UNITED STATES RAILROAD ADMINISTRATION
DIRECTOR GENERAL OF RAILROADS
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A MANUAL ON

FIRE PROTECTION FOR RAILROAD PROPERTIES

FOR THE USE AND INFORMATION OF
FIRE PROTECTION INSPECTORS

COMPILED BY

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The Appeal to America

SAFEGUARDING INDUSTRY

PRESIDENT WILSON says:

"Preventable fire is more than a private misfortune. It is a public dereliction. At a time like this of emergency and of manifest necessity for the conservation of national resources, it is more than ever a matter of deep and pressing consequence that every means should be taken to prevent this evil."

PREVENT FIRE LOSSES ON RAILROADS.

PREVENTING AND REDUCING THE FIRE WASTE OF THE NATION WILL HELP TO PROVIDE FOR THE NATION'S NEEDS.

1. All officers and employees of railroads should be on guard at all times, show their loyalty and cooperation, and through earnest efforts and constant vigilance accept their responsibility toward the elimination of the unnecessary fire loss to railroad properties.

2. Let each employee consider himself a fire inspector or warden, as far as his particular duties are concerned and in so far as any dangerous condition may come to his notice; and let each one have in mind constantly that through no act of his, or through no lack of action on his part, will he create a fire hazard or allow one to pass unnoticed.

3. If you know of or see a fire danger or hazard, report it immediately to your superior in charge of your department.

4. Keep in mind constantly that the first requisite in the prevention of fire waste is good housekeeping—meaning cleanliness. Remove accumulations of rubbish and waste, and guard inflammable property and materials from all sources of danger by fire. Guard against not only physical defects but neglects brought about through carelessness, indifference, ignorance, or willfulness on the part of any person. Smoking is a general habit; guard carefully against hazards and careless practices incident to it.

5. Railroad operation is in its nature so continuous that destruction of property used in it leaves marked consequential losses. The acceptance of individual responsibility will prevent not only large waste of property, which can not be replaced to day, but temporary loss of employment through the destruction of facilities and serious interference with operations.

W. G. McAdoo,
Director General of Railroads.

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FOREWORD.

FIRE PROTECTION APPLIED TO RAILROAD PROPERTIES.

The large values invested in railroad property, aside from right of way, roadbeds, etc., and the large liabilities involving the carriers, can be readily comprehended. We are dealing with a problem affecting billions of dollars in property value. When we glance at the enormous growth of the transportation lines in this country in the last 25 years, and with the careful study now given to all phases of safety and economy in operation, it can readily be seen that the question of fire protection and prevention should play no small part, for, aside from the destruction of values brought about by fire losses, there is always the incidental and consequential interruption of operations. The nature of the business of transportation requires that more than ordinary precautions be taken to safeguard against and keep free from the interruptions to their operations which fire loss and damage cause. Such interruption naturally varies with the importance of the property. As an illustration, we might cite the destruction by fire of an interlocking tower, with the subsequent detention or interruption in train service, on up to the large terminal and shop properties, dislocating the machinery of transportation and requiring readjustment involving far-reaching consequential details.

One of the first demands in connection with the study of fire prevention is that of good housekeeping, involving enforcements that will insure it through a large property as a matter of daily duty and through which means the possibility of fires may be largely avoided. This can be accomplished by the appointment of employees in each portion of a property with such authority as may be necessary to see that cleanliness is observed and through the posting of official notices in prominent places requiring the carrying out of fire-protection rules so prepared as to meet conditions usually found in railroad properties.

The protection of properties against fire is an important part of the duty of every officer and employee. Every fire in railroad property should be made the personal responsibility of some employee. It must be remembered that the majority of fire losses are preventable and that they are largely a matter of lack of cleanliness and carefulness, and that the great study of prevention must be along these lines.

This subject of fire-extinguishing apparatus is necessarily one of great detail and brings out the study of the extent and character of the properties, the natural conditions surrounding them, and their use and occupancy. The class of appliances will necessarily cover a wide range, starting, however, with the idea of having an ample supply of water to meet the maximum of conditions that might arise. Careful study is necessary to determine the specific character of fire-extinguishing devices required to meet the demands of each class of property. These include the use of a system of automatic protection which is

the best class that may be considered and which is recognized as the only one producing the maximum of efficiency and success in controlling fires; water mains and fire-hydrant systems under ample volume and pressure from public or private reservoir or other source of supply, with incidental fire pumps, elevated tanks, standpipes, fire hose, fire extinguishers, steam jets, sand pails, water barrels and pails; all of which must be studied and installed with a due regard to their relative values. An important fire-fighting agency on railroad properties is the locomotive or yard engine used at terminals and large yards remote from public protection, so equipped for supplying water under pressure with the aid of fire hose as to give good service in event of fires in rolling equipment and its lading.

Fire-alarm systems are an important factor, particularly in large properties, to obtain prompt use of fire appliances through the prompt summoning of drilled employees and municipal departments.

The success of the fire-prevention idea must be due entirely to well-organized forces in all departments. Without system and organization through the help and authority of executives or the general management, such matters can not be made an important factor with the men. The prevention of the occurrence of those things which hinder or retard the progress of operation or which are a menace to life and property is brought about or is enhanced by education through instructions, rules, etc., issued under an executive order. In this way cooperation is secured amongst the rank and file.

Fires, like accidents, happen at unexpected times. Continued vigilance is therefore essential, and without a general cooperation and knowledge of dangers we can not escape their consequences.

With the large values involved and elaborate expenditures made for devices and appliances for fire extinguishment, it is important that the furtherance of the organization idea should be pushed for its intelligent and prompt use, without which the expenditures are of no avail when manual use is required of the equipment. Therefore, in order to have the appliances serve the good purpose that was intended, it is necessary to so perfect the organization as to get the greatest amount of value therefrom.

Rigid and systematic inspection of all fire apparatus should also be made by specially delegated employees, preferably members of fire brigades, at least once a week; everything down to the smallest piece of apparatus should be in its place and in good order ready for use, and a report of such inspection should be made to those in authority.

Fire-prevention committees, fire marshals, chiefs or captains of fire brigades, are all necessary parts of an efficient organization, and the inspection of buildings and their valuable contents for fire hazards by such committees or members of fire departments are necessary. Members of fire departments, possibly uniformed or otherwise designated with authority, should be especially delegated to make at least weekly inspections and report to the authorities in charge on the conditions, and day and night watchmen should patrol all parts of the property for the same purpose, having their tours properly recorded on approved devices to assure efficiency.

There should be monthly conferences of officers or local committees at which matters of general interest might be considered with a view of continuing efforts for substantial improvements, for with all reasonable precaution there is still the factor that relaxation may be fatal.

While many of the railroads of the country have issued rules and regulations or instructions for the guidance of their employees in the proper care and management of their properties in respect to protection against loss by fire, we believe a "manual" or "handbook" on "fire-prevention" subjects will give an

opportunity to such roads as have not adopted any rules or regulations, of having some available suggestions which may be adopted for general information, education, and guidance throughout their properties, and used as a means of study for the prevention of fire losses, in other words, recommended practices.

The details are compiled from recommendations of the National Fire Protection Association, Railway Fire Protection Association, and other agencies dealing with the specific classes of risks found in railroad properties.

Underwriters' Laboratories and its Service.

The Underwriters' Laboratories (incorporated under the laws of the State of Illinois) operates under the direction of the National Board of Fire Underwriters, a general testing station and laboratories at 207 East Ohio Street, Chicago, and testing stations for electrical goods at New York and London. At these plants facilities are provided for the testing under uniform and standard conditions of any device or material having a bearing on the fire hazard. By means of these facilities manufacturers are able to secure expert authoritative opinions as to the merits of their wares, and property owners, architects, officials, and inspectors have ready access to full and complete data concerning appliances and materials which are proposed for use and which affect the fire hazard either as possible sources of fire or as means of discovering, retarding, or extinguishing fires.

Separate and individual pamphlets regarding regulations, rules, and requirements and standards prepared by the National Fire Protection Association, and adopted and published by the National Board of Fire Underwriters, can be secured from the nearest underwriters' bureaus or associations, in connection with specific subjects.

Transportation of Explosives and Other Dangerous Articles.

The Interstate Commerce Commission has issued under date of July 15, 1918, revised regulations for the transportation of explosives and other dangerous articles by freight and express. These regulations and the revised rules of the American Railway Association, which have been approved by the Director General of the United States Railroad Administration, have been published and issued by the Bureau of Explosives, 30 Vesey Street, New York City, September, 1918.

All fire inspectors, officers, and employees of railroads should be supplied with a copy of these revised regulations that they may study and be guided by the regulations in connection with this important subject.

GENERAL INFORMATION.

GENERAL RULES FOR THE PREVENTION OF FIRE LOSSES.

[Where standard requirements, rules, or specifications are mentioned the publications of the National Fire Protection Association or Railway Fire Protection Association are referred to.]

NOTE.—Where municipal or State ordinances or regulations may be in effect regarding any hazard, they should be ascertained.

CONSTRUCTION.

One of the greatest factors in determining the extent of fire losses and consequent interference with operations is the method and character of building construction. Wherever feasible, fireproof or fire-resisting materials should enter into the construction of buildings. The height and area are important factors to be considered.

Structures of large areas and those having sections used for varied purposes, and all adjoining and communicating buildings, should be divided by brick walls of standard thickness running up through and above the roof, cutting off cornices, with all door openings protected by standard automatic closing fire doors. In all exposed buildings windows to be provided with wired glass in metal sash and frames, or standard fire shutters, or both, or a system of open or automatic dry pipe sprinklers, where conditions warrant such an installation.

Wooden buildings should be built in a nonexposing position. Wooden lean-to or small frame buildings should not be connected to large valuable buildings or adjacent thereto.

All openings through walls and floors, including elevator shafts, stairways, belt holes, etc., should be protected by automatically closing doors or traps.

Fire walls, doors, and shutters should be made standard, according to specifications of the National Fire Protection Association.

Fireproof oil and paint stock rooms and houses located apart from and not exposing valuable property are recommended. (See special article.)

Flues, chimneys, and stacks: Care should be used in their construction so as to insure safety, particular attention being given to keep free of timbers. (See special article.)

It is recommended when drawing plans and specifications that provision be made for wireways for rendering concealed wiring in buildings permanently accessible. The channeling and pocketing of buildings for electric light or power wires, telephone, telegraph, or signaling system wiring is desirable; all wiring to be according to latest edition of the "National Electrical Code."

Provide substantial fire-wall cut-offs from shaving vaults, dry kilns, boiler houses, to adjoining planing mills or other buildings.

Skylights should be made of wired glass in metal frames in accordance with standard requirements or protected from sparks by screen guards supported on iron frames.

Fireproof or fire-resisting roofing materials are recommended to be used.

The use of wooden unventilated closets for men's clothes is not approved. Well ventilated metal closets or lockers to be kept away from wood structural material are recommended for workmen's clothing and tools.

It is recommended that separate buildings be provided, wherever possible, at shop plants for men's clothes lockers, wash rooms, etc., in order to keep this hazard out of main shop buildings.

Fire Doors.

Fire doors are used to protect openings in fire walls. They should be hung on both sides of the wall and should be arranged to close automatically. Only doors and hardware incidental thereto which are approved and bear the label of the Underwriters' Laboratories should be used. Contracts should specifically require this as unlabeled doors and hardware are seldom satisfactory either from the fire-stopping standpoint or from that of maintenance. Fire doors and shutters should be constructed and installed in accordance with the National Board rules.

In installing fire doors particular attention should be given to the lintels, frames, and sills. There are a variety of methods and materials which may be used, depending on the circumstances, but it should be borne in mind that the floor on one side of the wall may be destroyed, so no direct connection should be made to the floor or supporting timbers.

Where the door opening is used for heavy trucking it is advisable to protect the front edge of the door with sheet metal to prevent tearing the tin.

Fire doors should normally be kept closed but where conditions require the frequent use of the opening they may be held open by a counterweight with one or more fusible links or other device which will detach the weight when subjected to heat allowing the door to close automatically. The link should be in the door opening. Special approved automatic releases may be used. Home-made links should not be used as they can not be depended on to fuse at the proper temperature.

CARE OF PROPERTY.

BEING RULES FOR DIMINISHING FIRE HAZARDS.

In shops and other large properties or even single buildings a competent employee should be appointed, with authority, who should inspect all parts thoroughly and regularly to see that the premises are kept clean and free from any feature which might cause fire.

Standard covered metal receptacles should be provided for ashes, rubbish, greasy and oily rags and waste, torches and small oil supplies; and rubbish, ashes, and sweepings should not be allowed to accumulate on property, but should be disposed of daily. The use of wood boxes and barrels for these purposes should be prohibited. Oily clothing should be kept hung up in metal lockers.

All machinery, especially the journals, and space underneath should be kept clean; drip pans should be provided for all journals and gear wheels; never use sawdust for absorbing oil; drip pans should be cleaned frequently, especially in woodworking mills, as the dust saturated with some kinds of oil is subject to spontaneous ignition; all belts should be examined to prevent friction, especially against combustible materials; all bearings should be watched for heating; the babbitt in loose pulleys should not be allowed to show signs of wear.

Forges and furnaces should have hoods or shields over them; wooden floors should not be permitted around forges or anvil blocks and woodwork kept at least four feet distant or protected by asbestos or metal with air space; tire setting should be on a concrete or brick floor; portable oil tanks should be built specially strong and special attention given to safety appliances guarding both life and property.

All woodworking mills should have shavings and sawdust blower or exhaust systems.

The woodwork of the interior of shop buildings should be kept whitewashed, or treated with fire retardent paint.

Oil lamps should not be filled and trimmed after dark or near a fire, and care should be taken to keep surroundings, where such work is done, free of oil saturation, by having metal trays or metal covered stands provided on which to do that work.

All oils, paints, varnishes, and similar compounds should be kept in special outside building provided for the purpose. A day's supply only should be allowed outside of stock house, kept in metal receptacles. Special provision should be made for storage of gasoline, benzine, and other highly volatile oils and explosives, apart from and not exposing main buildings. Avoid the use of gasoline, benzine, etc., as far as possible. If no suitable substitute can be utilized and any highly volatile oils must be used, they should be used only in restricted quantities, by daylight only, and from approved safety cans. Main supply to be stored as indicated in special rules.

Braziers and furnaces (gasolene).—When not in use should be kept in a metal box outside of main buildings. Should be filled and lighted outside of buildings. The principal hazard is carelessness in handling, especially in setting them down after using them. Care should be taken to see that only approved devices are used.

Smoking should be prohibited and signs to that effect conspicuously posted. (See special article.)

Sawdust should not be used on floors and in spittoons; sand may be used. Use preferably noncombustible spittoons.

Metal receptacle should be provided for stock of matches; the use of safety matches only is recommended. Special outside structures should be provided for storage of large quantities of carbide, fusees, and torpedoes—they should be stored separately—supplies for local distribution should be kept in tight boxes. (See special article.)

Supplies of clean waste should be kept in metal or metal-lined wooden receptacles having covers to close automatically.

Dope should be kept in metal receptacles provided with a cover.

All fire doors and shutters should be closed nights, Sundays, and holidays, or whenever it is not necessary to keep them open.

Explosives should not be used or stored except under prescribed conditions. (See requirements of Interstate Commerce Commission for transporting and storing. See also bulletins of Bureau of Explosives.)

In large freight depots a metal or metal-lined bin should be provided for packing material; tracks both inside and outside of buildings should be kept free from rubbish.

Special attention should be given to the storage and care of records and paper files.

Telegraph and telephone wires in buildings should be properly insulated and equipped with approved protective devices, including excessive current protectors and lightning arrestors, and should be installed throughout in accordance with standard requirements.

See that all defects which tend to increase risk of, or cause fires, are given prompt attention.

Rolling equipment should not be stored on tracks where it will be subjected to exposure from buildings longer than is necessary. Stored rolling equipment should be swept clean, doors closed, and any accumulations of rubbish, dry grass, etc., removed from around same.

Stored cars should have ample facilities for prompt removal in case of fire.

Grass and weeds near wooden bridges, culverts, trestles, buildings, snow fences, or piles of ties or timber, must be kept cut and burned; old ties must be promptly inspected and burned; drift-wood and other rubbish must not be allowed to accumulate around bridges, trestles, or culverts. The regular mowing to be done strictly in accordance with instructions.

Lumber should not be piled within 50 feet of any building, preferably 100 feet, where exposures warrant.

LIGHTING.

The proper installation of all lighting systems is important; electricity and gas are preferred forms of lighting when properly installed.

Other forms of lighting may add a marked hazard (particularly gasoline and acetylene), and when used should be installed only in accordance with standard rules and requirements, and under special permission.

A distinct fire hazard is attached to the use of electricity and various electrical devices; all installations of wiring and apparatus should be well made by competent persons and according to the "National Electrical Code" and inspected and approved before current is turned on. They should be regularly examined by a competent electrician and any necessary repairs promptly made to put them in safe condition, or otherwise brought and kept up to standard. Electrical wiring or apparatus should not be tampered with or altered except by electrician with authority in such matters; special care should be taken not to overload systems.

Between shelves in record rooms drop cords are not desirable; ceiling sockets with reflectors should be used with the switch at entrance to shelves. When portable lights are necessary, use standard portable cords and lamps equipped with approved guard and handle.

Wires must not be hung on nails, gas fixtures, iron hooks, etc., but properly supported by and hung from prescribed and approved insulators. In all wiring, special attention should be paid to the mechanical execution of the work; careful running, connecting, soldering, taping, and securing and attaching of fittings.

Do not allow incandescent electric lights to come in contact with combustible material.

Gas fixtures should be made stationary; burners should be protected by wire guards or globes to prevent contact with woodwork or other combustible material. Protect woodwork above or alongside gas jets with asbestos board and tin.

Oil lamps, when used, should be rigidly and securely supported on substantial metal hangers or brackets. The use of glass font lamps is objectionable. Metal lamps should be used, and every care taken to keep from paper files and woodwork. Paper or pasteboard shades should not be used on any oil, gas, or electric light globes. Metal or porcelain should be used.

The use of torches is attended with danger, and should not be permitted where electricity is available. Every care should be exercised when used, both as to handling and storing. When not in use they should be kept in metal receptacles and not in wooden closets.

The use of open lights in oil houses, paint houses, planing mills, grain elevators, etc., and where inflammable vapors or dust are present should be prohibited. The use of vapor-proof incandescent lamps is recommended in such places.

Heating and Power.

The proper installation of all heating apparatus is important; the following recommendations are made relating to same:

Steam pipes should be properly supported and kept away from woodwork and should be properly bushed where passing through woodwork. Greasy and oily waste or other inflammable material should be kept away from the same and clothing should not be permitted to hang on or near same. The overhead method of steam piping is preferred.

Stoves should be securely erected with an air space beneath, and set on either stone, cemented brick, or metal mats of desirable thickness, and near-by woodwork protected by metal and asbestos board; stovepipes should be securely fastened and riveted. All combustible material must have proper clearance and protection from stovepipes, particularly where they pass through walls, partitions, etc.

The use of gasolene and oil stoves or ranges for cooking or heating purposes should be prohibited. Gas stoves, when used, should be connected with gas supply by rigid metal piping.

Chimneys and flues should be substantially and carefully constructed and not built up from posts or joists. Joists should not be permitted to run into the masonry work. All smoke pipes should run direct from furnace or stove to chimney.

All joists and woodwork should be protected by fireproof covering, metal and asbestos board, or by allowing sufficient air space between them and all heaters or furnaces and their pipes.

Boiler plants should be located in separate detached buildings, where practicable, or cut off from main building by division walls, extending through roof or in fireproof room, as provided for under special building specifications for this class of property. (See special article.)

The outside brick or concrete chimney or metal stack is preferable. Around boiler stacks, if of iron and if built up from inside building, where passing through roof, the smokestack opening must be twice the diameter of the stack; there should be a clearance from all woodwork equal to one-half the diameter of stack with properly constructed metal collar extending above and below all woodwork, one and one-half times the diameter of stack.

Clearance from boiler should be at least 6 feet to unprotected combustible structural materials above, at rear, and at sides, and 8 feet in front. If these conditions can not be complied with, all combustible surfaces should be protected by ¼ inch asbestos board, covered with sheet metal, with air space between, arranged to follow the surface of the wood so as to leave no concealed spaces.

Dynamos, motors, and electric wiring of all kinds must be installed and maintained according to the rules of the "National Electrical Code."

Where fuel oil is used for heating furnaces, the entire equipment should conform to recommendations of the National Fire Protection Association and Railway Fire Protection Association.

FIRE-FIGHTING SERVICE AND APPARATUS.

The installation of approved fire-fighting devices, such as automatic sprinklers, properly constructed standpipes with hose attached, water mains and

fire hydrants, fire hose, fire pumps, chemical extinguishers, water casks, and fire pails, with employees formed into brigades, trained in the use and handling of same, and regularly drilled, are of the utmost value.

From whatever source water for fire purposes is obtained, the supply should be ample and constant. Underground water mains for fire-hydrant systems should be cast iron, laid in complete circuit and, where the system is extensive, should be gridironed to afford circulation, never be less than six inches in diameter, and should never be run under buildings. They should be buried deep enough in ground to prevent injury from surface and freezing. All inside hose pipe lines should be controlled by outside valves.

A competent employee should be designated in all large properties whose duty shall be to inspect thoroughly and regularly all apparatus provided to extinguish fire, alarm systems, etc.; good order and condition of these devices is necessary that they may be depended upon. They should also be regularly tested.

Fire apparatus, including pumps, should not be used for other purposes; its use and location should be known by all employees.

Fire pumps should preferably be located in fireproof houses beyond reach of fire from other buildings, and should be constantly in condition for immediate and protracted use at their full capacity.

The use of frost-proof fire hydrants with at least two outlets, with separate hose gates on each, is recommended. Hydrants should be placed far enough, generally 50 to 75 feet, from building to prevent their being injured by falling walls or being otherwise rendered inaccessible.

Post indicator valves should be used to control underground water supplies in preference to sunken ones covered with traps. If indicator posts are not feasible, valves to be located in valve pits, and to be of the outside screw and yoke pattern, the location of such valves to be plainly marked by signs.

Water meters in fire-service mains are detrimental to flow of water. If their use is unavoidable only detector meters installed on a by-pass should be used and an approved gate valve placed in the direct connection.

Care should be exercised in the treatment of hose; it should be regularly tested (except linen) and drained and kept in well ventilated houses or properly reeled or folded on racks when not in use. (See special article.)

Water barrels and fire pails should be kept filled with water at all times and salt added in winter to prevent freezing. (See special article.)

Chemical extinguishers should be protected from freezing and recharged at least once a year with record of same kept on a card attached to machine. (See special article.)

Pails of clean, dry sand (with hand scoops for throwing) and carbon tetra chloride type of fire extinguisher are recommended where oils, paints or inflammable liquids are stored.

Designated locomotives in yard service are recommended to be equipped with special fire extinguishing apparatus for service in case of fire.

All fire hydrants, valves and connections should be regularly inspected, especially in winter, to guard against freezing. They should be occasionally tested, except in freezing weather.

The loss of a few minutes in sending in an alarm of fire may cause considerable additional loss. Private fire alarms are recommended so that the private brigades may get into service promptly. Where located in a city, a public fire alarm box and key should be located at or near premises so that no time may be lost in getting assistance from city department.

To secure regular and systematic inspection of property during nights, Sundays, holidays, or such times as it is not in operation, reliable watchmen should be maintained whose rounds should be recorded on an approved clock system;

rounds to be made at least every hour and a sufficient number of stations provided to insure their visiting all portions of property. They should be specially instructed in the location and use of fire extinguishing apparatus.

Only approved safety lanterns or electric lamps should be used by watchmen.

IN GENERAL.

All employees in charge of property should be held responsible for the carrying out of such specific rules and regulations as may be promulgated to enforce the above care and protection of property.

SELF-INSPECTION WITH REFERENCE TO FIRE PREVENTION AND PROTECTION.

Self-inspection promotes good housekeeping and means that you must personally make investigation of conditions by inspecting or appoint some one, whom you can hold responsible and in whom you have confidence, to do it for you.

Large sums of money are paid for fire protection apparatus, which is only waiting in its latent power to give an adequate return in case of fire. Water mains with fire hydrants and pumps and sprinkler systems cost thousands of dollars; fire hose, nozzles, fire extinguishers, water barrels and fire pails and sundry apparatus for fire fighting run into large outlays. Irretrievable in event of fire is the money spent if the hydrant has no wrench or is in an inoperative condition, the pump out of order, the sprinkler system with an unknown closed valve, the hose with a weak spot, the barrel empty, and the bucket not filled or near water.

Large capital has been invested in buildings and their contents, and large liabilities are involved by transportation lines, all of which has to be safeguarded. Very few buildings can be classed as "fireproof" and few can withstand a severe fire; therefore it becomes necessary to prevent a fire from starting or having started, to control it in its incipiency.

The first step in conserving property under your care is that of fire prevention; the second, fire protection. In theory one follows the other; in practice both are of equal importance, for statistics show that a large percentage of fires are preventable, the rest due to inherent causes; therefore the problem is to reduce the preventable fires and provide adequate fire protection for all.

The best fire protection apparatus and fire-resisting building stand for naught unless they are kept in good condition.

The mere fact that fire hazards may have been safeguarded and fire protection may have been installed originally in full accordance with standard requirements, is no guaranty that these conditions will remain. Proper upkeep is necessary, and frequent self inspection is the logical method of obtaining satisfactory results so that there may be no reflection upon individuals. Excuses are of no value after a property has been destroyed.

The following are brief suggestions for organizing a local inspection service of your property whatever the size:

Get in sympathy with the proposition to prevent "fire losses."

Read literature pertaining to the subject, which is readily obtainable and gives valuable suggestions.

If possible join a fire prevention association to reap the benefits of their experiences.

Issue rules and notices in the shape of posters, circulars, etc., and require a rigid enforcement of rules.

Hold foremen of each shop responsible for its condition as to cleanliness and fire-protection apparatus.

Prohibit smoking throughout your property.

Look into your exposure hazards. Sometimes an old inflammable building will jeopardize a large valuable structure more than the operation in that structure itself. Fire walls and door and window protection afford safeguards.

Advocate fire-resistant construction for new buildings.

Locate new buildings as far away from other buildings as feasible. Congested conditions are breeders of conflagrations.

Appoint a healthy and reliable night watchman, preferably one who does not smoke, and require him to register his tours on an approved clock system.

Appoint a competent active man for inspector. He need not necessarily be relieved of all other duties. Your fire chief would be best. Give him authority over the fire protection apparatus and authority to require minor hazards to be removed.

Local Inspector's Duties.

Make a written weekly report of all conditions. Report verbally and immediately any important hazard or bad condition.

Make recommendations for betterment.

Make daily, or at least weekly, inspections of entire property, inside and outside.

Examine all heating appliances.

Examine all fire hydrants.

Fill water barrels.

See that water barrels have buckets.

Fill water buckets.

Examine and recharge chemical fire extinguishers.

Keep fire hose in condition.

Have fire pump tested weekly.

Have fire alarm tested weekly.

Arrange fire drills.

Test fire hose under pressure yearly.

Examine automatic or other sprinkler installation.

Talk fire prevention and fire protection.

See that wrenches and all minor equipment are at fire hydrants.

See that each installation of hose has hose spanners.

See that all water valves are properly closed or opened as the requirements may demand.

Test fire apparatus on locomotives.

Examine roof ladders.

See that all oily waste has been placed in proper receptacles and daily disposed of.

Look for stray pieces of oily waste in out-of-way places.

Criticize conditions when necessary.

See that roadways are accessible to fire department.

Examine electric fuses and require the removal of unprotected or nonstandard connections.

Cause the removal of birds' nests from roof eaves and rafters.

Examine woodwork around stacks, furnaces, stoves, and steam pipes.

See that fire prevention and protection rules are obeyed.

See that shavings and sawdust are kept away from heating appliances.

See that small oil supplies are properly kept in suitably protected receptacles.

See that all fire doors and shutters are unobstructed, that they are in good repair and kept closed at night or when plant is not in operation.

Examine clothes lockers, closets, and other catch-alls and remove torches, oils, and cotton waste.

Make men acquainted with location of nearest fire alarm and its operation.

The duties of the inspector as set forth are given only as an outline and will increase in all directions as the man becomes experienced and takes the initiative. The time he consumes will vary with the size of the property; a few minutes in a freight warehouse to an entire day in a large terminal or shop plant is well expended, as it produces results.

RECOMMENDATIONS IN CONNECTION WITH CHIMNEYS, FLUES, STOVES, AND FURNACES.

Special attention should be given the construction and installation of chimneys, flues, furnaces, and stoves used for heating buildings and pipes leading therefrom and regular examination thereof and their surroundings before being put into service.

Constant operation of heating devices under intense heat in time will establish deterioration of their parts.

Reason: Radiated heat is of an intensely penetrating nature and will eventually set fire to wood or other combustible material which is heated to a temperature uncomfortable to the touch of the bare hand. An air or ventilating space between the source of heat or heat shield and the combustible material tends to carry away the heated particles of air by circulation.

Definitions.

Chimney: Walls, usually vertical, inclosing the passageway for products of combustion from a fire.

Flue is the opening through which smoke and gases escape.

Smoke pipe: Pipe connections from stove, range, or heater to chimney.

Stovepipe: See smoke pipe.

Chimneys.

Build all chimneys large enough to give a separate flue for each fire.

Chimney flues should be ample in size and carried as nearly straight as possible from their foundations to at least 3 feet above the highest projection of roof.

Chimneys must be built from the ground or supported therefrom with fireproof material, and none of their weight should be carried by anything except their foundations. Chimneys may form part of a 13 inch or more brick wall, in which case chimney should not be corbeled out more than 8 inches from wall, and that corbeling should consist of at least five courses of brick.

Construction.—Sound hard brick or reinforced concrete at least 8 inches thick and lined continuously throughout with 1 inch terra cotta pipe or fire clay.

Do not run floor joists or other woodwork into chimneys or flues, nor allow wood ceiling, lathing, or furring within 2 inches of brickwork.

No vent pipe from gas appliances should enter same flue used by an open flame fire.

Smoke pipe openings should only be closed with a tight metal flue cap after smoke pipe has been removed.

Smokepipes.

Smoke pipes should be constructed of substantial metal and be spark tight.

Should run directly from furnace or stove to chimney and be firmly held in place by metal thimble and plaster.

Long runs of pipe are dangerous and should be avoided.

Be careful of joints between lengths of pipes.

Smoke pipes should preferably not pass through floors, attics, or unused rooms, and never through closets.

Shall not be placed near any woodwork.

Where pipes pass through lath and plaster or wood partitions and ceilings they must be guarded by galvanized-iron ventilating collars at least one and one-half times the diameter of the pipes, or a concrete panel about 18 inches square, depending on spacing of studding and diameter of pipe, incasing smoke pipe so as to leave an air space of not less than 1 inch around it.

Where it is necessary that pipes pass through wooden roofs in the absence of brick chimneys they should be guarded in the same manner as where passing through wooden partitions.

Smoke pipe must be securely fastened to stove or furnace.

Stoves.

All stoves for heating purposes should be free from cracks, have well-fitting doors, and be supported on legs off the floor.

Should be placed 3 feet from lath and plaster or woodwork, or if same is protected by a metal shield with an air space or asbestos, then distance shall not be less than 18 inches.

A metal mat should be placed under and to extend at least 18 inches from all sides of all stoves that are placed on wooden floors.

Stoves should not be used in woodworking or paint shops, paint storehouses, oil houses, or where flammable vapors or dust are present.

Stoves without legs, such as laundry stoves, should not set directly on combustible floors; use a course of bricks or a 4-inch concrete slab laid on sheet metal and asbestos board over wooden floors.

Sand-drying stoves, where used, should be located in incombustible rooms.

Gas Stoves.

All woodwork under and near gas stoves must be covered with metal with an air space.

Gas connections must be of rigid metal pipe; never use rubber or other tubing.

Large gas appliances must be connected to an independent flue by a vent pipe.

Furnaces.

Furnaces should be installed only on noncombustible floors.

Top of furnace should be not less than 18 inches below a combustible ceiling or floor beam. Combustible material at this distance should be protected with sheet metal with an air space underneath or by hard asbestos board following contour of surface to be protected.

Top of furnace should have an insulating covering, such as sand or asbestos.

Woodwork within 4 feet of furnace must be protected with sheet metal with air space or hard asbestos board. No woodwork should be permitted under any circumstances within 2 feet.

Cold-air boxes of all hot-air furnaces should be made of incombustible material particularly for first 6 or 8 feet from furnace.

Hot-Air Pipes.

Hot-air pipes where passing through combustible partitions or floors should be of double-pipe construction with 1-inch air space between the pipes, or covered with heavy sheet asbestos.

Woodwork within 6 inches of hot-air pipes must be protected with incombustible material. No wood allowed under any circumstances closer than 3 inches.

Hot-Air Registers.

Woodwork around register boxes must be removed from and protected as recommended for hot-air pipes.

Registers placed on combustible floors must have a stone or iron border firmly set in mortar.

Steam and Hot-Water Pipes.

All woodwork less than 2 inches from pipes must be protected by a metal shield or collar, in which case it should not be closer than 1 inch.

Pipes conveying main steam supply should be wrapped with magnesia or asbestos covering.

General.

Ashes should not be stored in wooden boxes or barrels—use metal containers.

Do not use a wooden bin for ash storage; brick or incombustible constructed bins are safe.

Do not mix old papers or rubbish with ashes.

Keep space around fire free of all combustible materials.

Steam or hot-water radiators and pipes must not be used for drying racks for rags, clothes, and other inflammable material.

Do not permit rubbish to accumulate behind steam coils and radiators.

STEAM MAINS AND STEAM PIPES.

Pipes conveying main supply of steam should be wrapped with magnesia or asbestos covering, and where passing through wood partitions should have a clear space of at least 1 inch. Steam-pipe covering should preferably be carried in a single piece through floors and partitions.

It is advisable to examine covering, which may be done with a penknife. Very often it will be found that a cheap covering of combustible material has been substituted.

Steam mains should not rest on combustible material; should have metal hangers to support them, and the outer covering should be fastened to pipe with brass bands.

Steam heating pipes should rest on metal hangers or supports, and where passing through combustible floors or partitions should have at least a one-half inch air space from combustible material and a metal collar or thimble.

Steam radiators and steam pipes must not be used as receptacles on which to dry rags, clothes, or other combustible material.

Where radiators are placed in window recesses, or concealed spaces, care should be taken to see that such places have a noncombustible lining and ample air circulation. These inclosures should be cleaned and kept free from dust.

All steam pipes should be so installed that they can not come in contact with combustible material of any character.

GENERAL RECOMMENDATIONS IN CONNECTION WITH BOILER HOUSES, BOILER SETTINGS, AND BOILER STACKS.

The location of boilers furnishing steam for power warrants especial consideration, for their operation is one essentially requiring no delays for the economical running of the plant.

Three methods of installation are given, the preferable ones being No. 1 and No. 2 in order. No. 3 is not approved for new installations, but is given as a recommendation to make old boiler settings and surroundings safer.

No. 1.

Detached "fireproof" boiler house, constructed with brick, stone, or concrete parapeted walls; steel roof truss covered with metal, reinforced concrete or tile roofing and noncombustible floors. Wall openings exposed by other buildings to be protected with standard fire doors and shutters or approved wired glass in metal frames. Incombustible wall or roof ventilators should be installed for proper ventilation for which purpose also roofs should be elevated well above boilers.

No. 2.

Boiler houses attached to main building to be practically the same fireproof construction as given in No. 1 with the exception that party wall between boiler room and main building should be at least 18 inches in thickness and be parapeted 3 feet or more above roof of main building and in all cases make a complete cut-off from exposed wooden-roof monitors. This wall to have not more than one opening, in which case opening is to be protected by a standard automatic fire door each side.

No. 3.

Boiler installed in building not "fireproof."—Floor construction to be entirely of incombustible material to extend 8 feet in front and 4 feet at sides and rear of boiler.

Clearance between boiler and combustible structural material must be maintained; 4 feet above steam dome, 4 feet at sides and rear, and 8 feet in front. In existing installations, when the required clearance can not be observed, all exposed woodwork must be protected with a layer of asbestos board and sheet metal, in extreme instances with an air space between, same to follow contour of woodwork.

Ceilings above boilers inclosing a concealed space should not be permitted.

Means of ventilation must be provided to carry off the heat from under roof.

Smokestacks.

The outside brick chimney or metal stack is preferable.

Inside metal stacks should have their entire weight supported on a brick or concrete foundation.

Metal stacks passing through combustible roofs must have clearance and metal guards; i. e., all woodwork within one-half the diameter of stack to be removed, smokestack opening must be twice the diameter of the stack and a metal collar one and one-half times the diameter be placed around stack.

The height of stack or chimney must not be less than 15 feet above roof of building of which it is a part or that of the nearest adjoining building.

Breeching.

Metal breeching must have same clearance on all sides from combustible structural materials as required for boilers in installation No. 3.

Steam Pipes.

Main supply steam pipes must be wrapped with asbestos or magnesia or approved insulating covering and must have at least 1-inch clearance from woodwork.

General.

Boiler room should be occupied exclusively for steam-generating purposes.

Tops of boilers must not be used for drying combustible materials.

Dust must not be allowed to accumulate on top of boiler.

Ashes must not be deposited on combustible floors and must be removed to outside daily and not allowed to come in contact with inflammable material.

Ashes should preferably be dampened before being disposed of.

Oil fuel, if used, must have supply pipe equipped with an automatic and manual shut-off valve located outside of building in addition to the ordinary control valves at burners.

If shavings fuel is used, extreme care must be used in preventing shavings being scattered over floor. A hot coal or back draft on boiler is liable to ignite them.

Spark-arresting devices must be placed on all stacks and chimneys from boilers using wood, shavings, or refuse for fuel.

FOUNDRY BUILDINGS.

Construction.

The foundry should be detached or properly cut off from other buildings by standard fire walls. It should be constructed entirely of noncombustible material.

Floor should be noncombustible; walls should be brick, concrete, or iron; roof of iron or concrete on steel truss or girders; columns of steel or concrete. There should be no woodwork of any kind in the construction of building. Roofs of nearby or adjoining buildings should, where possible, be of fire-resisting construction or covered with metal.

Common Hazards.

Various features of heat, light, and power should be as safely installed as in the ordinary manufacturing building, electric light and power installations being made in accordance with the requirements of the "National Electrical Code." Electric wiring should preferably be run in metal conduit.

Special Hazards.

Cupola.

The cupola is a common cause of fire, either due to sparks or excessive heat igniting roof, charging platform, or other combustible material. Flasks, patterns, boards, etc., should, therefore, not even temporarily be placed in the vicinity of cupola. Cupola platform or charging floor should be constructed of iron or concrete.

Chimneys of cupolas should extend at least 10 feet above the highest point of any roof within a radius of 50 feet, and no woodwork shall be within 3 feet of any part of such device or its chimney.

Core Ovens.

Should be entirely of fire-resisting construction.

Flask Storage.

Flasks that are not in use should be stored in a detached shed, preferably of noncombustible material. They should not be stored in the foundry proper, but after using and before placing in the storage shed should be set aside to cool, wooden flasks being wet down after molds are broken.

Pattern Storage.

Patterns should be stored in a fire-resistive building unexposed by other property. Patterns are usually of considerable value and combustible; the storehouse should therefore be divided into small sections by standard fire walls.

Care and Maintenance.

The foundry roof in the vicinity of cupola, if not of fireproof construction, should be examined daily after cupola shuts down and before all employees leave, making sure that no hot cinders or smoldering embers remain thereon.

Fire Protection.

This class of property should be afforded as adequate protection from hydrants and hose as other shop buildings. Interior protection of standpipes and hose, chemical fire extinguishers, water barrels, and fire pails is desirable.

The pattern storehouse, owing to the large value involved in patterns, should be equipped with automatic sprinklers.

SHOP PRACTICES.

Inflammable and Explosive Compounds and Liquids.

The use in railroad shops of materials containing highly inflammable and explosive ingredients should be discouraged as far as possible and wherever practicable and the processes will permit, safer substitutes of nonexplosive and noninflammable character should be used. The standardization of safe methods coupled with the economies incident to the use of materials in various processes should be given every consideration.

The relative hazards of inflammable volatiles are usually determined by their flash points. The flash point of a substance is the temperature at which sufficient vapor is generated to cause it to flash without igniting the liquid, when a small flame or spark is brought in contact therewith. The burning or fire point of a liquid is somewhat higher, and is that temperature at which the vapor given off, when ignited, will continue to burn.

The following list comprises the more common inflammable volatiles:

- Acetone.
- Alcohol (grain).
- Alcohol (wood).
- Alcohol (denatured).
- Amyl acetate (banana oil).
- Benzine.
- Benzole.
- Columbian spirits.
- Carbon bisulphide.
- Collodion.
- Ether.
- Gasoline.
- Lacquer.
- Naphtha.
- Petroleum ether.
- Toluol.
- Turpentine.

Materials to be guarded especially are many forms of "cleansers" in the removal of paint and varnish from passenger coaches and locomotives and their parts.

The ingredients and dangers of all patented commercial fluids and compounds should be well known before being used and where necessary to be used, proper precautions should be taken by the employees handling. Dangers should be safely guarded. In using highly volatile substances particular attention should be given to keeping all open lights away, and approved containers for storage and handling are recommended.

Special attention is directed to the dangers that might arise to both life and property in the following processes:

Passenger coach and locomotive cleaning and paint removal therefrom; tire heating and removing; paint burning; cleaning triple valves; lacquering, etc.

The principal point is to know the ingredients of the materials used and stored and place warning signs to "keep lights and flame away" where highly volatile oils and materials are used, such as gasoline, paint and varnish removers, etc., and store and handle only in approved containers.

The principal hazards of shop buildings are:

- Heating.
- Blower systems.
- Rivet heaters.
- Oil furnaces.
- Burning or cleaning off paint.
- Glue pots.
- Lacquering.
- Locomotive tire heating.
- Drying.
- Lighting.
- Portable forges.
- Soldering, babbiting, and spring tempering.
- Tinners' pots.
- Torches.
- Caul boxes.
- Paints and oils.
- Upholstering.
- Hair or fiber picking.
- Spontaneous combustion of rags and waste.

FIRES IN COALING STATIONS.

Fires originating in coaling stations used for coaling locomotives and resulting in total losses are much too frequent.

Many have been through the experience of fire, have stood by practically helpless, and have seen the inconvenience caused and the consequential expenses until a new structure is built.

There seems to be no reason why the coaling stations built in the future should be subject to fire and be a total loss, unless it can be attributed to the habit of looking at the initial costs of building and giving no attention to the remuneration received from a long and uninterrupted service.

The principal causes of the fires have been sparks lodging in inflammable building material and birds' nests, smoking, spontaneous ignition of oily waste and bituminous coal, electrical defects, gasoline engines and their exhaust pipes, open flame torches, and other forms of hazards attributed to carelessness and exposure fires.

The following general survey of three classes of coaling stations is given:

Class 1.—Wooden constructed trestle and approach with gravity feed directly to tenders or to bins, some of which are housed in.

Fire protection usually consists of a few water barrels and buckets.

Class 2.—The wood constructed or wood frame structure with corrugated iron covered elevator houses, the coal being hoisted from track level by buckets,

either the grab, hand-filled, or belt type, and dumped in bins, from which it is discharged directly into the tenders. Steam, gasoline, or electricity is used for power, and in some few instances the entire power plant is located in a detached building, while in others only the steam boiler or gasoline engine is detached.

Protection: Water barrels and fire pails, chemical fire extinguishers, inside and outside perforated water pipes, open sprinkler heads, dry pipe automatic sprinklers and hose and standpipes. The amount of the equipment seems to depend upon the age and repair of the building.

Lighting: Oil torches and lanterns and electricity.

Heating: Coal stoves or steam in laborers' rest room and engine rooms.

Fire prevention and detection: Various rules prohibiting hazardous practices and watchman's service.

Fire detection: Automatic thermostat journal and sprinkler alarms.

Class 3.—Steel frame, corrugated iron covered, and the concrete and steel structure is placed in this class, the most modern being the type provided with self-cleaning or conical-shaped bins, which have no covers or ledges in which dust can accumulate. The coal is handled by conveyer buckets operated by electrical machinery.

Protection: None, except possibly chemical extinguishers for fires around the electrical apparatus.

In a general way we might add the following to apply particularly to classes 1 and 2:

Hazard: Sand drying with coal stoves in attached building or near-by sand houses.

After a general survey we arrive at the proposition to stop fires in coaling stations:

First. Build only with fire-resisting materials, thus making void practically all the opportunity for serious fire or total loss and the necessary protection therefrom.

Second. Make the wooden-constructed structures as safe as possible.

A. Where they are unsafe, antiquated, and expose valuable property, replace with modern equipment where possible.

B. Prohibit enginemen using blower on locomotive while standing alongside.

C. Remove all birds' nests, patch up all holes, and replace rotted-out timbers.

D. If station contains a men's rest room, line the room throughout with metal or prohibit practice of having such rooms, attached or exposed.

E. Prohibit the use of open-flame torches and lanterns. Use portable electric lanterns only.

F. If electric lighted, see that wires are in conduit and conduit securely fastened; that inclosed fuses only are used; and that switch is either snap or inclosed in dust-proof cabinet. That portable electric cords are heavily reinforced and have incandescent lamps protected with wire cage guards.

In general, see that the entire electric equipment is installed according to the National Electrical Code.

G. Where gasoline engine is used inside the building for power, remove it to a detached shelter, and use rope drive or preferably use some other source of power.

H. Condemn the stove sand drier and use steam if possible; if not, then be sure the stack from stove has proper clearance from all woodwork and that sand bin around stove is made of concrete. Where possible, drier should be in a detached building, not exposing coaling station.

I. If a steam boiler is used inside it would be preferable to have it relocated in a detached house. In any event, see that stack and boiler has proper clearance from all woodwork.

J. Provide approved self-closing metal cans for oily waste in engine room and on conveyor floor.

K. Install automatic sprinklers of the dry-pipe type covering every portion of the building. The next best protection would be a graduated pipe system with open sprinkler heads and the controlling valve accessibly located at the ground and standpipes and fire hose. These systems need ample water supply and pressure.

L. Install automatic journal alarms.

M. If the value of the structure, after all phases from an economic viewpoint have been considered does not warrant the best protection, then install plenty of water barrels and fire pails or bucket tanks and one or two approved chemical fire extinguishers, which should be protected from freezing.

N. Whether interior protection is provided or not, standard two-way fire hydrants, with standard hose houses and equipment, should be installed near the station.

O. If you have night watchman's service, install a key on the upper floor of station, and require watchman to register therefrom on his regular rounds.

P. Do not allow dust to accumulate in quantities in out of way places. The entire structure should be thoroughly cleaned once a month.

Q. Prohibit smoking in coaling stations at all times.

R. Do not fail to require proper inspection of all fire equipment to see that it is in working condition and order, especially in winter, when freeze-ups are likely to occur.

S. Bear in mind that buildings constructed of combustible material need constant attention with regard to repairs, condition as to cleanliness, fire prevention, and fire protection.

RECOMMENDATIONS IN CONNECTION WITH SHAVINGS AND SAWDUST DISPOSAL IN WOODWORKING MILLS.

The approved method of disposing of shavings and sawdust in woodworking mills consists of a blower which draws the refuse from the various woodworking machines up through suction pipes and discharges it into a storage vault, baling house, freight cars, or directly into a shavings-consuming device.

Blowers.

Blowers should have outside bearings preferably lubricated with a hard lubricant, so as to avoid oil drip and possible oily sawdust.

Blowers should have composition-metal blades to prevent liability of sparks from contact of blades with iron casing or nails.

Blowers should be located in an accessible position where they can be easily cleaned and inspected.

Blowers should be electrically grounded when operated by a belt drive, so as not to become charged with static electricity.

Ducts or Pipes.

Joints must be tight to prevent dust escaping or interfering with the action of blower, particularly in case of suction ducts.

Connections between pipes and change in direction of pipes should be made with long bends.

Suction ducts should be provided at all machines producing inflammable refuse.

Floor sweep-up ducts should be located in convenient places about mill room. These ducts must have bar guards, so that large material can not get into conveyor system and damage blower.

Interior of all ducts must be smooth and care must be exercised in making up joints that the inside lap of joint is not bent out of shape. Inside lap should be in the direction which refuse is conveyed.

Ducts must be made of noncombustible materials.

Cyclone Collectors or Separators.

Noncombustible construction only should be used.

Must not be located inside of buildings. The preferable location is a point outside above where refuse is to be discharged. Open-top cyclones must be provided with a metal canopy or a screen.

Discharge Duct from Cyclone.

Should run in as near a straight line as possible from cyclone to refuse-disposal points.

Ducts from cyclone feeding boiler fire boxes should be open at boiler end and discharge the refuse into an open metal receptacle or hopper attached to front of fire box. This arrangement will allow shavings to fall on floor when furnace feeder is choked or will give vent for a back fire.

Ducts to boiler fire box and to vault should be provided with independent dampers, preferably arranged so that one will be open while other is closed.

Shavings Vault.

Construction.—Brick or concrete walls, floor, and roof.

Location.—Outside of buildings.

Vaults built in connection with boiler rooms to be provided with only one small door opening, the sill of opening to be at least 6 inches above boiler-room floor. Opening must be 8 feet or more away from boiler firing door and preferably at right angles to the plane of the fire door. A standard automatic fire door must cover door opening.

Boiler setting must not in any case be used as one wall of vault. Elevated or second-story vaults for filling cars or baling machines must be constructed of incombustible material.

Refuse Burners.

Refuse burners should be detached at least 50 feet and of large size to effect complete combustion. Construction to be of metal, lined with fire brick or other insulating material to prevent early destruction of the casing from continued heat. The top of burner should be provided with a small mesh of heavy wire in the shape of a dome and covering the entire top of burner, the purpose being to arrest sparks.

Delivery Into Cars.

Where systems deliver shavings into cars directly from cyclone, the cars shall be moved to a safe distance from any building as soon as filled and at the close of the day's work. Only box cars having doors shall be used for this service, and whenever the blower systems are not in use the conveyor

discharge pipes shall be removed from the cars and the car doors closed. When system is discharging into car, a false door, with hole in it through which discharge pipe passes, should be inserted in door opening of car.

Baling.

Where shavings are baled by power, due precaution must be taken in the safe installation of the power, whether steam or electric motor. Electric lighting only, safely installed, should be used in baling room.

Fire Protection.

Steam jet for vault to consist of one automatic sprinkler head for each 1,000 cubic feet of vault. Steam-supply pipe to be connected directly to boilers and have controlling valve locked open, or a manual steam jet operated by an outside controlling quick acting lever valve may be used, in which case a sign should be posted designating the use of valve in case of fire. Standard automatic sprinklers under ample water pressure might be used.

For boiler room—1½-inch hose connection and 25 feet of 1½-inch hose.

Fire Prevention.

Keep shavings vault door closed while boiler fire box is open.

Run blower five minutes after mill is shut down so as to clean system.

Trimmings and refuse in mill not removed by blower system, must be removed by hand and taken to refuse burner, or otherwise suitably disposed of.

Dust, not taken up by blower system, should be cleaned out of all portions of building, including roof timbers, at least weekly. This cleaning may be accomplished by means of compressed air or vacuum system.

Open flame lights should be absolutely prohibited in shavings storage rooms.

RECOMMENDATIONS FOR STANDARD OIL HOUSE.

At terminals and division points it is necessary to carry in stock a large quantity of illuminating and lubricating oils, and it is important that these should be so stored and handled that they may not be a fire risk in themselves or be liable to become ignited from fires which originate from without.

The storage and handling of oils is recognized as a hazard of considerable magnitude. Many oils that do not give off inflammable vapors at ordinary temperature do so in large volume when but slightly warm, practically all are highly combustible under certain conditions and once ignited burn with great persistency, resisting water to a greater extent than most substances.

Handling of Oil.

Where large quantities of oils are used they should be stored outside in underground tanks with pumps inside building; otherwise, oil-storage room to be in basement constructed throughout of brick or concrete and oil pumped to room above.

Volatile oils, or those which give off ignitable or explosive vapors at ordinary temperature, should be isolated. It is best to bury tanks containing gasoline, benzine, or naphtha in the ground having top covered to a depth of at least two and one-half feet, using pumps to draw off such oils.

Construction—To be Fire Resisting.

With basement or separate underground vault (preferably outside stairway to basement).

Walls.—Brick or concrete throughout with no exposed steel.

Roof.—Concrete, without exposed steel, and properly ventilated.

Floor.—Concrete, graded and drained to one point.

Platform.—Concrete, graded and drained to outer edge.

Doors.—Approved standard automatic. Standard automatic trapdoors over all openings to basement. If trapdoors are not provided, stairs to basement to be inclosed in concrete, brick, or terra cotta tile and openings covered with approved standard automatic swinging doors.

Windows.—Wired glass in metal sash and frames.

Vent pipes.—To extend from the floor through roof, and to be turned down at outer end and screened.

Vent pipes from tanks.—To be carried up above the roof, turned down at outer end and screened.

Drain pipe.—To be extended outside of building to a point well removed from all buildings or to a separate safely arranged and ventilated receptacle.

Order and Care.

Racks, stands, and shelves for barrels or cans to be constructed of concrete, metal, or other incombustible material.

Waste can.—At least one approved standard metal self-closing oily waste can must be provided.

"*No smoking.*"—Signs must be posted in oil room and on the outside of building at doorway.

Sign reading "Danger—Keep lights and fire away" should be painted on door.

Heating.

Steam only to be used; pipes to be overhead.

Lighting.

Electricity, incandescent system; wires to be in metal conduit with keyless lamp sockets, and lamps covered with vapor-proof globes; all controlling switches and fuses to be outside.

Miscellaneous.

Glass gauges, the breakage of which would allow the escape of oil, should be avoided. If their use is necessary, they should have substantial protection or be arranged so that oil will not escape if broken. Preferably a slotted pipe to be used for guard. Valves on sight glasses to be normally closed.

Protection.

Steam jets to act automatically.

Approved automatic sprinklers to release steam from pipes; valve on pipe line to be sealed open at all times. Pipe sizes to be in accordance with rules governing the installation of automatic sprinkler equipment, viz:

¾-inch pipe—1 sprinkler.
1-inch pipe—2 sprinklers.
1¼-inch pipe—3 sprinklers.
1½-inch pipe—5 sprinklers.
2-inch pipe—10 sprinklers.
2½-inch pipe—20 sprinklers.
3-inch pipe—36 sprinklers.

If oil house is over 200 feet from boilers, supply pipes to be one size larger than regular schedule size.

Pipe from inside of building to boilers to be lagged to prevent condensation, and should be an independent line from boilers.

One automatic sprinkler jet to be provided for each 1,000 cubic feet.

Jets to be spaced not over 10 feet apart.

High-pressure steam to be maintained at all times.

Distributing pipes to be graded, sloping from main feeder, so that water from condensation will remain in pipes against sprinklers. Install steam trap under main riser to carry off condensation.

STEAM JETS TO BE OPERATED MANUALLY.

If automatic steam jets are not provided for, install steam jet, high-pressure connection, to be operated by hand; minimum size pipe to be 1 inch in diameter, supplying a room of 1,000 cubic feet or less. Rooms of a larger size require a larger size pipe, leading up to a size of at least 2 inches in diameter for a room of 5,000 cubic feet.

Controlling valve to be located on outside of building, with prominent sign located over same, designating its use.

SAND PAILS.

Three or more pails of clean, dry sand (with hand scoop for throwing) to be provided and located on shelf or hooks near doorway, or specially made sand box holding an equal amount of sand, with hand scoop for throwing.

CHEMICAL EXTINGUISHERS.

Approved hand chemical fire extinguishers, sufficient in number and so located as to be quickly accessible, are recommended. For oil fires the carbon tetra chloride type of extinguisher is considered the most effective. Also approved "Foam" type.

FIRE RISK—FREIGHT TRANSFER POINTS.

On most railroads there is a marked liability for serious loss and a marked fire risk at freight transfer stations where large accumulations of cars and their lading are found and where in many instances from 500 to 1,000 loaded cars may be congested, of a highly combustible nature, with their contents. Then, again, the transfer structures are usually constructed of wood, with wooden platforms several hundred feet long. Such properties are as a rule either remote from or inaccessible for city fire-fighting apparatus to reach them. They are, as a rule, also not well provided with water supplies in the shape of water mains under adequate pressure, with fire hydrants or accessible supplies of fire hose. The best protection found is usually that to be used only as a "first aid," or in the incipient stage of a fire, in the shape of water barrels and water pails or hand chemical extinguishers, with occasionally a portable chemical engine.

The hazard of these transfers is increased by accumulations of rubbish from time to time, as well as the pronounced hazard of smoking on the part of the employees. In the absence of efficient facilities for either dealing with a fire in its incipient stage or if it has become more or less pronounced, the effectiveness with which the fire-prevention features are watched is most valuable. A careful patrolling system by competent and physically fit day and night watchmen is quite necessary, particularly to see that the hazards produced through carelessness and indifference are averted. Ample watchmen's service should be provided to cover all points at frequent intervals.

Engineers in considering the construction or lay-out of large freight transfer points or terminals should carefully consider, when water supplies are available, the extension of yard mains and the location of fire hydrants, with supplies of fire hose to amply protect transfer stations and cars in the yard, and to allow sufficient space for the unhampered use of hydrants and hose for the protection of the entire property.

CLOTHES LOCKERS FOR EMPLOYEES.

The wooden closets or lockers used by railroad employees for their street clothing during working hours and their overalls and other belongings at night form concealed spaces for the origin of many fires.

The average workman, especially if foreign born, does not have any appreciable knowledge of spontaneous ignition and of the conditions leading up to it or of the necessity for ventilation in clothes lockers.

Too frequently upon inspection of employees' lockers we find their interior uncleanly, containing accumulations of old greasy clothing (usually piled at the bottom of locker), oily and clean waste, oil torches, cans of oil, "strike-anywhere" matches in paper boxes or lying about the shelf or floor of locker, employees' pipes, partly consumed cigars or cigarettes, etc. Under such conditions the average wooden clothes locker adds a pronounced hazard to a railroad property as the concealment afforded and the nature of their contents are especially favorable to the development of combustion, spontaneous or otherwise.

The following suggestions and recommendations are offered with a view of eliminating or at least reducing, as far as possible, this serious fire hazard:

Where practicable, a detached building with sanitary locker and wash rooms, where employees' clothing can be protected under ideal conditions as to situation and ventilation, should be provided. At large terminal properties, particularly warehouse piers and grain elevators, the detached, nonexposing locker building is most desirable.

Substantial constructed well ventilated metal lockers for employees' clothing should, wherever possible, be provided in preference to the wooden lockers. The metal locker is more sanitary.

Wooden clothes lockers should not be permitted in paint or smith shops, foundries, and oil or paint houses.

Wooden lockers if used should not rest on floors and should be so located that rubbish can not accumulate behind them. The tops of such lockers should slope at an angle of 45 degrees or more so as to completely prevent using the top as a shelf upon which to pile material of any sort. The doors should contain large panels of wire netting, preferably over four-fifths of their area, permitting free ventilation and a fair degree of inspection when locker can not be opened.

All lockers should be inspected and cleaned at least once each month, and employees should be instructed to keep all clothing hung up.

Oil torches, oils, greasy waste, and even clean waste should not be stored in clothes lockers or left in pockets of overalls. Instruction should be issued to employees not to leave matches in clothing while in lockers; the use of safety matches should be encouraged.

FIRE RISK IN CONNECTION WITH STORAGE OR CONCENTRATION OF CARS ON SIDINGS, IN YARDS, OR AT TERMINALS.

Numerous fire losses have been experienced by railroad companies in connection with rolling equipment, in many instances in the past where the cars have been empty and stored on sidings or in terminals.

Care should be taken to remove hay, straw, and other rubbish from all cars before they are stored, and to see that the doors of all box cars are closed, as well as the traps to ice boxes on refrigerator cars.

Rubbish should not be permitted to accumulate about the cars, and grass, weeds, and small growth should be cleaned away from tracks.

Cars should not be stored near hazardous risks or where they would expose or be exposed to any valuable adjacent property.

Where there is a large number of wooden cars subject to a conflagration risk, they should be spotted, wherever practicable, so they will be accessible in case of fire, for the purpose of either extinguishing the fire or moving the cars out of danger. A plan might be used such as storing cars in drafts of not more than six or eight cars, and separating the drafts by 60 or 80 feet; also in large yards every other track could be used for the storage of steel cars.

Ample facilities should be arranged for prompt removal in case of fire.

Watchman's service should be provided and watchman furnished in his watch box with an equipment of 2½-gallon chemical fire extinguishers, properly charged, and also instructed as to notifying the nearest yard office for procuring assistance of locomotives for removing the cars should a fire occur. The service of a watchman is possibly more requisite during the winter season when tramps are apt to live in and build fires on the floors of stored cars; there are the opportunities for sparks from passing locomotives setting fires, however, at all seasons. Watchman should also be instructed, if storage is near a municipality, as to the method of obtaining assistance from the city fire department if it is accessible for service.

If fire hydrants or plugs are available, supplies of fire hose, nozzles, and wrenches should be provided for use thereon by employees.

Yard engines should be equipped with fire-fighting apparatus.

Where large numbers of cars are stored in yards and where there are available water supplies distributed through adequate sized water mains, an efficient system of fire protection is one which makes use of standpipes and a specially designed nozzle, termed a "monitor" or "turret" nozzle. This device is so made that it can be turned in any direction and has been mechanically perfected, so that it is a durable piece of apparatus. Standpipes are installed at regular distances through car yards, attached to the water mains, and are erected in the form of a tower about 20 feet high, with a platform at the top for the nozzle, the platform being large enough for a man to easily work on. A ladder from the ground makes access to the platform easy. In this way the operator can view the yard and direct the nozzle to the exact point needed.

This, in many instances, affords a better degree of protection and gives better opportunity than hose streams both for fighting the fire and also for removal of cars, inasmuch as great difficulty is experienced in dragging hose between and over and under cars to get at the fire, and while hose is laid under cars removal of cars can not be made without cutting hose or interfering with fire fighting unless hose is run under rails between ties in runways. With a well-devised piping arrangement in the yards and these tower and nozzle arrangements, a heavy stream from the nozzle can be directed without the delay of bringing hose from distant parts. Naturally, this form of installation is dependent on an efficient supply and pressure of water, either from gravity supplies under sufficient head or pumps. When the yards are available for connection with high-pressure city mains, such connections should be made and also attachments for city fire department steamers. One man can easily operate the monitor nozzle, whereas it requires several men to drag a line of hose and operate it.

These systems have been installed by some railroads with good effect, and it is believed with proper maintenance and control of water supplies when demand is made upon them for fighting fires that these installations are about as practical a device as can be installed and give a well warranted protection when the large values at risk are considered.

PROTECTION OF CAMP CARS AGAINST LOSS BY FIRE.

Numerous fires have been experienced to camp-car equipment along railways and naturally with the character of labor and general class of occupancy, carelessness is apt to prevail and at least indifference as to fire prevention. Railroads have lost considerable equipment due to fires in this class, and other property in the neighborhood has also been destroyed by being closely exposed. We, therefore, make the following recommendations and suggestions for the better safeguarding of camp-car equipment against loss by fire:

Care.

Cars should not be placed near hazardous risks.

Ashes from stoves should be placed safe distance away from rolling stock, buildings, and material.

Only safety matches should be stored or used, and the commissary people occupying cars should be directed to observe this.

Standard rack should be provided for the proper care of fusees and torpedoes which have to be kept on hand.

Metal box should be provided for oil cans and waste.

Lighting.

Metal-bracketed wall lamps should be used, clearing woodwork and walls at least 6 inches on all sides, and lamps should be made stationary. Lamp bowls should be of metal and preferably be in one piece (without seams) to prevent leakage. Hand oil lamps and glass lamps should be prohibited.

The wall lamps should be so placed that the tops of chimneys will not be any closer than 3 feet from ceiling. Otherwise smoke bells should be provided.

Heating.

Stoves should be securely bolted to floors.

Metal protection of sufficient thickness should be provided for woodwork under stoves, extending at least 18 inches on all sides.

Stoves should clear wall woodwork at least 3 feet or walls protected with asbestos and tin with 1-inch air space between.

Stovepipes should be riveted at joints and clear woodwork at least 6 inches where passing through roof.

Location.

Camp cars should be so located as to avoid jeopardizing other rolling equipment or buildings.

FIRE PREVENTION AND PROTECTION IN GRAIN ELEVATORS.

In considering fire prevention and fire protection in elevators, all classes of elevators, from the small frame country elevator to the latest concrete terminal elevator, are taken into consideration. Each class of elevator construction has its own individual hazard, and while the general hazard is the same in all elevators, these individual hazards stand out more prominently in each.

Fire Hazards.

In taking up the general cause of fires in elevators it is hard to distinguish the greater of two sources of fires, general housekeeping or care of machinery.

DUST.

In the first of the two we have the ever-present dust caused in the general run of business, and which must be taken care of for various reasons. The reasons that dust must be taken care of from a fire standpoint are many, one of which is the possibility of explosions. These explosions are not caused, as thought by some, by fire communicating with a pile of dust, as a pile of dust ignited in this way will simply smoulder and burn over the top of the pile; but the dust that accumulates on girders, spouts, ledges, and other projections is dangerous on account of being disturbed, in falling mixes with the air, and if this reaches an open light or fire, then an explosion takes place which usually wrecks the building and sets fire to it. Dust should not be allowed to accumulate in any part of the building, but should be kept down to a minimum. All machinery, the journals, pulleys, drip pans, hoppers under elevator heads, the sinks at boots of elevators, the conveyors, should be kept as free from dust as possible. Dust should not be used to catch drippings of oil from journals or oil barrels.

SWEEPERS.

In large elevators men should be employed constantly sweeping to prevent dust from accumulating.

EXHAUST-FAN SYSTEM.

An exhaust-fan system for removing the dust is one of the later improvements for keeping the house clean. When a fan system is installed it should be connected above the pulley at the bottom of the elevator leg; at the top of the leg on the side where the grain is discharged, at the top of garners and scales and sufficient floor sweeps to take care of any dust that might escape the above. When a fan system is put in, it is necessary to have the joints of elevator legs, top and bottom and the scales and garners kept as tight as possible to get the best results. The dust from this system to be taken care of the same as suggested for cleaning machines.

CHAFF AND SILK FROM CORN.

The chaff from corn is a continual source of annoyance to elevator operators as it is carried by the wind all over the building.

In the small or country elevators, where corn is shelled, there is considerable litter caused by cobs, shucks, and silk or hair, which causes a distinct hazard on account of the disposition and danger of fire from sparks from passing locomotives or sparks from smokestack outside of the building and on the roof.

STORING OF UNUSED MATERIAL.

The storing of unused spouting, belting, and old material about the building makes a ready receptacle for accumulating dust and rubbish. This material should be taken out of the elevator and stored in some outside building, wherever possible, in order to reduce the possibility of a fire on account of these accumulations.

WASTE AND OLD CLOTHING.

The care of old clothing and oily waste is a hazard which should not be overlooked, as the clothing is always full of dust and there is more or less oil on it from contact with machinery. This clothing should not be kept in the elevator when it is possible to keep it in some outside building. Wherever it is necessary, on account of conditions, to keep clothing inside of the elevator it should be hung up in metal closets.

All waste, after it is used, should be kept in standard self-closing waste cans. These cans should be small so that not over the accumulation of one day's work would be kept in the building. These cans should be emptied daily and the waste burned.

MACHINERY.

The machinery in elevators is somewhat different from machinery in other plants, as it is likely to be thrown out of line by the raising or lowering of the house caused by loading, unloading, or transferring grain from one part of the house to the other. This is the case in the old-fashioned elevator with the line shaft upward of 100 feet long where bins are constructed of cribbing and the cupola or texas is supported directly on the bins instead of being supported independently. This action of the house is likely to cause hot journals on account of the shafting being out of line or causing a friction between the journal and the collar on the shaft.

This can be overcome by placing a loose soft metal washer between the journal and the collar. Long shafts have been known to creep several inches either way in hot or cold weather on account of expansion or contraction. The heads of elevators or the pulleys or belts at the heads of elevators often become shifted, causing frictions. This can be overcome by regulating the bridge trees, always remembering that the belt will run to the high side of the pulley. The strut board under the head pulley should never be horizontal, but should always be made on an incline toward the down leg sufficiently tapering to be self-cleaning. This is to prevent frictions between the bottom of head pulley and grain or dust that falls from the buckets onto the strut board. The various methods of operating the head pulleys differ in a number of ways. The most dangerous method being what is known as the friction head, which consists of a pulley made of compressed paper with iron flanges placed at spaces of about 6 to 8 inches between the paper. The paper extends about one-fourth inch above the iron flange on which the head pulley runs. This friction pulley is keyed rigidly to the main shaft and revolves all the time the machinery is running. To operate the elevator it is necessary by a lever and rope extending to the first floor, to lower the head pulley onto the friction pulley, so that the weight of pulley belt and grain that is elevating rests on the friction pulley. The dangerous part of this method consists in the paper on the pulley becoming worn down to the iron flanges, causing a spark or an electric spark. This electric spark can be overcome at least temporarily by connecting a wire from the journal of this pulley to the journal of the head pulley, but the proper course to pursue is to have the iron flanges turned down at least one-fourth inch below the paper.

The elevators operated by a clutch direct, a gear wheel operated from a gear on a clutch pulley or friction-clutch rope or belt drive are not so dangerous, as these are all outside of the elevator heads, but the shifting ropes on these should extend to the first floor for quick handling to throw the elevator out of gear in case of a choke. Care should be taken to see that these levers are not fastened down in any way that they can not be operated from the first floor.

CHOKES.

A choke in an elevator leg is often the cause of fires as the main shaft continues to run but the head pulley, belt or friction clutch stops, thereby causing a friction, which may cause a fire unless it is relieved by the shifting ropes or the gearing gives way. A choke may be caused by the friction clutch, friction pulley or belt drive slipping, by overloading, by permitting the bucket belt to become loose, by permitting the scale or garner to fill up the grain

back up to the leg or to have an iron bar or board fall out of the car into the boot of the elevator.

At the bottom of the elevator we have a hazard that calls for very close inspection of the elevator boot. This boot is usually constructed of iron with slides at front and rear to remove chokes. Inside of this boot is the pulley and belt. The journals are on the outside of the boot, but in some cases inclosed in an outer cover or pocket to prevent the grain coming out around the journal. The best journal used at this point is what is known as the car journal box as the pulley acts as an idler, the bearing is on the top, as on a railroad car, and there is room in the bottom of the box to pack with hair or moss to hold the supply of oil. This pulley is regulated by rods extending to the first floor, so that when the belt stretches or shifts, it can be regulated to prevent a friction between the casing and belt or pulley.

OILING BEARING AT BOOTS.

These journals are often oiled through pipes from the first floor, but this is bad practice, as the pipe may become separated, the oil may not feed properly, or the journal may be running hot from some cause and would not be discovered until probably too late, as the oiler is not compelled to go down into the sink to do the oiling, where long pipes are used.

In cold climates the oil is likely to freeze in these pipes, and cases have been noted where the oiler, instead of taking the pipe out and having it cleaned, would have a long rod or wire heated red hot and force it through the frozen oil in the pipe. This naturally adds an additional hazard on account of the method of oiling. A small pipe, say not over 1 foot in length, would be permissible, as this would provide a reservoir for oil that would hold sufficient oil to keep the journal in good condition for several hours.

CONVEYORS.

The belt conveyors should all be above the floors and all bearings exposed. The screw conveyors should have loose tops, so that in case of a choke the top will raise, permitting the grain to come out on the floor.

SHOVEL SHAFT.

The shovel shaft, idlers and all journals should be accessible and above the floors.

CLEANING MACHINERY.

Where cleaning machines are used special care should be taken as these run at high speed. These should be kept out of main building wherever possible and where there is a fan attached this should be connected by metal piping to the outside, preferably to a separate house or if arrangements are made for burning the dust under the boiler through an approved automatic feed spout. This dust should never be blown into a dust room inside the building or out of the ventilator on the roof.

STATIC ELECTRICITY.

Static electricity has been known to cause a number of fires in elevators. This is caused by belts slipping either on account of the belts being overloaded or too loose on the pulleys or by rapidly moving belts under suitable atmospheric conditions. Static electricity can be overcome in a large degree by grounding the shafting or bearings. This should be done in all large elevators where the machinery is driven by belts and shafts, but it is unnecessary where elevators are driven direct by motors.

WINDOW SCREENS.

The windows of elevators should be covered with screening of heavy wire to prevent sparks from the outside entering. All windows should be kept open while the elevator is in operation to permit all the dust possible to escape.

COOPERING GRAIN DOORS.

Where grain doors are coopered outside of the building they should be kept at least 50 feet from the elevator.

OILER.

The oiler is one of the most important men in the elevator from two sides. The first is in the watchfulness and care of machinery to keep it from heating, and the other is to keep the journals and drip pans clean. The latter is easily done if the oiler will carry a piece of waste with him and wherever oil is allowed to run over wipe it up so there will be no oil on the outside of the journal to catch the flying dust and cause it to accumulate, if the oil is kept off of the outside of journals and they are kept dry, the matter of cleaning is much easier.

ELECTRIC MOTOR.

Where the machinery is operated by electric motors, they should be of the inclosed or induction type, in order to prevent danger from the sparking of the brushes, the starting box and the resistance coils, which are a constant source of danger on account of dust unless inclosed in a separate inclosure.

LIGHTING.

The lighting in an elevator should be electric, installed according to the requirements of the "National Electrical Code." Where there is no electric current, electric flash-lights should be used. Open gas jets, kerosene-oil lamps, or gasoline lighting systems should never be permitted. Switchmen, while handling cars in the building, should be compelled to use electric flash-lights or electric-extension lights. In no event should they be permitted to use the ordinary switchmen's lantern. Do not lower artificial lights into bins to determine the amount of grain they contain, a weighted tape should be used for this purpose.

LOCOMOTIVES.

Locomotives, while switching cars, should never, under any conditions be permitted to enter building, on account of the possibility of fire from a spark from the stack or dropping fire from the ash pan. Railroad cars should not be left in the elevator or on tracks adjoining over night where it is possible to move them. Where possible effort should be made to require all steam vessels tied up alongside elevator or passing within 150 feet of same to put spark arresters on their stacks.

HEAT.

There are only two parts of an elevator that need heat, the foreman's office on the ground floor and the weigher's office on the scale floor. These should be heated by steam and all woodwork protected from the steam pipes. These pipes, where passing through the house, should be covered with approved covering to prevent dust sett'ing on them. Stoves should not be permitted in an elevator under any consideration.

OIL ROOM, LUNCH ROOM, AND CARPENTER SHOP.

It is recommended that the oil room, men's lunch rooms, and carpenter shop be outside of the main building whenever possible.

SMOKING AND MATCHES.

Smoking should not be permitted in any part of the elevator. Men should not be permitted to carry matches into the building.

OUTSIDE WALLS.

Where the wooden-bin walls are covered with corrugated iron special attention should be paid to the condition of this iron, as an opening would make a ready receptacle for a spark to lodge in.

LIGHTNING.

Lightning, according to statistics from various insurance companies, has been the cause of quite a number of fires in elevators. All elevator buildings should be thoroughly equipped with lightning rods.

SAFEGUARDS RECOMMENDED FOR DRIERS AND SULPHUR BLEACHERS.

The hazards incident to the use of grain dryers can not be eliminated or safeguarded to such an extent that their introduction inside the elevator would not cause a material increase in the fire hazard. Their introduction inside the elevator should be prohibited.

Notwithstanding the fact that the grain and foreign matter mixed therewith are the only materials of a combustible nature contained in a structure constructed in accordance with the underwriters' regulations, it is believed that a fan-driven fire in this dust and grain would result in considerable damage to the apparatus and possibly to the structure. For this reason the following recommendations for safeguards are appended:

First. An adequate system of automatic steam jets should be provided for extinguishing fires in the apparatus. High-degree automatic sprinklers can be arranged so as to automatically fill the apparatus with steam in cases of fire.

The steam pipes for sprinklers and all other parts of the apparatus should be so arranged that all condensation can be removed during cold weather and when the drier is not in use.

Second. If the fan is driven by an independent engine a system of fusible links should be so arranged that the fusing of any link would close a shut-off valve on the steam connection supplying the engine. Attachments for automatically stopping the fan when the power is from other sources should be provided if practicable.

Third. An automatic fire-alarm system should be installed, placing alarms in the engine room and at other points if desirable.

Fourth. A thorough system of automatic sprinklers should be installed when the drier is used in connection with the sprinklered elevator.

When installed outside the elevator and in accordance with the underwriters' rules and requirements, grain driers, even of approved construction, are considered as adding to the fire hazard of the elevators in connection with which they are used, according to the construction of the drier building and the distance which they are removed from the elevator.

SULPHUR BLEACHERS.

The sulphur-burning furnace should be set at least 25 feet distant from the elevator, and be of fireproof construction. When necessary to get the furnace closer than 25 feet, the fume pipe should be not less than 25 feet in length.

The same regulations should also apply to sulphur bleachers as to grain driers in reference to communication, but the inclosure for burning sulphur should be so arranged with division walls that in case of a choke in the conveyor after passing the bleacher the grain can not back up to the pan in which the sulphur is burned.

Fire Protection.

The best means of fire protection is a standard installation of automatic sprinklers, although the automatic sprinkler is not as effective in an elevator as in other classes of buildings. It is necessary to have a dry system on account of cold weather. When a sprinkler head is released on account of fire, the air expelled from this opening blows the dust about in such a manner as may cause an explosion. The standards require inside standpipes with hose on the various floors sufficient to reach all parts of the buildings. There is a question whether the hose at the various outlets should be standard 2½-inch fire hose or a smaller size, either 1½-inch or 2-inch hose. It is a well known fact that one man can not handle a 2½-inch hose line if it has an effective pressure on it. Therefore it is reasonable to say that a 1½-inch hose with nozzles having ½-inch openings would be the most serviceable. These inside standpipes should be supplied from a pump or pumps in the boiler house of sufficient capacity to furnish requisite volume and pressure. Where water can be obtained from city mains, with sufficient pressure to reach the top of the building, a by-pass around the pumps should be provided so that in case of the elevator being shut down or no steam on the boilers this water could be used. Where pumps are provided steam pressure sufficient to operate the pump should be maintained at all times. These standpipes should be arranged for draining, so that in winter there will be no water on the standpipes, as the buildings are open and the water in the pipes would be subject to freezing. Standpipes should be under outside control, so that if it is found impossible to use this protection on account of headway gained by a fire, the post indicator valve controlling can be shut, and the water supply reserved for hydrants or other protection that may be available. Water barrels with fire pails should be placed on all floors of the elevator, apportioned about one to each leg in a regular elevator or one to each 500 square feet in other buildings.

Approved 2½-gallon chemical fire extinguishers are advisable as additional protection, but these would have to be kept in the engine room or office in the winter unless the nonfreezing type is used. In elevators where electric motors are used carbon tetrachloride extinguishers should be provided. Either of these extinguishers or sand in buckets should be provided for oil rooms. Axes and pike poles should be provided on all floors. Signal alarms from all hose outlets to the engine room should be arranged for turning in fire alarms or notifying the engineer to start the fire pump.

Fire brigades should be organized among employees and regularly drilled twice a month in order that employees may become familiar with handling fire apparatus provided. Daily inspection should be made of all fire equipment and a weekly report form forwarded to proper official.

A sufficient number of night, Sunday, and holiday watchmen should be maintained to cover all portions of elevator hourly, with necessary approved watchman's clock-service stations properly located for registration. Watchmen should be instructed with regard to location of fire alarm boxes, interior standpipe and firehose connections, fire pails, chemical extinguishers, etc. The first tour should be made immediately after elevator has closed down.

Electric journal alarms from journals to an indicator in engine room which operates in case of a journal getting hot are recommended, and when installed should be tested daily.

Guarding and Identification.

When possible, special guards should be provided outside of elevator to prevent entrance of unauthorized persons. When military guards can not be procured, special civilian armed guards should be provided.

Where practicable, barbed wire fences or other suitable man-tight inclosures should be erected.

Special electric-flood lighting should be provided at night to illuminate guarded area and approaches thereto.

No persons should be allowed to secure admission to elevator or guarded inclosure except upon presentation of proper pass credential and a special employee should be designated to check crews of vessels tied up at elevator, as well as "grain levelers," observing their actions while at work and that all have left premises when loading or unloading is completed. The use of properly authenticated photographic passes is recommended for inspectors and employees.

RECOMMENDATIONS FOR STORAGE AND HANDLING OF BITUMINOUS COAL.

To Prevent Spontaneous Ignition and Fire Losses.

It is important, in order to prevent spontaneous ignition, that the following rules be complied with as far as practicable:

The storage ground should not be of a marshy nature or be subject to drainage from any source.

Coal should not be stored near external sources of heat, even though heat transmitted be moderate, and should be located away from and not stored against buildings.

Avoid admission of air to interior of pile through interstices around foreign objects such as timbers or irregular brickwork or through porous bottoms, such as coarse cinders.

Do not permit pieces of wood, oily waste, or other easily combustible material to be mixed with coal during storage, as they may form a starting point for fire.

The height of piles should be limited to 12 feet. Arrange piles in as many units as possible, restricting the length and width as far as possible, in order to provide spacing not only for ventilation purposes but to expedite rehandling if necessary, and limit amount of coal in one pile subject to loss. There should be a distance of at least 5 feet between piles, and this space maintained free for complete ventilation and dispersion of occluded gases.

Pile so that lump and fine are distributed as evenly as possible; not, as is often done, allowing lumps to roll down from the peak and form air passages at the bottom of the pile.

Where coal is stowed under shelter or inside of structure, most perfect surface ventilation should be secured to facilitate the escape of gas by the circulation of the atmosphere.

In coal with a tendency toward heating temperature rises are comparatively gradual, and if detected in time complete combustion may be prevented by rehandling. If ignition point is reached, fire may burn for a considerable time in interior of pile before becoming apparent. For detection and prevention of fire, hollow iron pipes staggered every 50 feet through piles may be used, driven within 1 foot or so from bottom, these pipes to be pointed and closed at bottom to facilitate installation and provided with a stopper for closing the opening at the top, to prevent admission of air; daily thermometer readings, or readings

every few days should be taken in order that any excessive rise in temperature may be readily detected, and when temperature has reached 125 degrees rehandling should be started. High sulphur coal should be especially watched, owing to danger of "heating."

Wherever it is possible to do so, all wet coal, and especially that wetted by snow and ice, should be disposed of for immediate use without first being stowed; if, however, its stowage is unavoidable, it should form the top of the pile and be spread out as thinly as may be practicable to expedite drying by evaporation.

The only effectual way of extinguishing fire in coal storage is by rehandling. Water is not generally successfully applied in extinguishing fire in a coal pile, because it is impossible thoroughly to saturate pile; the best method of handling coal in danger of fire is to load it out and saturate it so that it will be thoroughly cooled off. The best preventive of loss in coal storage is constant inspection for incipient heating and immediate removal of coal from spot affected. Special care should be exercised in loading out coal that has been on fire into cars for passage through wooden mechanical coaling plants, to see that fire has been extinguished and coal is not heated. Coal which has a tendency to spontaneous ignition should be turned over frequently.

Where large quantities of coal are stored, special watchman protection, day and night, should be provided, watchman registering hourly from approved portable clock stations properly distributed. Temperature readings should be taken by watchman at least once during the night and proper record kept of same.

FREIGHT-CAR HEATING.

Before cold weather provision should be made to assure proper attention by agents, conductors, car inspectors, and others to the serious hazard in connection with the use of heated cars.

No heating apparatus should be permitted that has not been approved by proper railroad officials and rules and regulations should be promulgated for their installation and operation. The use of gasoline stoves or torches should be prohibited.

All heating apparatus should be overhauled, repaired, and put in safe condition.

Agent at point of origin should be held responsible for preparation of car and should not permit car to go forward unless heating apparatus is installed in accordance with rules.

Car inspectors or other designated employees should be instructed to examine freight cars provided with heating apparatus and if installation is not in accordance with rules or otherwise unsafe, cars must not be allowed to proceed.

Cars equipped with heating apparatus should not be placed in trains or storage yards next to cars bearing explosive or inflammable placards.

AUTOMATIC FIRE PROTECTION FOR RAILROAD PROPERTIES.

The automatic sprinkler, when properly installed and kept in good working condition, has so effectively shown its ability to extinguish fires or hold them in check that we can not ignore it and its usefulness in our pursuit of safety from loss by fire; we should, therefore, emphasize the importance of automatic

fire protection as at present perfected and available for the protection of railroad structures of large valuations and their highly valued and inflammable contents, as well as for the protection of important operations, and ask that a more careful study be given to the subject, bringing about a better realization of the value of automatic sprinklers in preventing serious fires.

The theory of fire control by means of automatic sprinklers is to check a fire in its incipiency through the agency of the heat of the fire itself. It is different from other means of safeguarding property from destruction by fire through the fact that the installation is entirely automatic and always on duty; that is, no human agent is required to operate it, the fire being made to put itself out automatically. The system, in brief, consists of lines of piping carried through a building near the ceilings or roofs, parallel thereto and in all covered and inclosed places, attached to which are sprinkler "heads," each covering or protecting a designated area of floor space, the piping containing water under pressure, the sprinkler head, which is a valve device, being kept closed under normal conditions by means of a piece of fusible metal, having a low melting point, the melting temperature varying in accordance with the conditions under which the apparatus is to be installed and used. In case of fire the fusible part of the sprinkler melts as soon as the temperature in the vicinity of the sprinkler head reaches the melting point of the solder, the strut or levers are released, and the water is discharged through the opening against the deflector and showered upon the flames in the form of a heavy water spray.

The amount of water discharged of course depends upon the water pressure, ranging from 12 gallons of water per minute under 5 pounds pressure to 50 gallons per minute at 70 pounds pressure.

The usual type of automatic sprinkler system is known as the "wet" pipe system, the pipes being constantly kept full of water under pressure, which is showered upon a fire as soon as the sprinkler head opens. A "dry" system is used, however, in locations where there is danger that the water will freeze, and in such cases the exposed pipes in the system contain air under pressure, the water being excluded from the pipes back to a safety point by special "dry pipe valves," in which case when the sprinkler heads open the compressed air is released, the dry-pipe valve opens and admits the water. Wherever there is no danger of freezing the "wet" system is preferable, because of a quicker application of the water and the fact that there is not a complication of dry-pipe valves. Dry-pipe systems are subject to more complication, both in operation and maintenance, the wet-pipe system being also more readily placed back in service after operation. It is advisable wherever possible to use a wet system, and frequently it will cost less to install the amount of steam piping necessary to maintain the temperature of the building above freezing than the cost of installing the extra equipment for the dry system. The wet system is more efficient, in that in a dry system after a sprinkler opens it might require from one to two minutes to exhaust the air in the pipes before the water reaches the orifice.

The efficiency of a sprinkler system depends entirely on having reliable sources of water supply, two sources wherever possible, and both under sufficient volume and pressure as to be thoroughly dependable and ample at all times, and naturally every possible precaution must be taken to prevent interruption of the service. Sources for such supplies are public mains, private water systems, gravity and pressure tanks and steam and electric driven pumps. Attachments may also be made for city fire engines to connect with the system. Full details as to water supply and construction of systems must necessarily be taken into

consideration with the character, occupancy, and location of the property to be protected, and, from an engineering standpoint, it is therefore necessary to view the requirements of each property and the available facilities in considering such installations.

When the cost of such installations, distributed over a period of years, is considered in relation to the values of building and contents, it may be considered a most economic form of protection, and valuable not only as conserving a large valuation from possible loss but as protecting the operation of the property. Large shop structures in railroad operation, including general storehouses, where large valuations are found incident to supplies, machine shops, foundries, planing mills, car erecting, painting and repair shops and coaling stations, are illustrations of large values found on railroads, and where this class of protection would be most valuable, as experience has frequently shown that fires once started in the roofs of large shops unprotected by sprinklers are practically incapable of being controlled by hose streams, no matter how efficient the fire brigade, for the reason that such roofs are very dry, almost tinder as it were, and only require a spark to ignite them, and the currents of air which always exist in large buildings sweep the fire rapidly along the roof unless controlled at its start, which is the function of the sprinkler. Terminal warehouses and piers, through which not only large quantities of freight are constantly moving, but stored, are other types of property where this class of protection is most valuable.

The regulations of the National Board of Fire Underwriters governing the installation of automatic sprinkler equipments recommended by the National Fire Protection Association should be carefully followed, and all plans for the installation of automatic sprinkler apparatus should be in accord with the regulations.

STEAM FIRE PUMPS.

Design should be standard. "Trade" pumps, especially if of old design, frequently are unable to meet demands of fire service.

Location.—Pumps should preferably be located in fireproof room, as near to boiler as possible, cut off from rest of plant and accessible from outside. An unexposed separate building for pump and boiler is preferred.

Maintenance.—Pump should be always in the best of condition, ready for instant service. Tests will usually develop defects. Leaking valves, defective packing, worn piston rods, etc., are frequent defects.

Steam supply should be examined with a view to the following:

(1) Steam main or mains should be run in such a manner as to be free from possible damage through burning of buildings and falling of walls.

(2) Mains should be run as direct as possible. Throttle valve should be of globe pattern and should always be in horizontal pipe.

(3) Main should be an independent line from header on boiler.

(4) All other connections in boiler house should have valves in boiler house, so as to concentrate the supply to pump.

(5) If supplied by two lines, each line should be valved in boiler house, and also in pump room.

(6) Steam line should be properly trapped so as to take care of condensation, and so installed as to take care of expansion and contraction.

(7) Minimum steam pressure of 50 pounds should be maintained at all times.

(8) Recording steam gauge preferably should be provided, to be carefully examined, and dials to be filed daily.

Cylinder cocks, on bottom of steam cylinders, must be kept open so as to relieve cylinders from condensation, and they should discharge into open cups connected with sewer.

Suction connection.—Pump taking water under head must have indicator or O. S. and Y. valve in each suction supply. Where pump takes suction under lift, a foot valve may be supplied where lift approximates 15 feet or where suction pipe is long. Strainers are generally needed where suction is taken from reservoir or stream. Orifice of strainers should be ten times the area of suction pipe. Suction wells or sumps are sometimes advisable, intakes thereto to be properly screened.

Priming tank.—This must be provided where pumps take suction under a lift, unless there is another reliable source of water supply for priming. A priming tank should have a capacity of not less than one-half of the rated capacity of pump.

Reservoir.—If reservoir is provided with automatic fill connection, its efficiency should be tested by drawing water from reservoir.

Discharge connection.—Gate valve in the discharge line must be open at all times.

Care and tests.—The following is suggested:

(1) Pump room should be kept clean, heated, and well lighted.

(2) Pump to be kept well lubricated at all times.

(3) Ample supply of oils to be kept in pump room, in metal cans, with drip pans.

(4) Pump to be run at least once a week, for a period of several minutes, preferably at full capacity.

(5) See if relief valve is properly adjusted.

(6) At each inspection run the pump and discharge through relief valve.

Automatic regulator.—If provided, automatic regulator should be adjusted to maintain a pressure of 75 pounds at the ground level, plus any additional pressure which may be required to maintain 25 pounds pressure upon highest sprinklers in sprinklered properties.

Automatic regulator should be of approved type. Many now in use are poorly designed.

Regulator should be tested, and required to maintain the desired water pressure (within 10 per cent) at any speed of pump from zero to full speed.

Regulator should always be placed on by-pass, having valve above and below to permit of repairs; valve in addition to be provided in main line.

Auxiliary pump, if used to prevent needless travel on the part of fire pump, should have regulator set about 5 to 10 pounds higher than regulator on fire pump. Auxiliary pump should be of approved type, and not less in size than 7 by 3 by 6 inches.

Fire pumps should not be used for domestic service.

RECOMMENDATIONS IN CONNECTION WITH PRIVATE FIRE BRIGADES.

Their Organization, Maintenance, and Usefulness.

When a fire occurs, excitement and confusion often prevail; and as fires in any class of property are ordinarily not extinguished by pouring water into the building promiscuously, but should be scientifically and carefully sought out and fought, the private fire brigade, trained in the use of fire apparatus, is most important.

Experience has shown that the efforts of undrilled employees, however well intended, will not control a fire as promptly as a disciplined force made familiar with the protective apparatus by regular drill and practice.

No fire brigade can be a success unless the management of the property, both general and local, are first interested and believe in it and are willing to encourage the men.

The principle of a private fire brigade organization is essentially that of mutual protection; to the management the safeguarding and preservation of the property; to the employees their permanent occupation.

The thorough organization and drilling of private fire brigades greatly enhances the value of and is a necessary adjunct to the use of private fire apparatus, which in large properties is purchased and installed at considerable expense. Many properties, such as shops, mills, and terminals of transportation lines, are isolated, depending more or less (in some instances absolutely) on the efforts of the employees to extinguish fires. Such drilled employees are also of more assistance to the public fire department, when available, than an undisciplined force, and *should always be in full harmony with the public department.*

The manner of organizing a fire brigade in any property will necessarily depend upon its size and character, as well as upon the character of the fire-extinguishing apparatus used or required (the kind and amount of apparatus needed will depend upon the size, construction, number, and distribution of buildings to be protected). The following detailed suggestions for the formation and maintenance of private brigades embrace sufficient general data upon which to base an organization, either large or small, and can readily be modified and applied to suit the requirements of each individual case.

GENERAL SUGGESTIONS.

The entire brigade can be made up from employees of any property with but little interference with their other duties. It is important that all large properties should have the constant service of a private fire organization, and therefore in planning one consideration should be given to not only the organization of brigades for regular day service, but for nights, Sundays, and holidays; in other words, the property should never be without the prompt service of trained men. There should always be a specific number of men in each company, and vacancies should be filled as soon as they occur.

The selection of men for a fire brigade should be made from the regular, steady employees, who are cool-headed and well posted as to all the buildings and their various parts. It is well to appoint such men as live within hearing distance of the fire signal, if possible. There should be some means of identification for admission to the property during nights, Sundays, and holidays provided members of the fire brigade. A fire-brigade badge would be suitable.

The ideal private fire brigade should be organized under a special constitution and by-laws and hold regular meetings.

The members should be subject to discipline, and acts of unusual merit involving personal risk and endurance should be fittingly rewarded by the authorities.

Membership in the brigade should of itself confer distinction and, if possible, carry with it some privilege sufficiently attractive to make membership desirable and sought after. Various means may be adopted to secure these features. There could be clubrooms, with a view of encouraging social intercourse through the medium of the fire-brigade organization, special remuneration for services, annual tournaments between different shop brigades, with suitable prizes.

An organization in a large property consisting of several companies, composed of a small number of men in each, is desirable and makes it possible for better direction with less confusion in connection with the work of fire extinguishment.

While special duties are suggested for members of the companies comprising the brigade or department, as given in detail following, every man should be so instructed and drilled that he may perform any of the other duties outlined and be available for whatever duty may be assigned him at the time of a fire.

ORGANIZATION.

The fire department should consist of the following:

CHIEF.

The head of the fire brigade should be some one ordinarily in authority on the premises, and should preferably be a man with some experience in fire-department operations. He should be held responsible for the care and condition of all fire-fighting appliances, be given ample authority in such matters, and have entire charge of the employees and fire brigades during fires and practice drills. He should make frequent inspections of the property and equipment and make at least monthly reports of the operations of the fire brigade and of the condition of the property and the fire apparatus to those higher in authority, such as the manager, superintendent, or master mechanic; and if any part of the apparatus is missing or out of order, personally see that it is replaced or corrected. He should be familiar with all water supplies, pipes, valves, etc., and their service and purposes.

ASSISTANT CHIEF.

It may be desirable, in some instances, to have more than one assistant chief. This officer should be a reliable man who is in attendance at the property the greater part of the time, and one who has authority over the men. The assistant chief will assume the duties of the chief in his absence, and it is desirable, under the organization, to arrange, wherever possible, that either the chief or one of the assistant chiefs is always on the property.

Hose companies.

The number of hose companies should ordinarily be equal to one-half the total number of the possible fire streams that can be played on any one fire. However, all large single building properties should have one full company, even though only used as a bucket and fire extinguisher brigade. The number of men in each company should ordinarily be 10, including the captain and lieutenant, in order that all the duties may be properly performed, the men being designated as follows:

Captain.
Lieutenant.
Six hose and nozzle men.
Two hydrant men.

CAPTAIN.

The captain shall be in charge of a company under the direction of the chief and shall be responsible to the chief for the condition of the appliances under his charge.

LIEUTENANT.

The lieutenant shall assist the captain or take his place in event of his absence.

HYDRANT MEN.

These men shall make the hydrant connections and have charge of the hydrant, subject to the orders of their superiors, one man to stay at the hydrant all the time, the other to assist in handling the hose.

HOSE MEN OR NOZZLE MEN.

These men should draw hose cart and assist in laying lines of hose and have charge of the nozzle; three men to each stream.

Chemical engine company.

There should be at least six men in each company, including captain and lieutenant. Two men should have charge of operating the engine tank, and of recharging same. These men should be held responsible for the proper charging and condition of the engine at all times, also for having extra charges at hand. Two men to be selected to carry hose and direct nozzle.

Ladder companies.

Where there are high buildings it is essential that ladder companies, independent of the hose companies, should be organized. They should be in charge of a captain, who should have a sufficient number of men, ordinarily about six, including a lieutenant, and should raise the necessary ladders, assist in entering buildings, rooms, etc., and prepare proper access for the hose men. Permanent ladders attached to the sides of buildings for reaching roofs greatly facilitate the work of the firemen.

Engineers.

The chief engineer of the plant, under the directions of the fire chief, should have the immediate charge of the entire pumping system and be provided with a sufficient number of assistants to look after pumps, boilers, or motors and see that the requisite water pressure is maintained.

Valves.

If water system is controlled by valves which require turning in case of fire under direction of the chief, the engineer or captain of one of the companies should be in charge of all the valves, either he or one of his assistants should attend to opening any valves controlling primary or supplementary water service. *This is a very important duty, as in the confusion of a fire it has often been demonstrated that the wrong valves are opened or closed; or valves operated at the wrong time, seriously interfering with the water supply and pressure.*

Salvage corps.

It is important that a number of trustworthy employees, under a foreman, should be organized and instructed concerning the best course to follow in saving property from fire or water damage. These men should be utilized to proceed immediately to the scene of the fire and cover all machinery and stock with waterproof covers to prevent water damage. This organization should be provided with the necessary paraphernalia, such as rubber blankets, or whatever may be required to cover the contents of a building. After a fire they can

be utilized in sweeping out or wiping off machinery, and draining off or sopping up water, separating the undamaged from the damaged property, and otherwise preventing further damage to the property.

Apparatus inside buildings.

Buildings equipped with hand fire apparatus should have men designated to operate each special device as follows:

One man for each chemical fire extinguisher.

One man for each two buckets of water.

Two men for each water barrel and buckets.

Two men for each standpipe and hose connected thereto.

It is preferable to select men working in the particular building to perform these duties, for instance, detail the men nearest to each fire appliance the special duty of getting that particular apparatus into action in the event of fire in that building. All the above men to be under the authority of the fire brigade, but not necessarily members.

General.

When an alarm of fire is sounded, all members of fire brigade must instantly proceed to the position assigned them, regardless of the nature of their employment at the time, and be subject to and carry out the orders of the chief, assistant chief, or captain of their respective companies.

In the event of a fire, the chief should give immediate orders to have the machinery stopped in the building where the fire fighting is going on; and the electrician should take such action as will insure safety to life and property endangered from electrical equipment. If gas or oil are piped into buildings for any purpose the supply should be immediately cut off.

All employees, regardless of whether they are members of the fire department, should be instructed, on discovering a fire, to immediately sound an alarm from the nearest fire-alarm station, and in the manner shown by directions, which should be conspicuously posted at each station, and also make an immediate effort to extinguish the fire with the apparatus at hand. All employees, not members of the fire brigade should, if called upon, give assistance in case of fire, and should obey the orders of the chief.

Rigid inspection of all fire apparatus and fire hazards should be made under the direction of the chief by one of the captains or a member of a company at least once a week to see that every piece of apparatus is in its place and in good order ready for use. A report of such inspection should be made to the chief.

In buildings equipped with automatic sprinklers a comprehensive system of inspection of all sprinkler valves and water supplies should be maintained.

It is desirable after each day's work is finished to have one man designated in each building to see that the fire apparatus is in good condition and ready for the use of the night watchman if necessary.

All members of the fire brigade should familiarize themselves with the regulations and organization of the entire department, and they should be required to report to their captain or chief when they expect to be absent, so that their places may be filled.

It is well to call the fire brigade together occasionally for instruction along all lines, including hazards incident to the property, cleanliness, care, and use of fire apparatus, causes of fires, and have these matters continually impressed upon all employees.

In large freight houses or around transfer platforms where many cars are stored several men outside of the brigade organization should have as an

assigned duty, on the sounding of the fire alarm, the removal of all gangplanks between cars and between cars and platform, so that there will be no wrecking of cars and preventing their removal when yard engines start to pull cars to safety.

It is recommended that "Instructions and Rules Governing the Fire Department" be printed and posted in conspicuous places throughout the property, so that all employees may become familiar with them. These should show:

1. The detail of men with respective duties.
2. Brief instructions as to the duties of each detail.
3. Location of fire-alarm stations with box numbers.
4. Instructions for sending alarm.
5. How alarm will be sounded on whistle or gongs, sending city alarm, and such miscellaneous instructions as may be selected from the suggestions here given.

FIRE DRILLS.

Practice drills should be held as frequently as possible, at least once every two weeks, and preferably at times without previous notice, in order to test the readiness of the brigade to respond to an actual fire call. It is also advisable to arrange for night drills with such employees as have been organized into night brigades. It would be well to make a regular record of drills and report the date on which held, together with the time of the alarm, the number of companies and men responding, the time it took to respond; and if water is used, the length of time it took to get it into service, together with the fire district the test was made in, and the method of sounding alarm. Such report of brigade drills could be kept on file for reference of officials or submitted for their information.

Rivalry between the hose companies is a good thing, in respect to quick service, and should be encouraged, and a record kept of the time of responding to alarms.

It is very important to instruct beginners in fire fighting in the proper laying and coupling of hose; the difference between left and right hand threads and how to make coupling connections so as not to cross the thread; the opening and closing of hydrants; unreeling hose from hose cart or getting it out of hydrant hose house and laying lines of hose from the hydrant; to lay enough, not too much or too little, for the service required; how to raise ladders; how to handle nozzles and direct streams of water; how to mount roofs from scaling ladders; and the use of hooks, axes, etc.

Drills should include laying lines of hose and carrying them into and onto the different buildings, in order that the men may become familiar with handling the hose and making the coupling connections rapidly and without confusion. The chief should direct where ladders should be placed and where hose should be carried and streams directed. As a general rule, except in freezing weather, pump should be started and water turned on to accustom the men to the recoil and weight. It is well to select for each drill a different building, assuming the one selected or the adjoining one to be on fire; and practice drills should be made in response to an alarm with the full service and discipline in effect as in case of actual fire from the sending in of the alarm down to the most minute detail.

To protect men from accidents on ladders, ladder straps should be used with hose intended to be carried onto buildings to take the weight off the men and place it on the ladders.

Hose lines with water should never be manned on a roof with less than three men, and they should be assisted by extra men to pass signals and to assist in case the hose becomes unmanageable.

During practice special attention should be given to the laying of hose without twists or kinks, avoiding all short turns or bends at any place, beginning at the hydrant and throughout the length of the hose, the play pipe being held so as to make a gradual curve of the hose from the ground up; otherwise twists or kinks are liable to pull the hose away from the pipemen when the water is turned on, making it impossible to hold the pipe, or the hose is liable to burst or be weakened, interfering with the free flow of water.

At times when conditions are favorable, a sufficient number of hose lines should be stretched to test the maximum working capacity of the water distribution system.

At the conclusion of the drill and on order from the chief, the companies should return all apparatus to its proper place and see that it is in readiness to respond to subsequent calls. If the hose has been wet, it should be placed upon a drying rack and thoroughly dried before being placed on the carts or in hydrant hose houses. A supply of dry hose should be on the cart while the hose which was in use is drying.

EQUIPMENT AND SUPPLIES.

The following is necessary for the complete equipment of a fire brigade, the amount necessarily depending on the extent of the property:

Sufficient fire hose to concentrate, if necessary, the total capacity of the water supply upon any building or section of the property.

A thoroughly good quality of standard 2½-inch cotton, rubber-lined fire hose is required, the couplings to correspond to those of the city fire department. (See special article on purchase, use, and care of fire hose.)

Standard hydrant-hose houses or hose-cart house for keeping equipment.

A supply of standard play pipes to be distributed with the equipment of hose. Play pipes should have a plain, smooth nozzle, and care should be taken that its thread corresponds with the thread on the hose coupling. Play pipes should be handled carefully so as not to dent them. The smoothness of the bore in them is important for a good stream. The tips or nozzle outlets should be of size to suit water supply and pressure.

A supply of hose spanners, and plug wrenches should be provided and distributed with the hose equipment and kept on the hose carts and in the hose houses.

Fire axes and bars should be carried on all hose and ladder carts or distributed in hose houses.

Coils of one-half-inch hemp rope with snap hooks for the hose and ladder companies, the length to be about two and one-half times the height of the highest building.

A supply of water barrels and fire pails for each building.

A supply of lanterns of a pattern which will prevent the lamp being dropped through the bottom of body or extinguished by a spray of water striking it. The glass should be guarded with a fender.

Hose drying racks or towers are essential for the proper care of hose after service. Racks should be made long enough to take full lengths, 50 feet of hose, and inclined sufficiently to allow drainage.

A "nozzle rest" should be provided for use in case of extra heavy pressure and strong streams, for attaching to the play pipes, by the use of which one man can hold and direct the stream.

Chemical hand fire extinguishers, other than those furnished and distributed in accessible and conspicuous places throughout the property, should be provided for the use of the fire brigades. (See special articles on chemical fire extinguishers.)

Hose carts should be strong, light, and simple in construction, having a capacity of from 300 to 500 feet of hose, the capacity to depend on the distribution of the hose throughout the property. If hose is distributed in houses or on reels at hydrants, the supply of hose on cart is to supplement same.

Ladder truck should be well and strongly made and easily handled by six men. It should be equipped with extension ladders of sufficient length to reach the highest roofs, where practical, besides single ladders, fire axes, lanterns, tool box, etc. If permanent ladders have been erected on the buildings, the provision of the ladder truck is not so essential.

COOPERATION WITH CITY FIRE DEPARTMENTS.

It would be desirable to invite the chief and other members of the public fire department to go through the property and explain to them the installation of the private equipment and private fire organization and their purposes; have them inspect the property periodically so that they may become familiar with the arrangement of the buildings, location of fire hydrants, valves, etc., so that in case of necessity they may have a knowledge of the conditions and private facilities for fighting fires.

Employees should be detailed to pilot the firemen to the fire by the safest and most direct route and to render such other assistance as may be needful.

FIRE ALARMS AND ALARM SYSTEMS.

With a properly organized fire-fighting force, the fire-alarm system is installed with a view of diminishing the time elapsing between the discovery of a fire and the bringing into use of the fire apparatus, and such adjunct is therefore quite necessary.

The character of such system will naturally depend upon the size and extent of the property and its character, and will vary from a gong installed for manual pull to an electric fire-alarm system of numerous boxes where the transmission of an alarm is entirely automatic after the manual operation at the various box locations.

A "general alarm" is essential to summon the fire brigade from their work or homes, and when it can be arranged, a steam whistle signal is preferable; the general alarm to be followed by a location alarm, represented by a specified number of blasts on whistle designating the various districts of the property so that the brigades may proceed to the location sounded.

If an electric fire-alarm system is justified, the proper number of fire alarm boxes should be distributed to adequately cover and be easily accessible from all parts of the property, and should preferably be located outside of buildings where they can be readily reached. These boxes should be on a system centering in the main power plant, from which point the general whistle alarm is to be sounded. It may be necessary in some properties to have gongs and indicators installed on the circuit in the various buildings in which the members of the brigade are employed, in addition to the indicator and gong in the power

house, as the noise of the shop operation might prevent the whistle or other alarm from being distinctly heard.

Electric fire-alarm systems should be tested daily from alternate boxes.

The question of a fire-alarm system depends so much on the extent and character of the property, that no detailed recommendations can be given.

If a property is located so as to be within the call limits of the public fire department, a fire-alarm signal box connected with the city or town fire-alarm service should be installed on the property. In instances where the property is extensive, several boxes are necessary, or auxiliary boxes connected with the main box. In smaller properties an auxiliary box connected with the nearest public fire-alarm box is recommended, or if not possible, a key to the nearest public box obtained and its location carefully designated, together with that of the box. *In event of fire the public department should be immediately summoned.*

FIGHTING FIRE.

Alarm.—When a fire is discovered act quickly and keep cool. Pails of water or chemical extinguishers should be used immediately if available and the fire can be reached with them. *The fire alarm should be turned in as quickly as possible.*

If the fire is beyond the fire pail or chemical fire extinguisher stage get water on from the hose as quickly as possible and carry the play pipe as close up to the fire as the heat will allow. A "solid stream" will "knock out" a fire, while a "spray" is practically useless. Play the stream at the *base of flames*, so as to drench the material actually on fire.

Fire brigade should remember that one good stream is more effective than two poor ones, so don't put on too many streams and thereby reduce your water pressure.

Detail responsible men to watch flying sparks and embers and to extinguish small fires caused by them.

As soon as practicable notify persons in charge of property of the fire.

When you realize that a building, which is on fire, can not be saved immediately devote your best efforts to preventing the spread of the fire to adjoining buildings.

If any of the buildings on fire are equipped with standpipes or automatic sprinklers, give special attention to the water supply, and when a building has collapsed, or the fire is absolutely beyond control, see that the sprinkler supplies and vertical pipe supplies have their connecting valves closed, so that the fire mains will not be drained by broken piping inside the building.

Use water freely to check a fire. Once the fire is under control, however, use water as sparingly as possible, so as to minimize water damage to stock. This is especially important if the water supply is limited.

After a fire.—As soon as the fire is "out" use every effort to save the materials and stock and safeguard machinery. Put on a special watchman, if necessary, to safeguard the property.

Remember that all fires have a very small beginning, and can be extinguished if you act quickly; therefore keep your fire apparatus ready for instant use and drill your fire brigades regularly and thoroughly. Have your men well informed as to location of all valves and other apparatus. Drills should be had every two weeks by day and night fire brigades.

SUGGESTIONS FOR THE PURCHASE, USE, AND CARE OF FIRE HOSE.

Fire hose is one of the most important of fire-extinguishing agencies, and, as with all fire-extinguishing apparatus, to be reliable should be of the best material and workmanship. It should always be in perfect working order and at all times properly cared for.

Purchasers are advised that specifications have been prepared for the manufacture of fire hose for "fire-department use," having been adopted by the National Fire Protection Association and National Board of Fire Underwriters after conference with hose manufacturers. Such specifications cover the manufacture of the cotton fabric, rubber lining, couplings, size, weight and flexibility, strength, etc.

Such specifications are known as the "National Standard" and are furnished hose manufacturers, and purchasers are therefore advised when buying hose to require that a *guaranty be given* by the manufacturer *that the hose sold is made to at least meet such requirements* and that any hose not meeting same after service and tests may be returned at the manufacturer's expense and is to be replaced. The above is mentioned as a caution against buying any *inferior* grades.

Each brand of hose should be conspicuously and distinctly marked with the name of the manufacturer, the trade name of the hose, together with the date of manufacture, stenciled upon every piece of hose, twice in each length. It would be well also for each corporation or plant to stencil its name on the hose, so that the ownership may be known.

Fire hose is subjected to a severe class of service, the importance of which makes it essential that the utmost care be given to the quality of the materials and the character of the workmanship employed in its manufacture.

By purchasing only the best hose and giving it the small amount of attention suggested, the greatest practicable durability will be assured.

Experience has shown that a good cotton rubber-lined hose, properly cared for, will frequently last 10 or 15 years.

A cheap grade of fire hose is by far the most costly purchase. Do not purchase inferior grades of hose on the grounds of cheapness. Hose is always made to fit the price paid for it. The best quality and consequently more expensive hose is usually cheaper in the end, on account of greater durability of the better grade of rubber compounds used in its manufacture.

Kinds of Hose for Fire Service.

COTTON RUBBER-LINED HOSE.

For use on the yard hydrants of shops, mills, terminals, or other property and for the interior of large stations, warehouses, piers, shops, etc., a single "jacketed" or "ply" cotton rubber-lined hose is suitable for ordinary pressures and recommended. For many yards and buildings it is preferable to the thicker and heavier jacketed hose, as it is easier to handle and more quickly dried and more economical for the customer.

For yards or buildings where hose would receive rough handling or be liable to heavier wear and pressures, the same quality of hose is recommended with additional jackets, separate or interwoven, composed of the same kind of cotton fabric.

The light grades of fire hose on the market, generally known as "mill hose," are too light and generally of too low grade for the best service in shops, terminals, and manufacturing establishments and are not recommended.

For use on yard hydrants, no hose smaller in inside diameter than 2½ inches should be used.

The loss of pressure is three times as great in 2-inch hose as in 2½-inch hose, and, although where a line of only 50 feet is used the effect of friction is not much, for longer lines it is a serious detriment.

UNLINED LINEN HOSE.

For fire hose to hang up in exceptionally dry, warm rooms, corridors of office buildings, hotels, etc., unlined linen hose is suitable and recommended. Specifications are also prepared for its manufacture, and purchasers should be assured that hose of this class meets the requirements of the "National Standard."

Its chief value is for short lines for brief use inside some class of buildings and is best on account of its lightness, compactness, and convenience for use by one man alone.

Two and one-half inch hose is the standard size used for attachment to standpipes inside buildings, depending upon the water supply, although 1½ inch and 1½ inch are lighter and more easily handled, and may be used.

Durability depends upon the preliminary preparation and spinning of the fabric; and hose manufactured in accordance with the special specifications for this class of hose is therefore necessary, that it may hold water and stand a high pressure.

Linen hose is injured every time it is wet, but if kept in a dry place, may continue a reliable safeguard for 20 years or more. It is not suitable for lines of more than 50 or 100 feet in length, because of the loss of pressure due to friction caused by its interior roughness; and *it is not suitable for outside use*, because holes quickly chafe through it under pulsations of pump or when laid over sharp stones, cinders, material, or around sharp corners.

It will be seen that only under exceptional conditions is linen hose recommended, on account of inability to test it or the water facilities, where used. (See Care of.)

CARE OF COTTON RUBBER-LINED HOSE.

Owners of hose and those responsible for its care are cautioned and urged—

To run water through it occasionally (at least four times a year), as it keeps the rubber in good condition and lengthens its life; but to drain the hose and allow the cotton fabric to become thoroughly dry before stowing away again.

To test it about once a year to about 150 pounds pressure to make sure it is in good condition.

If put on a cart and allowed to remain after use, wet hose is liable to become damaged quickly. For this reason it should be removed from the cart as soon as it is returned to the hose house, and dry hose substituted. In making this change, the requisite number of lengths of dry hose should be gotten ready, the couplings and washers examined, and the threads treated with a little tallow or mineral oil. The wet hose should be unreeled in sections and the dry hose reeled on. The wet hose should be hung up in a tower or laid on racks to dry. If the hose is dirty, it should be brushed off with a broom after drying.

If a drying tower is not practicable, a slanting ventilated hose drying rack is recommended as a simple and effective arrangement, to be used for drying hose after it has been wet, either at a fire or at a test. The rack should be 52 feet long, 4 feet wide or more, 1 foot high at the lower end and at least 3 feet high at the upper end, and with slatted top; and may be built in sections to facilitate moving.

The rack facilitates the proper care of the hose, which will tend to prolong its life and thus reduce the cost of a perishable part of the equipment.

Keep the hose valves tight so that hose will not be wet by leakage.

Where cotton rubber-lined hose is attached to standpipes on the interior of large stations, warehouses, piers, shops, etc., in order to prevent leakage entering hose at hose connections, place a one-fourth inch drip cock in body of valve or a fitting with drip cock as near valve as possible, leaving it open to drain away leakage.

To avoid keeping hose in warm rooms, but preferably in a small, well ventilated hose house.

To roll up or stretch out all stock hose, as far as possible, to prevent sharp bends or kinks in it which may injure both fabric and lining.

CARE OF UNLINED LINEN HOSE.

Cautions.

Never wet unlined linen hose except to use at a fire.

Keep the hose valves tight so that it will not be wet by leakage. This is the most common cause of injury to hose of this kind. Use a well-made brass-bodied gate valve.

To prevent leakage entering hose at hose connections, place a one-fourth-inch drip cock in body of valve or a fitting with drip cock as near valve as possible, leaving it open to drain away leakage.

Stretch the hose out from time to time, that it may be dried between the layers. Racks for linen hose should allow it to hang vertically, as this gives better ventilation than if folds are laid horizontally.

MISCELLANEOUS SUGGESTIONS.

The necessity for uniformity in the size and screw threads of hose couplings throughout the country has often been strongly emphasized, as is the case when one neighborhood is likely to call upon another, in event of a serious fire. A "National Standard" for size and thread of hose couplings and hydrant fittings has been considered and has been adopted by many associations of National influence in matters regarding fire protection and extinguishment. Particular attention is called in this direction to owners or operators of shops and other large properties to see that their fire hose and fire hydrant couplings conform to the National Standard threads wherever possible ($2\frac{1}{2}$ by $3\frac{1}{16}$ inches, seven and one-half threads to the inch), but that they are uniform with those of the nearest municipality, so that when the city fire department is called upon, the hose connections may be of service. Where couplings are not uniform, adapters should be provided.

Nothing increases the efficiency of a private fire department more than the ability to *quickly* put a stream of water upon a fire. Hose should therefore preferably be kept in a small house and attached to each hydrant ready for instant use, as the delay caused by bringing hose and appliances from distant parts of the shop, yard, or premises often results in a serious fire.

Fire-brigade hose, play pipes, etc., for use on yard hydrants, should not be kept inside of the main building, for, should a fire occur, access to them might be impossible; moreover, rubber-lined hose deteriorates more rapidly in heated, close rooms than when kept on slatted shelves in an outside, well-ventilated hose house.

If it is not found expedient or the character of the property forbids the location of a hose house at each hydrant, or it is otherwise more desirable, hose houses are recommended in which to keep the fire hose on carts.

Such house should be substantially built, and centrally located. It should be large enough to contain hose carts and possibly either a steam or chemical engine and ladder truck, as the conditions may require with storage space for supplies. In some cases it would be well to provide sleeping quarters in the hose house for the men of the fire brigades, as there would thereby be a saving in time in getting quick response to a fire at night.

The doors should open outward and provide ample exit space for all apparatus.

Hose carts should be strong, light, and simple in construction, with a carrying capacity of 300 to 500 feet of hose, and equipment of play pipes, plug wrenches, hose spanners, etc.

FIRE HYDRANTS.

A fire hydrant which offers the least amount of resistance to the flow of water through it should be used. Hydrants should have at least two hose connections and be designed so as to overcome the danger of freezing by automatic drainage upon closing the hydrant valve; and also to at least meet the requirements of "standard specifications," as to materials, parts, and workmanship.

In placing hydrants they should be so located as to allow of the concentration at any point of two or more streams from lines of hose not more than 250 feet in length. The fewer the number of hydrants, the more hose will be necessary. Hydrants and pipe are more economical than hose and more durable and efficient. A long line of hose is more difficult to handle than a short one, more time is consumed in laying it, and the loss of pressure from friction is greatly increased.

Hydrants should be placed far enough from buildings to escape being injured by falling walls. They should be frequently inspected and tested except in freezing weather, and their couplings should be occasionally treated with a little mineral oil.

Hydrants in new installations should conform in all particulars to standard, with two or more 2½-inch outlets (fitted with independent hose gates).

Care should be taken that threads on hose outlets correspond exactly to the threads on the public fire department hose.

In installing new hydrants care should be taken that they are fastened to the piping in a secure manner, by means of clamps attached to lugs cast on hydrant body. Each hydrant should be set on flat stone and gravel, and broken material placed under and around to give proper drainage.

(*a*) Observe if any hydrants are leaking, and if so require immediate repairs.

(*b*) See that hydrant stems and caps are well lubricated.

(*c*) See that the arrow (indicating proper direction to turn hydrant open) is not obliterated. If it is, require a new arrow to be painted on.

(*d*) All hydrants should be flushed out thoroughly at least yearly.

(*e*) To test hydrants properly attach gauge to special testing outlet (or if there is no gauge outlet, gauge plug can be inserted in a nozzle, and the gauge attached to one outlet) and obtain static pressure by opening hydrant, then flowing pressure by opening one or more outlets.

(*f*) Do not test hydrants in cold weather by opening them. There is too much liability of their draining improperly, and consequent danger that they

will freeze after the test. If there is reason to suspect that hydrants are not draining properly, test by "sounding" with the hand on an open outlet. A mild turn of stem will furnish any evidence of frozen conditions.

Another means of testing is to lower a weight into hydrant. The presence of ice can be determined by the sound, and water by the wetting of the weight.

SPECIFICATIONS FOR THE CONSTRUCTION AND EQUIPMENT OF FIRE-HOSE HOUSES.

The standard hose house specified herein provides an accessible place where the hose and small equipment necessary for yard protection may be assembled at hydrant and kept in good condition and ready for instant use. This house follows the "National Standard."

Construction.

Location.—Houses should be located so that two or three way hydrants may be as close to the front of the house as possible and still allow sufficient room back of the doors for the hose gates and attached hose.

Foundations.—To consist of a brick pier or wooden post at each corner, 8 to 12 inches square and 8 inches high above the ground.

Note.—The depth of foundations should be sufficient to prevent serious displacement by frost.

Material.—To be of good lumber, free from injurious knots, and seasoned to prevent serious warping. Sheathing, roof, doors, and shelving to be of ⅞-inch matched stuff, dressed on one side.

Frame.—To be made of 3 by 4 and 2 by 4 inch material.

Roof.—To be made water-tight by tinning or its equivalent and to be properly inclined for drainage.

Doors.—To be in pairs, to open the full width of the front, to be hung on heavy T hinges bolted on and to swing 1 foot clear of the ground.

To be provided with substantial battens at top and bottom and a suitable diagonal cross brace well nailed on.

Note.—Care should be taken to select well-seasoned stuff in order to prevent warping. Extra wide battens and cross braces should also be used.

Hose shelves.—To be made of 3-inch slats, spaced ½ inch apart.

Note.—The object of the slats is to permit the circulation of air around the hose. The spacing named should not be exceeded, as the hose is liable to catch in wider openings.

Two shelves supported on the horizontal framing and extending across the house to be provided.

Note.—The lower shelf is designed to hold 100 feet of hose attached to the hydrant. The upper shelf is designed to hold the spare hose.

Floors.—To be constructed of ⅞-inch lumber not exceeding 4 inches wide and laid open. Flooring to be cut away around hydrant so as not to interfere with the swing of spanner at any outlet.

Ventilation.—An opening permitting the free circulation of air to be provided under the eaves. This opening to be protected by a strip.

Hardware.

Hinges.—To be extra heavy wrought T pattern, 16 inches long, to be securely bolted through the doors and framing of the house by ⅝-inch machine bolts.

Note.—The hinges should be installed so as to allow the doors to swing back against the sides of the house. The bolts should be provided with washers next to the woodwork.

Latch.—Doors on houses to be provided with a latch made of 2 by ¼ inch iron at least 24 inches long. Latch to be loosely bolted to one door near the center, to be provided with a handle and arranged so as to drop into a catch on the opposite door. Catch to be made of 2 by ¼ inch iron bolted through the door by at least two bolts.

NOTE.—The latch does away with the necessity of an upright post in the center of the doorway and provides for fastening two large doors without bolting one on the inside.

Locks.—Ordinarily hose houses should not be locked, but where it is necessary to guard against theft, they may be fastened with a brittle lock or hasp having a substantial appearance, but which can be easily broken in case of necessity.

Door fastening.—A light bar of round iron, pointed and hung to bottom of door, to be provided for holding each door open.

PAINTING.

House to be thoroughly painted on the outside with two good coats and conspicuously stenciled "Fire Hose."

EQUIPMENT.

Hose.—One hundred feet of 2½-inch cotton rubber-lined hose to be coupled and attached to hydrant and laid in laps on lower shelf. This hose to have standard play pipe attached.

At least two lengths, 50 feet each, of extra hose to be stored in separate coils on upper shelf, with female coupling outside.

Couplings.—To be interchangeable with the public service.

Play pipes.—To be Standard pattern.

NOTE.—The National Standard play pipe has swivel handles, a perfectly smooth tapering tube 30 inches long and is wound and painted. It has a 1⅛-inch smooth bore nozzle.

Miscellaneous.—Each house to be supplied with two axes, two bars, one extra play pipe, two ladder straps, four spanners, one extra hydrant wrench, one lantern and a coil of one-half inch rope, two and one-half times the height of highest building. A supply of rubber hose washers should be hung conspicuously.

Hydrant wrench to be always on hydrant.

INSTALLATION OF FIRE PAILS AND WATER BARRELS.

IN PASSENGER AND FREIGHT STATIONS, WAREHOUSES, PIERS, SHOPS, OFFICES AND OTHER MISCELLANEOUS RAILROAD PROPERTIES.

The value of fire pails as a protection against the spread of fire is recognized very generally by those who have the care of property under their charge; this is pointed out in regularly prepared statistics showing their serviceableness where installed and kept in proper condition for use when needed.

The first few minutes after the start of a fire usually determine its extent; it is therefore quite essential, especially in the above classes of property, that this simple means be provided, at least, for the extinguishment of fires in their incipiency. Fire pails and water barrels are useful only when they are filled, within easy reach, and near at hand; and in order to provide some guarantee of efficiency, and that a uniform method may be used, the following specifications are presented for their installation:

1. WHERE RECOMMENDED.

In passenger, freight, and combined passenger and freight stations, warehouses, piers, wharves, shops, offices, coal tipples, and such other miscellaneous

property where the occupancy or operation produces or invites hazards and where the value would warrant the installation of some immediate means of extinguishment in case of fire.

2. NUMBER RECOMMENDED.

In passenger stations, three pails for ordinary size buildings, increasing the number by one pail for about each 500 square feet of floor space over the first 2,000 square feet.

In freight stations at least one barrel and two pails for ordinary size; increasing the number in larger buildings by one barrel and two pails for each additional 3,000 square feet of floor space over the first 3,000 square feet, so as to make them readily accessible to all parts.

In combined passenger and freight stations, one barrel and two fire pails to be placed in freight room, increasing the number in larger buildings as indicated for freight stations.

In shop buildings, one barrel and two pails to be distributed for about each 3,000 square feet of floor space.

In warehouses, two pails for a floor space of 1,000 square feet or less, increasing the number by an additional pail for each additional 500 square feet.

In other and miscellaneous property as conditions may require and permit.

3. PAILS REQUIRED.

To be of galvanized iron.

Capacity, 12 quarts.

To be painted red.

To be lettered "FIRE"; letters to be black, not less than 2½ inches high.

Round or conical bottoms recommended, as otherwise employees are likely to use pails for ordinary purposes. Covers not required, but recommended so that dust and dirt may be kept out and water kept cleaner.

Wooden pails not recommended.

NOTE.—The use of an iron pail in preference to a pail of wood or other material is a matter of service and economy, in addition to the greater likelihood that an iron pail will be found serviceable when suddenly wanted for use.

It has been found advisable to require that pails be painted red, with the word "FIRE" in black letters of a prominent size. The red color is useful because of its general association with fire; it helps to make the pail clearly visible when wanted; and, with the word "FIRE," it is a constant reminder that the pail is there for a special purpose, the putting out of fire, and is not to be taken away or used for ordinary purposes.

4. BARRELS REQUIRED.

To be a good oak barrel, capacity to be not less than 50 gallons. To be painted red, with word "FIRE" stencilled thereon in black letters not less than six inches high.

To have a cover with a handle.

5. SETTING FOR PAILS.

To be fixed, permanent and reserved for fire pails. Shelves or brackets are the approved setting, but they must be intended for, and limited in their use to, fire pails.

Fire pails should not be placed on the floor, window sills, safes, desks, radiators, boxes, on or under work tables or benches, on top of one another or in tiers.

To be not lower than 2 feet above the floor, measured from the floor to the bottom of the pail.

To be not higher than 5 feet above the floor, measured from the floor to the top of the pail.

When round-bottomed pails are used and set in shelves, the holes cut for the oval bottom should be only large enough to receive the oval, that is, the flange of the bottom should rest on the wood and not be set into the opening.

NOTE.—The placing at a medium height is devised to permit of grasping the pail without spilling half its contents; if a pail is placed more than 5 feet high, it is likely to be out of the reach of the average person; and if set lower than 2 feet, it is likely to be overlooked or to be knocked from its position.

A permanent setting, such as hooks or shelves, is intended to make sure that the pail will be given a fixed position, which will become familiar to the occupants who, in time of excitement, can rely on finding pails in a definite spot.

6. DISTRIBUTION OF PAILS.

To provide pails near at hand in every part of the premises; on each floor and in basements.

To provide extra pails near dangerous features.

In groups of 2, 3, 4, 5, or 6, but not larger than 6.

An equipment of 12 pails or less on a floor, to be divided into groups of 2 or 3.

An equipment of 24 pails or less on a floor, to be divided into groups of 2, 3, or 4.

An equipment of more than 24 pails on a floor, to be divided in groups of not more than 6.

Groups to be placed diagonally opposite, i. e., "staggered."

7. LOCATION.

In a clear space, providing free and unimpeded access.

In close proximity to exits, such as stairways, elevators, doorways, etc.

In a familiar place, within constant sight of the occupants.

Not to be blocked by merchandise or machinery, or covered with rubbish or other materials.

8. FILLING.

Water pails.—To be kept filled regularly with clean water.

Sand pails.—Where oils, paints or inflammable liquids are kept, used or stored, one-half of the total number of pails required, to be kept filled with clean dry sand, and a scoop to be provided for use in throwing the sand. Sand pails should not be filled so full as to make them inconveniently heavy; two-thirds full is sufficient.

NOTE.—Regular refilling is a precaution recommended to make sure that the pails shall contain water.

Sand.—Water should not be used on burning liquids, such as oils, etc., as it may not extinguish the fire but float the burning liquids to a distance, and thereby spread the fire. Some material such as sand should be used, first, to keep the burning liquid from spreading and then to smother the fire.

9. FREEZING.

When fire barrels and pails are located where there is a liability of the water being frozen in cold weather, it is recommended that chloride of calcium or salt be placed in each to retard freezing. The density of the solution required will depend upon existing temperatures. The following tables have been suggested as an appropriate mixture for the solution:

Commercial calcium chloride.		Common salt (sodium chloride).	
Pounds per gallon.	Freezing point (degrees Fahrenheit).	Pounds per gallon.	Freezing point (degrees Fahrenheit).
½	29 above zero.	½	24 above zero.
1	27 above zero.	1	18 above zero.
1¼	25 above zero.	1¼	15 above zero.
1½	23 above zero.	1½	12 above zero.
1¾	21 above zero.	1¾	9 above zero.
2	18 above zero.	2	6 above zero.
2¼	14 above zero.	2¼	3 above zero.
2½	8 above zero.	2½	1 above zero.
3	Zero.	3	3 below zero.
3½	6 below zero.	3½	8 below zero.
4	17 below zero.		
4½	27 below zero.		
5	39 below zero.		
5½	54 below zero.		

The solution should preferably be mixed in a vat before being placed in barrels, care being exercised to see that the salt is entirely dissolved. If dumped into a barrel and covered with water, or if thrown into a barrel of water, the salt will be only partially dissolved and unsatisfactory results obtained. It is necessary that the chloride of calcium or the salt be dissolved by thorough stirring.

Calcium chloride is possibly superior to salt in the following respects: it does not readily corrode steel tanks and barrel hoops; it has no odor and will remain odorless even if left standing for a long time, and its affinity for moisture prevents evaporation of the water.

Where calcium chloride solution is used, wooden barrels should first be well coated inside with asphaltum or with a mixture of crude paraffin and resin to prevent shrinking of staves and consequent leakage.

10. CARE.

The person having charge of the property should be held responsible for the proper maintenance of this equipment, that it be kept in constant condition for immediate service.

CHEMICAL FIRE EXTINGUISHERS.

If a chemical fire extinguisher is improperly charged or kept in such manner that it is useless as a fire-extinguishing agent, it belies its name and becomes no longer a "fire extinguisher," but a more or less harmful deception. When upon discovery of fire, an extinguisher is carried to the fire only to find it will not operate through some defect in charging, much valuable time has been lost, perhaps allowing fire to get beyond control and destroy valuable property and equipment.

Upon inspection many chemical fire extinguishers have been found improperly charged, without charges, or inaccessibly located, any of which defects might easily have been eliminated with a little thought or care. It has been found that acid bottles in extinguishers have been filled to the top without regard to explicit directions to put in only 4 ounces of sulphuric acid. The extinguisher shell has been found filled to the very top with bicarbonate of soda solution instead of only within 3 inches of top; also the bicarbonate of soda (powder) should be thoroughly stirred to insure a good solution. A

common criticism of inspectors has been the placing of extinguishers where they are not accessible or liable to be covered up or knocked over and accidentally discharged. Locating extinguishers where exposed to freezing temperatures in winter should be carefully avoided. Stoppels have been found missing from acid bottles. In some cases hose has been cut or worn so it would not stand the pressure generated.

All of these and other defects have been found in actual practice over many properties. This apparatus has been purchased at considerable cost and should be properly maintained in order to make them available for the service intended.

The purchase of chemical fire extinguishers, however, is a very essential and economical outlay to prevent the spread of possible disastrous fires, as the approved 2½-gallon soda and acid chemical fire extinguisher is one of the best pieces of hand fire apparatus known to-day for the extinguishment of small or incipient fires. But, like any other mechanism, it needs intelligent and careful supervision, and the best preventive for the defects noted above would be to assign an intelligent man to the duty of charging extinguishers and give orders to inspect them once a week to see that they are in condition for instant use, this man to be held responsible for the condition of the apparatus. Carefully examine hose, hose nozzle, and connection, observing whether or not the latter shows signs of corrosion. If hose shows signs of deterioration, have a new hose provided.

Agents and others in charge of small properties, with insufficient number of extinguishers to warrant the assigning of one man to look after them, should be given full directions and specially instructed that they will be held directly responsible for the condition of the chemical fire extinguishers.

Only those approved by the Underwriters' Laboratories should be used. The use of others may be dangerous and their continued use should be forbidden unless they have been carefully tested.

Two and one-half gallon soda-and-acid type extinguishers are effective on incipient fires where water or solutions containing a large percentage of water are effective. They are not effective on electric arcs, apparatus and wiring carrying high voltages. For this reason and because of the conductivity of the liquid they are not recommended for this service. They are of limited service in hazardous liquid fires. They must be protected from freezing. During extremely cold weather it is advisable to group the extinguishers in a room sufficiently heated to prevent freezing. They should be hung in conspicuous places, the top not over six feet from the floor.

They should be discharged, cleaned, and recharged at least once a year and the date marked on attached tag. At least two extra charges for each extinguisher should be kept on hand so that it can be immediately recharged after using.

Forty-gallon soda-and-acid extinguishers mounted on wheels and equipped with suitable hose are particularly adapted for use in large warehouses, shop properties, piers, and terminal yards, especially where water supplies are inadequate or the properties are difficult of access. They should be kept in a convenient, centrally located place where not likely to freeze.

One-quart carbon-tetrachloride type extinguishers are effective on incipient fires in hazardous liquid, calcium carbide, and rapidly burning materials (such as nitrocellulose, "celluloid") and on incipient fires in cotton and fabrics. They are of service in fires not easily extinguished by water. They are especially adapted for garage, automobile, and motor boat use and for electri-

cal fires. Because of low freezing point of the extinguishing liquids (minus 50° F.) these extinguishers are recommended for such service where low temperatures prevail. They are not recommended for service on fires in freely burning material (such as wood) of any considerable quantity. On account of their small size, besides being hung in conspicuous places, the location should also be designated by a suitable sign. These extinguishers should always be kept full, any liquid used being replaced immediately. An extra supply of the liquid should be kept on hand.

Dry powder extinguishers usually consist of a tin tube containing about ten cents worth of bicarbonate of soda (ordinary baking soda). Under certain favorable conditions they have been known to extinguish fires, but their attempted use is liable to cause delay in the use of water or other efficient extinguishing agents. Therefore it is suggested that those at present supplied be removed and no more furnished.

FIRE-EXTINGUISHING APPARATUS ON LOCOMOTIVES.

Experience has demonstrated that yard engines equipped with fire-extinguishing apparatus have proved their worth for fire protection around railroad property, particularly at terminals and in large car yards where the service of water mains and fire hydrants is not available.

Many of the railroads of the country to-day have equipped their yard engines throughout their entire system with fire-extinguishing apparatus.

Engines provided with fire-extinguishing apparatus afford a flexible fire-protection system, as the equipment can be moved from place to place and is always ready for operation by the engineer, fireman, and yard crews.

The extinguishing apparatus as applied to engines are steam pumps or steam nozzles of various kinds. There are several types capable of throwing very satisfactory fire streams from which the motive-power department of each railroad can select the type best suited for the kind of yard locomotives used.

The hose equipment recommended should consist of three 50-foot sections of 2½-inch unlined linen hose coiled in cheese form and carried in a box under the running board or in the cab, the nozzle to be of standard smooth bore with ⅝-inch opening. This equipment with a steam pressure of 150 pounds will provide an effective fire stream capable of delivery to a distance of 75 feet. Where impossible to obtain unlined linen hose cotton rubber-lined hose may be used.

In order to obtain the greatest efficiency from yard locomotives equipped with fire extinguishing apparatus, yards should be divided into districts, each of which is designated by a number. When a fire is discovered a general alarm on whistle is sounded calling the attention of the crews of yard engines and by a code of signals engineers and firemen of locomotives can tell immediately in which district the fire is located. To insure prompt response yardmasters and train directors are instructed to give the locomotives clear track in reaching the scene of the fire, and in cases where the locomotives are moving or shifting cars, the crews are instructed to uncouple the engines and proceed without delay to the fire immediately upon the sounding of the alarm, on the way to the fire connecting up the hose and preparing to get into service immediately upon arrival. A fire brigade organization should be formed in each yard or district and special instructions should be issued by the division superintendent and posted on the bulletin boards in the district covered.

The fire-brigade organization should be planned on the following lines:

Conductor should be held responsible for his own crew.

First brakeman: Laying of hose lines and assisting at nozzle.

Fireman: Coupling hose to locomotive extinguisher and assisting engineman.

Engineman: Care and operation of fire extinguisher.

Suitable fire signals should be arranged for summoning yard locomotives. Fire drills should be held every two weeks and reports made to the superintendent. Water should not be turned on during freezing weather.

FIRE CARS.

At large yards where water supplies are not readily available and the cost of installing water mains is prohibitive, the fire protection afforded by shifting engines equipped with fire-extinguishing apparatus can be supplemented by fire cars; these fire cars, however, should not be considered a substitute for or qualifying the desirability of equipping all shifting engines with fire-extinguishing apparatus.

Fire cars should provide for a total tank capacity of at least 10,000 gallons and should be equipped with a 500 G. P. M. steam fire pump provided with a steam connection so arranged that it can be quickly coupled with the engine. The fire pump should supply two 2½-inch hose connections. A supply of 1,000 feet of 2½-inch C. R. L. double jacket fire hose should be kept on reel on the fire car; also a supply of 1⅛-inch smoothbore nozzles, spanners, axes, lanterns, fire pails, etc., should be provided. It is preferable to equip the fire car with a small house to protect the fire pump, hose equipment, etc. A yard locomotive should be readily available to move the fire car whenever necessary and the shop or yard fire brigades should be drilled every two weeks in handling the fire apparatus and fire pump on the fire car.

During freezing weather suitable arrangements must be made to prevent the water in the fire-car tank from freezing, either by keeping it in a heated building or by keeping an engine attached at all times, or by providing a connection with the yard steam lines.

This plan has been already adopted by two or three Northern railroads.

ASSIST PUBLIC FIRE DEPARTMENTS.

Convenient Means of Access to Railroad Terminals, Shops, and Other Properties for Public Fire Departments.

A very important point, which should engage the attention of engineers of railroads or terminal superintendents, is the convenient means of access to important properties for the city fire departments, where it is expected they would render important service in connection with fighting any possible fires that might occur in large and valuable properties. Readily accessible roadways should be built suitable for transporting fire engines or hose carts and trucks, and the heads of the city fire departments should be made thoroughly acquainted with such permanant highways, and railroad employees, such as fire chiefs, yardmasters, watchmen, etc., should be instructed as to where to direct the fire departments to enter the premises, when necessary, and any telephone operators should be given similar instructions in order to direct access of fire departments. These roadways to be properly illuminated.

This is a matter which is very apt to be overlooked, and experience has shown that with the isolation and remoteness of many important railroad properties and operations that very little attention has been given to the construction of roadways of such a character as would permit the entrance of city fire departments when needed.

A very good plan adopted by one company has been to show in colored ink on plan or blue print of properties the various paths by which city fire companies can reach their several properties.

A WARNING AS COLD WEATHER APPROACHES.

A Seasonable Word to Fire Inspectors, Superintendents, Master Mechanics, Agents, Foremen, and Others in Charge of Property and its Fire Protection.

As the winter season approaches attention should be called to the care and protection of heating and lighting facilities and fire-extinguishing apparatus, and to use every precautionary measure possible in the interest of fire prevention.

Special attention should be given to and examinations made of chimneys, flues, stoves, furnaces, heaters, and pipes leading therefrom, radiators, and their surroundings to see that they are in proper condition before putting into service, and that all inflammable surroundings are removed or protected. Steam pipes should be examined, and where passing through or in contact with woodwork or other combustible material should be properly insulated or surrounded with an ample air space. The placing of combustible material against steam pipes and radiators should be prohibited.

Lighting installations should be carefully examined and properly safeguarded.

Car heaters of all types should be overhauled and put in safe condition for use.

All water mains and pipes, automatic sprinkler systems, fire pumps, fire hydrants, fittings, valves, connections, and outlets should be flushed, operated, or examined to see that pipes and parts are free of obstructions and in good operative condition, and, where there is liability of freezing, to arrange the necessary protection against frost, or see that water supplies to exposed pipe lines are properly closed off at valves provided for the purpose, and that exposed pipes and fittings are properly drained. Selected and responsible employees should be fully posted as to the purpose of all controlling valves and make frequent inspection of all fire equipment.

Measures should be taken to prevent or retard water in barrels and fire pails in cold buildings from freezing by adding salt, a combination of salt and bicarbonate of soda, or calcium chloride. Chemical extinguishers should be examined to see that they are properly charged, and, where liable to freeze, removed from cold and placed in heated rooms during winter. Fire hose should be examined, tested, and accessibly located. All hose, fire-hydrant fittings, and other fire-extinguishing apparatus should be prepared for prompt service.

WATCHMEN'S SERVICE.

A good, efficient, intelligent watchman is a valuable help from a fire-protection standpoint.

A man who carefully goes over every portion of property once an hour should discover most fires in their incipiency, and if he is intelligent enough to act promptly, turn in the alarm of fire and then do what he can to extinguish it, he will, in most cases, render valuable aid.

The watchman should devote his energies to watching the property and not be obliged to sweep up, attend fires, or other class of work. He should be fully instructed as to just what to do; he should know the location of fire-alarm boxes or other means of fire notification; he should know the use and location of the various fire-protection apparatus, how to use hand fire apparatus, and in general have an intelligent idea of all matters connected with the fire protection of the plant.

In permitting a man to assume watch and care over property representing large values, the management should employ not only a strong and able-bodied one, but one who is trustworthy and honest, as we should realize that large values are at stake and we are leaving the care of property to one man at a time when he must temporarily at least rely on his own resources. It certainly is false economy to hire a cheap man for work of such importance, and yet we often find the position of watchman filled by an aged, decrepit, unintelligent, or otherwise inefficient man, who is probably unfitted for any other kind of work.

He should report for duty before those whose responsibility he assumes leave the premises; begin his first inspection or tour immediately after operations are suspended, it being especially important that this tour be carefully and diligently made, including all parts of the premises; and make tours of inspection once every hour throughout all portions of the property during the entire night, until the arrival in the morning of such persons as shall relieve him of his responsibility.

An interval of rest of from 15 to 20 minutes between each tour of inspection should be given the watchman. If trip consumes less than 15 minutes, two tours should be made each hour.

Where the premises to be covered are of such area as to consume an hour or more for one trip, two watchmen should be employed, either dividing the area or making tours alternately.

Day Service on Sundays, Holidays, Etc.

During the daytime on Sundays and holidays, or when the plant is not in operation during the day, tours of inspection by day watchman at intervals of at least two hours are recommended.

Methods of Supervision.

To promote the efficiency of watchman's service a system of supervision should be employed, of which the three principal methods are the central station system, the local or approved stationary systems with stationary clock connected with electric wiring to designated points, and the portable watch clock. Stations should be so located that all parts of property are visited.

The "central-station" system has the advantage of immediately following up any failure of the watchman to register his rounds; it is based on a fixed rental charge and can only be used in the larger cities and towns.

The portable watchman's clocks have been greatly improved in all ways, and their simplicity, cheapness, and general reliability have brought them into common use and the present approved types give good satisfaction.

Records of such service to be checked and changed daily unless the clock is arranged to register distinctly for more than a 12-hour period, in which

case the dials may remain on for not over two days. Records should be dated and kept on file for inspection.

Qualifications of Watchman.

The following qualifications for a watchman are suggested in addition to those referred to above:

Watchman should not be permitted to smoke while on duty. He should refrain from all intoxicants. In fact, a watchman without these habits is particularly preferable, and should be given especially favorable recognition by his employers.

He should immediately make report to the management of any defective apparatus, or of the misplacement of the same.

Upon assuming his regular duties he must see that all fire doors and shutters are closed, and that they are in operative order where they are not of the self-closing type. He must close doors to stairways and other vertical openings.

The watchman must carefully observe the matter of cleanliness, especially the presence of oily waste, rags, workmen's clothes, rubbish and useless inflammable material. He should take instant care or removal of same, or report to management for attention.

He must familiarize himself with location of all furnaces, boilers, heaters, or other heating apparatus, and their arrangement, especially observing upon his rounds the condition of same, and of any combustible material nearby.

Must know the exact location of gas shut-off valves, and of electric lighting and power cut-out switch.

He must have full instructions as to the details of operation, turning on and shutting off automatic sprinkler equipment.

The watchman must be instructed as to prompt manner in which to communicate instantly with superintendent or other company officials.

He must not leave the premises unguarded during duty hours. He should, during his rounds, observe from the premises all adjoining exposing properties. In case of seeing a neighboring fire, he should also turn in a fire alarm.

Watchman should not be permitted to carry or use other than safety matches. He should be provided with and use an approved safety lantern or electric lamp.

Experience has demonstrated that in certain classes of properties such as grain elevators, coal breakers, piers, woodworking mills, paint shops and paint stock houses, oil houses, etc., only safety electric lanterns should be used.

The watchman must never lose sight of the fact that he is intrusted with the important responsibility of protecting large values against loss by fire and that many employees are dependent for their livelihood upon the permanent operation of the plant and property over which he has charge.

Inspector's Review of Watchman's Clock Records.

The inspector should review the watchman's records, and occasionally visit the plant at night to check up his work. The inspector should take the time and trouble to explain to the watchman the use of the fire apparatus to such an extent that the watchman can give the proper alarms and start in motion any of the pumps or other fire appliances which are not absolutely automatic. The watchman should be encouraged to assist the inspector by calling to the inspector's attention any conditions that he may observe during his rounds that would be of interest to the inspector in his work.

THE FIRE HAZARD IN CONNECTION WITH "SMOKING."

For several years past records have shown that hundreds of thousands of dollars of railroad property and property in the care or custody of railroads as carriers have been destroyed by fire due to carelessness and indifference on the

part of employees in connection with smoking in shops, freight stations, warehouses, etc.

Every year adds some exceptional losses traceable to this particular class of indifference. It should be recognized that large values are involved which should be preserved and that there must be a personal responsibility felt in accepting the regulations and orders restricting smoking or prohibiting it in properties of large values and where inflammables are handled and it must be recognized to-day more than ever, that property values should not be damaged or destroyed through carelessness and indifference or other preventable causes. Property and material destroyed cannot be replaced. They are lost.

Smoking should be prohibited in shops, coaling stations, piers, warehouses, storehouses, freight houses and offices, including record rooms and around freight platforms, and in all other places where inflammable materials are handled or stored, and if not already done, conspicuous "NO SMOKING" *signs should be posted*, and all watchmen and guards, officers and other employees in charge of the property must be instructed to see that *this rule is rigidly enforced.*

If we restrict the hazard of smoking and prohibit it in valuable properties we will do much toward preventing the possibility of large property destruction by fire traceable to preventable causes principally through carelessness and indifference to dangers.

FIRE DANGER IN MACHINE-SHOP SWEEPINGS.

Machine-shop sweepings generally consist of oily waste, iron filings or borings, small pieces of wood, excelsior and, in some few instances, stray pieces of calcium carbide or the residue from an oxyacetylene machine. Sweepings are invariably more or less oily.

Iron filings or borings are subject to heating due to oxidation, which takes place very rapidly in the presence of moisture and the absence of oil on the metal. There are instances of piles of iron filings becoming heated to such an extent as to ignite woodwork.

Calcium carbide readily heats and gives off inflammable gas when moistened, likewise the oxyacetylene machine residue which has not spent its chemical action.

The wooden pieces and excelsior simply add fuel to the combination if ignited.

There arises the necessity of taking certain precautionary measures in the handling of machine shop sweepings. The sweepings should never be allowed to lie on the floor overnight, but should be swept up and removed daily. Metal cans with lids form an excellent receptacle for storing the sweepings temporarily in the shop. Oily waste and inflammable material should be removed from filings before storing. Filings should then be deposited outside of the building where they will be sheltered from rain.

WASTE PAPERS.

Waste paper generally causes an uncleanly condition and invites an added fire hazard, which seems to vary with the building, in a modern constructed building the paper is kept in fair to good condition, while in an old inflammable building it is apt to be kept very poorly.

Methods in Practice.

First. Starting at the desk the scrap paper is supposed to be deposited in the receptacles provided, such as manufactured paper baskets. (Too frequently the paper is thrown on floor or lodges back of radiators.)

Second. Removed by janitor at night or early morning.

Third. Burned in open fireplaces, furnaces or stoves inside building, or outside of building exposing same; or taken to basement and stored in bins or old burlap bags. In a few cases a paper press is used.

Fourth. After sufficient quantity has accumulated it is sold directly or shipped to some central point for disposal.

With all the haphazard methods of caring for waste paper there is little wonder that so many fires can be attributed to its presence. Matches, supposedly out, are often thrown in the baskets, scraps on floors and under, and pieces lodged back of steam coils, in hot-air registers or near furnaces are very often ignited.

The compensation received for waste paper is very little, and it does not pay for the risk taken in storing it in buildings in a careless manner. A systematic collecting and storing of waste paper will make the operation a safe and profitable one.

The following suggestions are offered:

Provide incombustible receptacles for waste papers in all offices, preferably one at each desk.

Prohibit throwing papers on floors.

Empty all paper baskets each night and remove any paper in contact with the heating system.

Small quantities of waste papers are not worth saving for selling, and should be burned outside, away from buildings in a wire net incinerator so that burning pieces can not be blown about. It is poor economic practice to use the heating apparatus in the building for burning, besides it presents a hazard in having it in the furnace room and also in that burning paper may get through flue openings not properly capped. Open fireplaces inside should never be used.

Where local facilities can be used to dispose of waste papers daily or every few days, a large metal-lined storage box with lid should be provided and kept in basement or outside of building for the temporary storage of the papers. This practice must be watched carefully and regulated so that the storage box is emptied before it is full.

In large office buildings, terminals and such property where waste paper accumulates rapidly, install a hand paper press. Keep press in basement, preferably in separate fireproofed room.

Prohibit storing paper in bags.

Place all papers collected at night immediately in press or storage box.

Keep press and storage box out of furnace room.

Keep three fire pails filled with water or chemical fire extinguisher in storage room.

As soon as a number of bales of paper are collected arrange to dispose of same.

Fireproof rooms for waste paper can be constructed in basement, of concrete, brick or tile, equipped with fire doors or are attained by the lining of rooms with tile.

STANDARD WASTE CAN.

Large quantities of cotton or wool waste are used in railroad properties for cleaning machinery or other purposes. Oily waste is liable to spontaneous ignition and has been a frequent cause of fire.

Cotton or wool waste or rags and an oxidizing oil, such as most animal or vegetable oils, form an undesirable combination, and when used care must be taken to see that they are not allowed to lie around or be swept into corners, where they may heat and ignite. Pure mineral oil will not oxidize, and the hazard of spontaneous ignition is not present where this is used, but as the mineral oils are apt to be adulterated with vegetable or animal oils no feeling of security should be allowed to exist and the greatest care should be exercised.

Greasy and oily waste or rags are not only subject to spontaneous ignition, but make an intense fire, which is difficult to extinguish.

Metal cans of approved construction, supported on legs and having self-closing lids, should be distributed about shops, and orders issued that all oily waste should be placed therein. Cans should be emptied at close of the day's work, or oftener, if necessary, and oily waste burned or deposited in reclaiming bin. It is recommended that a special man, particularly in machine, paint, and woodworking shops, make a daily inspection of the entire building to remove any oily waste that had been carelessly left in out-of-way places, such as under benches, back of steam coils, etc.

The National Standard can is the best type obtainable and should be used. Cans bearing the label of the Underwriters' Laboratories may be obtained from various manufacturers.

The rules and requirements of the National Board of Fire Underwriters for the construction of waste cans, are as follows:

Size.—To be not smaller than 11 inches diameter and 11 inches deep inside, nor larger than 22 by 25 inches inside, if used for oily waste. Inside diameter to be not less than 90 per cent of height, excluding legs. It is desirable to use a number of smaller cans, rather than fewer large ones.

Body.—For cans 11 by 11 inches inside, not less than No. 26 gauge United States standard (0.0187 inch) galvanized iron or steel, and increase thickness one number in gauge for each 3-inch increase in diameter.

Legs.—To be made of band iron not less than 12 gauge United States standard (0.1093 inch), three-fourths inch wide, riveted to side and bottom of can, two rivets at each end, and not less than 3 inches high for cans 11 by 11 inches, three legs on each can; for large sizes, not more than 4 inches high, gauge and width increased in proportion to size of can, using 11 by 11 inches as base.

Cover.—To be in two sections, width of one section to be equal to about one-third the diameter and riveted to the can with the movable lid permanently and freely hinged to the rigid section without soldering, and to have a device to prevent opening more than a 60-degree angle from horizontal and weighted sufficiently to make closure positive and automatic. Iron to be of at least two numbers heavier than the body, lid to extend beyond the body of the can, finished with a hemmed or wired edge, and made rigid by two strips of band iron one-eighth by 1 inch, riveted inside lengthwise and outside crosswise, respectively, in the middle of the lid, the outer end bent upward at an angle of about 45 degrees.

Handles.—To be riveted to the rigid portion of the cover and preferably made from band iron one-eighth by 1 inch, bent to form a stop for the lid. Side handles must be supplied on cans larger in diameter than 16 inches.

Construction.—Can to be assembled with all seams lock-jointed or riveted and attachments riveted on. Body of can to be wired at top with wire not smaller than No. 9 for can 11 by 11 inches, proportionately heavier for larger cans, or finished with band iron of equivalent strength.

Marking.—Each can to be plainly and permanently marked with its trade-name and the name, initials, or trade-mark of the manufacturer.

Reclaiming Oil From Waste.

Where it is the practice to reclaim oil from waste and use the waste again, the process should be done in a room of fire-resisting construction or in a well-detached building.

Clean Waste.

Metal waste cans or metal receptacles with covers are recommended for all supplies of clean waste in roundhouses, shop buildings, or other miscellaneous properties, as almost any collection of so-called "clean waste" is liable to have in it oily waste, where an employee has used a small portion for wiping off machinery or for wiping in paint shops, etc. The common practice of each employee storing a supply of so-called "clean waste" in his wooden locker is hazardous.

HAZARD OF OPEN-FLAME TORCHES.

Numerous fires originating from the careless handling of open-flame torches in and about various railroad buildings and rolling stock forcibly draw attention to the hazard incident to this form of lighting. While the danger attending the use of open-flame oil torches is generally recognized, we believe the elimination or safeguarding of this hazard is not receiving the attention that it should on the part of many.

The use of torches should be confined to under and around locomotives. Every care should be exercised by employees when using torches, both as to handling and storing, and when not in use they should be kept in metal receptacles.

The use of torches in coaling stations should be prohibited at all times and if electric lighting is not available, safety lanterns should then be used.

Inspectors' oil or electric lanterns only should be used for car inspection.

The following losses have been specially selected to point out the hazard incident to either the careless handling or improper storage of torches:

A fire which destroyed several small wooden shop buildings originated in a cupboard used by the workmen for individual tools and clothing, caused by an engine overhauler looking for a bolt in the cupboard and using an ordinary torch, the flame of which came in contact with the clothing in the cupboard.

Fire originated in one of a number of wooden clothes lockers in a lumber foreman's office at shops, caused by lighted torch left therein by one of the employees.

Fire originating from the careless handling of a torch, started in the upper part of a wooden constructed mechanical coaling station at a large shop plant and before it was extinguished by shop employees and town volunteer fire department with hose streams, the station and machinery suffered a loss to the extent of about 50 per cent. This station was lighted with electricity but employees had been in the habit of using torches around machinery for making repairs and oiling.

Fire caused by flame from a torch used by a car inspector ignited burlap wrapping in a box car, badly damaging the car and lading, consisting of tires.

STORAGE AND HANDLING OF SMALL OIL SUPPLIES AT MISCELLANEOUS RAILROAD PROPERTIES, OTHER THAN GENERAL STORAGE POINTS.

A considerable hazard in connection with depots, freight houses, warehouses, towers, coaling stations, and other miscellaneous properties along the line of road is the storage of oil supplies without proper safeguards; and at the same time it is undoubtedly one of the most difficult hazards to guard against.

On many railroads, small supplies of oil will be found scattered around throughout the various station buildings, quantity and location depending upon the use it is put to and convenience of the user. At many places the oil supplies will be surrounded by an oil soaked floor and small quantities of oily waste or rags will be in evidence; no thought whatsoever is given to the hazard involved.

The dangers of such storage without proper precautions are evident, particularly where floors become thoroughly saturated from constant lamp filling drippings.

Many agents not only use oil for illuminating purposes but likewise take care of signal lights, and in some cases supply of gasoline for cooking and motor car purposes is kept on hand. Sometimes this oil is kept outside of buildings but more often it is found stored in the coal bin, or in one corner of the freight room, and quite frequently in concealed places like closets underneath stairways or with records.

Suggestions and Recommendations.

Oil storage of every nature at station buildings and properties other than standard oil houses should be entirely removed, wherever possible, and housed in a separate and inexpensive structure built expressly for that purpose, in a portion of which provision can also be made for the coal supply. This combination coal and oil house should be located a sufficient distance from all other properties to permit possible destruction by fire without endangering any other structure, but not far enough away to seriously interfere with its convenient and economical use.

All lamps and lanterns to be filled and trimmed in this structure.

The ordinary metal tray or sand box is of course an advantage over the old system of allowing cans of oil to set on wooden floors of freight house, but for reasons explained above, it is the recommendation that a separate, isolated coal and oil house be given preference; but if for any reason this can not be arranged, or wherever it becomes impracticable to construct a separate building, it is recommended that a metal-lined oil cabinet for filling lamps and the storage of oil be installed in freight room.

Regardless of where or how oil is stored a supply of fine dry sand for extinguishing fires is a requisite that should never be overlooked.

At large terminal warehouses, where electricity is usually installed for lighting, it is frequently found that oil is stored in building (generally basement), often in large quantities, for use in car heaters during the winter months or for oiling warehouse trucks, etc. Regardless of precautions taken to guard against fire in connection with such storage the danger is great and the immense values at risk do not warrant the presence of oil of any kind or quantity. It is recommended in such instances that a separate building be constructed similar to that suggested for station buildings and miscellaneous properties wherever practicable. Where it is felt that a larger expense is warranted, or the city ordinances or fire authorities prohibit the construction of a wooden building, a brick or concrete oil house should be built.

FIRING UP LOCOMOTIVES.

(*a*) *Shavings and oil.*—Mixing bin should be of metal with tight fitting self-closing cover and should be kept away from inflammable material.

(*b*) *Oily waste.*—Should be kept in safety waste cans or barrels and in the smallest quantity practicable.

(*c*) *Fuel oil.*—Equipment and operation should conform to the rules of the National Board of Fire Underwriters.

(*d*) *Kindling.*—Should preferably be kept in a closed shed, not exposing other property. If piled in the open, should be a safe distance from tracks and buildings.

"SAFETY" VOLATILE OIL CANS.

Where benzine, gasoline, naphtha and other inflammable liquids are used for cleaning or spraying, care should be taken to see that the smallest quantities possible are used, and that the same are handled in approved safety cans especially designed for the purpose.

Ascertain for what purpose inflammable liquids may be used, and if a substitute not so hazardous could be employed.

Find out where cans are stored overnight, when they are filled, and where main supply of oil is stored.

Do not permit cans to be placed in rooms having open lights or fires.

Cans should be substantially constructed, without leak, and must have proper working automatic valve outlet. They should be of standard type.

Inflammable liquids are dangerous regardless of the manner in which they are used, and by no means should they be permitted in open pans, pails or other open receptacles.

ROOF TIMBERS OF BLACKSMITH SHOPS, FOUNDRIES, AND SIMILAR BUILDINGS.

The roof timbers of blacksmith shops, foundries, and similar class of buildings should be periodically cleaned of all soot, dust, etc. If allowed to collect thereon it adds to the rapid ignition and spread of flames.

After cleaning roof timbers a good coating of whitewash should be applied, the following formula being considered a good fire retardent:

WHITE-WASH FORMULA AS USED BY THE UNITED STATES GOVERNMENT.

Slack one-half bushel of unslacked lime with boiling water, keeping it covered during the process; strain it, and add a peck of salt dissolved in warm water; three pounds of ground rice, put in boiling water and boil to a thin paste; one-half pound of powdered Spanish whiting and a pound of clear glue dissolved in hot water; mix these well together and let the mixture stand for several days. Keep the wash thus prepared in a kettle or portable furnace and when used put it on as hot as possible with painter's or white-wash brushes.

White wash affords better service when applied by a hand brush rather than a spraying machine.

PAINT STOCK AND ITS FIRE HAZARDS.

At shops and terminals where it is necessary to carry a stock of paints and paint oils it is important that every precaution be taken to reduce to a minimum the fire risk arising from the hazards involved, the greatest of which are:

FIRST.

Spontaneous ignition due to carelessness in not removing and destroying all inflammable material such as rags, waste, etc., which have become impregnated with paints or oils.—Coming under this class we might mention linseed oil and lampblack.

Linseed oil upon waste or rags is a hazard that is generally recognized, but all paints and paint oils should be considered hazardous as regards spontaneous ignition if fibrous, combustible material be impregnated with them.

Lampblack mixed with oils such as linseed and turpentine becomes an unstable product. Its hazards are similar to those attributed to charcoal, although its quality to absorb oxygen is more energetic than charcoal. Moisture and heat tend to accelerate the point of spontaneous ignition.

SECOND.

The danger of vapor ignition from inflammable or volatile oils or paints.—Under this class might be mentioned benzine, turpentine, turpentine substitutes, paints, varnishes, and lacquers.

Benzine or other inflammable solvents are very often used in paint thinners, japans, driers, etc.

Turpentine is inflammable, but only slightly volatile, at ordinary temperatures, and is less dangerous than most solvents. It is seldom used pure, however. Volatile solvents are often used with it on account of cheapening and for quicker drying purposes. Commercial turpentine may contain impurities which lower the flash point.

Turpentine substitutes.—There are various turpentine substitutes upon the market consisting wholly or principally of petroleum products which have as high a flash point as, and consequently are no more hazardous than, turpentine. Various other turpentine substitutes, however, have flash points approximately from 32° F. up, and it is suggested that a guaranty be obtained from the manufacturer that the flash point is not below 80° F.

Paint in which a low flash-point compound is used is a hazard if a flame or an open light may be brought near the containing vessel or a freshly painted surface. Many ready-mixed paints, especially of cheaper grades, have a low flash point.

Varnishes are of two kinds; so-called turpentine varnishes and alcohol or spirit varnishes. All spirit varnishes present a flash hazard, and so do many of the so-called turpentine varnishes, owing to the inflammable solvents used.

Lacquers, unless known to have a high flash point, should be considered hazardous, and only a minimum quantity allowed outside of stock room or vault.

Varnish removers usually contain highly volatile or inflammable substances, and only a minimum quantity should be permitted outside of stock room.

SUGGESTIONS AND RECOMMENDATIONS.

LOCATION OF PAINT AND PAINT-OILS STOCK.

Storage, handling, and mixing to be in a detached building, and wherever possible located in a nonexposing position to all other property.

CONSTRUCTION OF STORAGE BUILDING.

To be of fire-resistive construction, one story with or without basement; preferably of small area or subdivided by standard fire walls into rooms not over 2,500 square feet in area. Standard automatic fire doors in the walls as well as standard automatic trapdoor at opening to basement (preferably construct outside stairway to basement); windows to be wired glass in metal sash and frame. Building should be well ventilated.

Heating.—Steam or hot water.

Lighting.—Electric; wiring in metal conduit; incandescent lamps provided with vapor-tight globes and wire guards; keyless sockets and outside fuse and switch terminals.

PRECAUTIONS.

Oil thinners and solvents should always be kept in metal tanks or cans.

Metal drip pans should be placed under all faucets and these frequently and systematically cleaned. Paint and oil drippings should be removed daily. When an absorbent is necessary, sand should be used and immediately disposed of. Never use sawdust.

Benches or shelves to be of metal or noncombustible material and should be kept cleaned.

Waste cans.—At least one standard metal, self-closing, oily-waste can must be provided. All oily waste or rags to be deposited therein and removed from building at the close of each day's work.

"*No smoking*" *signs* must be posted in building and on the outside of building at doorway.

Sign reading "Danger—keep lights and fires away" should be posted at doorway. No open lights or portable oil lights should be used.

Employees' clothing should be kept in well-ventilated metal lockers located elsewhere than in stock room.

Where finishing is done, benzine or naphtha must not be used by workmen for washing hands. Crude oil or kerosene is a good substitute to remove varnish and filler from the hands where special preparations are not provided.

Highly volatile oils.—Large quantities of oils, such as gasoline, benzine, and naphtha, should be isolated. They are less hazardous when buried in the ground or in a separate fire-resisting vault outside of the regular paint stock house.

Acids should be stored away from combustible material.

Varnish removers should be considered as highly inflammable, and their use and storage restricted to a minimum, unless reasonably certain they do not contain dangerous constituents.

Lampblack should be kept in metal cans or barrels provided with metal covers and away from source of heat, oils, or moisture.

INTERIOR FIRE PROTECTION.

Automatic sprinkler protection.—To be installed throughout building or building to be provided with a high-pressure steam jet or pipe line for flooding with steam in case of fire, operating valves outside.

Approved hand chemical fire extinguishers, sufficient in number and so located as to be quickly accessible, are recommended.

Sand pails.—Three or more pails of clean, dry sand (with hand scoop for throwing) to be provided and located on shelf or hooks near doorway or at other accessible points.

GENERAL RECOMMENDATIONS IN CONNECTION WITH STORAGE OF RAILWAY FUSEES AND TORPEDOES.

Railway fusees and track torpedoes are classed by the Interstate Commerce Commission in the group of "less dangerous explosives" as fireworks; more specifically fusees as "common fireworks" and torpedoes as "special fireworks" with placards "Inflammable," "Handle carefully" and "Keep fire away."

The hazard of railway fusees and torpedoes is recognized by the Bureau of Explosives, to whom due acknowledgment is given for suggestions as to handling or storage.

Fusees—Handled in Original Unbroken Shipping Packages in Quantities at Distribution Centers.

Fusees should be stored in a small magazine apart from any other building and preferably 40 feet from other building or lumber storage. Local conditions at all storage points must be considered. This magazine should be constructed of light material, covered inside and outside with incombustible material. It should be so constructed as to keep out rain, snow and sparks, and should be provided with a ventilator. No artificial means of heating or lighting shall be employed. Dryness may be promoted by having the magazine elevated a foot or more above the ground, and supported on posts or pilings and so arranged that there is free circulation of air between the bottom of the magazine and the surface of the ground.

Local supplies of fusees for distribution over storehouse counter.

Not more than 4 gross of fusees to be kept in general storehouse at any time. Any broken packages to be kept in a tight metal-lined or ¼-inch asbestos-board-lined wood box with a spring-hinge or self-closing cover. Box to be used for no other purpose and kept in a dry place, not in proximity to any artificial source of light or heat.

Torpedoes—Handled in Original Unbroken Shipping Packages in Quantities at Distribution Centers.

Torpedoes should be stored in a separate magazine similar to that used for fusees.

Local supplies of torpedoes for distribution over storehouse counter.

Not more than 10 gross of torpedoes to be kept in general storehouse at any time. Broken packages or loose torpedoes to be kept in a tight ¼-inch asbestos-board-lined wood box, with sliding cover, used for no other purpose. A sliding cover is recommended in preference to a drop-hinged cover to prevent the possibility of a premature explosion of torpedo in case a torpedo should rest over edge of box. Box to be kept in a dry place not in proximity to any artificial source of light or heat. Care should be observed to prevent the accidental dropping of torpedoes on floors where they might be exploded by stepping on them or being run over by trucks.

General.

Placard all magazines and storage boxes:

"Explosives—Handle carefully—Keep fire away."

Do not store fusees and torpedoes in same magazine or box.

Torpedoes should not be carried on the person, or in the clothing of employees.

Do not store fusees and torpedoes with other explosives or inflammables.

Exercise care in keeping fusees dry; improperly made fusees if damp are liable to spontaneous ignition.

Broken, wet, or oily fusees should be destroyed by burning.

Broken or defective torpedoes should be destroyed by immersing in water.

Fusees and Torpedoes—Miscellaneous Supplies.

Such loose supplies as have been obtained by trainmen from storehouses and as are frequently found in trainmen's clothes lockers, engine cab, cabooses, towers and stations, with no designated receptacle, but loosely placed. We

suggest as a suitable receptacle for these small supplies a small metal or rectangular-shaped wood box with spring-hinged cover. Box to be only large enough to hold the requisite number of fusees, with one end of box partitioned off for storage of the torpedoes. Racks may be used to advantage in cabooses for fusees.

The above suggestions not to interfere with any special and safe practice already in operation, such as that in connection with passenger trainmen's metal receptacles, as are now used for carrying flags, fusees and torpedoes; but to make provision for a special receptacle where not provided in the cases mentioned above.

GAS AND GASOLINE ENGINES.

In inspecting these devices the following features should be observed:

(*a*) Gas or gasoline engines should not be located in rooms where dust and inflammable flyings prevail, or materials of any sort are stored. The engine room should be kept clean and free from accumulations of oil and grease, and should be well ventilated. Rooms, containing gasoline engines should be lighted by electricity and be free from open flame or heat. A waste can and chemical extinguisher should be provided therein. Observe if engine is an approved type.

(*b*) If gas bags are used for gas engines, they must be inclosed in a substantial gas-tight metal drum, vented to the outer air through a pipe used for no other purpose.

(*c*) Regulators should be so designed as to prevent the flow of gas into room in case the engine shuts down from any cause. Pressure regulators should be of approved construction. If a pulsating gasometer is used, a valve should be located on pipe to the same, and be accessible.

(*d*) Note if piping is properly installed and allowances are made for expansion and contraction, jarring and vibration.

(*e*) Careful examination of exhaust pots should be made. See that they are placed on firm foundation and at least 12 inches from woodwork or combustible material.

(*f*) Exhaust pipe, whether direct from engine or from mufflers, should, where practicable, be carried above the roof of the building in which the engine is contained, and above adjoining buildings. When buildings are too high to make this practicable, the pipe should end at least 10 feet from any wall opening.

No exhaust pipe should be within 9 inches of any woodwork or any wooden lath and plaster partition or ceiling.

Where exhaust pipes pass through combustible partitions, they should be guarded by galvanized iron ventilated thimbles at least 12 inches larger in diameter than the pipes, or by galvanized iron thimbles built in at least 8 inches of brickwork or other incombustible material. They should not, under any circumstances, be connected into chimneys or flues, except that the pipe may pass up in flues used for no other purpose. No exhaust pipe should pass through any floor, nor through a roof having wooden framework or covering without special insulation and ventilated thimble.

NOTE.—This pipe is liable to become very hot and should have additional protection where dust or inflammable flyings are present.

(*g*) Hot tube ignition is hazardous. Electric ignition only should be used.

(*h*) Note if gasoline feed cup is rigidly secured to engine, and is in proper order and properly operating.

(*i*) Water pockets in exhaust pipes should be provided with suitable means for drainage.

(*j*) Due consideration should be given the cleaning of the cylinders, valves, and exhaust pipe, as often as the quality of the fuel may necessitate.

(*k*) Observe the location of gasoline supply tank. This should be buried, as per published standard.

(*l*) Note if openings for pipes through outside walls are securely cemented and made water, gas, and oil tight.

(*m*) Observe if fill and vent pipes are properly installed.

(*n*) Observe if gasoline feed pump is properly installed and in proper working order, and provided with check valves.

(*o*) In no event should supply tanks of gasoline be erected on the walls of the building. Gravity feed is hazardous, regardless of location of supply tank.

(*p*) Portable gasoline engines should comply in all particulars with standard regulations. Gasoline tank should be filled during daylight hours only, and while the engine is not in operation. Tanks should be filled by means of safety cans from properly installed gasoline supply tank.

VENTILATING SYSTEMS FROM KITCHENS, AND SETTING OF RANGES.

Numerous fires occur in hotels, restaurants, dwellings, etc., due to poorly constructed kitchen ventilating systems, defective setting of cooking ranges, etc.; the general hazard in connection with which should receive special attention and be guarded against.

Walls, floors, and ceilings of kitchens should preferably be built of fire-resisting materials when ranges can be set to wall and floor without the special precautions described herein. This is especially recommended for hotels, etc., where ranges having two or more fire boxes are used.

Ranges.

A kitchen range shall not be placed less than 3 feet from any woodwork or combustible material unless protection by metal shields is afforded, in which case the distance shall be not less than 18 inches; the metal to be so attached as to leave an air space between it and the combustible material and to extend at least 3 feet above top of range.

Ranges allowing an air space of less than 4 inches between ash box and floor should be located on floors of fire-resisting construction such as brick, tile, or concrete; if set over combustible flooring a hearth shall be provided, constructed of 4-inch hollow tile or two courses of brick placed on sheet metal or one-eighth inch asbestos board, the lower course of brick to be laid so as to permit circulation of air between the bricks. The brick or terra-cotta work shall extend 12 inches beyond the range at sides and rear and 24 inches in front.

Ranges allowing an air space of more than 4 inches between ash box and floor, if placed over combustible flooring, should be set upon sheet metal or its equivalent; the metal to extend 12 inches beyond range at sides and rear and 24 inches in front.

Ranges having 2 fire boxes or more should be installed on combustible floors only as prescribed for ranges having an air space less than 4 inches between the bottom of ash box and floor line.

Gas connections to ranges or hot plates must be by metal pipe—flexible tubing should never be used.

Smokepipes.

Smokepipes must be securely fastened to range, be constructed of substantial metal and be spark tight and not placed near any woodwork unless protection

of sheet metal with an air space is provided; should run directly to standard brick chimney, be firmly held in place by plaster and metal thimble and where it possibly can be avoided they should not pass through floors, attics, or unused rooms and never through closets or other concealed spaces.

Where the pipes must necessarily pass through lath and plaster or wood partitions and ceilings or combustible roofs, they must be guarded by galvanized iron ventilating collars at least one and a half times the diameter of pipes, or a concrete panel at least 18 inches square (depending on spacing of studding and diameter of pipe) and casing the smokepipe so as to leave a space of not less than 1 inch around it.

Smokepipes shall not be permitted inside of vent flues from ranges.

Range Hoods.

All large ranges should be provided with hoods, constructed of substantial metal and large enough to collect all greasy vapors. The hood should preferably be placed at least 9 inches below any wooden or other combustible ceiling.

Ventilating Pipes Conducting Greasy Vapors.

Should be constructed of a proper gauge metal to suit their size and conditions of surrounding, so substantially built that they may burn out without damage to the building or building contents. The pipes should be securely fastened to the top of range hood with metal flange sleeve securely riveted or bolted to both pipe and hood.

Ventilating pipes should not pass through closets or concealed spaces.

A ventilating pipe connected with a hood over a range shall be an individual pipe, having no connection with any other pipe, and shall not be run near any woodwork or combustible material. The pipe shall go either outside of the building, to be securely fastened to the outside wall, with a clearance of at least 4 inches therefrom, and discharge at least 4 feet above the roof, or be connected with a suitable brick flue lined with burnt clay, which shall be used exclusively for ventilating pipe of the range.

Ventilating pipe, where passing through combustible roofs, ceilings, partitions, etc., shall be installed in accordance with requirements for smokepipes.

The pipe must be large enough to promptly and adequately take care of vapors and fumes; its diameter should be governed by the area of kitchen and change of air required, but in no case shall it be less than 8 inches its entire length.

Horizontal ventilating pipes for ranges in kitchens should be avoided as much as possible.

Fans.

Fans and power apparatus in connection with ventilation should be so located that surroundings are incombustible and should have ventilation to the open air.

ELECTRICITY AS A FIRE DANGER AND HAZARDS OF ELECTRIC WIRING.

Numerous fire losses occur through electrical causes. It should be the purpose of inspectors to draw more closely to the attention of electricians or mechanical superintendents having in charge the lighting, heating, and power of properties, the probably well-known but at the same time frequently overlooked defects which produce fire hazards.

Electrical causes of fires may be classed as "avoidable" and "inherent;" the first class covering such cases where there is no element which can not be controlled; the second class may or may not be anticipated and can not be entirely removed. The elements of danger introducing "avoidable hazards" may be eliminated by proper design, construction, and installation. Some of the defects in electrical equipment, or general causes of electrical fires, might be mentioned as follows:

Poorly designed fittings with the use of improper materials.

Overloading of mains and branch circuits.

The misuse of apparatus and materials, including use of switches, fuse blocks, sockets, wire cord, and other fittings and materials for carrying current in excess of rated capacity; broken or defective switches.

Poor workmanship producing dangerous conditions, including slack wires, poor arrangement, splices not well made, wires poorly supported or run too close to pipes or other metal work without providing proper protection; careless connection of conductors to switches, etc., and skinning and cleaning of wires; cutting flexible tubing too short at outlets, kinking and injuring wires in handling, loose screws in fittings, etc.

Wires in concealed spaces without proper protection, such as in partitions and division walls.

Wires wrapped around nails or hooks and not rigidly supported by proper insulators.

Wires carried through woodwork bunched without protection.

Placing of wires in molding in damp and wet places; installation of combination fixtures without insulating joints.

Incandescent electric lights in contact with combustible material.

The use of link fuse cut-outs not placed in fire-resisting cabinets; frequently installed in closets, attics, and other inaccessible places, this class of fuse being faulty in that they expose surrounding material to arcing and molten fuse metal.

Service wires not provided with approved switch and cut-out where they enter buildings.

The very common practice of using ordinary flexible cord for portable use, thus exposing it to abrasion.

We might summarize many other causes of electrical fires, but the above are picked out as indicating numerous defects met with in practice.

The "National Electrical Code" is recognized as giving the proper rules for safety of installations, supplementing which is the use of approved fittings only for satisfactory work. While it would require too much detail to even outline the rules, the following general suggestions and cautions are made:

(1) *Wiring.*—Afford complete protection against overloads or short circuits. All high-potential wires to be placed in plain sight and rigidly supported; protected on side walls from mechanical injury by substantial boxing. Wires passing through floors, walls, or partitions to be properly protected by insulating tubes, and where crossing open exposed joists, to be incased in approved metal conduit, molding, or attached to approved porcelain supports. Wires liable to mechanical injury to be incased in approved metal conduit or boxed in; where passing through or over shelving should be placed in metal conduit or molding or removed to a location where there will be no liability to mechanical injury; to be properly protected by continuous and firmly fixed nonconductor where paralleling or where liable to come in contact with metal pipe or other conducting materials; should be run over rather than under pipes likely to gather moisture or leak; where in attics to be protected from mechanical injury and where entering buildings to have drip loops. It is important that all

discarded wiring and fittings should be removed; all joints to be spliced or made so as to be both mechanically and electrically secure without soldering, the joints to be soldered and covered with an insulation equal to that of the conductors; service wires to be provided with approved switch and cut-out where the service enters, arranged to cut off current from all devices, including meters.

(2) *Conduit.*—Concealed wires should be placed in approved metal conduit or armored cable when it is impracticable to properly support them on insulators; electric light and power wires in elevator shafts to be placed in such conduit or cable; conduit should be continuous from outlet to outlet or to junction boxes and be securely fastened in same. Signal wires should not be placed in the same conduit with light and power wires.

(3) *Lamps.*—Incandescent lamps should be well supported and where liable to mechanical injury be equipped with substantial wire guards and no combustible lamp shades permitted to be used thereon. Arc lamps located where they are exposed to flyings or small particles of inflammable materials should have carbons inclosed completely in tight globes; or where located near inflammable material should have wire netting over globes and be equipped with approved spark arresters. For portable incandescent lamps, reinforced wiring or cable, designed to withstand such service, to be used, and the lamps be protected by wire guards. Incandescent lamps in rooms where there are inflammable gases should be provided with vapor-proof globes and keyless sockets.

(4) *Flexible cords* should not be hung on nails, metal work or stapled to woodwork, etc.; should not be used as support for electric fixtures, or be used where exposed to dampness and should be protected, if in contact with metal, by approved flexible tubing.

(5) *Cut-outs* should be located as to be readily accessible, not exposed to inflammable gases, where located in damp places to be inclosed in approved fire and moisture proof cabinet, and where in vicinity of readily combustible materials, to be removed or inclosed in approved cabinet. The use of open link cut-outs discouraged; where used, to be inclosed in approved fireproof cabinets. Cabinets should be substantially constructed of metal or well-seasoned wood and lined with noncombustible insulating material such as slate, marble, or asbestos board; door to be securely hung and arranged to be kept closed, by strong hook or catch.

(6) *Heating devices* should never be concealed but at all times be in plain sight. Circuits should be equipped with a pilot lamp placed so that it will be lighted when the current is on the heating apparatus. Electric irons should be provided with approved stands to hold them. Electric heating apparatus should be placed in a safe location and carefully isolated or protected from combustible material.

(7) *Apparatus.*—Generators and motors should be placed in a dry location and should not be located in rooms where hazardous processes are carried on or where there are inflammable gases or flyings of combustible materials, unless in the latter case, the motors are of the inclosed type or otherwise protected.

Rheostats should be located at least 1 foot from combustible material or separated by being mounted on bases of noncombustible, nonabsorptive insulating material, such as slate or marble, and securely mounted thereon. All switches and rheostats used in connection with electric motors to be located within sight of and accessible to motor. Base frames of generators and motors operating at 550 volts or less should be properly insulated from ground and when above that voltage properly grounded. Electric apparatus should

be properly protected by lightning arresters; all switch-boards to be made of noncombustible material such as slate or marble and be placed in dry location. Service switches to be placed on service wires in a readily accessible place, as near as possible to the point where the wires enter buildings and arranged to cut off current from all apparatus, including meters; knife switches to be so placed that they will tend to open by gravity. All switches subject to inflammable flyings and those subject to mechanial injury should be placed in fireproof and dust-proof cabinets, and those located in damp places should be placed in moisture-proof cabinets.

Transformers must not be placed inside of any building excepting central stations and substations without special permission; those located inside power stations should be arranged in an approved manner; and if installed in other buildings to be in noncombustible rooms. Oil-cooled transformers should be filled and tested in separate noncombustible rooms and the temperature of the oil should not be raised by means of a fire built under the tanks, but preferably by steam coils.

(8) *In general.*—In all electric work, conductors, however well insulated, should always be treated as bare and alive, to the end that under no conditions, existing or likely to exist, can a ground or short circuit occur, and so that all leakage from conductor to conductor, or between conductor and ground, may be reduced to the minimum.

In all wiring, special attention should be paid to the mechanical execution of the work. Careful and neat running, connecting, soldering, taping of conductors, and securing and attaching of fittings, are specially conducive to security and efficiency.

In laying out an installation, except for constant current systems, every reasonable effort should be made to secure distribution centers located in easily accessible places, at which points the cut-outs and switches controlling the several branch circuits can be grouped for convenience and safety of operation. The load should be divided as evenly as possible among the branches, and all complicated and unnecessary wiring avoided.

Architects and engineers are urged, when drawing plans and specifications, to make provision for the channeling and pocketing of buildings for electric light and power wires, and also for telephone, district messenger, and other signaling system wiring.

When buildings are unoccupied or operations have ceased, all electric current should be cut off at main switches.

The problem of fighting fires in and about electrical apparatus is a serious one owing to the fact that water, if used, is liable to damage insulation and cause corrosion of the metal parts, and then again there is danger to life in handling ordinary streams in contact with high voltages. Carbon tetrachloride extinguishers are effective in extinguishing electric arcs of considerable capacity.

A copy of the latest edition of the "National Electrical Code" should be placed in the hands of all electrical superintendents and foremen.

INSTALLATION AND CARE OF KEROSENE-OIL LAMPS.

The small railroad stations in towns and villages, signal towers, pumping stations, and other buildings in isolated locations continue to be very generally lighted by kerosene-oil lamps. This form of lighting must be considered as more hazardous than electricity or gas, as in addition to an open flame, the oil,

in case of fire, immediately contributes inflammable liquid, which aids in the spread of flames, and under certain conditions an explosion occurs. This form of lighting carries with it both a fire and explosion hazard.

Where possible, electric or gas lighting systems should be used instead of oil of any nature.

Good maintenance and care are necessary at all times in order to prevent fires originating from explosion of lamps, lamps upset, lamps turned too high, ignition of inflammable material therefrom; etc. Bracket lamps should always be rigid; swinging lamps are hazardous.

The National Fire Protection Association recommend the following precautions of safety, which should receive attention:

The bowl or receptacle containing oil should not be of glass or of breakable material, but be constituted of substantial metal.

Receptacles containing oil should never be filled to an overflow point, but filled to a point that will permit an air space above the oil. Receptacles should not be permitted to become dry or empty, and should be filled at regular intervals. Lamps used regularly should receive daily examination.

Lamps should not be filled while burning. Cleaning cloths and waste should be kept in approved metal waste can. Old wicks, when removed, should be burned immediately.

All portable lamps should be so designed that they may not be readily upset or overturned.

Suspended lamps should preferably be securely fastened to rigid fixtures; should be free from contact with partitions, shelving, ceiling, and combustible material. Proper shields should be provided overhead when lamps are placed within 24 inches of combustible ceiling or material above.

Lamps should not be permitted to burn indefinitely in dark cellars, area ways, halls, attics, or at places which are not constantly under supervision.

Those in charge of property should not leave premises unoccupied indefinitely and permit lights to burn during their absence. This is a common cause of fire.

Lamps should not be suspended nor placed where there is a strong or continuous draft, unless properly shielded.

Burners must be securely fastened to oil receptacle and should be kept clean and properly adjusted at all times. See that small vent pipe through burner is kept clean.

Wicks should never be permitted to become so short as to fail to readily absorb oil from receptacles. When receptacles are filled, wicks should be carefully examined, and immediately replaced if too short. Wicks must be kept evenly trimmed and must be of proper width to fit burner. Narrow wicks are dangerous. Wicks must be kept free from crusty accumulation of carbon deposits, and must not be allowed to become shreddy or ragged.

Inflammable shades should never be used, nor should chandeliers or fixtures be decorated with combustible material for artistic purposes or otherwise. This practice in particular should be condemned.

Chimneys should be securely adjusted to burner frames. Cracked chimneys should immediately be replaced with new ones. Do not glue paper or cloth over cracks of chimneys.

Danger in the Use of Kerosene for Heat and Light.

The use of kerosene or "coal oil" for fuel in various classes of buildings is regarded as much more hazardous than the use of ordinary fuel, such as coal. The use of this oil for lighting is also more hazardous than electric or gas light. Wherever such kerosene oil equipments are necessary, special precautions should be observed.

There are many hazards in common with the use of both oil stoves and lamps, their maintenance and care, and the storage of oils, etc., and precautions by which many hazards may be eliminated are given below:

STORAGE OF CANS AND BARRELS OF OIL.

All oil cans should be kept in metal or metal-lined boxes or closets.

A can or barrel of oil should never be kept in the same room with a furnace, stove, or fire of any kind, but preferably outside of buildings. Partly filled or empty oil cans and oil barrels nearly always contain an explosive vapor, especially after standing in a warm place or in the sun. Special attention should be given to supposedly empty oil barrels and receptacles to see that they are well drained and kept in a cool place, preferably away from all buildings, and that their filling and vent holes are properly closed.

DISPOSAL OF WASTE AND RAGS.

Rags or waste used for wiping oil stoves should be immediately removed from the buildings and burned; or deposited in approved self-closing metal waste cans, to be emptied daily.

FILLING.

Stoves and lamps should be filled only by daylight, and never while burning or near a fire.

Filling and trimming should be done on a metal or metal-covered shelf.

Do *not smoke* while filling stoves or lamps.

Do not fill to overflow point, but permit an air space above oil.

Do not allow oil stoves or lamps to burn until oil receptacles are empty. Excess accumulation of dangerous vapors may result.

MISCELLANEOUS.

The following special precautions should be observed in use of kerosene stoves:

Do not carry stoves about while lighted, or place lighted stoves in passageways where they are liable to be upset. The portableness of oil stoves constitutes one of their hazards. A coal stove, when properly installed, is more permanently and firmly set and the surroundings more carefully guarded.

Do not place oil stoves under wood shelves, desks, tables, etc.

Keep all papers from floor and from hanging over or about stoves.

The following precautions should be observed in use of kerosene lamps:

Lamps should be used only in rigid fixtures, free from danger of contact with inflammable material.

Do not hang papers over or near lamps.

DANGERS OF GASOLINE.

Fatalities on account of gasoline fires are on the increase and, in harmony with experiences respecting human indifference, the increasing use of gasoline and other liquids which are dangerous because of their ready inflammability, will probably increase the number of accidents which cause loss of life as well as great damage to property.

A feature, however, which is not readily comprehended and which is a serious source of danger is the fact that a mixture of the gasoline vapor and air is highly explosive under certain conditions.

When we hear of a disastrous gasoline explosion we may be sure that it resulted from the mixing of the vapor from the gasoline with air in the proportion necessary to form an explosive mixture.

The behavior of illuminating gas, which burns quietly when liberated alone, but explodes when a mixture with air is ignited, is quite analogous. The public has been slow to appreciate these distinctions, and hence they deserve emphasis. Again the public can not make distinctions between the explosive vapor and the purely combustible vapor; therefore certain precautions must be taken in handling this hazardous fluid.

At ordinary temperatures air will hold from 5 to 28 per cent of gasoline vapor. As gasoline vapor is about three times as heavy as air, in a room containing a mixture of the vapor with air, the vapor is found in largest proportion near the floor. According to experts there is needed only a small proportion of gasoline vapor to render air explosive—1.4 cubic feet of vapor to 97.5 cubic feet of air. One gallon of gasoline, under ideal conditions, can render 2,100 cubic feet of air explosive.

A dangerous feature of gasoline vapor is that it may travel a considerable distance from the gasoline and there be ignited, the flash traveling back to the container of the liquid and causing a roaring fire in a few seconds.

When gasoline is passed from one metallic vessel into another, especially through a chamois-skin strainer, frictional electricity is apt to be generated, which under certain conditions jumps in the form of a spark which may ignite the gasoline vapor and cause an explosion. Chamois-skin strainers should not be used. Use only wire-gauze strainers and see that funnels are so equipped.

Don't store gasoline or other highly volatile oils in large or small quantities where other oils, paints, etc., are stored, or use or handle in valuable properties or where they would endanger life or property of any kind. Store in a specially constructed container or building built on approved lines and in an isolated location.

Don't use gasoline in processes where it can be avoided and where a less dangerous substitute can be used as advantageously and economically.

Don't permit or use open lights or flames at or near places where gasoline and other highly dangerous and inflammable liquids are used or stored. Post signs in such locations, giving this rule.

Have these dangerous liquids handled only by experienced men who realize the dangers, and use only from approved "safety cans."

Storage and Handling of Empty Gasoline Barrels.

These barrels are a source of danger and should receive greater care.

Drain the barrels thoroughly and allow all accumulated vapor to escape; remembering that gasoline vapor is heavier than air. Also store the barrels in a cool or shady place.

Keep their filling or vent holes properly closed.

Before empty barrels or receptacles are transported, Interstate Commerce Commission Regulation No. 1895–A, reading as follows, should be observed:

Empty barrels, kegs, or drums previously used for the shipment of an inflammable or corrosive liquid, must have their filling and vent holes properly closed. They should be loaded in open or stock cars when practicable. Labels are not required on such packages, and cars should not be placarded, but lighted lanterns or other open-flame lights should be kept away.

LACQUERING AND BUFFING.

Lacquers, a group of varnishes, used to prevent the polished surfaces of metals from tarnishing, need more than ordinary care in handling. Their use is still one of the necessary hazards of the present-day railroad car shops, and

they will continue to be a fruitful source of fire until a dull or natural metal finish is favored.

The word "lacquer" in the commercial field means that class of spirit varnishes applied to metals to give them a thin transparent flexible film coating.

Lacquers are chiefly made with a pyroxylin and celluloid base dissolved and thinned in alcohol, amyl-acetate, benzene, etc.; with a few exceptions the resulting varnish is very volatile, has a low flash point, and its vapors take fire at comparatively low temperatures.

There are two principal processes of applying lacquer to metal after it has been cleaned by the caustic soda and acid baths; first by brushing on; second by dipping the article in a tank of lacquer or by spraying. In both methods the wet lacquered article is partly dried in sawdust and then further dried in an oven.

The first method is used in small car shops where the amount of material to finish is not large and usually can be done by one man. The hazard of this occupation is not especially marked and can be easily guarded against by having a metal cover for lacquer container, the immediate surroundings incombustible, electric illumination, steam heating, and some hand fire-extinguishing apparatus.

The second method is used in large car shops where a considerable amount of work is required; there is a marked hazard in this method, and many of the recommendations given below are requirements of National Board of Fire Underwriters as to the best way of safeguarding against it.

The shop plant using the dip-tank process is necessarily a centralized one or the main plant of the railroad, and therefore very large values in buildings and contents and rolling equipment are involved; with few exceptions the values are concentrated and congested. Past practice has been to locate the lacquering department, whether of the brushing on or dip-tank method, in a fenced-off corner of the main paint shop, and in a few instances bricked-off room or detached frame buildings have been provided; the location of the hazard, however, has been one which invariably exposed surrounding properties.

The following suggestions are made primarily for the construction and installation of new lacquering and buffing departments; all present departments, however, should be made to conform to same as far as possible.

Location.—The work should be done in a building located in a nonexposing position to all other property.

Construction.—Building to be of fire-resistive construction, not over two stories high, of small area or subdivided by fire walls into rooms not over 2,500 square feet in area. Floors to drain to overflow into outside special cistern. No openings between floors. Stairways and elevator should be installed outside and preferably in fireproof towers.

Lighting.—Electric wiring in metal conduit; incandescent lamps with vapor-tight globes, keyless sockets, and outside fuses and switches.

Power.—Steam or electric; when possible, shafting to be operated by outside motors.

Ventilation.—Room should be well ventilated at top and bottom by suitable screened openings and if necessary an exhaust fan system should be installed. It is desirable to have a metal hood of larger area than dip tank suspended directly above tank and terminating in a metal vent pipe.

Heating.—Steam or hot water.

Tanks.—To be constructed of steel or cast iron.

Covers.—May be either hinged or sliding on tracks and should be normally held open by approved types of metal chains containing fusible links, one such link to be near cover at tank and one at the point where chain is fastened to building wall or ceiling. Such covers may be constructed either

of metal or tongued-and-grooved boards covered on all surfaces by lock-jointed tin, and in all cases such covers must overlap the sides and ends of tanks at least 2 inches. All covers to be so designed and installed that operation will be automatic and secure positive closing without danger of sticking when released by the action of heat on the fusible links or by manual operation. Covers to be closed and fit tight when tanks are not in use.

Drip boards.—To be of incombustible material and readily permit of cleaning.

Agitator.—If necessary each tank should be provided with an agitator.

Overflow.—Tank to have an iron or steel overflow pipe leading outside of building to a cistern. Overflow to have a coarse strainer at tank.

Drains.—Each tank should preferably be provided with a drain pipe of sufficient size to empty tank in about 60 seconds. Drain to be provided with a valve capable of being operated both manually and automatically. Drain pipe to be connected directly or through an overflow pipe to cistern.

Cistern.—To be of sufficient size to hold the aggregate capacity of all tanks emptying into it. To be detached at least 30 feet from any building and located in ground, or to be so arranged that any overflow can not endanger property. Overflow and drain pipes to terminate in bottom of cistern under water.

Dry boxes.—Should be constructed entirely of brick, iron, asbestos board, or other non-combustible material, with no inflammable material therein and well insulated from outside combustible material. Large boxes should have vents with slight draft leading to the outside of building.

Heating dry boxes.—Steam heat only to be used, with the pipes installed at the sides to prevent accumulations of drip lacquer thereon.

Polishing and buffing.—Wheels using an oil lubricant create a hazard; and should be equipped with a metal pipe dust collecting system, discharging into an outside metal dust box half filled with water. The oily lint and dust is liable to spontaneous ignition, and the polishing and buffing should be done, if possible, in a room used for no other purpose.

Emery wheels.—Locate at a safe distance from inflammable liquids.

Storage of materials.—The main supply of lacquers to be kept in a detached building. All unused lacquer in the lacquering room should be removed to this building at night. Acids should be stored away from combustible material.

Fire prevention.—Clean and remove all lint from polishing and buffing room at end of each day's work.

Prohibit the use of open lights or allowing watchmen taking in oil lantern.

Interior fire protection.—Entire building to be equipped with automatic sprinklers, or with a high pressure steam jet or pipe line for flooding with steam in case of fire; operating valves to be located outside, with signs conspicuously posted designating their use.

A few approved hand chemical fire extinguishers should be provided.

A large box of sawdust with a shovel should be kept in accessible location near lacquer dip tank; sawdust to be mixed with bicarbonate of soda in the proportion of 10 pounds of soda to 1 bushel of sawdust. In event of fire in dip tank this mixture will float on the burning liquid, acting as an extinguishing blanket by excluding the oxygen of the atmosphere.

PROTECTION AGAINST LIGHTNING.

The National Board of Fire Underwriters publish suggestions for protection against lightning, amongst which are the following:

Lightning rods should have as few joints as possible, these to be mechanically and electrically secure and to be protected from corrosion. It is essential that

the conductors be continuous and, therefore, the fewer the joints and the better these are protected from corrosion, the less chance of crippling the protection due to a break in the conductors.

Conductors never to be insulated from structures, but to be fastened securely in place, suitable allowance being made for expansion, by clamps of same material as conductor, the vertical rods being carried a sufficient distance from the wall to avoid sharp bends around projecting masonry or brickwork. In all cases as straight a run as possible should be provided and the conductors should incline downward. The conductors should never be run through iron pipes and should be run as far as practicable away from interior pipes.

Protection against lightning is usually advisable on country buildings, on isolated buildings and on all buildings, wherever located, having elevated features such as tall chimneys, steeples, high-peaked or gable roofs, and flagpoles.

Since the amount of protection which any building should have will depend upon its location, construction, nature of its occupancy, and the value of the building as compared with the expense necessary to provide the protection, definite rules can not be laid down for the installation of lightning conductors.

In general, all metal buildings, metal chimneys or stacks need only to be grounded.

STORAGE OF RECORDS AND INCIDENTAL FIRE DANGERS.

The question of storage of records and files is a serious one to the chief clerks, agents, and others in charge of such matters, and also to those interested in the prevention of fires. Lack of time and space to properly arrange the files are the two greatest obstacles to overcome. It has been found that a common practice is to use attics and other spaces unfit for office use.

All fires occurring in record rooms are due to carelessness.

The hazards in connection with storage of records are caused principally by the fact that through lack of space in many cases the records, usually composed of tissue papers and other inflammable materials are piled in a more or less disorderly manner on the floor and in spaces not intended for their reception. In smaller offices, stations, etc., the entire clerical force has access to the files, and it has been found, where smoking is allowed in the offices, clerks will also carry their lighted pipes, cigarettes, etc., into the record room, or where smoking is prohibited in the offices, the record room, being in an inconspicuous location, is made a rendezvous for smokers. On account of the great inflammability of the contents of record rooms, and the fact of their being in more or less concealed spaces usually, this practice is extremely hazardous. A cigarette stub in a pile of tissue paper records can work a great deal of havoc in a little time, as has been proven through experience.

Records and old files are primarily meant for reference, and if not kept in a systematic and orderly manner it becomes extremely hard to refer to them. For instance, it would seem to be an impossibility to refer intelligently to records that are stored in the coal bin and more or less buried in coal, as was actually found at one station. This example is an extreme one, but there are many other common examples to be found on many railroads where it would be nearly as hard to find a file in the record rooms. It would be an economy in office practice and reduce the fire hazard as well to take time and space to file old records systematically.

A good practice found at one office building might economically be inaugurated in other locations. Outside, and a short distance from this office, a small building has been erected and fitted with shelves, skylights, electric portable lights with reinforced cords, etc., and is used for the storage of all records. It is kept locked, and anyone wishing to procure records has to get the key from the chief clerk or his assistant. In cases where such outside buildings are used, the building should be of fire-resistive construction, lighted by electricity, with all portable cords of heavy, reinforced type, electric lamps protected by wire cage guards, with shelves so arranged as to hold all records in such manner that they can be readily referred to. Lights to be controlled from outside switch with outside pilot light to indicate when current is on. Smoking should be absolutely prohibited under penalty.

In large record rooms for general offices it is recommended that a custodian be employed on duty in the rooms at all times.

In all record rooms or vaults and houses, a supply of 2½-gallon chemical fire extinguishers should be conspicuously located, and in large record rooms and buildings, automatic sprinkler systems and standpipe connections with hose, installed in standard manner, are recommended.

Metal shelving for storage of records is preferable.

Spaces in record rooms, set aside for purposes other than record storage and filing, should be prohibited.

In smaller offices and stations where the number and importance of records would not warrant an outside building or a vault, a room could be set aside for filing purposes, with communications to other rooms cut off except one door, to be kept locked, lighted in similar manner to vault, and one man responsible for condition; where the size of the station does not warrant the room, a closet with shelving should be installed of sufficient size to hold the records in an orderly manner.

In view of the difficulty of adjusting losses by fire or duplicating records at various properties where the files have been destroyed, it is recommended that at all buildings where current files are kept, particularly such as storehouses, office buildings, and shop buildings, that a vault, constructed on fireproof lines, be erected either in or convenient to the building so that all current files, valuable records, tracings, drawings, etc., may be kept therein.

Heating of all record rooms and houses should be by hot water or steam systems, with radiators well guarded and pipes covered by approved insulating materials. A large fire in a general office building occurred not very long ago from records in contact with steam pipes igniting.

SPONTANEOUS IGNITION.

The phenomenon of spontaneous ignition has been the subject of exhaustive study for many years, and is still one of exceeding interest from the frequency with which it occurs, and from the fact that there is apparently so little general knowledge of the conditions favorable to its occurrence. If the origin of fire is not clearly apparent, the cause is usually assigned to spontaneous combustion, without any particular effort being made to ascertain if this assumption is correct, or it is said to be unknown, while full knowledge of the conditions existing prior to the occurrence would show that very simple precautions would probably have removed the danger.

In the more hazardous processes of manufacture, conducted by experts, the dangers are recognized and safeguarded, but the unskilled, careless, and indif-

ferent are responsible for enormous losses that can, in great measure, be easily prevented by understanding a few simple principles.

Spontaneous ignition of vegetable, animal, and metallic substances may be defined as follows:

Ignition by the internal development of heat without the action of an external agent.—The action is as follows: Porous substances absorb air, oxidation raises the temperature, which in turn accelerates the oxidation with increasing rapidity until fire ensues. The low conducting power of porous substances greatly facilitates combustion by preventing the dissipation of the heat generated.

"Oxidation always produces heat, but most frequently in such small quantities that it is imperceptible. Nevertheless, however slight the heat evolved in the oxidation of a substance may be, if confined it will usually in time raise the temperature of the substance undergoing oxidation to the point of ignition, resulting in fire. Chemically, therefore, a fire may be described as oxidation at a temperature at or above the point of ignition of the oxidized substance; also as a phenomenon, due to combustion or oxidation of a substance, evolving heat and light."

Moisture is a factor in nearly every known case of spontaneous ignition.

Oxygen is the most widely diffused and important of the elements; it forms over one-fifth of the atmosphere, eight-ninths of all water, and probably one-third of the earth's crust. It has also the widest range of affinity of known substances, this action of combining being known as oxidation, and by its immediate agency combustion and life are alone sustained. Oxygen is the principal supporter of combustion, and all ordinary combustion is the combination of the oxygen of the air with the burning substance.

Wood subjected to direct contact with fire is quickly consumed, its carbon and hydrogen combine with the oxygen of the air forming carbonic-acid gas, water, and unconsumed gases which pass off in smoke, and there remains but a small quantity of ash. Wood exposed to moisture in the presence of air decays or "dry rots," which is exactly the same process except that the combustion is much slower, and a log of wood may require many years for complete consumption.

The amount of heat generated is precisely the same in slow as in rapid combustion of equal quantities of material, but in slow combustion it is unnoticeable.

Another form of slow combustion is the rusting of metals, principally iron, which in the form of fine borings, filings, and turnings exposed to the elements in large quantities will cause a decided rise in temperature through oxidation.

Various substances have an affinity for oxygen to a greater or smaller degree, and the chemical action is therefore more rapid in some mixtures than in others.

No vegetable oil will cause spontaneous ignition unless it has the property of drying by reason of absorbing oxygen, and no animal oil will cause spontaneous ignition unless it has the property of becoming rancid. The danger of causing fire is directly proportionate to the degree that an oil may have either the one or the other of these properties.

Mineral oils in their liquid state have no affinity for oxygen and are therefore less hazardous than vegetable oils, but it is well to bear in mind that "Oiled everything is dangerous," and that moisture promotes spontaneous ignition.

GUARDING AND IDENTIFICATION AT LARGE TERMINALS, SHOPS, PIERS, AND STORAGE WAREHOUSES.

Where valuations and conditions warrant, special guards should be provided to prevent entrance of unauthorized persons. When military guards can not be procured, special civilian armed guards should be provided.

Where practicable, barbed-wire fences or other man-tight inclosures should be erected.

Special electric flood lighting should be provided at night to illuminate guarded area.

No persons should be allowed to secure admission to guarded inclosure except upon presentation of proper pass credential. The use of properly authenticated photographic passes is recommended for inspectors and employees.

RECOMMENDATIONS FOR SAFEGUARDING THE FIRE HAZARD AT TRACK AND OVERHEAD BRIDGES.

In view of the importance of these structures from an operating standpoint and to prevent the interruption of traffic due to their destruction or damage by fire, the following recommendations should be complied with wherever practicable and when valuations and conditions warrant:

Spark Hazard.

Instructions should be issued and rigidly enforced that especial care should be exercised to prevent sparks escaping from smokestacks or hot coals from ash pans of locomotives while crossing track bridges or passing under overhead bridges and to prevent burning waste being thrown from locomotives.

All Bridges.

Vegetable growth should be cleared away for a distance of at least 25 feet on approaches and from around combustible bents.

Fire Equipment.

Barrels of water should be buried in the ground at ends of structures, also casks should be placed at least every 200 feet along structure. Pails should be kept hung on or in each cask. Water may be retarded from freezing by addition of calcium chloride or common salt dissolved in each gallon of water. See table, page 64, and notes on solutions. Where track bridges are of metal construction fire equipment should be provided for extinguishing fires in wooden floor systems.

Creosoted Timber Structures.

In the case of creosoted timber trestles or creosoted ties and deck material, sandboxes provided with covers, so as to keep sand dry, should be provided. Each sand box should contain an old shovel for use in throwing sand on a fire while in an incipient stage. Water tends to spread a fire in case of creosoted material, while sand smothers it.

CAR-INSPECTORS' HOUSES.

These are usually buildings of comparatively small value in themselves, but owing to the cars, crippled and otherwise, near by, should have more protection than the values of the buildings alone would seem to warrant. Barrels of water with pails attached should be distributed liberally along the repair tracks, and about the buildings. At least one approved 2½-gallon extinguisher should be kept in each heated building. Oils, paints, dope, etc., should be in a building used only for that purpose, located at least 15 feet from other buildings and tracks, if of brick or concrete, and at least 50 feet, if of wood. Blacksmith shop should be in a separate building detached at a safe distance. The cripple tracks should be cleaned frequently of old waste, wood chips, shavings, etc., and the refuse burned in a proper incinerator set at a safe distance from combustible property.

RULES AND REQUIREMENTS FOR STORAGE OF CALCIUM CARBIDE.

It is necessary for the safeguarding of property as well as lives to provide special storage facilities for any quantity of such material, and special attention is directed to the following rules in connection with storage:

A. Calcium carbide in quantities not to exceed 600 pounds may be stored inside property, when contained in approved metal packages not to exceed 100 pounds each, provided that the place of storage be dry, waterproof, and well ventilated, and also provided that all packages shall be sealed and the seals shall not be broken.

NOTE.—When in use in buildings, all but one of the packages shall be sealed and the seals shall not be broken so long as there is carbide in excess of 1 pound in any other unsealed package in the building.

B. Calcium carbide in quantities in excess of 600 pounds to be stored in approved metal packages above ground, in detached buildings, used exclusively for the storage of calcium carbide; such buildings shall be constructed to be dry, waterproof, and well ventilated, and kept under lock and key.

C. Packages to be approved must be made of metal of sufficient strength to insure handling the package without rupture, and be provided with a screwed top or its equivalent.

They must be constructed so as to be water and air tight without the use of solder, and conspicuously marked "*Calcium carbide—Dangerous if not kept dry.*"

NOTE.—All machines utilizing calcium carbide should be approved and installed in full accordance with the rules and requirements of the National Board of Fire Underwriters.

DIP TANKS.

These tanks should be of metal, limited to the smallest size practicable for the purpose required. They should rest either upon an incombustible floor, or a floor covered with metal so as to be readily cleaned.

They should have metal tops or covers which should always be in place when the tanks are not in use, covers preferably to be automatic closing. Covers may be permanently attached to ends of tank, arranged to operate automatically by means of fusible links and counterbalance weights.

Dip tanks should be provided with an overflow pipe and metal drip boards, so that excessive liquid may flow into catch drain. The drain pipe should be near the bottom of all tanks, and contents of tank should be drawn off at night and returned to oil house or vault.

Dip tanks should be located in a room used exclusively for dipping purposes, preferably detached or properly cut off above grade with no basement below. Not to exceed one day's supply of oils and mixtures should be kept therein.

Dipping rooms of an extensive nature should be in a detached building, or properly cut off from main building, room preferably to be fireproof or of incombustible finish.

There should be no open lights nor flame in room in which dipping is carried on. Electric lights should have vapor-proof globes, keyless sockets; switches to be outside of room. Steam heating is advised.

Dipping room should be well ventilated to the open air. Special inquiry should be made as to the mixtures comprising the dipping fluid, and place of storage of main supply.

An ample supply of pails of sand, chemical extinguishers, and blankets should be at hand. A mixture of sawdust and bicarbonate of soda should be available in pails. Steam jets or automatic sprinklers are also advisable.

INSPECTION OF ASH PANS AND SPARK ARRESTERS.

The following rules are given for the care and inspection of ashpans and spark-arresting appliances in locomotives:

1. A careful and thorough inspection of every part of the spark-arresting appliances in front end of locomotives must be made every time the front end door is opened for whatever purpose, but at intervals of not more than seven days, and at the same time, the ashpans, hoppers, slides, or other apparatus for dumping cinders, and dampers must also be inspected. Observe if the slide or hopper operates properly and closes tight. When conditions, such as extreme drought, or the state of adjoining property or crops require it, this inspection must be made at least once every 24 hours.

2. A record of condition on arrival must be made under the proper heading on an approved form, immediately following each inspection, with the date made, together with a complete statement of any repairs or renewals required. The above record to be made and signed by the person who made the inspection.

3. Nettings and spark arresters must be put in perfectly tight and serviceable condition before the locomotive is put into service. Renew netting and plates in front and when worn thin or defective, instead of patching them. Ashpans and hoppers must be tight and dampers, slides, or apparatus for dumping cinders must be in good working order, closing tight.

4. Record of repairs and renewals made must be entered under the proper heading on an approved form when repairs have been made, with the date; the entry to be made and signed by the person doing the work.

5. These are the minimum requirements and local conditions or regulations requiring additional precautions are not affected hereby.

HANDLING, STORAGE, AND TRANSPORTATION OF COTTON.

New or remodeled cotton platforms should preferably be detached, that is, located 80 feet from depots and other buildings, and when located on grade or curve when over 100 bales capacity, it is desirable to have them protected with roof covered with incombustible material.

Cotton platforms must be equipped with one water barrel and two conical or round-bottom fire pails for each 500 square feet of space, no platform to have less than two fire barrels and four fire pails. Conspicuous "NO SMOKING" signs must be prominently posted and a sufficient number of pike poles and cotton hooks kept convenient for immediate use.

When water connection is convenient, pipe lines should be extended and hose connections or hydrants installed in sufficient number to protect the property.

The utmost care must be used in burning right of way, and in burning crossties or scrap lumber care must be used to have the fire a sufficient distance from track to prevent passing trains which may contain cars of cotton picking up flying sparks.

Each agent must personally see that water barrels and buckets are properly distributed and are ready for immediate service, and agents at terminals and large stations must see that all fire-extinguishing equipment, including water barrels, fire buckets, and hose and chemical extinguishers, are in serviceable condition and that conspicuous "NO SMOKING" signs are posted.

Agents must not permit the accumulation of cotton at their station, and whenever it begins to accumulate that fact must be reported to the proper officials.

Agents should make every effort to load all cotton received during the day, but when necessary to leave any accumulation on platform overnight, and particularly when there are 100 bales or more a watchman should be arranged for with instructions to prohibit trespassing and to watch cotton carefully, particularly on and after passing of trains, and to examine closely for fire after passing of each train.

Agents should wherever possible not receipt for cotton delivered after 5 p. m. and under conditions making late loading necessary, extreme care should be exercised with lights.

Caution agents as to the danger of receiving cotton that has been freshly ginned, as there is a liability of spark being concealed in bale in which case fire will burst through at an average period of 48 hours. Cotton indicating heating should be refused and isolated and notice sent to the proper officials giving evidence of heat and the name of the gin from which the cotton was received.

When space permits agents should keep cotton separated by lots on platforms and provide for intervening space for concentrations.

When congestion necessitates ground storage, cotton should be kept separated from platform by intervening space.

Platform space under and around same and tracks adjacent thereto must be kept clean and scrap cotton and other inflammable material picked up.

Cotton must be loaded in closed cars only.

When ventilator cars are used, all vents must be securely closed and if the openings can not be closed spark-tight, the cars must not be used for loading cotton.

When loading cotton, agents must see that car doors facing main track are kept closed, and before car is moved *doors should be closed* and cleated and all openings closed spark tight.

Conductors must not move box cars loaded with cotton until they are satisfied that all openings have been securely closed as above required.

The parking of caboose and boarding cars within 80 feet of cotton platform should be prohibited.

While in transit, cars containing cotton should be located midway of train, if practicable, and at least 10 cars from engine, and under no circumstances placed next to cars containing explosives.

While in transit, conductors should instruct crew to keep a constant watch on cotton cars and to see that doors remain closed.

Smoking by train crews or others around cars loaded with cotton must be prohibited.

Hot journal boxes on cars containing cotton must be given immediate attention. They must not be allowed to blaze.

Each caboose in cotton territory must be equipped with necessary iron-handled pike poles, cotton hooks, and round bottom or cone-shaped buckets.

Engineman must not work steam when passing cotton if possible to avoid it.

When necessary to use steam, they must work the throttle as lightly as possible.

Engineman must not clean ash pans or shake grates within 100 feet of cotton.

If engine stack starts throwing fire on road, the engineer should call the conductor's attention to it in order that extra precautions may be taken by train crew to guard against fire. Report of the same must be made by conductor and engineer at end of the run.

In case of fire in transit, conductor must stop train promptly unless the burning car or cars can be moved to water tank, or other water supply.

Every effort must be made to put out the fire; if this can not be done at once, the burning car or cars must be cut out and placed where no other property will be damaged.

Train crews will be expected to exercise good judgment in connection with foregoing rules for the reduction of fire loss.

The use of platforms for weighing and storing cotton before offered for shipment and bill of lading issued, should only be permitted by specific directions of Federal Managers.

Loafing or loitering around cotton platforms should be prevented.

No person should be permitted to discharge fire works near or around place where cotton is stored.

Car inspectors should not pass cars of cotton when car is not spark-tight.

Due consideration may be given to the provisions of such of these rules as may not require a strict compliance where oil is used exclusively for fuel in locomotives.

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