has been found to be very effective, as it is not likely to fall off during the fire exposure and high temperatures do not penetrate it rapidly. Where walls and ceilings are protected against moderate fire attack, the fire may burn through the wood floors almost universally used with wood framing and may spread into the hollow spaces back of the finish, particularly where no fire-stopping is present.

When the additional expense is felt to be justified, fire-resistive interior construction for dwellings can be obtained in a number of forms, including for floors several forms of light-steel protected framing, hollow clay, or gypsum tile between reinforced-concrete ribs or protected-steel beams, and reinforced-concrete slabs and beams.

Nonbearing partitions can be of steel studs covered with plaster on plasterboard or on metal or wire lath, of hollow-clay tile, or of gypsum or concrete blocks. Load-bearing partitions can be of heavy steel studs protected by plaster on metal or wire lath or of suitable thickness of hollow-clay tile, concrete block, poured concrete, or brick.

Chimneys and fireplaces

Chimney fires are less common in modern houses than in those of older construction, but it pays to be sure that all chimneys and flues are built in accordance with recognized fire regulation standards, such as the National Board of Fire Underwriters "Standard Ordinance for Chimney Construction" and the National Bureau of Standards "Building Code Requirements for New Dwelling Construction."

Chimneys should be of adequate strength and size and should be constructed in a careful and workmanlike manner. Masonry chimneys should have a suitable foundation extending deep enough not to be affected by frost. All joints of brickwork should be completely filled with mortar, care being taken to see that all bricks are laid in full beds of mortar and all cross joints solidly filled. Chimneys should be plumb and properly secured to the building to prevent overturn from wind or other causes. High unsupported sections should be guyed or braced. If the walls of a chimney are not more than 4 inches thick, flues of refractory clay or other approved material should be installed on the inside to carry the products of combustion. Such flues should be constructed with tight mortar-filled joints. Chimneys should be high enough to provide the proper draft. Care should be taken to avoid back drafts. Special types of chimneys made of metal or other incombustible materials are being introduced. These should be used only after securing definite assurance from reliable sources that they will be safe when properly installed.

Fireplaces require great care in the manner of their construction in order to avoid fire hazard. The walls should be not less than 8 inches thick and should be lined with firebrick or other heat-resisting material. If the walls are built of stone or hollow units they should be not less than 12 inches thick. All fireplaces should have incombustible hearths of brick, stone, tile, or other approved incombustible material supported on masonry arch or reinforced concrete slab. Such hearths should extend at least 16 inches outside the chimney breast and not less than 8 inches on each side of the fireplace opening. No combustible construction should be placed within 4 inches of the back wall of any fireplace. No combustible mantel or other combustible construction or finish should be placed within 4 inches of either side or 8 inches of the top of any fireplace opening, and no combustible mantel shelf should be less

than 12 inches above such opening. For fireplaces, it is especially important for good draft to design the flue on the "effective area" principle, and an effective area of flue of one-twelfth of the area of the fireplace opening is desirable. A smoke test of the chimney is recommended before its acceptance. Where wood has been used to form the hearth support, make sure that it is later removed, as it may catch fire. Not more than one connection should be made to a flue in any story except that a vent from a small gas-burning appliance may enter the same flue *above* a smoke pipe. All unused openings in a chimney should be effectively closed.

A good way to prevent fires starting around chimneys is to place wood structural members, such as joists and rafters, at least 2 inches from the chimney. Other woodwork should be kept away from the surface of the chimney. If supporting strips for flooring or trim are necessarily close to the chimney they should be insulated by asbestos paper at least $\frac{1}{8}$ inch thick.

Doors

For ordinary interior construction there is little to be gained in providing more fire protection for openings between rooms than is afforded by wood doors and frames of ordinary design. With well-protected basement ceilings, or a fire-resistive first-floor construction, a heavier wood door or the lighter type of metal or metal-clad door leading to the basement might be used.

Firestopping

No house can be called well constructed if suitable and adequate firestops are lacking. Generally speaking, all the open spaces within the walls and under the floors of the various rooms should be separated by firestops. All firestops should be made as nearly air-tight as possible. Special care should be taken to close off all basement openings into walls and partitions, because a large number of residence fires start in the basements; and if the flames and hot gases gain access to the spaces between the studding the fire will quickly spread to all parts of the house.

Where the framing involves hollow spaces with combustible framing members or finishes, the spread of fire can be retarded by closure of the hollow spaces at the floor, wall, and roof lines. Well-fitted board or plank stops can serve as temporary checks, but somewhat better results can be obtained with incombustible materials fully filling the spaces in walls and partitions, opposite

hollow spaces in floors and for 4 inches or more above them. Board stops at the midheight of walls and partitions are also desirable. With outside masonry walls without hollow furring spaces, firestopping need be applied only at intersections of hollow interior partitions with floor and roof construction and at the exterior roof lines. Among incombustible materials suitable for firestopping are cinders, ashes, refuse mortar, plaster, concrete, hollow tile, brick, gypsum block, and mineral wool. The coarser material should be mixed with fine material or mortar to prevent large voids. The firestopping material can be supported on horizontal wood strips not less than 2 inches thick beneath the filling and by 1 inch boards opposite the hollow floor spaces. Metal or wire mesh may also be used for these purposes. Generally, considerable care and expense are required to obtain a good job of firestopping.

Heating appliances

Heating boilers (both steam and hot water) should be covered on the sides and tops with suitable insulating material, such as asbestos, not less than 1 inch thick. The tops of hot-air furnaces should be at least 24 inches below the floor joists. There should be a clearance of at least 48 inches in a horizontal direction between the front of every hot-air furnace, steam boiler, or hot-water boiler and any combustible material; at all other points this clearance should be not less than 24 inches. Where appliances or combustible materials are properly insulated some reduction in the clearances is permissible, but expert advice should be sought in such instances. Wherever possible, steam boilers, hot-water boilers, and hot-air furnaces should be mounted on incombustible floors. Pipes for hot air, steam, and hot water should be covered with suitable insulating material.

Provision should be made in the walls of a boiler room for an adequate supply of fresh air to supply the needs of proper combustion in the heater. Suitable openings with grilles can be installed when the walls are built or a separate duct from the outside can be installed. Provision for fresh air is very necessary to the proper combustion of fuel and consequent avoidance of carbon monoxide gas. Chimney flues of size insufficient to carry off the gases constitute a hazard from carbon monoxide. Flues should not be smaller than 70 square inches for warm air, hot water and low-pressure steam heating appliances. For gas-burning appliances

the vents should be not less than 3 inches in diameter. Flues and vents should have cross-sectioned areas at least equal to the aggregate areas of the vents of appliances connected to them. Where a blower is used for forced draft it should be ascertained that flues are of adequate size to carry off the gases.

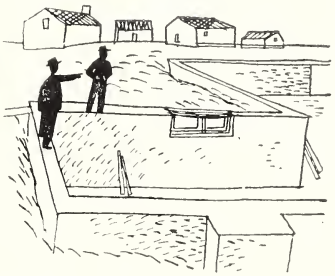
Heating furnaces and boilers should be mounted on the ground or on floors of fireproof or semifireproof construction with noncombustible flooring and surface finish, or on fireproof slabs or arches having no combustible materials against the underside thereof. Such construction should in all cases extend not less than 12 inches beyond the appliance on all sides and where solid fuel is used should extend not less than 18 inches at the front or side where ashes are removed.

Heating furnaces and boilers should be installed with the proper amount of clearance from combustible construction depending on the type of equipment, the fuel, and the insulation applied to the adjacent construction. This clearance will vary from 6 to 18 inches. Where the material located near a furnace is composed of wood or similar combustible material it is desirable to cover such material or construction with insulation such as asbestos, millboard, or 28-gage sheet metal spaced out 1 inch. The smoke pipes should be of heavy gage and be securely supported in position.

Floor furnaces should not be installed in floors of combustible construction unless approved specifically for such installation and installed in accordance with the conditions of such approval. Floor furnaces should be supported independently of the floor grilles. Smoke pipes of floor furnaces and other types of furnaces should be installed at a safe distance from woodwork or other combustible material. A minimum distance of 12 inches should be provided from such adjacent materials. It would also be well to cover all adjacent combustible materials with a suitable insulation such as asbestos, magnesia, sheet metal, etc. Covering or insulation on hot-air, steam or hot-water pipes should be of noncombustible material. If a pipeless furnace has no temperature controls or radiation screen, it is desirable to place the radiating dome at least 3 feet below the floor level. Partitions should never be built over registers. Great care should be taken to properly insulate all combustible material around the floor registers and around hot-air pipes. Sufficient clearance should be provided from timber and other combustible material and a covering of tin or other metal provided. Where a smoke pipe enters a chimney a metal sleeve or thimble should be

installed with a tight joint with the brickwork. Where smoke pipes enter a flue of vitreous tile the connection should be made with a special fitting as it is bad practice to cut into a tile flue which is in place. Flue linings should be installed as the stack is built and not dropped into place after the chimney or stack has been built. No vent pipe from a gas appliance should be interconnected with any other vent pipe, smoke pipe or flue unless such gas appliance is equipped with an automatic device to prevent the escape of unburned gas at the main burner or burners.

For coal and wood-burning cooking ranges a clearance of 24 inches is desirable. Gas and electric ranges should have a clearance of 6 inches (see also chapter 4, section 13).



4. STRUCTURAL CONSIDERATIONS

Miscellaneous structural elements

In the erection of a dwelling, materials and methods of construction necessary to prevent the collapse of any part of the structure should be used.

Consideration should be given to recognized standards such as those of the American Standards Association, American Society for Testing Materials, etc., covering materials and methods of construction involved in the work of excavation, foundations, masonry work, iron and steel, etc.

The structural members of a dwelling should be designed of ample strength to sustain safely all loads that may be imposed upon them. A minimum live load for floors of 40 pounds per square foot is generally assumed. Roofs should be designed for snow loads where snow occurs. Proper stiffening of the framework should be secured by corner bracing to resist wind pressure. Roofs should be securely anchored to the frame and the frame anchored to the foundation. Serious injury may be suffered by the occupants of dwellings when roofs are blown or torn off and buildings moved from their foundations due to failure to provide for the action of heavy winds. Poorly constructed buildings often collapse entirely

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during heavy windstorms while well-constructed ones may suffer very minor damage.

Foundations

Foundation walls should extend below the frost level and the horizontal area at the bottom should be such that the safe carrying capacity of the soil is not exceeded. Foundation walls should be built of stone, brick, concrete, solid or hollow masonry units, or hollow walls of brick. They should be of sufficient strength and thickness to resist lateral pressures from adjacent earth and to support their vertical loads. The exterior surface of all foundation walls should be dampproofed or waterproofed to exclude water, gas, and dampness. Basement floors should be paved and the surface so graded that it will drain properly. Provision should be made for suitable floor drains and sewer connection. It is well to install a 4-inch open tile drain in a bed of gravel around the exterior wall with a proper slope and a sewer connection.

Where first-floor construction is subject to decay or corrosion, provision should be made for the proper ventilation of all enclosed spaces under a dwelling by suitable openings left in the enclosing walls. Such openings should be fitted with grilles, shutters, and screens when so required. Suitable sleeves of metal should be built into basement walls for the entrance of electric, gas, water, and telephone lines. Failure to do so necessitates the cutting of holes, often with injurious effect.

Termites

In some sections of the country, termite infestation constitutes a menace to the structural safety of dwellings. Regular inspection of points where termites might gain entrance is desirable. No encouragement should be given by leaving boards, stakes, or scraps of lumber about. All timber should preferably be kept from contact with the earth, but, if touching the earth it should be pressure treated with creosote, or other suitable preservative. Where there is no basement under the house, there should be a space of at least 18 inches between the lower side of any wood members and the ground, and the surface of the ground should be so graded that no water will stand there. Foundation walls of unit masonry should be capped with 4 inches of reinforced-concrete or equivalent. Special care should be taken at porches to see that they do not provide avenues of travel from the ground to foundation woodwork. In some cases, shields consisting of copper flashings extending out

over foundation walls for a distance of 2 inches and bent down at an angle of forty-five degrees have been used to act as a barrier against the travel of the termites. Wood basement columns should rest upon concrete footings elevated not less than 3 inches above the general floor level.

5. MISCELLANEOUS HAZARDS

Abatement of noise

More attention should be given to construction methods necessary for the elimination of noise that is transferred through the walls and floors of a dwelling. This applies especially to multiple dwellings where the transmission of disturbing noises from one dwelling unit to another interferes with proper rest and desirable privacy. Walls and floors separating such units should be constructed in part at least of sound-deadening materials. There are on the market a number of satisfactory commercial products serving this purpose, such as acoustical tile, mineral wool, rock wool, hair felt, structural tile with an air space, etc.

Doors

A bolt or lock on any door should be so constructed that the door may be unlocked from the outside. Doors which give access to closets or other closed spaces should have handles on both sides. Doors between connecting rooms should be of single section and of a type that can be anchored. Doors should be hinged in such a way that they will not interfere with one another. Doors leading to an attic should open into the attic and doors to basement should open out from basement stairs. Doors with glass panels below lock level and in "pushing areas" should not be used. Locks on exterior doors should be of the cylinder type and not of the type that can be opened with a skeleton key. An attic door should be of adequate size to admit an adult person. An attic door should have knobs on both sides. Two means of exit should be provided from each living unit. Doors to fire escapes should open out and their locks should be of the keyless type. There should be an outside entrance to the basement.

Exclusion of dust and gas

Due to suction much dust, soot, and gas is drawn from basements into the living quarters of dwellings. Where it is possible to seal off

the boiler room from the rest of the house, and basement this should be done. Doors leading from the first floor to basement and from basement to boiler room should be dust-proofed by the application of felt, rubber, or other suitable material. This work can be done at small expense and will do much to exclude dangerous gas, ash dust, and soot. Care should be taken to provide a tight floor above all basement spaces, with all joints between walls and floors back of baseboards tightly closed. It is well to install a double wood floor with building paper between the wood layers. All openings around floor pipes should be covered tightly with floor plates. It is well to make provision for proper ventilation of boiler room and basement to the outside air with the installation of the necessary vents and grilles. Grilles should be equipped with insect screens and dampers or shutters.

Exclusion of vermin

All dwellings should be constructed in such manner that rats and other vermin will be excluded. All basement openings including doors and windows should be made to exclude vermin by the use of screens, grilles, etc. All connections to sewers should be provided with traps; and suitable covers should be provided for cellar drains. All possible means of entrance of vermin should be carefully closed off.

All windows and doors should be screened full height to exclude insects. Such screens should be designed to fit and operate in a suitable manner in each individual opening. The frames should be of wood or metal as best suited and each have a covering of wire cloth in accordance with Federal Specification RR–C–451A, and should be of number 18 mesh, regular. Many serious injuries have been inflicted on the occupants of dwellings by the intrusion of rats, reptiles, and other disease carrying vermin. Public authorities have become acutely conscious to this type of hazard, and are intensifying their efforts to rid residential areas of vermin of all kinds.

Electric equipment

The electrical installation in the home should be made only with standard materials installed by skilled workmen. The specifications should require compliance with the rules of the National Electrical Code and the National Electrical Safety Code. These specifications will secure an installation properly grounded, equipped with fuses,

and equipped to comply with a number of precautions, such as the use of porcelain sockets in basements and an enclosed main switch. Since these codes contain only the minimum requirements for eliminating the most obvious hazards, such specifications will not necessarily provide the highest degree of safety which may be desired by the householder (see chapter 3).

At distribution points, if panel boards are used they should have no live parts exposed (dead-front type) and there should be not only a switch ahead of every fuse, but a main switch to disconnect the conductors which feed the panel boards.

Wall switches are a convenience in every room, but should invariably be supplied in the bathroom or other rooms where the hands may be wet. It is convenient to have a wall switch at the point of usual entrance to the room which it controls. If a large room is frequently entered from more than one door, it is convenient to have control switches at both entrances and this can easily be accomplished. Similar dual control is desirable for the electric lights on stairways, one point being at the foot of the stairs and the other upon the upper floor.

In the bathroom it is desirable to have none of the usual convenience outlets for connecting portable appliances so that there will be no temptation to use such appliances in that room. However, a bathroom fixture which includes a convenience outlet is frequently provided for use of an electric razor. If such a fixture is installed in the bathroom the convenience outlet should not be used for other appliances which are not so well insulated as electric razors. If the use of an electric air heater is contemplated between seasons when the room may not be otherwise heated, it is far preferable to make a permanent installation of such heater and equip it with a wall switch. Many fatal accidents have been caused by the handling of electrical heaters in bathrooms.

A circuit-breaker is a type of switch which will automatically open the circuit whenever it is overloaded or a short-circuit occurs. It thus takes the place of a fuse and at the same time can be closed and opened by hand like any other switch.

Small-capacity circuit-breakers which may be used in place of both switch and fuse to control branch electric circuits, including both lightning circuits and those to appliances, such as the washing machine.

In planning the electrical installation, separate circuits should be provided for any apparatus taking more than six amperes. Such

apparatus will include an electric range and an electric water heater and the group of appliances used in the laundry.

One or more receptacle circuits should be provided for small appliance load in kitchen, laundry, pantry, dining room and breakfast room using conductors not smaller than No. 12 American Wire Gage. Other circuits in the home should be arranged so that adequate capacity will be available to take care of additional loads which may gradually be added over a period of years. For information on adequate wiring, inquiry should be made to the National Electrical Manufacturers Association, 155 East Forty-fourth Street, New York City.

For rural dwellings which are supplied through overhead conductors, it is desirable to protect against the possibility of a lightning surge coming in over the wires and either shocking the inmates or setting the building on fire. The hazard is not likely to exist if the wires enter the building through conduit, but if the wires enter separately the one which is not grounded should be equipped with a simple form of lightning arrester whose other terminal is connected to ground. This arrester may be of the form commonly used to protect against similar surges on radio antennas, and should not be in proximity to flammable material.

Gas equipment

The hazards involved in the use of manufactured or natural gas in the home are discussed in a previous chapter (chapter 5). It is sufficient to repeat here that gas piping should be installed only by skilled workmen, and that the suggestions already given should be carefully followed.

6. LIGHTNING CONDUCTORS

Considerations which will determine the advisability of equipping a residence with lightning conductors cannot be fully stated here. These considerations are discussed in Handbook H40 of the National Bureau of Standards entitled "Code for Protection against Lightning", copies of which may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 20 cents a copy. This publication contains detailed specifications for the construction and installation of lightning conductor systems. There is less likelihood of a dwelling being set on fire by lightning than a barn, on account of the nature of the contents, but for the protection of the family, lightning protection

is desirable in those locations where the dwelling is particularly exposed to lightning storms. The following is a very brief summary of principles which should be followed in designing lightning conductor system protection.

General

In assembling lightning conductors it is preferable that all parts be made of the same kind of metal or of combinations of metals which will not produce excessive corrosion by galvanic action in the presence of moisture.

Conductors

Conductors may be in the form of cable, tube, strip, or rod having round, square, star, or other solid cross section. Copper conductors should weigh not less than 187.5 pounds per 1,000 feet and galvanized steel not less than 320 pounds per 1,000 feet.

Fasteners

The devices used for securing conductors to buildings may be in the form of metal straps held down by nails or screws, or in the form of a screw with a forked top which can be closed over the conductor.

Elevation conductors

Elevation conductors, or the conductors which with the points serve as air terminals for receiving the discharge, should be solid and somewhat heavier than the other conductors. The height of the elevation conductors should be such as to place the point at least 10 inches above the object protected. Joints between sections of conductors should be secure, both electrically and mechanically.

Location of air terminals

Air terminals with points should be placed at every chimney, ventilator, gable, and other projection of the building where lightning is likely to strike, and at intervals of not more than 25 feet along ridges and parapets.

Coursing of conductors

Conductors should be run along ridges and parapets, and over flat surfaces if need be, so as to connect all of the air terminals together. At least two down conductors should be provided for each system, with additional down conductors if the total number of air terminals

exceeds six or the building is more than 100 feet long. The arrangements of down conductors should be such as to space them as nearly uniformly about the building as practicable, and also such that a lightning discharge to any air terminal has at least two paths from the foot of the terminal to ground.

Ground connections

The foot of every down conductor should be grounded (1) by continuing the lightning conductor at least 10 feet into the ground, (2) by connecting to a driven ground conductor, or (3) by laying at least 12 feet of the down conductor in a 3-foot trench extending radially from the building. Where bedrock is close to the surface, or if the soil is dry, in addition to the conductors laid radially, a similar conductor should be buried which encircles the structure to be protected and connects all the down conductors together.

Where a buried water pipe is available, one of the down conductors should be connected to it at some point outside of the building.

Interconnection of metal

Every metal part of appreciable size on the exterior of a building should be made a part of the lightning-conductor system by connecting it to the conductor at the upper (or nearest) end and grounding it at its lower (or farthest) end. Metal on the interior which comes within 6 feet of down conductors, or projects through the roof should also be connected to the conductor.

7. MECHANICAL HAZARDS

Items contributing to mechanical hazards in the home are discussed in chapter 7, but those which should be considered in the building construction will be mentioned here. Porches, balconies, etc., should be provided on the open sides with railings not less than 42 inches high with midrail to prevent the possibility of falling off the edge.

Such falls may cause serious injuries even when the height is not more than 2 or 3 feet. An acceptable substitute for the railing along the edge of a low porch is a set of flower boxes which extend the complete length of the porch.

Low window sills should be avoided, especially at stairway landings. Where they already exist, the windows should have one or more crossbars to prevent children and others from falling out of the window. Built-in screens are safer and frequently more efficient than portable types.

In designing the bathroom, especially where built-in tubs are installed in tiled rooms, provision should be made for a hand grip built into the wall.

In the North, sloping roofs directly over steps or walks should be equipped with snow guards to prevent heavy weights of snow from falling off the roof onto the head of the passer-by.

8. PLUMBING

All water closets should be so secured to the waste pipes that there can be no escape of foul gas from soil pipes. This connection is best made by the use of a gasket composed of asbestos or other suitable material. No frostproof type of water closet should be installed in a dwelling.

All lavatories should be securely fastened to the walls or otherwise securely supported. An approved air gap should be provided in all over-rim supplies as a protection against backflow. This same type of protection should be installed in all cases where it is possible to have a backflow from waste pipes or tanks into the water-supply system used for human consumption. Where it is not possible to install an air gap, suitable approved backflow preventers should be provided.

No interconnection or cross connection should be made between a water-supply system carrying water meeting accepted standards of purity and any other water-supply system.

An approved relief valve should be installed in each hot-water system and so located that there is no shut-off or check valve between the tank and the relief valve. This valve may be omitted in installations where pressure due to hot-water expansion can be relieved by expansion into the cold-water main. Failure to make such installations is often the cause of the bursting of hot-water tanks.

Where hot-water pipe coils are installed in a furnace they should be made from copper or brass pipe and fittings.

A hose connection should be installed in all basements.

9. STAIRS AND SIDEWALKS

The proper design of stairs is an important factor in the prevention of accidents. Winding stairs are especially hazardous. Their construction is prohibited in many localities. A stairway should not be made too steep and a proper proportion should be maintained between the dimensions of the riser and the tread. Satisfactory values are 7 or 7½ inches for the riser and 10 or 11 inches for the tread. In any case these values should be such that the sum of the tread plus twice the height of the riser equals 25 inches. The preferred slope of a stairs is between 30 and 38 degrees. Where treads of stairs are constructed of concrete, terrazzo, or marble, it is desirable to make the wearing surface nonslip by imbedding an abrasive aggregate into the wearing surface or by channeling the wearing surface. All stair treads should have nosings. Stairs should not be constructed with open backs.

All stairs having 4 or more risers should have a handrail on one side. Stairways 44 to 66 inches in width should have a handrail on each side. Stairways over 66 inches in width should have a handrail on each side and one in the middle. Doors should not open directly onto a stairway but onto a landing the width of which is such that the distance between the door arc and the newel post is not less than the width of the stairs. The distance between the landings in the run of a stairs should not exceed 17 risers.

Lights which can be controlled from both the head and foot of the stairs should be provided for all interior stairs. Exterior stairs and steps should be lighted by lights which can be controlled from within the house.

Walkways along the edges of terraces more than 18 inches above grade should be provided with suitable handrails. Masonry walks in the approaches to a dwelling should not have a slope greater than one-half inch to the foot as a greater slope is a distinct hazard, particularly when it is wet or icy. All walks should be so constructed that the surface does not present a tripping hazard. All walks should be so laid as to drain properly. Downspouts from roofs should be connected to sewers where possible and not discharge at grade or onto sidewalks.

11. FIRST AID

1. AID TO THE PATIENT

When injuries occur there should be a readiness to do something for the injured person in order that the results of an accident may be lessened. This suggests first aid. However, it should be remembered that in many cases of injury medical attention by a physician may be necessary. For that reason, a physician should be promptly summoned, especially if there is any doubt as to the nature of the injury or if the injury is at all severe.

Methods of first aid for various types of injuries can be considered here only briefly, but it is well for the housewife and other members of a household to secure instructions on first-aid treatment of injuries, etc., whenever there is such an opportunity. In many localities courses in first-aid training are given under the auspices of the American Red Cross or the staff of the local hospital. The following recommendations are those proposed by a medical doctor formerly with the United States Public Health Service.

Immediate Aid to the Patient

After any type of accident the first thing for the first-aider to do is to determine if the patient is bleeding, and if so, to what extent. If it is a large artery the patient may die in a few minutes if bleeding is not arrested. Hemorrhage may be stopped in three ways:

(*a*) Pressure over the wound with a dressing.
(*b*) Manual pressure in the wound.
(*c*) Use of a tourniquet.

Usually simple pressure with a few layers of gauze is sufficient to control hemorrhage. However, if bleeding is not arrested by this method the use of a properly applied tourniquet is indicated.

A tourniquet should be at least 1 inch wide. In an emergency, a necktie, handkerchief, towel or belt can be used. If the bleeding is from the hand or forearm, the tourniquet should be placed a hand's breadth from the armpit. If from the leg, it should be placed a hand's breadth from the groin. In applying a tourniquet, place several layers of gauze or a handkerchief around the site to prevent injury to the tissue. If a handkerchief is used, tie one-half knot, then place a piece of stick (a pencil or a ruler will do) on the knot and tie a square knot over it. Twist the stick rapidly until the bleeding stops. The common error is that the tourniquet is too loose. This may increase bleeding, rather than stop it. The tourniquet may be too tight and cut the skin, damaging the tissues. Do not let a tourniquet be hidden, as it may be forgotten and kept on too long. A tourniquet should be loosened every 30 minutes for 2 or 3 minutes to prevent damage to the nerves and blood vessels. For that reason the first aid instructions of the American Red Cross require that every patient with a tourniquet be marked on the forehead with a red crayon.

There is one instance where a tourniquet should not be used. That is where venous bleeding occurs. The most common instance is bleeding from a varicose vein or varicose ulcer of the leg. This happens quite frequently in the home where a housewife strikes her leg against some object. The treatment is simple, namely, lay the patient down, and elevate the leg as high as possible and apply a pressure bandage. The leg should be kept elevated until a physician arrives. Venous bleeding may be recognized by the dark-blue color of the blood whereas arterial blood is bright red and pulsating in character.

General Care of the Patient

Place the patient in a comfortable position. Do not be in too great a hurry to move him. There is often the possibility of a fracture, hence examine the extremities with gentleness. If a fracture is suspected, it is best to apply a splint. If no splint boards are available, wrap the arm or leg in a pillow and tie it on with a bandage.

If a person is vomiting turn the head to one side to prevent aspiration of stomach contents into the lungs.

The head should be slightly elevated unless the person is in shock. Any tight clothing should be loosened. One should also examine the mouth and remove any foreign substance, especially false teeth or bridgework that the person might swallow. It may be necessary to remove clothing to get at the wound. Do not hesitate to cut away a portion of the clothing to get at a serious wound.

The ideal antiseptic has not been found as yet. The most commonly used is tincture of iodine, 2.5 percent solution. However, this antiseptic can be very irritating and should be used sparingly. Some of the mercurial antiseptics which today can be used with comparative safety are merthiolate, metaphen, mercresin, and zephrain.

The slightest abrasion of the skin may have serious results if an infection sets in, as it may lead to blood poisoning. Wounds of a penetrating or perforating character are particularly dangerous on account of their liability to develop tetanus infection. Consequently, no scratch or cut should go without some attention. Of equal or greater importance than any of the commonly used antiseptic solutions is thorough mechanical cleaning of the injury with warm water and soap. These are usually available but frequently omitted. It is a common misconception that the use of antiseptics is sufficient and can be entirely relied on. After thoroughly cleaning the place of injury, an antiseptic may be applied to skin abrasions.

Almost any severe injury is accompanied by a greater or less degree of shock. The degree of shock is not always proportional to to the extent of injury. Except in cases where profuse hemorrhage exists, shock should be treated first and the injury second. The symptoms of this condition are a weak and rapid pulse, and pallor of the skin, which is cold and clammy and covered with perspiration. Usually the patient is sufficiently conscious to answer questions in an indifferent way though complete unconsciousness may exist. Respiration is rapid and shallow and usually irregular. Treatment consists in placing the patient in a recumbent position with the head low. While plenty of fresh air should be admitted, the body should be kept thoroughly warm by wrapping in woolen blankets and by the application of hot-water bottles. The medical treatment consists in the use of stimulants, the most readily obtainable of which is black coffee or spirits of ammonia (a teaspoonful in a

small quantity of water). It should be remembered that an unconscious patient or a semiconscious patient is not able to take fluid by mouth without danger of strangling.

Treatment of Scalds and Burns

The proper treatment of scalds and burns will often lessen the pain caused by them and will also result in early healing. Burns and scalds may be followed by shock and the treatment in these cases is similar to that given below.

Burns and scalds are serious and dangerous to life in proportion to the extent and depth of the injury. A burn covering a large area, though quite superficial, is as serious or more so than a much deeper burn in which a smaller skin area has been involved. Large or deep burns are not cases for household remedies, but slight or moderately severe burns and scalds, such as are commonly met with, may be handled by simple methods.

It should be understood that all burns of a serious nature should be placed in the care of a physician immediately. Often burns when first seen do not appear to be as serious as they do some hours later.

Among the remedies usually found in the household, ordinary baking soda is perhaps the most efficient. This should be made into a strong solution with water and applied to the burned area. The surface should not be permitted to dry, but should be kept moistened with water. For the minor burns a boric-acid or vaseline dressing will suffice. Absorbent cotton should never be used as a dressing—sterilized gauze should be used.

The simple blistering that follows minor first-degree burns is best treated by opening the blister, permitting the inclosed serous fluid to escape. The skin should not, however, be removed.

If the burning agent is pitch or tar, and adheres to the skin, it should not be removed; it will come away later with the blistered skin. Vaseline, with a pressure dressing, forms a soothing application.

The best method of handling minor burns about the eye, which have not involved the eyeball proper, consists in the application of dressings kept moist with boric-acid solution. Any burn which actually results in destruction of any portion of the cornea is, of course, a case for expert treatment.

If the eye is red from contact with the flames or hot fluid, sweet or castor oil is perhaps the best household remedy to drop in. A bandage lightly applied over the eyes to keep out the light will be soothing.

If the patient has breathed the flame or steam, the condition is apt to be a serious one, even though it does not appear so at once. Complete rest and quiet, an ice bag to the chest, the giving of milk and cream, half-and-half, if swallowing is possible, should be employed.

The scars resulting from burns and scalds always contract, and in severe cases treatment by a physician may prevent terrible deformities.

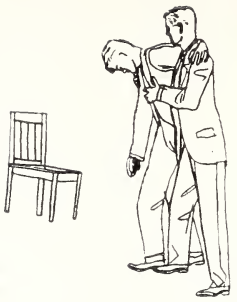
Chemical burns may occur in the household and it is important to know what is the nature of the chemical. If it is an acid, the burned area should be thoroughly washed with a solution of bicarbonate of soda. If it is an alkali, an acid solution, e.g., vinegar, should be used. It may be that the nature of the chemical will not be known and hence copious amounts of water may be used. Clothing that may have been contaminated by the chemical should, of course, be removed immediately.

Treatment of Bruises

A bruise or contusion is an injury where the tissues beneath the skin have been torn, but the skin itself has not been opened. Blood oozes out of the injured blood vessels, but cannot escape as the skin is still intact. The symptoms are swelling, tenderness, and a feeling of soreness and pain. Discoloration of the skin occurs quickly in superficial contusions and in places where loose tissue abounds, but only after days if the injury is deep-seated. This discoloration is at first red and then successively purple, black, green, and yellow. This play of colors is due to the changes which take place in the blood while undergoing absorption.

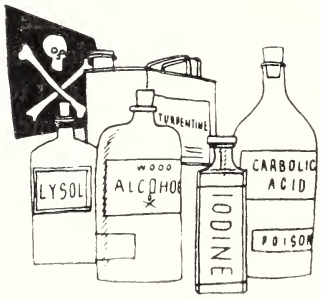
A pad or gauze or soft towel should be lightly bandaged over the injured part to lessen internal bleeding, after which cold applications should be applied except in old or feeble persons or where the contusion is sufficiently severe to cause shock. In the latter case the shock should be treated first and the contusion after all danger is over. In old, greatly debilitated, or acutely ill persons, heat is preferable, as cold might cause gangrene. It is often of benefit to use a saturated solution of epsom salts, or evaporating solutions, such as witch hazel, or a 15 percent solution of alcohol in water. A contusion should not be opened, except in rare cases when it is necessary to stop persistent bleeding. If an opening is made through the skin, germs are liable to enter and cause severe inflammation, resulting in the formation of pus or perhaps blood poisoning.

2. EMERGENCIES



There are times when a little knowledge of heart disease may be of great value in dealing with heart attacks. One of the most common is angina pectoris. The main symptom of this disease is pain in the chest, usually under the breastbone or in the pit of the stomach. This pain may radiate down the arm and is described as tightness or squeezing in character. Quite frequently it is attended by vomiting, and naturally is thought to be an attack of acute indigestion. The only first aid that can be given in the home is to have the patient sit quietly until the pain subsides. If the patient has been under the care of a physician he will usually carry nitroglycerin tablets given to him by the physician. One of these tablets should be placed under the patient's tongue. If the pain or vomiting continues, a doctor should be called at once. The recognition of this type of heart attack, not putting it down as just indigestion, and seeking medical aid at once, may save a person's life.

3. POISONING



Poisoning in the household is a rather frequent occurrence. It is usually due to carelessness on the part of parents since it occurs most frequently in children. The prevention of these mishaps is most important. Poisonous drugs should be kept separated from other drugs in the household. They should be clearly marked so that one's attention is brought to the danger of the drug immedi-

ately. Any bottle or box of medicine that is not labeled should not be used. Moreover, this type of unlabeled medicine should be discarded.

Children playing in the bathroom are attracted by the bright colored capsules and medicines, and thinking they are candy, the children may often take a poisonous dose. Adults should look at the label of a bottle of medicine *twice, before taking the contents or giving them to others.*

Some of the most common drugs that may be found in the home are tincture of iodine, carbolic acid, turpentine, lysol, bichloride of mercury. Among the various sedatives are phenobarbital, nembutal, seconal, and sodium amytal. Other medicines are strychnine, wood alcohol, morphine and atropine. Another common cause of accident is the ingestion of fuel oil or kerosine by children.

It may be that the poisonous substance is unknown. In general, vomiting should be induced and large quantities of fluid taken to dilute the substance.

To induce quick vomiting, a tablespoonful of salt in warm water or the whites of several raw eggs can be used effectively. Syrup of ipecac, one-half to one tablespoonful in warm water is another method. In cases where the poison is unknown, one may use the universal antidote, namely, two parts of charcoal, one part of magnesium oxide, and one part tannic acid.

After the poisonous material has been vomited up, quantities of milk may be given. If the patient has taken lysol, or phenol, use 3 tablespoons of epsom salts in a glass of water to induce vomiting. Follow this with egg white and milk.

Sometimes iodine will be swallowed with suicidal intent. Usually this does nothing more than cause rather severe burns of the mouth, throat and stomach, since the pain from the burns is so severe the patient usually does not take enough of the iodine to poison himself. In case of iodine poisoning, a solution of starch should be given. If vomiting occurs, repeat the giving of the starch solution until the stomach has been washed out several times.

Rat poison may be accidentally taken by children. This poison is usually arsenic. Toxic symptoms are vomiting, abdominal pain, and diarrhea. The treatment is to induce vomiting as quickly as possible. After this, milk and egg whites should be given.

Poisoning may occur from an overdose of sleeping pills. The toxic symptoms of this type of poisoning are slow, shallow breathing, and the pupils of the eyes are very small. Specific antidotes for

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this type of poisoning are usually not available in the home and for that reason a physician should be called as quickly as possible. In the meantime, strong coffee should be given, and efforts made to keep the patient awake, by cold applications and by forceable walking.

Carbon monoxide poisoning is a rather common cause of poisoning and prompt first aid may save a life. The symptoms are dizziness, headache, and coma. Treatment consists in getting the victim into fresh air quickly and calling a physician. In the meantime start artificial respiration.

4. ARTIFICIAL RESPIRATION

When breathing has ceased in any human being because of electrical shock, asphyxiation, or submersion in water, immediate effort should be made to start breathing again. The time element here is of utmost importance and artificial respiration should be commenced immediately without losing time in transporting the patient from one place to another, or in waiting for a physician. Many lives have been saved by the prompt efforts of those who knew how to apply the Schaeffer prone-pressure method of resuscitation, and many lives have been lost because no one present had that knowledge. Boy scouts and girl scouts are now generally trained in that method of resuscitation and their services may be called upon when there is no adult present who is familiar with that method.

Every adult member of the household should familiarize himself or herself with the Schaeffer prone-pressure method of resuscitation. The directions given below for the application of that method are those which have been prepared by a committee consisting of representatives of the United States Public Health Service, the American Red Cross, the National Safety Council, the U. S. Bureau of Mines, and the National Bureau of Standards, and other interested organizations.

(*a*) Lay the patient on his belly, one arm extended directly over-

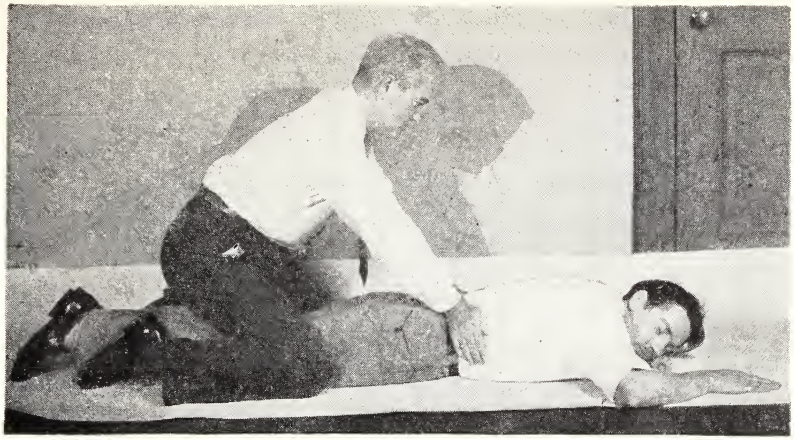

FIGURE 4.—*Initial position for resuscitation.*

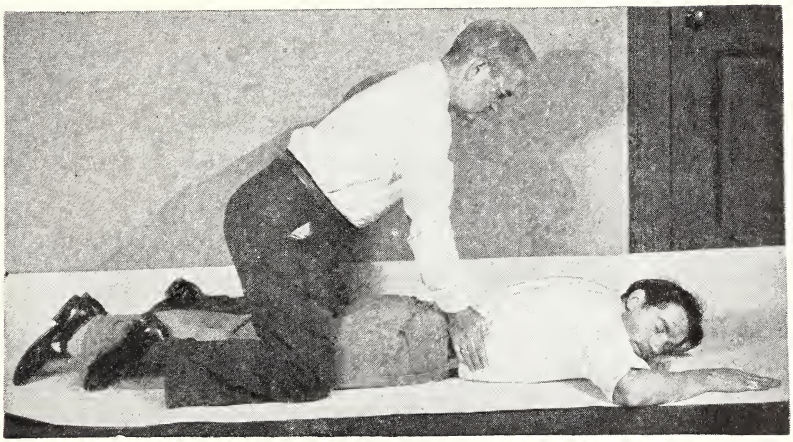

FIGURE 5.—*Second position for resuscitation.*

head, the other arm bent at elbow and with the face turned toward and resting on hand or forearm so that the nose and mouth are free for breathing. Examine the mouth to be sure that no foreign objects such as false teeth are in the mouth.

(*b*) Kneel straddling the patient's thighs with your knees placed at such a distance from the hip bones as will allow you to assume the position shown in figure 4.

Place the palms of the hands on the small of the back with fingers resting on the ribs, the little finger just touching the lowest rib, with the thumb and fingers in a natural position, and the tips of the fingers just out of sight.

(*c*) With arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear upon the patient. The shoulder should be directly over the heel of the hand at the end of the forward swing (fig. 5). Do not bend your elbows. This operation should take about 2 seconds.

(*d*) Now immediately swing backward so as to completely remove the pressure, thus returning to the position in figure 4.

(*e*) After 2 seconds, swing forward again. Thus repeat deliberately 12 to 15 times a minute the double movement of compression and release, a complete respiration in 4 or 5 seconds.

(*f*) Continue artificial respiration without interruption 4 hours or longer until natural breathing is restored.

(*g*) As soon as this artificial respiration has been started and while it is being continued, an assistant should loosen any tight clothing about the patient's neck, chest, or waist. *Keep the patient warm. Do not give any liquids whatever by mouth until the patient is fully conscious.*

(*h*) To avoid strain on the heart when the patient revives, he should be kept lying down and not allowed to stand or sit up. If the doctor has not arrived by the time the patient has revived, the patient should be given some stimulant, such as one teaspoonful of aromatic spirits of ammonia in a small glass of water or a hot drink of coffee or tea, etc. The patient should be kept warm.

(*i*) Resuscitation should be carried on at the nearest possible point to where the patient received his injuries. He should not be moved from this point until he is breathing normally of his own volition and then moved only in a lying position. Should it be necessary, due to extreme weather conditions, etc., to move the patient before he is breathing normally, resuscitation should be carried on during the time that he is being moved.

(*j*) A brief return of natural respiration is not a certain indication for stopping resuscitation. Not infrequently the patient, after a temporary recovery of respiration, stops breathing again. The patient must be watched and if natural breathing stops, artificial respiration should be resumed at once.

(*k*) In carrying out resuscitation it may be necessary to change the operator. This change *must* be made without losing the rhythm of respiration. By this procedure no confusion results at the time of change of operator and a regular rhythm is kept up.

12. TABLES

1. Accidental injuries by severity of injury 1933-43, inclusive.
2. Foreign and United States accidental death rates per 100,000 population 1933-43, inclusive.
3. Accidental home injuries by severity of injury 1933-43, inclusive.
4. Deaths from home accidents by type of accident 1933-43, inclusive.
5. Deaths from accidents in the home by type of accident and age group 1940-43, inclusive.
6. Cost of accidents in the home 1933-43, inclusive.
7. Characteristics of some refrigerant vapors.
8. Causes of loss of life by fire 1930-45.
9. Estimated distribution of United States fire losses by occupancies, 1940-44, inclusive.
10. Estimated distribution of United States fire losses by causes, 1940-44, inclusive.
11. Characteristics of Underwriters' Laboratories and Factory Mutual Laboratories approved hand fire extinguishers.

TABLE 1.—*Accidental injuries by severity of injury 1933–43, inclusive*[1]

Types of injury	1933	1934	1935	1936	1937	1938
Fatalities	90,000	101,000	100,000	111,000	106,000	94,000
Permanent disabilities[2]	330,000	370,000	360,000	400,000	375,000	330,000
Temporary total disabilities	8,400,000	9,350,000	8,980,000	10,330,000	9,400,000	8,600,000
Total, all injuries.	8,820,000	9,821,000	9,440,000	10,841,000	9,881,000	9,024,000

Types of injury	1939	1940	1941	1942	1943	Total
Fatalities	93,000	96,500	102,500	93,000	97,500	1,084,500
Permanent disabilities[2]	320,000	330,000	350,000	320,000	350,000	3,835,000
Temporary total disabilities	8,500,000	8,800,000	8,950,000	8,750,000	9,750,000	99,810,000
Total, all injuries.	8,913,000	9,226,500	9,402,500	9,163,000	10,197,500	104,729,500

[1] Source: Approximations by the National Safety Council, based on United States Census Bureau records and other data.

[2] The term "permanent disability" includes both permanent partial and permanent total disability as defined in the American Standard Method of Compiling Industrial Injury Rates.

TABLE 2.—*Foreign and United States accidental death rates per 100,000 population 1933–43, inclusive*[1]

Country	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942	1943
Australia	44.9	[2]	50.7	53.3	57.6	56.4	[2]	[2]	[2]	[2]	[2]
Belgium	30.3	29.3	[2]	33.4	34.2	32.4	[2]	[2]			
Canada	48.1	49.7	53.4	58.1	56.2	[2]	53.7	55.0			
Ceylon	41.1	38.7	40.6	40.1	[2]	[2]	37.9	[2]			
Chili	76.6	82.1	72.3	76.5	84.7	81.0	[2]	[2]			
Denmark	30.4	30.6	[2]	33.2	31.2	[2]	32.9	34.4			
England & Wales	41.7	41.9	40.7	42.4	42.5	41.8	[2]	[2]			
Estonia	[2]	[2]	[2]	[2]	45.5	[2]					
Finland	38.9	[2]	[2]	47.4	47.5	44.9					
France	49.3	48.6	[2]	45.9	[2]	[2]					
Germany	34.6	38.8	41.7	43.4	[2]	[2]					
Hungary	[2]	25.4	[2]	27.5	30.6	31.9					
Irish Free State	30.1	27.8	29.6	30.6	28.2	[2]	27.8				
Italy	32.2	33.0	[2]	32.2	33.5	32.5	[2]				
Japan	44.6	46.7	41.7	42.9	42.2	44.0					
Lithuania	[2]	30.4	[2]	31.0	32.2	37.1					
Mexico	[2]	[2]	[2]	[2]	61.8	[2]					
Netherlands	28.5	27.6	26.7	27.8	27.3	28.3					
New Zealand	41.5	43.5	41.9	46.8	48.4	53.0	45.2				
Northern Ireland	40.2	41.0	39.9	41.1	41.5	[2]	38.0				
Norway	35.5	37.2	33.2	36.6	35.8	41.5	[2]				
Portugal	[2]	[2]	[2]	[2]	41.3	[2]					
Rumania	[2]	[2]	[2]	[2]	35.2	[2]					
Scotland	46.5	46.0	44.8	46.4	51.2	47.6					
Spain	[2]	[2]	28.6	[2]	[2]	[2]					
Sweden	35.0	36.4	[2]	39.3	39.5	42.5					
Switzerland	62.4	59.4	60.0	55.9	57.7	[2]	54.9				
Union of South Africa	42.1	46.4	50.9	[2]	51.9	[2]	53.2				
United States	72.4	79.9	78.2	85.7	81.4	72.3	70.7	73.4	76.3	71.7	73.9
Uruguay	[2]	[2]	[2]	[2]	31.7	28.0	[2]	[2]		[2]	[2]

[1]Source: National Safety Council data given in Accident Facts.
[2]Data not obtainable.

TABLE 3.—*Accidental home injuries by severity of injury 1933–43, inclusive*[1]

Types of injury	1933	1934	1935	1936	1937	1938
Fatalities	30,000	34,000	32,000	37,000	32,000	31,500
Permanent disabilities[2]	130,000	150,000	140,000	170,000	140,000	140,000
Temporary total disabilities	4,230,000	4,950,000	4,460,000	5,450,000	4,600,000	4,500,000
Total, all injuries.	4,390,000	5,134,000	4,632,000	5,657,000	4,772,000	4,671,500

Types of injury	1939	1940	1941	1942	1943	Total
Fatalities	32,000	32,500	30,000	30,500	33,500	355,000
Permanent disabilities[2]	140,000	140,000	130,000	120,000	130,000	1,530,000
Temporary total disabilities	4,550,000	4,700,000	4,500,000	4,450,000	4,700,000	51,090,000
Total, all injuries.	4,722,000	4,872,500	4,660,000	4,600,500	4,863,500	52,975,000

[1] Source: Approximations by the National Safety Council, based on United States Census Bureau records and other data.

[2] The term "permanent disability" includes both permanent partial and permanent total disability as defined in the American Standard Method of Compiling Industrial Injury Rates.

TABLE 4.—*Deaths from home accidents by type of accident 1933–43, inclusive*[1]

Type of accident	1933	1934	1935	1936	1937	1938
Falls	14,100	15,900	15,900	17,500	16,000	15,900
Burns, explosions	5,400	6,000	5,800	6,250	5,600	5,300
Poisonings (gas excepted)	1,500	1,700	1,700	1,650	1,700	1,650
Firearms	800	800	750	750	1,100	1,300
Mechanical suffocation	800	900	1,000	1,150	1,100	1,100
Poisonous gas	1,000	1,000	1,000	1,100	1,100	950
Other home accidents	6,400	7,700	5,850	8,600	5,400	5,300
Totals	30,000	34,000	32,000	37,000	32,000	31,500

Type of accident	1939	1940	1941	1942	1943	Totals
Falls	16,400	16,000	15,900	15,500	17,000	176,000
Burns, explosions	5,500	6,100	5,300	5,400	6,600	63,250
Poisonings (gas excepted)	1,550	1,650	1,400	1,400	1,500	17,400
Firearms	1,250	1,400	1,100	1,200	1,000	11,450
Mechanical suffocation	1,100	1,350	1,350	1,400	1,600	12,850
Poisonous gas	1,000	1,200	1,000	1,100	1,400	11,850
Other home accidents	5,200	4,800	3,950	4,500	4,400	62,100
Totals	32,000	32,500	30,000	30,500	33,500	355,000

[1] Source: Approximations by the National Safety Council, based on United States Census Bureau records and other data.

TABLE 5.—*Deaths from accidents in the home by type of accident and age group 1940–43, inclusive*[1]

Type of accident	Details by age group						
	0 to 4 years	5 to 14 years	15 to 24 years	25 to 44 years	45 to 64 years	65 years and over	Total—all ages
Falls	1,330	850	470	1,450	5,900	54,400	64,400
Burns, explosions	6,550	2,750	1,190	3,010	3,600	6,300	23,400
Poisonings (gas excepted)	1,980	250	340	1,350	1,300	730	5,950
Firearms	340	1,150	1,090	1,170	720	230	4,700
Mechanical suffocation	5,420	50	40	80	80	30	5,700
Poisonous gas	230	180	410	1,030	1,350	1,500	4,700
Other home accidents	5,400	1,870	960	1,510	1,850	6,060	17,650
Totals	21,250	7,100	4,500	9,600	14,800	69,250	126,500

[1] Source: Approximations by the National Safety Council, based on United States Census Bureau records and other data.

TABLE 6.—*Cost of accidents in the home 1933–43, inclusive*[1]

Year	Wage loss	Medical expense	Overhead cost of insurance	Total cost
1933	$400,000,000	$140,000,000	$10,000,000	$550,000,000
1934	470,000,000	160,000,000	10,000,000	640,000,000
1935	430,000,000	150,000,000	10,000,000	590,000,000
1936	530,000,000	180,000,000	10,000,000	720,000,000
1937	450,000,000	150,000,000	10,000,000	610,000,000
1938	440,000,000	140,000,000	10,000,000	590,000,000
1939	450,000,000	140,000,000	10,000,000	600,000,000
1940	460,000,000	150,000,000	10,000,000	620,000,000
1941	440,000,000	140,000,000	10,000,000	590,000,000
1942	420,000,000	130,000,000	10,000,000	560,000,000
1943	450,000,000	140,000,000	10,000,000	600,000,000
Total....	$4,940,000,000	$1,620,000,000	$110,000,000	$6,670,000,000

[1] Source: Approximations by the National Safety Council, based on data from the United States Census Bureau, state industrial commissions, and insurance companies, and other sources of information. Wage loss includes loss of wages (or value of services) due to temporary inability to work, lower wages when returned to work due to permanent partial disability, and the value of anticipated future earnings for permanent total disabilities and deaths. Medical expense includes doctors' and hospitals' fees. Overhead cost of insurance includes all administrative, selling and claim settlement expenses for insurance companies, but *not* the money paid on claims. Claims paid are included in the wage loss and medical expense totals.

TABLE 7.—*Characteristics of some refrigerant vapors*[1]

Trade name	Chemical name	Toxicity				Flammable or explosive limits when mixed with air	
		Percentage by volume				Percentage by volume	
		Kills most animals in very short time	Dangerous in ½ to 1 hour	Maximum amount for 1 hour without serious disturbances	Maximum amount for prolonged exposure	Lower limit	Upper limit
.....	Ammonia	0.5 to 1.0	0.25 to 0.45	0.03	0.01	16.0	25.0
Freon–12	Dichlorodifluoromethane	.....	30.0	.....	.....	(2)	(2)
Dielene	Dichloroethylene	.....	2.0	.....	.....	5.6	11.4
Carrene	Dichloromethane	.....	5.0	.....	.....	(2)	(2)
Freon–114	Dichlorotetrafluoroethane	.....	20.0	.....	.....	(2)	(2)
.....	Ethyl chloride	15.0 to 30.0	6.0 to 10.0	4.0	2.0	3.7	12.0
Artic	Methyl chloride	15.0 to 30.0	2.0 to 4.0	0.7	0.05 to 0.10	8.1	17.2
.....	Methyl formate	.....	2.0	.....	.....	4.5	20.0
.....	Sulfur dioxide	0.2	0.04 to 0.05	.005 to 0.02	.001	(2)	(2)
Freon–11	Trichloromonofluoromethane .	.....	10.0	.....	.....	(2)	(2)

[1] Source: National Bureau of Standards Letter Circular LC419.

[2] Nonflammable at ordinary temperatures.

TABLE 8.—*Causes of loss of life by fire 1930–45*

[A record, 1930–45, of fires reported to the National Fire Protection Association, representing about a 10 percent typical sample of total estimated fire fatalities][1]

Causes	Fatalities
Aircraft fires	861
Asphyxiation by smoke or gas	802
Clothing, bedding ignited from bonfires, fireplaces, stoves, etc.	1,440
Children alone in the house	473
Children playing with matches	254
Entering burning building	196
Escaping fire, jumped, fell or drowned	186
Explosion of chemicals, gases, dusts, etc.	1,889
Fire fighting	471
Flammable liquids, vapors, alcohol, gasoline, oil, paints, etc.	2,466
Forest and brush fires	197
Marine fires	541
Mine fires and explosions	1,362
Motor vehicle fires	1,062
Nitrocellulose materials	61
Railroad rolling stock fires	133
Trapped in burning building	5,311
Miscellaneous known causes	401
No data as to cause	486
Total	18,592

[1] Source: National Fire Protection Association Quarterly for July 1945.

NOTE.—United States Bureau of Census figures as to the total number of reported fatalities due to conflagrations and burns are less than those of the National Fire Protection Association. However, United States Bureau of Census figures do not include fire casualty deaths due to drowning when forced overboard from a fire at sea, accidents to firemen sustained at fires or in responding to fires, and deaths from diseases, such as pneumonia contracted as a result of fire exposure, which may not occur until long after the date of the fire and which may not include any mention of fire on the death certificate. National Fire Protection Association data include such fatalities and for that reason have been used in preparation of the above table.

TABLE 9.—*Estimated distribution of United States fire losses by occupancies, 1940–44, inclusive*[1]

[Approximate estimate from State fire marshals' reports][1]

Occupancy	Number of fires	Loss	Loss per fire
Public Buildings (hospitals, schools, churches, theatres, libraries, amusement halls, etc.)	57,000	$153,200,000	$2687.71
Dwellings (hotels, apartments, rooming houses, homes, etc.)	1,908,800	510,800,000	267.61
Mercantile (office buildings, warehouses, restaurants, and other mercantiles)	332,850	388,300,000	1166.59
Manufacturing (mills, packing plants, bakeries, laundries, woodworking and metal-working shops, etc.)	146,450	364,700,000	2490.27
Miscellaneous (barns, lumber yards, railroad and wharf properties, power plants, oil tanks, motor vehicles, filling stations, etc.)	948,900	372,000,000	392.03
Totals	3,394,000	$1,789,000,000	$527.11

[1] Source: National Fire Protection Association Quarterly, October 1941 to October 1945.

These estimated figures are intended to show the relative order of magnitude of fire losses by occupancies and while they are reasonable approximations based on the experience in typical states they should not be taken as exact records for each class.

TABLE 10.—*Estimated distribution of United States fire losses by causes, 1940–44, inclusive*[1]

[Approximate estimate from State fire marshals' reports][1]

Causes	Number of fires	Loss	Loss per fire
Chimneys, flues, defective or overheated	260,000	$96,800,000	$372.31
Sparks on roofs	255,500	50,400,000	197.26
Defective or overheated heating equipment	245,000	83,750,000	341.84
Rubbish	105,000	15,900,000	151.43
Combustibles near heaters	46,500	25,600,000	550.54
Open lights, flames, sparks	99,000	36,500,000	368.69
Hot ashes, coals	71,000	18,000,000	253.52
Oil burners	52,000	24,300,000	467.31
Smoking and matches	598,500	128,350,000	214.45
Children and matches	122,500	16,600,000	135.51
Electrical wiring and appliances	363,000	173,980,000	479.28
Flammable liquids, dry cleaning, etc.	118,500	49,600,000	418.57
Torches, welding, cutting, plumbers, etc.	23,500	34,350,000	1461.70
Lamps, lanterns, stoves	92,000	35,200,000	382.61
Gas and appliances	20,000	9,750,000	487.50
Grease, tar, etc.	66,500	18,500,000	278.19
Spontaneous ignition	81,500	92,300,000	1132.51
Fireworks	5,300	920,000	173.58
Lightning	144,500	46,750,000	323.53
Thawing pipes	9,900	3,550,000	358.58
Sparks from machinery, friction	13,300	12,000,000	902.25
Incendiary, suspicious	22,000	37,850,000	1720.45
Miscellaneous	114,500	49,850,000	435.37
Unknown	309,000	612,500,000	1982.20
Explosions	52,500	51,800,000	986.67
Exposure	100,000	63,100,000	631.00
Films, nitrocellulose	3,000	800,000	266.67
Total	3,394,000	$1,789,000,000	$527.11

[1] Source: National Fire Protection Association Quarterly, October 1941 to October 1945.

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[1]U. S. GOVERNMENT PRINTING OFFICE: 1947—748316

TABLE 11.—*Characteristics of Underwriters' Laboratories and Factory Mutual Laboratories approved ha*

TYPE OF EXTINGUISHER		DRY CHEMICAL	CARBON DIOXIDE	VAPORIZING LIQUID	FOAM	SODA AND ACID	WATER TYPE	LOADED STREAM
SUITABILITY	CLASS A FIRES Wood, Cloth, Paper, Rubbish, Etc.	NO But will control small fires.	NO But will control small fires.	NO But will control small fires.	YES	YES	YES	YES
	CLASS B FIRES Oil, Gasoline, Grease, Paint, Etc.	YES	YES	YES	YES	NO	NO	YES
	CLASS C FIRES Electrical Equipment	YES	YES	YES	NO	NO	NO	NO
NOMINAL CAPACITIES AND CORRESPONDING UNDERWRITERS' LABORATORIES CLASSIFICATION Letters designate class of fire. Numbers denote the number of extinguishers necessary to form one unit of First-Aid Hand Fire Protection.		15 lb. 20 lb. 25 lb. 30 lb. } B-1, C-1	2 lb. B-4 2 lb.* } B-2, C-2 4 lb. 7½ lb. B-2, C-1 10 lb. 15 lb. } B-1, C-1 20 lb. * Trigger Control	1 qt. 1¼ qt. 1½ qt. } B-2, C-2 2 qt. 1 gal. 2 gal. } B-2, C-1 3 gal.	1¼ gal. 1½ gal. } A-2, B-2 2½ gal. 5 gal. } A-1, B-1	1¼ gal. 1½ gal. } A-2 2½ gal. A-1	2½ gal. A-1	1 gal. A-2, B-4 1¾ gal. 2½ gal. } A-1, B-2
EXTINGUISHERS RECOMMENDED BY FACTORY MUTUAL LABORATORIES for use on gasoline pan fires of the areas specified.		15 lb.— 8 sq. ft. 20 lb.—12½ sq. ft. 25 lb.—10 sq. ft. 30 lb.—16 sq. ft.	2 lb.:— 1 sq. ft. 4 lb. — 2½ sq. ft. 7½ lb. — 3 sq. ft. 10 lb. — 5 sq. ft. 15 lb. — 8 sq. ft. 20 lb. — 9 sq. ft.	Not Recommended by Factory Mutual Laboratories for flammable liquid fires except those of small size.	1¼ gal. — 2½ sq. ft. 1½ gal. — 3 sq. ft. 2½ gal. — 5 sq. ft. 5 gal. — 10 sq. ft.	Not Recommended by Factory Mutual Laboratories for flammable liquid fires.	Not Recommended by Factory Mutual Laboratories for flammable liquid fires.	Not Recommended by Factory Mutual Laboratories for flammable liquid fires.
MAXIMUM EFFECTIVE RANGE		20 ft. to 25 ft.	3 ft. to 5 ft.	20 ft. to 30 ft.	30 ft. to 35 ft.	30 ft. to 40 ft.	30 ft. to 40 ft.	30 ft. to 40 ft.
APPROXIMATE WEIGHT, FULLY CHARGED		15 lb. 20 lb. } 40 lb. 25 lb. 30 lb. } 55 lb.	7½ lb.— 35 lb. 15 lb.—50 to 60 lb. 20 lb.—55 to 75 lb.	1 qt. — 7 lb. 1 gal.—25 to 35 lb. 3 gal.— 75 lb.	1¼ gal. 1½ gal. } 20 lb. to 25 lb. 2½ gal. — 35 lb. 5 gal. — 70 lb.	1¼ gal. 1½ gal. } 20 lb. to 25 lb. 2½ gal. — 35 lb.	2½ gal. — 35 lb.	1 gal. 1¾ gal. } 20 lb. to 25 lb. 2½ gal. — 40 lb.
SUBJECT TO FREEZING		NO	NO	NO	YES	YES	YES	NO
YEARLY INSPECTION		Weigh cartridge	Weigh	Partly Discharge	Discharge	Discharge	Weigh cartridge	Weigh cartridge
OPERATION		15 lb. 25 lb. } Turn Handwheel 20 lb. 30 lb. } Push Lever Down	Turn Handwheel, Pull Trigger or Squeeze Handle	Pump or Open Valve	Invert	Invert	Invert and bump on floor	Invert and bump on floor
MEANS OF EXPELLING EXTINGUISHING AGENT		Carbon dioxide cartridge	Under pressure in extinguisher	Pump, air pressure, or carbon dioxide cartridge	Chemical reaction to form carbon dioxide	Chemical reaction to form carbon dioxide	Carbon dioxide cartridge	Carbon dioxide cartridge
COMPOSITION OF EXTINGUISHER CHARGE		Specially treated sodium bicarbonate in powdered form with important components for producing free-flow and water-repellancy.	Carbon dioxide	Specially treated carbon tetrachloride with important components for lowering freezing point and avoiding corrosion.	Solutions of aluminum sulfate and sodium bicarbonate with foam stabilizing agent.	Sodium bicarbonate solution and sulfuric acid	Water	Solutions of potassium carbonate and special salts.

CALCIUM CHLORIDE SOLUTIONS FOR WATER PAILS AND HAND PUMP EXTINGUISHERS

2½ Gallons Anti-Freezing Solution

NOTE: This table based on granulated 75% calcium chloride

Freezing Temperature	Water	Calcium Chloride	Specific Gravity	Degrees Baume
10° F.	2 gal. 1 qt.	5 lb.	1.139	17.7
Zero F.	2 gal. 1 qt.	6⅛ lb.	1.175	21.6
10° below zero F.	2 gal.	7 lb. 6 oz.	1.205	24.7
20° below zero F.	2 gal.	8 lb. 6 oz.	1.228	26.9
30° below zero F.	2 gal.	9 lb. 2 oz.	1.246	28.6
40° below zero F.	2 gal.	10 lb.	1.263	30.2

THIS CHART IS BASED ON INFORMATIO

"National Fire Codes for Extinguishing and Alarm Equip
"Handbook of Fire Protection", 9th Edition (1941), Nati
Fire Protection Equipment" (1946), Underwriters' Labora
tories. . . . . "List of Approved Equipment" (1946), Fa

[1] Reproduced from table issued October 1946 by Ansul Chemical Company, Fire Extinguisher Division, Marinette, Wis.