**POLICE DEPARTMENT.**—The department is under the supervision of a single commissioner, Stephen O'Meara; William H. Pierce, superintendent, is the executive head. Active force, 1,473.

**Equipment.**—A 2-horse patrol wagon, carrying ropes and a stretcher, is stationed in each of the 16 districts. The signaling system, under the direction of John Weigel, consists of 462 patrol boxes on 60 all metallic, normally closed circuits. Boxes are equipped with telephones on separate telephone circuits. Department telephone lines connect each police station with headquarters, the latter having connection to a public telephone exchange through eight trunk lines, and with the fire department exchange through one trunk line. Patrolmen report at least once an hour.

**Fire Service.**—Alarms of fire are received on gongs at all police stations, and a patrol wagon with 2 to 5 men responds to fire alarms; if more men are needed the officer in charge telephones to his station house and assistance is sent from adjacent districts. Fire lines are established and co-operation with the fire department is good.

**PUBLIC SERVICE CORPORATIONS.**—The Boston Elevated Railway Company maintains 6 emergency wagons, one of which responds with a crew to all fires where the property of the company may be involved. They assist the fire department by cutting the wires or shutting off current when requested. Alarms are received at the emergency stations on gongs and their emergency wagons, several of which are motor trucks, have right of way on the street over ordinary traffic.

The Edison Illuminating Company receives alarms at its office and sends one or more men to all large fires; in the downtown districts a man is sent on first alarms. They report to the officer in charge and execute his orders.

The Boston Consolidated Gas Company receives alarms and sends a man to all fires, who reports to the officer in command.

The public service corporations render proper assistance at large fires.

**TELEPHONE SERVICE.**—The New England Telephone and Telegraph Company, with 14 exchanges in the city, supplies service to about 75,000 telephones, more than 53,000 of which are connected to exchanges in or near the business districts. One-, two- and four-party lines are used, a majority being 1- and 2-party lines; some coin-box service is also supplied. The Main and Fort Hill exchanges and the general company offices are in an 8-story fireproof building in the congested value district; three other exchanges are in fireproof buildings having exposed windows of wired glass in metal frames; the outlying exchanges are in joisted brick buildings. Internal hazards in all exchanges are well guarded, and good private fire protection is provided; fire brigades are organized among the employees at exchanges.

Wires are underground throughout the specified underground district; circuits are properly protected. During 1910 about 43 per cent. of the total alarms were received by telephone. The use of telephones for reporting fires is confined mostly to residential districts.

**LOCAL ALARM SYSTEMS.**—The Boston Automatic Fire Alarm Company maintains automatic fire alarm and sprinkler supervisory services; there are 495 thermostat installations, and 120 water flow and 18 sprinkler supervisory services.

The central office is at the present time in the same joisted brick building as five years ago, but will be moved in a short time to new quarters in a 12-story office building of fireproof construction. All wiring will be in conduit, all instruments mounted on incombustible bases with switchboards of slate or marble. The building is equipped with inside standpipes and hose, chemical extinguishers and fire doors between sections, but window protection is not provided on street sides and the interior trim is of wood. Alarms are automatically recorded by a pen register and sounded on a tapper bell, there being two pens on the register on each circuit for recording signals. The alarms are transmitted to gongs in the fire and protective department stations by means of a manual 5-dial transmitter, and are recorded in the central office by a tape register and indicated on a circuit annunciator.

Eleven alarm circuits and switches provide means of sending alarms to the fire stations nearest the location from which an alarm is received. Fire alarm headquarters is notified of all alarms by telephone, immediately on their receipt. Two or more operators are always on duty, and at night a trouble man is at the central office; other trouble men can be called at any time by telephone. Circuits are automatically tested every 15 minutes, and installations are inspected monthly by the company and semi-annually by the underwriters. All installations require the approval of the Boston Board of Fire Underwriters.

Thermostats are 12 to 15 feet apart in the old equipments and about 10 feet apart in the newer ones; when installed in connection with automatic sprinkler systems, a thermostat is placed near each sprinkler head. Wiring in the newer equipments is well installed but in the older systems, cotton-covered office wire is used. Wires are underground, except in outlying sections and from distributing boxes in block interiors, from which they are run along buildings to service entrances. Both paper and rubber insulated cables are used and are in ducts with low-tension wires only. Both closed and open, metallic circuit systems are in use. The alarm circuits are all-metallic and normally closed, and heavy battery is used in sending alarms. A manual alarm box is put on each floor of the buildings protected; these are on separate circuits.

The sprinkler supervisory systems include water

flow, gate valve, pressure or gravity tank alarms, which are received on a tape register and tapper bell. Wiring on the premises of subscribers is almost entirely in conduit. Water-flow alarms are transmitted to the protective department; subscribers are notified of all alarms and their cause.

During 1910, 173 automatic alarms were received.

The Auxiliary Fire Alarm Company maintains auxiliary fire alarm systems which are connected with 50 fire alarm boxes on the municipal system. The older installations are of open circuit type; those of more recent date employ closed circuits. Wiring is well installed and in conduit inside of buildings, in the newer equipments; outside annunciators and local gongs are installed with the larger systems. Each system, including the fire alarm box, and all inside stations, is inspected and tested by an employee of the company at least once a month.

Fire alarms are received at the company's office on a register and tapper and the municipal fire alarm office notifies an inspector of the company when an alarm has been received from an auxiliarized box. The inspector immediately goes to the box after an alarm and sees that the system is in condition for sending before leaving.

**CENTRAL STATION WATCH SERVICE AND SPRINKLER SUPERVISORY SYSTEMS.**—The American District Telegraph Company maintains central station watch, fire alarm and sprinkler supervisory systems. The central office is in an office building of fireproof construction without window protection. Standpipes and hose and chemical extinguishers are installed on each floor, and chemical, dry powder and Pyrene fire extinguishers are kept in the company's quarters which are on the ground floor.

There are 112 subscribers to the watch and fire alarm service, using 1,977 boxes, nearly all of which are of approved types. There are 53 box circuits working on the McCullough system, used exclusively for this service; all but three connect less than 41 boxes when serving more than one subscriber.

Signals are received on tape registers and flash lamps on local circuits. A manual transmitter is used to send alarms to fire alarm headquarters, where they are received on a tape register, and to a tape register and gong in each protective department station. A direct telephone line to the fire alarm headquarters is used to confirm all alarms.

Each installation, including all the boxes, is inspected once a month; a test alarm is sent out by the transmitter daily and telephones are tested twice daily. Box circuits are under constant test for opens and grounds.

There are 22 subscribers to the sprinkler supervisory service; 3 installations include water flow alarms only; the others variously include water flow, gate valves closing, high and low water, pressure and temperature alarms. Signals are received on pen registers, two being connected on each circuit. Water flow alarms are transmitted to the protective department by telephone. A manual fire alarm box is not included with these equipments where an automatic alarm system is installed in the same building. Equipments are inspected once a month and reports of all signals are sent to the local underwriters and to subscribers. Installations of both services require the approval of the Boston Board of Fire Underwriters. Wiring in all recent equipments is in conduit and of No. 16 single-braided rubber-covered copper wire; in older equipments of the central station watch service it is variously of duplex lead covered cable, in wooden moulding, partly in conduit or open work. Most of the outside circuits are underground, of No. 16 copper wire with rubber or paper insulation, and in ducts with low-tension signaling systems only. From distributing boxes in block interiors, wires are strung along buildings, using No. 14 double-braided rubber-covered copper. Overhead lines are partly in cables of No. 16 paper-insulated copper wire in lead sheathing. Fuses are installed at subscribers and at the central office. Current is supplied from storage batteries in duplicate sets.

A force of 25 men is on duty at night including 10 watch service register clerks and 8 patrol men and runners.

**NOTIFICATION COMPANIES.**—The Boston Fire and Police Notification Company, with about 600 subscribers in addition to those of the watch service, receives all bell, still and watch service alarms. The Boston Fire Patrol, with about 700 subscribers, receive bell, still and A. D. T. alarms; they maintain a watchman service, including two rounds nightly in some buildings and call up regular watchmen at stated hours for identification. Both companies notify subscribers when fire threatens their property.

**OUTSIDE AND MUTUAL AID.**—An arrangement is now being worked out whereby Boston and the surrounding towns and cities will mutually assist each other at times of large fires. At the present time Boston sends an engine on first alarms from certain points in Chelsea, Somerville and Milton, gongs or tappers on the fire alarm systems of these places being installed in the nearest Boston fire stations. Engines are sent to Boston from these places on alarms from points near the city limits. Under the proposed arrangement, tappers or gongs on the Boston fire alarm system will be installed in fire department quarters in Winthrop, Revere, Chelsea, Everett, Somerville, Cambridge, Watertown, Newton, Brookline, Dedham, Hyde Park, Milton and Quincy, and apparatus from these places will come to Boston on or before a general alarm and take stations in districts adjoining their

own towns or cities, where gongs or tappers connected with their respective fire alarm systems will be installed to enable them to answer alarms whether in Boston or in their own districts.

This arrangement will provide for 11 engines, 1 ladder truck and 3 hose companies moving in from outside on a general alarm, and make 21 engines available to protect the city after a general alarm, as against 7 at the present time; 14 ladder trucks as against 11 at present, 9 chemical engines and 3 hose wagons where 7 chemical engines are now available. Some of the departments in the towns and cities which do not adjoin Boston will assist by protecting parts of the cities which have sent companies into Boston.

The following cities outside of the Metropolitan district could send assistance within two hours:

| City. | Distance, Miles. | Number of Engines. |
|---|---|---|
| Brockton | 20 | 6 |
| Lawrence | 26 | 4 |
| Lowell | 28 | 6 |
| Haverhill | 34 | 5 |
| Worcester | 44 | 8 |
| Providence | 45 | 17 |
| Fall River | 51 | 6 |
| New Bedford | 57 | 8 |

Hose couplings used in all except the two latter places will fit Boston hydrants. Special and universal couplings have been provided for use of out of town engines.

The proposed mutual aid will be of great value to all cities and towns in the Metropolitan district.

# STRUCTURAL CONDITIONS AND HAZARDS.

## BUILDING DEPARTMENT.

**ORGANIZATION.—General.**—A department for the survey and inspection of buildings in Boston was created by State law in 1871; fire limits were established by ordinance in the same year. By an amendment of 1907, the executive head of the department, the Building Commissioner, is appointed by the Mayor for a 5-year term. The Commissioner must have had at least five years experience as an architect, a builder or a civil engineer. He is required to grant permits for the construction, alteration, removal or tearing down of buildings or structures and for plumbing, gas fitting and the maintenance of steam boilers and furnaces, when applications are made and filed and proposed construction conforms with the laws; he, or one of his inspectors, must examine as often as is practicable every building in course of construction or alteration, make a record of violations and of all other matters relative thereto; he is also required to examine buildings reported as dangerous and those damaged by fire or otherwise. Persons appointed by the commissioner as inspectors of construction must have had at least five years' experience as builder, civil engineer, architect or as a superintendent or foreman or a competent mechanic in charge of construction.

**Personnel.**—Mr. Arthur G. Everett was appointed building commissioner May 1, 1908, prior to which time he was a practising architect; he was secretary of the board of appeal for 15 years. There are also a clerk of the department and 18 building inspectors, including a supervisor of plans, plumbing and gas fitting inspectors, office clerks and constables, making a total force of 61.

**Permits and Appeals.**—A permit from the building commissioner must be obtained before the construction or alteration of any building or structure may be commenced. The application for permit must be made on a printed form furnished by the commissioner, giving a full description of the proposed construction. Plans, in duplicate, are required to be submitted with the application, and one set remains as a permanent department record.

Appeals may be taken to a board of appeal when the commissioner refuses a permit or when a person has been ordered by him to incur any expense. This board consists of five members, appointed by the mayor for 5-year terms, the term of one member expiring each year; four members of the board are appointed from candidates nominated by real estate exchanges, societies of architects and civil engineers, master builders and contractors associations and by the building trades council. Methods of construction or maintenance equivalent to those required by the provisions of the building law may be allowed with the written consent of the commissioner and the board of appeal.

**Inspections.**—Inspections of buildings in course of construction or alteration are made as occasion demands, the number of visits depending upon the importance of the building and the condition found at the time of the previous inspection; the figures given in the annual reports of the commissioner indicate that inspections are numerous.

**Records.**—Applications for permits and plans of buildings are permanently filed, the latter in fireproof vaults. Inspectors' records of inspections, in comprehensive note book form, are filed and records of department business are duly entered in a book; adequate indexes are maintained. Partial fireproof filing facilities are provided.

**BUILDING LAWS.—General.**—The present building law is an act of the State Legislature in effect August 1, 1907. Building regulations were

first passed in 1679; these have been repealed, amended and amplified many times.

The compilation of the present law was largely made by a local architect and an engineer, members of a paid commission of eight members appointed by the mayor; the other members consisted of a lawyer, a builder, a former building inspector, a labor union representative and two representatives of the real estate interests. It deals with the organization of the building department, the duties of the commissioner and inspectors, the granting of permits, and provides for a board of appeal which has authority to decide questions which have been ruled upon by the commissioner and have been protested.

It is fairly comprehensive and deals with the various types of construction, except mill and slow burning, covers plumbing and has exhaustive requirements for theatres and tenements. Fireproof construction is required for buildings over 75 feet in height, for those used for habitation and more than 5 stories, or 65 feet, in height or exceeding 5,000 square feet in area, and for theatres. Building heights must not exceed two and one-half times the width of bordering streets and must be not over 125 feet in any case. Undivided floor areas of joisted brick buildings must not exceed 10,000 square feet; those of fireproof construction may exceed this amount when the building has a frontage of more than 50 feet on each of two streets and is equipped with automatic sprinklers.

Wooden buildings are limited to 45 feet in height and must not be nearer than 3 feet to any adjoining lot line and not nearer than 6 feet to any adjoining building unless the side wall is of brick or concrete, 8 inches thick and parapetted; frame ranges are required to have an 8-inch, parapetted brick or concrete wall between adjoining houses.

When used above the first floor for mercantile and storage purposes, all fireproof buildings and all joisted buildings more than 3 stories high must have vertical openings protected by fireproof enclosures; such enclosures must have automatic doors and all glazing in same must be with wired glass. Windows exposed at a smaller distance than 20 feet, in buildings over 30 feet in height must be protected by tin-clad shutters or be of wired glass in metal frames. The provisions covering wall thicknesses, concrete construction, parapets, openings in division and party walls, and fire stops, lack detail. The required protection for structural steel is below that usually required; private fire protection in the way of standpipes and automatic sprinklers is required only in theatres and buildings of large floor area. The law in general, while containing numerous good requirements, is meagre in many of its provisions, lacks detail, and is vague or conflicting in providing power of enforcement.

**Enforcement.**—In so far as could be judged at the time of inspection the enforcement of the laws appears to be fairly good, although the force of the department provided for inspection and supervision is manifestly inadequate.

**Fire Limits.**—These are known locally as building limits and, as shown on the accompanying map, include between Fort Point Channel, Boston Harbor, the Charles River and bounding street lines on the south approximately two miles from the city hall, excepting that portion south of Dover street, between Albany street and Fort Point Channel. Within these limits frame buildings are prohibited, except wharf and market sheds not exceeding 27 feet in height, temporary sheds for construction purposes, and coal and grain elevators, covered with slate, tile, metal, or other incombustible material. Outside the fire limits, incombustible roof construction is not required.

**Proposed Amendments.**—In January, 1911, a bill was introduced in the legislature to amend the building law. The proposed amendment provides that joisted brick buildings used for habitation be limited to 2,500 square feet in area; that frame buildings used for habitation be limited to 2,000 square feet; that adjoining wooden buildings be separated by 20 feet, unless the side walls are of brick or concrete; that all new frame buildings have incombustible roof coverings and that roofs on existing buildings may be renewed only with incombustible coverings, to the end that on or before January 1, 1925, all frame buildings shall be so covered, and that the fire limits be materially extended.

**LOCAL CONDITIONS.**—The congested value district, the combined block area of which covers 215 acres, contains approximately 2,792 buildings of fireproof, mill or slow-burning and joisted brick construction; there are also a number of frame buildings.

One hundred and ninety-four buildings, covering 16 per cent. of the area built upon, are of fireproof construction. Records of the Boston Board of Fire Underwriters show that of 122 fireproof buildings erected in the city during the past 5 years, including those built in the congested value district, 88 have steel frame, with terra-cotta floor arches or floors of reinforced concrete, 23 have brick walls and reinforced concrete columns, beams and floors, and 11 are entirely of reinforced concrete construction. Most of these are office buildings, but there are several mercantile and storage warehouse buildings and theatres. Areas are small to excessive, the largest being a 7-story department store covering 46,100 square feet. Seventy-three per cent. are 9 stories or less in height; 52 buildings are higher, the highest being 13 stories. Vertical openings in the newer buildings of mercantile occupancy are generally protected; window protection, either of wired glass or shutters, is present in considerable number, but is not general. Six buildings are equipped with automatic sprinklers, and about 94 with inside standpipes. The number of these buildings has increased by 46, or 31 per cent.,

and in proportion to the area covered, by 26 per cent. since the inspection of 1905.

About 132 buildings, covering 9 per cent. of the area built upon, are classed as mill or slow-burning construction. A number of these are of standard mill construction, but for the most part they are deficient on account of the use of unprotected steel columns and girders and the close and non-standard spacing of beams; a large proportion of these buildings have protected vertical openings, and windows are generally protected, except where buildings front on the numerous narrow streets.

The remaining 75 per cent. of area built upon is covered by buildings of joisted brick and frame construction, the latter being of minor importance. There are about 2,466 joisted brick buildings; many are heavy joisted. Fifty-nine per cent. are 4 stories or less in height, and 40 per cent. are 5 or 6 stories; twenty-six buildings are 7, and three are 8 stories high. Areas range from small to excessive, the majority being moderate; among the largest are a 6-story department store of 52,000 square feet and a 6-story hotel of 34,000 square feet. Much of this construction is old, with light walls and low parapets, many not exceeding 6 inches in height. Unprotected stair and elevator openings are numerous, especially in the old buildings. The amount of window protection ranges from small to fairly adequate in the different sections of the district, except that in many places it is lacking where needed on account of the narrow street width.

There are 107 operative automatic sprinkler equipments in buildings of joisted brick and mill construction, and 6 in fireproof buildings; all but seven have two sources of supply, and a number of them are further provided with connections to private fire pumps. One hundred and forty-nine buildings are provided with inside standpipes and hose, and a large number have automatic fire alarm systems.

The frame construction is on the outskirts of the district and usually in small areas and of low to moderate heights, occupied as stables, woodworkers and small mercantiles.

**CONCLUSIONS.**—The building laws deal with numerous matters of importance from a fire protection standpoint, and are an improvement over the former laws, especially in regard to protection on badly exposed windows, but as this is not required on old buildings, the material benefit from this regulation is remote. The protection required for vertical openings and the restriction of heights and areas are excellent, but the permitting of frame market and wharf sheds within the fire limits, and the lack of restriction of the use of shingle roofs outside these limits are features of especial danger to the city. The fire limits have not been extended since 1881, and cover no part of the congested suburbs or the hazardously located lumber district. The provisions of the laws relating to structural steel construction are deficient in that they omit details, do not always require roof members to be fireproofed, and allow protection of steel to be below present day standards. Considering the increasing use of reinforced concrete construction, the regulations are lacking in that they do not specify provisions for the mixing of concrete, that limiting proportions of mixture are indefinite, and other necessary matters are left to be passed upon by the commissioner, thereby encumbering him with unnecessary details. Requirements for standpipes apply only to theatres, and for automatic sprinklers, to theatres and buildings of excessive area. "Reasonable means of egress in case of fire" is specified, but outside fire-escapes with standpipes are not required. The building department has not been strengthened since 1905, but the laws in their application to fire protection appear to be fairly well enforced.

Construction in the congested value district is mostly joisted brick, but a considerable portion is of mainly well designed fireproof type; in the older buildings, conditions are poor to fair. Outside of the fire limits, with the exception of some wharf and warehouse properties, construction is practically all frame.

## EXPLOSIVES AND INFLAMMABLES.

**ORGANIZATION. — Supervision.** — A State law of 1904, amended at various times, confers and imposes the power to regulate the storage, sale, manufacture and use of explosives and inflammables upon the detective and fire inspection department of the State District Police. The Chief of the District Police has, by authority given him, designated the Fire Commissioner as the city official to grant permits for the keeping, storage, manufacture and sale of explosives in accordance with rules and regulations established by the District Police. The Board of Street Commissioners has, by ordinance, the power to grant licenses permitting the use of buildings or structures for the keeping, storage, manufacture or sale of explosives and inflammables.

**Personnel.**—Mr. J. H. Whitney is chief of the district police; Mr. George C. Neal has been deputy chief since 1904 and is in charge of the detective and fire inspection department; Mr. Chas. D. Daly is fire commissioner, and Mr. Salem D. Charles, chairman of the board of street commissioners. Deputy chief Neal has 8 inspectors, 3 of whom are assigned to the work of the department in Boston. There are four inspectors of petroleum, appointed by the mayor, who make tests of deliveries when received at the local storage plants and at other times when their services are requested by dealers; they are not required to devote their entire time to this work.

**Licenses and Permits.**—An application for a license to keep or handle explosives and inflam-

mables must first be made to the board of street commissioners; this application is referred to the fire commissioner, and an examination and report as to the suitability of the premises is made by a district chief of the fire department; this report being favorable, a license may be issued by the street commissioners, after a public hearing. Applications must also be made to the fire commissioner for permits to keep explosives as to quantity; permits for inflammable fluids are issued by the district police. Licenses and permits are not required to be renewed yearly, provided occupants file annually a certificate of registration with the proper officials, stating their disposition to continue the use of buildings for the same purposes.

**Inspections.**—District chiefs of the fire department make inspections of all premises, prior to the issuing of licenses, and inspections of buildings as to construction and care of premises are continually being made by officers of the fire department in their several districts; reports of hazardous conditions are made to the fire commissioner, who requests their removal. A member of the fire department is permanently assigned as an "explosives detail," and devotes his time to the inspection of premises where explosives and inflammables are kept. He pays particular attention to the supervision of the transportation within the city limits. The district chief whose district covers the garage section of the city makes frequent inspections of such places handling gasolene. Very few inspections are made by the district police. Suitable records of inspections made by the "explosives detail" are filed with the fire commissioner.

**LAWS AND REGULATIONS.—General.**—The State law places the supervision of explosives and inflammables in the hands of the district police, and gives them authority to make regulations for the keeping, storage, sale or other disposition of such substances. Regulations for a number of substances have been made, those governing the transportation of explosives, under date of 1907; for the keeping, storage, manufacture, sale and use of explosives, in 1909, and for the keeping, storage, transportation, manufacture, sale and use of fireworks and firecrackers in 1910. The State law of 1902, governing oils, is still in force; regulations to provide for their use, in detail, are now being prepared. The principal provisions of the laws now in force are the following:

**Explosives.**—Four hundred pounds of high explosives and 600 pounds of gunpowder may be stored together in a magazine on land, if authorized; if stored separately, 1,000 pounds of high explosives and 1,500 pounds of gunpowder may be kept. The location of magazines with reference to buildings, waterways, other magazines and exposed places, is regulated by a comprehensive table of distances in accordance with English standards, materially increased; provisions for construction and protection of magazines are good. Gunpowder for retail may be kept in stores in amounts not exceeding 25 pounds in tin or copper canisters, suitably located; five pounds may be kept in any building or other structure that is not used as a dwelling. Large quantities of high explosives and gunpowder must be stored on magazine boats in the harbor, anchored at designated points; the maximum amount allowed is 10,000 pounds, except when the boat is used exclusively for such storage, when the limit is 50,000 pounds. The restrictions over the storage, sale and manufacture of detonators, fixed ammunition, and the use of explosives in blasting, are good. The regulations covering transportation of explosives through the streets provide adequate restrictions.

**Fireworks and Firecrackers.**—A State law of 1910 prohibits the storage and use of blank cartridges for celebration purposes and of firecrackers more than 2 inches in length and 3/8 of an inch in diameter, or of a greater explosive power than a firecracker of such size containing black powder only. The discharge is prohibited except on July 4th and June 17th, except by permit from the fire commissioner. From June 10th to July 10th, common fireworks to the amount of 800 pounds, and special fireworks to 400 pounds, may be stored and sold at wholesale after obtaining a permit; during the remainder of the year one-third of these amounts may be stored in buildings outside of the fire limits. During the same period, amounts for retail must not exceed 200 pounds of common and 100 pounds of special fireworks; and at other times, one-third of these amounts. Restrictions on the nature of the occupancy with which fireworks may be stored in combination are also specified.

**Combustible Fibres.**—The fire commissioner is required by city ordinance to cause to have examined all places where shavings or other materials liable to cause fire are kept. When he deems them to be kept in a dangerous manner, he is authorized to cause their removal at the expense of the occupant, in case of the refusal or neglect of the latter to do so on request.

**Oils.**—A city ordinance and a State law provide that petroleum, camphene, burning fluid, or naphtha, shall not be manufactured or kept in the basement or upon the first floor of a wooden building, nor upon any street or wharf; all such fluids kept above the cellar must be in metallic vessels securely closed. These substances must not give off a gas under 100 degrees Fahrenheit, nor ignite at a temperature of less than 110 degrees. All kerosene and every product of petroleum for illuminating purposes kept for sale must be inspected by a city oil inspector.

Regulations of the district police limit the amount of gasolene, naphtha or benzine in drug stores, no part of the building being used as a dwelling, lodging-house or place of assembly, to 2 gallons, and if the building is used for any of the

above purposes, to 1 gallon; gasolene at garages is limited to 560 gallons, except by special permit, and when in excess of 10 gallons, must be kept in self-closing safety tanks, portable filling tanks, or underground, preferably outside the buildings. Specifications are provided for the construction of tanks and for piping; these are of a preliminary nature and have not been issued as official. Permits for storage are issued by the deputy chief of the district police, after examination and with special regard to location and use.

**LOCAL CONDITIONS.**—No dynamite or other high explosive is manufactured within the city, and none was found in the business district. Explosives to the amount of 38,000 pounds have in the past been stored in boats located in the harbor; the deputy chief of the district police, in February, 1911, ordered the amount reduced to 15,000 pounds. The transportation of dynamite from the storages on the harbor boats through the city streets has been prohibited, with the idea of having the city discontinued as a distributing centre for explosives. Gunpowder was found in a few instances in sporting goods stores, the largest quantity being about 25 pounds; conditions of storage, as to quick removal, are good. Several sporting goods houses carry, in season, stocks of fixed ammunition up to one carload in amount. Calcium carbide in the congested value district is kept in small package lots, stored in metal container, and this class of storage was noted at several garages. Wholesale grocers keep matches in carload lots; a wholesale match warehouse, 5 stories high, occupies each floor for storage, the total quantity being about 20 carloads. Printers and small dry-cleaners carry gasolene in small quantity, usually in safety cans; most of the dry-cleaning is done at establishments well outside the business district. Wholesale dealers and jobbers keep kerosene and lubricating and illuminating oils in 1- to 40-barrel lots and dispose of them in original packages. One retail establishment has four 100-gallon drums, one each for gasolene, benzine, naphtha and other volatile oil, and several barrels of gasolene for delivery in original packages, with good condition of premises. A second has a 400-gallon underground tank for gasolene, and a 300-gallon tank for kerosene inside of building, and, during the day, has from 2 to 12 barrels of gasolene and kerosene in storage; these are removed at night to storehouses outside the business district.

Of the large number of garages and automobile repair shops, about 60 are grouped in a district, several blocks wide, along either side of Columbus avenue, south of Boylston street. Several of these buildings are of fireproof construction and gasolene is stored in underground tanks, fitted with approved pumps; the largest amount of gasolene noted in any garage was 560 gallons. Of the buildings used for these purposes, other than those of fireproof construction, a number are in poor condition, and several auto salesrooms store automobiles with gasolene in machines, the buildings being occupied as dwellings above the first floor. At a retail oil store in the congested value district, two 25-gallon cans of gasolene were kept on the sidewalk, the basement having thirteen 60-gallon tanks of lubricating oils, in addition to several barrels of heavy oils and a few bales of waste.

At the Standard Oil Company's storage plant in East Boston, on Chelsea Creek, two yards containing numerous large metal tanks with bases below the adjoining ground level, are each surrounded by masonry walls 5 or more feet high. A group of buildings for filling, shipping and handling are of fireproof construction. A third yard, with small tanks and joisted and frame buildings, is also comprised in the plant. On account of the detached location, good protection for tanks and superior construction of buildings, the hazard from the tank storage is relatively small; the smaller yard severely exposes the buildings of the gas works and of a fertilizer factory. A second oil storage plant of small size is isolated on Massachusetts avenue near Magazine street, and offers no hazard. An oil works and refinery at First and E streets, South Boston, occupies the larger part of a city block, having several 3-story frame tenements in one corner. The plant includes numerous tanks for storage, stills, and brick buildings for filling and cooperage. The ground surface of the plant is below the graded street levels and any oil overflow should be retained, but the plant as a whole is a serious exposure to congested frame 3-story flats and manufacturing plants on two sides.

**CONCLUSIONS.**—The State police have only in part fulfilled the duty of drafting regulations for the handling of dangerous materials; those covering gunpowder and high explosives, fireworks and firecrackers are good, but those applying to inflammable fluids and other substances are temporary and incomplete.

The inspections made by officers of the fire department are systematic and of great value in giving them a knowledge of the location of hazardous substances. They appear to be effective, as local conditions were found to be good insofar as the substances covered by the laws are concerned; however, the necessity for adequate laws regarding handling of inflammable oils is very apparent.

The maintaining of small oil storage warehouses in the business district, permitted by the present system of registration, and of automobile repair shops in buildings of ordinary construction, more than 1-story high, together with outdoor handling and retailing of gasolene, are features which are apt to lead to undesirable results. The wholesale oil storages vary, from presenting no hazard to one of moderately severe exposure.

# ELECTRICITY.

**ORGANIZATION AND CONTROL.—General.**—A State law of 1894 creates a department of wires in the City of Boston, and provides for the appointment of a Commissioner of Wires by the Mayor for a 3-year term. The Commissioner has exclusive authority over all outside and underground wires, and all inside wires designed to carry electric light or power current. The department is divided into divisions; the interior division, under a chief inspector, supervises wiring inside of buildings, and the exterior division, also under a chief inspector, has charge of all street construction, both overhead and underground. A laboratory is maintained for testing electrical fittings and apparatus.

The Boston Board of Fire Underwriters maintains an electrical department, which consists of a chief inspector, who also has charge of automatic sprinkler equipments, and four assistants.

**Personnel.**—Mr. James E. Cole has been commissioner of wires since 1908; he has been in the department since its inception in 1890, having been chief electrician and chief inspector of the interior division prior to his appointment as commissioner. Mr. Walter J. Burke was appointed chief inspector of the interior division this year, having previously been assistant chief inspector since 1908. Mr. Peter F. Dolan is chief inspector of the exterior division. The interior division has a force of 12 inspectors, including the chief, and the exterior division a force of 17 inspectors and 2 engineers.

**Permits.**—Notification of intention to commence the wiring of any building must be sent to the department by contractors before any work is started. After satisfactory completion of work, permits to supply current are issued to the lighting company. Temporary permits are occasionally issued for a partial equipment. Certificates of approval are issued only on request.

**Inspections.**—New interior installations are inspected during installation and on completion. Old work is usually inspected by the city in connection with new work or when defective conditions are reported. Department stores are inspected monthly and theatres weekly, and a detailed inspection and report on the latter each month. The inspectors of the exterior division inspect all new work and maintain general supervision over overhead and underground wiring during construction.

The underwriters are notified by contractors of new work, and all work to be concealed is inspected by them during installation, but only a small amount of open work is inspected. Old work is inspected when attention is called to particularly bad conditions.

**Records.**—Comprehensive reports of all inspections, certificates, and other details which facilitate department work, are kept. Detail plans of underground and overhead work are systematically filed, and complete card catalog index records are maintained. The records of the department are complete and well kept.

**LAWS, ORDINANCES AND REGULATIONS.**—The State laws make the commissioner of wires the sole judge of what constitutes proper insulation and of the safe installation of electric conductors and appliances within buildings, and he is authorized to make such rules and regulations as may be deemed necessary for safety. The rules and requirements, as made, embody the National Electrical Code, with some slight changes. Current may not be supplied to any wires that are to be used for electric light, heating or power, without permission from the commissioner, and a penalty is provided for violation. The commissioner is authorized to have the current cut off from any installation which he considers unsafe.

The National Electrical Code is enforced by the Boston Board of Fire Underwriters.

A State law of 1894 required that, before 1900, all wires, except long distance telephone wires and trolley wires, must be underground in that part of Boston proper north of Dover and Berkeley streets. State laws of 1898 and 1908 require that in each year from 1900 to 1919, inclusive, the commissioner must select two miles of streets outside of the above district, wherein he shall cause to be placed underground all wires, except those previously mentioned, or such as are carried on elevated railway structures.

**INSIDE WORK.**—In February and March, 1911, examinations of about 50 inside electrical installations were made by a National Board engineer to ascertain the quality of the supervision maintained and the general condition of electric wiring for light and power; these equipments included those in process of installation, or recently completed, and some old work. A large amount of new work is being installed in conduit or in metal moulding. The new work showed an excellent class of workmanship, indicated frequent inspection and efficient supervision, and the use of the more recently approved fittings and materials; about the only defect noted was that flexible pendant cords were too long in a few cases. As there have been extensions or alterations to numerous old equipments, in which cases the entire installation has been brought up to a comparatively safe condition, the general condition of much of the old work is fair to good, although there has been no complete and systematic reinspection of old wiring in any special section or district. There are more than 300 private plants supplying current for individual buildings or groups of buildings.

**OUTSIDE WORK.**—All wires required to be placed underground in the specified district and as required yearly, have been so placed; services from the underground system, as a rule, enter the buildings underground, but a few are brought up in the

interior of blocks and distributed overhead. There are, however, more than 300 miles of streets with wires overhead.

Overhead light and power wires have triple-braided, weatherproof insulation, in fair to good condition. In the underground district, transformers are usually in manholes, a few are in fireproof vaults in buildings; in the overhead district they are on poles. No series arc lighting circuits enter buildings; the maximum voltage of circuits of this class is 8,500 volts, direct current. Signalling systems are properly protected by fuses.

The Edison Electric Illuminating Company furnishes current for commercial light and power; this is generated at two stations in the congested value district and at one in South Boston. Except for 13,200- and 6,600-volt transmission lines to some outlying towns, which are underground in the more thickly settled parts of the city, the maximum primary voltage is 4,500, alternating current. This is transformed first to 2,250 volts and then to 110-220 volts.

The Boston Elevated Railway Company operates the subway and elevated lines and the electric street railways with rail return; return feeders of about one-third the capacity of outgoing feeders are installed. On those streets within the prescribed underground district on which the transportation lines are elevated, feeders are carried on the elevated structures.

The following companies maintain low-tension or signalling systems; New England Telephone & Telegraph Company, Western Union Telegraph Company, American District Telegraph Company, Postal Telegraph and Cable Company, Boston Automatic Fire Alarm Company, Boston Auxiliary Fire Alarm Company, Boston District Messenger Company, Mutual District Messenger Company, Stock Quotation Telegraph Company, United Telegram Company and the municipal fire and police departments.

**ELECTROLYSIS.**—The City, the Metropolitan Water and Sewerage Board and the traction company make continual tests for current on the water pipes, and are endeavoring to reduce trouble from this cause to a minimum. Within the past few years, several instances of damage have appeared; at Waltham and Washington streets, a section of 12-inch water main was found to have disintegrated from electrolytic action; in Callahan place, Brighton, two holes about 1½ inches in diameter were found in a 6-inch main, probably due to electrolysis as this main was in the vicinity of a large power house. Several years ago the pipe lines crossing Chelsea Creek, between Chelsea and East Boston, were found to be especially subject to disturbance, and at one point a hole was cut through a pipe while making an examination. The city has detailed a man to make tests at certain stations where current is known to be flowing and to gather other data in regard to this work.

The Metropolitan Water and Sewerage Board is equipping all new pipe lines of their system with insulating joints at intervals of about 500 feet, wooden staves being substituted for lead and jute in making the joints, as the rubber gaskets formerly used as insulating material were found to have failed. At the wooden insulated joints a by-pass wire is arranged so that measurements of the efficiency of the joints may be made; the information obtained indicated that the amount of current flowing on the pipe lines so equipped is less than 10 per cent. of the quantity which would flow if the joint had not been used. The Boston Elevated Railway Company has one man who devotes nearly all his time to making tests for leakage and to making examinations of trouble and damage reported to sub-surface metals. The company aims to make tests of the bonding of its system at least once a year, making repairs where necessary. The traction company has a working agreement with the telephone company, electric light company, one telegraph company and one central station watch service company whereby any trouble found by either of the latter is brought to their attention and a remedy agreed upon.

**CONCLUSIONS.**—The inspection of electric wiring is under good municipal control; the underwriters inspection department is well organized and adds to the improvement of general conditions. The municipal department, under a very progressive and capable official, is organized to efficiently supervise inside, outside and underground wires, and the laws are adequate. Enforcement is good and new wiring is in good condition; old wiring in buildings of special occupancy is inspected regularly, but no systematic inspection of old wiring in general has been made. The extensive underground section, with provisions for its increase annually, is an excellent feature; the supervision maintained over existing overhead wiring is efficient, resulting in a good class of construction. Electrolytic action on water mains has been evident for several years; the various interests concerned realize this, and are endeavoring to reduce the trouble to a minimum.

## CONFLAGRATION HAZARD.

**CONGESTED VALUE DISTRICT.—Limits.**—Beginning at Fort Point channel and Summer street; Fort Point channel, Oliver street extended, Atlantic avenue, South Market, Quincy Row, Mercantile, Richmond, Commercial, Lewis, North, Richmond, Hanover, Endicott, Stillman, Stillman Place, Lynn, Thatcher, Washington, Causeway, Merrimac, Pitts, Green, Cambridge, Bowdoin, Beacon, Park, Tremont, Boylston, Park Square, Eliot, Kneeland, Harrison, Beach, Albany, Kneeland, Atlantic and Summer, to place of beginning.

**General.**—The district lies on the peninsula between Fort Point channel and the Charles river, bordering on the former on its eastern side. It is

irregular in shape, having an extreme length of approximately 5,900 feet and width of half that amount. The district covers 335 acres within bounding street lines; of this, 215 acres is in block areas, 94 per cent. of which is built upon; it is fairly level, although there are a number of short streets with grades of 7 to 10 per cent.; streets are all in good condition. There are no overhead wires except trolley wires to hamper fire department operations. Values range from low to very high, the former being in the northern and northeastern sections and the higher values in the southern and central parts of the district. The district is exposed on the east and north by the wharfs and a congested tenement district, and on the south by residential districts and a minor mercantile district. The Common and the State House grounds serve as effective fire breaks for a large part of the western boundary.

For description, the district is divided into the following five sections, each possessing sufficiently common characteristics to warrant such division.

**First Section.—Market House and Produce.—** Bounded by Atlantic, South Market, Quincy Row, Mercantile, Richmond, Commercial, Lewis, North, Richmond, Hanover, Endicott, Cross, Union, Dock Square, Faneuil Hall Square, Merchants Row, Chatham, Chatham Row, India and Milk streets.

The section is situated in the northeastern part of the district and the occupancy consists of produce commission and market houses and wholesale groceries, with an occasional factory; buildings used as tenements above the first floor occupy the northern part. Values are evenly distributed and are from moderate to high.

Seven buildings are of fireproof and four of slow burning or mill construction; the remainder are joisted brick. Many buildings are old, have light party walls and low parapets and show the effects of age; a considerable number have pitched or mansard roofs with numerous dormer windows. With the exception of 7 buildings which are 7 stories high, two of these being of fireproof type, and two of 8 stories, construction ranges from 3 to 6 stories, 37 per cent. being 5 stories high or over. Areas are generally moderate. Vertical openings are generally unprotected and the amount of window protection is very small. Private fire protection is extremely small in amount. There are several large blocks, but as a rule they are small or long and narrow, either cut up by alleys or with buildings extending from street to street. Streets are, with few exceptions, narrow. On account of the general congestion, ordinary construction and the lack of protection against exposure, the section has a high potential hazard, but the probability of a fire starting within the section and extending over more than a small part of its area would, under normal conditions, be moderate. The section would furnish ready fuel for a conflagration. The following blocks are lacking in fire resisting features and afford opportunity for destructive fires:

Block bounded by Richmond, Fulton, Lewis and North.—A compactly built, triangular shaped block with several inaccessible courts. Construction is principally joisted brick, 3 to 6 stories high, with a few intermingling frames. A 2- to 5-story stable and a 6-story machinery works are of large area. Other occupancies include candy factories, a number of furniture and paper stock storage houses and tenements in numerous buildings above the first floor. A number of buildings have 12-inch walls for a height of 4 or 5 stories; of the small amount of window protection, some is in poor condition. On account of the general weak construction, lack of protection and hazardous occupancies the hazard of the block is high.

Block bounded by Fulton, Cross, North and Barrett.—A small, solidly built block. A 5-story nonstandard mill building, equipped with automatic sprinklers and occupied as a wholesale drug establishment, is located at one end of the block and connects with a 6-story stable of large area. A manufacturing drug concern occupies a second corner of the block. There is some window protection but the several occupancies combine to make the block of conflagration breeding possibilities under slightly adverse conditions.

Block bounded by North Market, Merchants Row, South Market and Commercial.—A 2-story ordinary joisted stone building 510 feet long by 50 feet wide, used as a market and agricultural machinery storage warehouse, occupies the whole block. The probability of serious fires here is small but one under headway would seriously expose 4- to 6-story joisted brick buildings across a street on the north.

Block bounded by Hanover, Blackstone, North and Union.—Divided into 6 parts by narrow alleys and lanes. Occupancies include 5- and 6-story cold storage plants, a hotel and several drug stores. Construction is joisted brick with intermingled frame, and the amount of window protection is moderate. Although the general accessibility is good, the inferior construction, of which the weak walls constitute a feature, and the many mutual exposures afford opportunity for a fire under headway to extend over the block.

**Second Section—General Wholesale.**—Bounded by Milk, Broad, Central, India, Milk, Atlantic, Oliver extended, Fort Point channel, Summer, Atlantic, Kneeland, Albany, Beach, Harrison, Chauncy, Summer and Hawley.

This section is located in the southeastern end of the congested value district, and covers 35 per cent. of the built-up area. It is occupied mainly as miscellaneous wholesale mercantiles, those of leather and shoes and machinery constituting a large number, with office buildings along Milk street, the northern limit of the section, and publishing and light manufacturing establishments distributed throughout. Values are generally high.

Two-thirds of the construction, by area built upon, is joisted brick, mainly 4 to 6 stories high;

nearly 24 per cent. is slow burning or non-standard mill construction, 5 to 6 stories high, and the remainder, or 62 buildings, is of fireproof construction, 74 per cent. being 6 stories or higher. The buildings have substantial and fairly well parapetted walls, have been erected since the conflagration in 1872 and are generally in fair condition. Areas are generally moderate, and a number of elevator and other floor openings are protected. Exposed windows are protected with tin-clad shutters in a large number of individual buildings but no block is so completely equipped as to be immune from exposures. Forty per cent. of the automatic sprinkler equipments in the congested value district are in this section, and in 5 blocks at the southern and southeastern ends buildings so equipped are well grouped. Streets are of fair width in comparison with the others of the district and blocks are usually of small to moderate size, or divided by alleys, so that accessibility is generally good.

Improved construction constitutes one-third of the whole, buildings are of moderate area and height, a number are provided with protection against exposure, numerous buildings are equipped with automatic sprinklers and automatic fire alarm systems, and the section, while having a moderate potential hazard, is one in which the probability of sweeping fires originating and extending is small, under normal conditions. Under adverse conditions the advantages of construction and equipment mentioned above would be overcome by the fact that there is no substantial fire barrier in the section, and the central portion, which contains the weakest buildings of the section, is particularly exposed on the northwestern side by the retail section of the congested value district. One feature which lessens the probability of fires extending is that the eastern side can be reached by fire boat streams. There are no blocks wherein the conflagration hazard is high in comparison with that of the other blocks of the section.

**Third Section—Manufacturing and Warehouse.**—Bounded by Cross, Endicott, Stillman, Stillman Place, Lynn, Thatcher, Washington, Causeway, Merrimac, Pitts, Green, Court, Tremont Row, Brattle, Adams Square, Dock Square and Union.

The section lies in the northwestern part of the district and adjoins the First Section on the west; it is largely of a manufacturing and warehouse occupancy, containing also wholesale and retail mercantiles, the latter principally along Washington and Hanover streets. Values range from low to high, the proportions of values being about evenly distributed; the number of furniture houses is large, and there are several wood working plants in the centre of the section. Joisted brick buildings, of which a few are heavy joisted, constitute 87 per cent. of the total number; there are only 14 fireproofs, of which all except two are 7 stories or less in height, and there is a small percentage of frame construction, principally in the northern end. Five of the joisted brick buildings are 7 stories high; of the remainder, those of 4 stories and less, and those of 5 and 6 stories are in the proportion of 9 to 11. Areas, although excessive in a few cases, are mostly moderate. Many of the wall thicknesses are light, parapets low and numerous buildings are French-roofed with slate covered sides on the upper stories. In the buildings of multiple occupancy, which comprise a large part of the whole, there is very little protection to vertical openings. The amount of window protection and the number of sprinkler equipments and other private protective appliances is small. An open space, 235 feet wide, occupied by the subway and elevated railway tracks, extends from Haymarket Square to the northern end of the section and effectively cuts off a small portion of the section.

The conflagration hazard for the section, except in the triangular part east of Haverhill street, which contains 4 of the large-area fireproofs, is high on account of the general inferior and weak construction, the several large-area blocks of high combustibility containing conflagration breeders, the narrow streets and the lack of protection against external and internal fires. The blocks in which the conflagration hazard is especially marked are the following:

Block bounded by Hanover, Portland and Sudbury.—This block covers about 3½ acres and is 93 per cent. built-up with 2- to 6-story joisted brick buildings and a 3-story fireproof theatre in the block interior. An excessive area, 6-story hotel occupies the centre of the block. There are several inaccessible open courts and the accessibility to the block interior is poor. There is a small amount of window protection, but mutual exposures are numerous, a number of the occupancies are hazardous, the hazard of the block is extremely high and it is mutually exposing with adjacent similar blocks.

Block bounded by Elm, Union, Friend and Washington. Solidly built with 5-story joisted brick buildings in small to large areas; occupied as paint works, furniture houses, and clothing establishments. Several of the party walls are pierced, but openings are protected by double fire doors. The hazard of the block itself is small but a serious fire here would offer severe exposure to adjacent blocks across the narrow streets.

**Fourth Section—Retail.**—Bounded by Brattle, Tremont Row, Court, Cambridge, Bowdoin, Beacon, Park, Tremont, Boylston, Park Square, Eliot, Kneeland, Harrison, Chauncy, Summer, Hawley, Milk and Washington.

This section forms the southwestern part of the district and adjoins the Second, Third and Fifth Sections. It is three-quarters of a mile long in its extreme length; the southern portion is comparatively narrow, being 2 blocks, or about 750 feet, in average width. It contains numerous small to moderate size mercantiles with offices above the first floor, several large department stores, a number of theatres and moving picture theatres and the county court house, with groups of dwellings on the

northwestern extremity. Values are high and fairly evenly distributed.

This section contains 72 fireproofs, covering 22 per cent. of the built-up area; twenty are 10 stories or higher, the highest being 13 stories. At the northern end a number of these buildings are grouped and would form a valuable local fire barrier except for the lack of protection against external exposure; elsewhere the fireproofs are scattered.

The remaining buildings are practically all joisted brick, ranging from small to excessive areas and being generally low; 63 per cent. are 4 stories or less in height, the highest being six of 7 stories. Construction is old and weak and lacks adequate protection, either internal or external, except for the moderate number of automatic sprinkler equipments.

In the portion west of Washington street there are a number of very large blocks, with poorly accessible and crowded interiors, and occupancies are hazardous. The streets are narrow. East of Washington street, between Summer and Essex streets, is a group of excessive area department stores having sprinkler equipments. The Common prevents exposure to the district from the west.

The most dangerous conditions in the city are found in this section, which forms a continuous chain with the worst portion of Section Three. The potential hazard of much of the section is unusually high; that the probability element is not equally high is due to the sprinkler protection in the department stores and in a number of other hazardous occupancies. Nevertheless, there is a very strong combination of bad features affecting the probability hazard and making the conflagration hazard as a whole worse than in any other part of the city. The localities in which the conflagration hazard is especially marked are as follows:

Block bounded by Tremont, West, Washington and Boylston. This block covers nearly 8 acres and is divided into several areas by streets and alleys which increase the number of exposures through unprotected windows. There are eight fireproof buildings, six of which are located in the southern part; several have inadequate window protection. Several theatres and hotels are included among the larger areas. Although there is some window protection in good condition, it is not general, and exposures are numerous, especially on the narrow street which partially intersects the block. The prevailing construction is joisted brick and the hazard is severe, especially as the open spaces are too narrow to be of much value in fighting a large fire.

Block bounded by Tremont, School, Washington and Bromfield. This block is divided by narrow streets and alleys into 5 separate areas. There are 4 fireproof buildings, but none is protected against external fires. The remaining construction is joisted brick and stone, 3 to 8 stories high, generally in small to moderate areas. Many of the occupancies in the block interior are hazardous, being wood workers, sign painters and small restaurants. On account of the inferior construction and poor protection and the numerous hazardous occupancies, the hazard of the block is severe and is only slightly offset by the fair accessibility.

The two blocks bounded by Tremont, Winter, Washington and West streets and the portion of the block between City Hall avenue, Court, Washington and School streets have conditions very similar to those of the two blocks just described and with similar hazard, thus forming a chain of conflagration breeding blocks from Boylston to Court streets.

**Fifth Section—Financial and Office.**—Bounded by Faneuil Hall Square, Dock Square, Adams Square, Washington, Milk, Broad, Central, India, Chatham Row, Chatham and Merchants Row.

This is a small section covering 13 acres of the built-up area, in the centre of the district and entirely surrounded by the other four sections. Values are fairly high, being found mostly in the buildings themselves.

Thirty-nine buildings, or 23 per cent. of the total number, are of fireproof construction and cover 47 per cent. of the built-up area; 28 of them are 8 stories or higher, the highest being 12 stories. The remaining construction is joisted brick, in moderate areas and heights; only 6 buildings are 6 stories high. The amount of window protection is extremely small.

On account of the large proportion of fireproof construction and the non-hazardous occupancy, the potential hazard is low and the probability of serious fire originating here is small, but because of the general lack of protection on windows, the section would offer little resistence to a well developed conflagration. Under favorable conditions, the construction of this section, combined with the fireproofs in Section Four, would form a fairly effective fire stop between the northern and southern parts of the congested value district.

**OUTSIDE OF CONGESTED VALUE DISTRICT.—Wharf District.**—This extends along the harbor front from Northern avenue to Foster street, and is bounded on the land side by Atlantic avenue and Commercial street. At the southern and northern ends, on the street frontage, there are numerous joisted brick buildings, 3 to 5 stories high and of small to moderate area, with occupancies of general storage, ship and importers' supplies, a wholesale candy establishment and loft buildings; a large cold storage plant, an electric power station and a warehouse are of fireproof construction, and several other buildings are of mill construction. Along the water front, and in the centre of the district, the construction consists largely of low, frame, metal-clad dock property on piles, with slips between adjacent docks; a number of the dock buildings are used for fish receiving and shipping; otherwise the sheds, at

times, contain very high values in transit. The potential hazard of the district is fairly high, but on account of the improved construction in the northern section and the low height of the other buildings, their ready accessibility to both water and land fire apparatus and the fact that the prevailing direction of the winds tends to carry a fire toward the harbor rather than landward, the probability of a general conflagration in this district is small. In case of an adverse wind, this district would moderately expose part of the congested value district and a tenement district, across the streets 80 to 100 feet in width.

**Lumber and Manufacturing District.**—This district is bounded by South bay, Northampton street, Harrison avenue, and Dover street. The eastern portion, between the bay and Albany street, contains coal yards, stables and yards with large quantities of lumber in storage either in piles or housed in frame structures. The western portion includes numerous large joisted brick manufacturing plants, among which those such as use large quantities of lumber predominate. There is congestion of these plants in spots, and the district contains compactly built ranges of 3-story brick tenements and dwellings. Owing to the large quantities of lumber in storage to the east of Albany street, this section being outside of the fire limits, a fire once beyond control is liable to develop into a conflagration.

**South Boston.**—Along the Fort Point channel and the harbor front is a high value section consisting of storage warehouses, wharf and railroad terminal sheds, various factories and a sugar refinery. Inland along Summer street numerous 7- to 9-story wool-storage warehouses are of fireproof construction; several other buildings are of mill construction and the remainder of joisted brick, averaging 5 stories in height. Many of these buildings have well-parapetted walls and windows protected with tin-clad shutters; the wharf sheds are frame and tin clad. Values are high. Although the fairly large amount of window protection reduces the hazard, a fire once beyond control is liable to develop into a conflagration. Outside of the warehouse district, construction is almost wholly of frame, except along Broadway, where joisted brick prevails; there is congestion in spots, notably around the intersection of E and 5th streets and L and 7th streets, and fires of conflagration proportions are very probable on account of the high combustibility of the construction and the shingle roofs. The district is well cut off from the congested value district by Fort Point channel, has good water supply and hydrant distribution and is readily accessible from the city proper for the concentration of fire department apparatus.

**Charlestown.**—Except for the buildings in the United States Navy Yard, which are of substantial construction and without congestion, the joisted brick buildings located about City Square and the rows of brick dwellings and small mercantiles, buildings are practically all frame, occupied as dwellings and flats. In the western part of the district there are numerous large stables and sheds, and along the water front are grain elevators, railroad terminal sheds and dock property of frame construction, some being tin clad. There is much congestion, streets are narrow, and ground surfaces rise steeply in places.

A conflagration could easily sweep almost the entire area of Charlestown, as there are no fire breaks of value. The presence of stables and elevators in highly combustible surroundings makes the probability element of the conflagration hazard serious, in spite of the fair water supply and hydrant distribution, and protection afforded by the engine companies from the city proper.

**East Boston.**—East Boston is practically an island, being separated from the city proper by Boston harbor, which affords communication by ferry. Along the water front, which is of considerable extent, are wharf properties, sheds, and a few factories. At times, values of stocks are high; that of buildings is low. Construction is of inferior class, except for an occasional elevator or storage warehouse. Outside of the wharf district, construction is principally frame dwellings and flats, usually with spaces 2 to 6 feet wide separating them.

There is congestion in many places, notably at the intersection of Cottage and Summer streets, and streets are of only fair width, so that the entire district is subject to a sweeping fire. Although the water supply is good, the lack of accessibility for fire department apparatus from the other sections of the city increases the probability hazard.

**Dorchester and Roxbury.**—Commencing almost immediately south of the fire limits, construction in these districts is practically all frame, ranging from detached dwellings to rows of 3- and 4-story flats, with spaces between ranging from 2 to 10 feet. Many of the 3-story flat buildings have incombustible roof coverings, but practically all of the detached dwellings have shingle roofs. At the points of greatest congestion, there is usually a small mercantile district with a few joisted brick buildings. A fire once beyond control would be very liable to extend over a large area.

**CONCLUSIONS.**—The features which make the potential hazard high in the congested value district are the grouping of seriously exposed, poorly accessible and structurally weak buildings, many with multiple occupancy, the lack of horizontal and vertical opening protection where especially needed, the many very large floor areas and the narrow streets, from which it would be difficult to make a stand against a conflagration.

Across the centre of the district is a grouping of fireproof buildings which should form a fire barrier; their efficiency as such, however, is greatly reduced by the large proportion of unprotected windows and, although they might prove barriers

for a local conflagration, their efficiency in cutting off a fire of large proportions is very doubtful.

The probability of sweeping fires occurring is largely dependent on the facilities provided to suppress them; the water supply is adequate and reliable, but at pressure only sufficient for engine supply, and the fire department, though efficient, is liable to be undermanned at certain times of day to such an extent as to be unable to cope with simultaneous fires in the congested value district without withdrawing the protection from the other parts of the city. An important mitigating feature is found in the many automatic sprinkler equipments and the window-opening protection. The conflagration hazard is considerably more marked in the section along either side and west of Washington street, where there are many high values, and the prevailing direction of winds would tend to carry a fire to the parts to the eastward. The probability of a conflagration extending over a considerable part of the district is serious.

In the wharf district of Boston proper the conflagration hazard is moderate. The lumber district is liable to fires of conflagration proportions and exposes groups of congested joisted brick woodworking plants.

Charlestown, South and East Boston have stretches of wharf properties in which serious fires are liable to occur and otherwise are built-up with congested frame structures, which in many places afford opportunity for local conflagrations.

In the congested parts of Dorchester and Roxbury, where 3-story frame flat buildings are separated by narrow spaces affording many mutual exposures, the possibility of fires extending over considerable areas is very pronounced, and the hazard from flying-brand fires in those sections in which buildings are roofed with shingles is serious.

# RECOMMENDATIONS.

## WATER SUPPLY.

*Records.*

1. That records in the water department be improved:

*a.* By keeping plats of the distribution system up to date, both at division engineer's office and at the Albany street yards.

*b.* By completing the records of service locations.

*c.* By completing, compiling and filing card catalog records of gate valves, duplicate set to be carried on emergency truck.

*d.* By compiling hydrant records in card catalog form.

*Fire Service.*

2. That an employee of the department, prepared to operate valves, respond to first alarms in high value districts and second alarms elsewhere, and co-operate with the fire department.

*Pumping Stations.*

3. That standard hose houses be erected over the hydrants at the Chestnut Hill stations, each equipped with 250 feet of 2½-inch cotton, rubber-lined hose with nozzle attached.

4. That sprinkler equipments be installed in the Chestnut Hill High service and West Roxbury pumping stations.

*Distributing Reservoirs.*

5. That the storage in the Southern High and Southern Extra High services be increased by the construction of reservoirs of ample capacity at suitable locations within each service, to safeguard supply to those sections at present dependent upon single supply mains.

*Distribution System.*

6. That the 16-inch High service main across Fort Point channel be connected, so that the Southern High service may be available for the supply of private fire-fighting equipment from the duplicate mains already laid in that section.

7. That the distribution system be strengthened by the installation of the following mains, in addition to those contemplated by the Division Engineer and shown in red on Plan No. 1 accompanying this report:

| Diameter, Inches. | Along | From | To |
|---|---|---|---|
| 16.. | Most feasible route. | 36" Metropolitan main in Newton..... | 16" main on Commonwealth Ave. |
| 16.. | Dudley Avenue.... | S. Walter St... | Belgrade Ave. |
| 16.. | Birch St. and Metropolitan Ave..... | Albano St..... | W. Roxbury pumping station. |
| 16.. | Auburn and Roslindale Sts..... | W. Roxbury pumping station..... | Bellevue standpipe. |

8. That the three mains crossing the Charles river on the Warren avenue bridge be placed in a tunnel below the river bed.

9. That the older mains 20 inches and larger in diameter be cleaned.

10. That dead ends be eliminated wherever practicable, those along service limits by double mains in the streets.

*Gate Valves.*

11. That additional gates be set so that no single case of accident, breakage or repairs to the pipe system in important mercantile and manufacturing districts will necessitate shutting from service a length of main greater than 500 feet, and in other districts lengths greater than 800 feet.

*Hydrants.*

12. That all connections between the hydrant and the main be equipped with a gate valve.

13. That the use of hydrants be restricted to fire department purposes and the flushing of mains.

*High Pressure Fire System.*

14. That a High Pressure Separate Fire Main System be constructed and put in operation at the earliest possible date, the system to cover the congested value district and such other adjoining high value sections as possible with the money available, and to consist of:

A fireproof pumping station, with all openings protected in an approved manner and removed from the zone of sweeping conflagrations. Station to be equipped with sufficient pumping units of moderate capacity to aggregate a total capacity of 20,000 gallons per minute at 300 pounds pressure, taking suction from a fresh water supply, preferably the Charles River Basin, and delivering into the grid-iron system through well looped and gated discharge connections.

The distribution system to be connected with the pumping station through duplicate supply mains and to be so designed as to deliver the full capacity of 20,000 gallons per minute about any block within the area served, without excessive loss of head; to contain no pipes less than 12 inches in diameter, no dead ends, and be connected at all intersections. Connections to be provided to the system so that

the fireboats may be used as auxiliary pumping stations in case of emergencies, and system to be provided with gate valves so placed that not more than two hydrants will have to be cut out at one time.

Hydrants to be of ample dimensions, with 4 independently gated hose outlets, and connected to the mains through 8-inch gated connections; to be so distributed that the average area served by each shall not exceed 40,000 square feet.

## FIRE DEPARTMENT.

*Organization.*

15. That members be retired from active fire duty on reaching the age of 62 years, unless at that time they are unusually efficient.

16. That the strength of the fire department be increased by providing additional members, relief men or substitutes, so that the least number of men in quarters at any time, including meal hours, will be as follows:

*a.* In the congested value district: 7 men in each engine and ladder company.

*b.* In other parts of the city proper and in mercantile, manufacturing and warehouse districts in South Boston, East Boston, Charlestown and Roxbury: 6 men in each engine and ladder company.

*c.* In other districts: 5 men in each engine, 4 men in ladder and 3 men in chemical companies.

*New Companies and Apparatus.*

17. That engine companies equipped with engines of 900 gallons capacity be established as follows:

*a.* With one of the present engine companies in the Back Bay district.

*b.* In the vicinity of Main and Chelsea streets, Charlestown.

18. That chemical companies kept in service, especially those in outlying districts, be provided with automobile apparatus having motors of at least 50 h.-p. It will be possible, when this is done, to abandon most of the stations occupied by chemical companies only.

19. That until all of the companies have been strengthened, as called for under Recommendation No. 16, each automobile chemical engine have a crew at all times of not less than 6 men and act as an auxiliary squad.

*Hose Wagons and Hose.*

20. That each hose wagon carry about equal amounts of 2½- and 3-inch hose, with a total of at least 1,000 feet, and that a complete shift be provided for each wagon; all 2½- and 3-inch hose to be fitted with 2½-inch couplings, properly beveled.

*Operation.*

21. That the running card provide assignments for at least one additional alarm before a general alarm, or use be made of adjacent boxes in calling for more companies than are provided for by the present assignments.

22. That in all cases where 3½-inch hose is not used, 3-inch hose be used for laying lines from hydrants or engines to the entrance of buildings, and to turret pipes, ladder pipes and water towers.

23. That all engines be tested yearly, following instructions published by the National Board of Fire Underwriters. Pumps showing more than 7 per cent. slip should be examined and engines developing less than 90 per cent. of their reasonable capacity should be overhauled or their crews drilled; engines unable to discharge 90 per cent. of their capacity after overhauling should be replaced.

## FIRE ALARM.

*Organization.*

24. That superannuated members of the force be retired and new men taken on only when the total force is less than 30, including all details from the fire force.

*Headquarters.*

25. That fire alarm headquarters be removed to a fireproof building, so located as to be free from exposures, or that the protection of the present headquarters building be improved as follows:

*a.* By placing wired glass windows in metal frames in, or providing fire shutters on, all exterior window openings, and providing approved fire doors on all doorways.

*b.* By connecting outside sprinklers of an approved type with both High and Low service water mains.

*c.* By removing all wood and cabinet work from the fire alarm quarters. Switchboards to be mounted on iron frames and all instruments on incombustible mountings.

*Equipment.*

26. That the central office be remodeled and additional equipment provided as follows:

*a.* Receiving instruments to operate through closed circuits.

*b.* Box signals to flash a lamp, in addition to operating a tapper or sounder and buzzer and a register.

*c.* Registers for incoming alarms to be connected so that a record will be obtained under all conditions of operation.

*d.* All obsolete equipment and unnecessary wiring to be removed and the central office rewired, using No. 16 copper wire with approved rubber insulation inside of the protectors. Connections between switchboards and instruments to be in conduit. Wires to have flame proof braid and be properly made up on the back of boards.

*e.* Connections between cable terminal board and protectors to be of No. 14 double-braided, rubber-covered copper wire in conduit.

*f.* Storage batteries supported on glass and porcelain on iron racks in a well ventilated room to be installed to replace the generators now in use.

*Fire Stations.*

27. That a punch register connected with a tapper circuit, and a Morse signalling set on a gong circuit, be installed in each fire station.

*Boxes.*

28. That additional boxes be installed, so that a box shall be within 500 feet of every building in mercantile and manufacturing sections, and elsewhere within 800 feet of every valuable group of buildings.

29. That future installation of boxes be of successive, non-interfering type, with platinum or silver contacts, with internal mechanism protected against abnormal currents, outer cases and lightning arresters adequately grounded, and with keyless, self-actuating doors, glass panel doors, or with keys attached under guard; present boxes to be replaced or remodeled to conform to above.

30. That iron pipes for wires from overhead lines to boxes be carried up poles to cross-arms. Boxes and a wide band on the supporting poles to be painted red annually.

*Circuits.*

31. That the condition of circuits be improved:

*a.* By increasing the number of box circuits, so that not more than 20 boxes will be connected to one circuit.

*b.* By running circuits inside of fire stations in accordance with the requirements of the National Electrical Code.

*c.* By providing cable ends, including those at junction boxes, with heads and suitable terminal boards of slate; approved fuses and lightning arresters to be installed at junction of overhead and underground construction.

*d.* By removing fire alarm circuits from poles carrying high-tension lines.

*e.* Providing direct lines to the fire department switchboard from each telephone exchange.

*Operation.*

32. That complete records of trouble be kept, showing time when each circuit is cleared and who has done the work.

## BUILDING DEPARTMENT.

33. That the building department inspection force be increased to provide for more frequent inspections, particularly of frame structures.

34. That the building laws be so revised as to include more detailed and modern requirements for construction and fire prevention.

35. That the fire limits be extended to include more territory on the south, in Boston proper, all of Charlestown and East Boston, part of South Boston inland from Fort Point channel and the harbor, and sections of Dorchester and Roxbury, and that proper restrictions for preventing congestion of frame construction be provided and shingle roofs be prohibited throughout the entire city.

## EXPLOSIVES AND INFLAMMABLES.

36. That complete regulations governing the manufacture, sale, storage, transportation and handling of inflammable fluids be promulgated by the district police at the earliest possible date.

## ELECTRICITY.

37. That a complete reinspection of all old wiring in the business districts be made, defects corrected, and all wiring subsequently reinspected at suitable intervals.

## CONFLAGRATION HAZARD.

38. That the owners of existing defectively constructed buildings, which are so located as to be fire hazards to surrounding property, be required to properly protect floor, window and party wall openings, in so far as such protection is feasible.

39. That automatic sprinkler equipments, with outside steamer connections and controlling valve near the main in street, be required in all buildings which, by reason of their size, construction or occupancy, singly or combined, might act as conflagration breeders.

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APRIL, 1911.

# GENERAL SUMMARY.

## CITY IN GENERAL.

Population 678,800. Important seaport and commercial center. Surface rolling, grades generally moderate, streets generally narrow. Average wind velocities high; high winds frequent. Winter temperatures severe. Average number of fires and loss per capita high.

## FIRE-FIGHTING FACILITIES.

**Water Supply.**—Supply works under jurisdiction of Metropolitan Water and Sewerage Board, an efficient organization. Supply ample, conveyed to the city by gravity through conduits of sufficient capacity, and distributed in five services, partly by gravity and partly by pumping; non-fireproof stations, ample in capacity; distributing reservoirs contain 20 days' supply, those on the two Low services of ample capacity. Distribution system owned and operated by the municipality; water department recently reorganized. Consumption somewhat excessive, but being reduced by the installation of meters. Pressures moderate, well maintained under heavy drafts. Provision made for supply to sprinkler equipments in most high value districts. Large mains generally adequate and well arranged, except in unimportant outlying districts; minor distributers of fair size, generally well gridironed and being improved. Carrying capacity of mains considerably affected; electrolytic conditions well handled. Gate valves regurarly inspected; generally well spaced. Hydrants of good size, subject to moderately efficient inspection and well distributed.

**Fire Department.**—Full paid, under good supervision; financial support liberal. Civil service regulations for appointments; training of members thorough, discipline good. Companies seriously undermanned during meal hours in vacation periods. Apparatus well distributed, of good type, generally in excellent condition and well supplied with minor equipment. Engines of satisfactory sizes and mainly in good condition. Three fire boats for additional protection along the water fronts. Excellent equipment for large streams. Hose mainly in good condition and regularly tested; supply ample. New repair shop in course of construction. Fire stations mainly well located. Response to alarms generally prompt and satisfactory; a general alarm leaves insufficient protection for other fires. Fire methods thoroughly modern. Inspections of buildings good; records are well kept.

**Fire Alarm System.**—Manual system, well maintained as a branch of the fire department; headquarters in a fireproof building, severely exposed; operating room contains much woodwork, window protection deficient. Headquarters equipment lacks modern indicating and testing devices; some obsolete equipment occupies valuable space. Motor-generators used instead of storage batteries. Telephone systems fairly good. House instruments suitable, but registers lacking. Boxes of plain interfering type; generally in good condition, with keyless doors; distribution mainly good in high value districts; fair to good elsewhere. Much outside work underground; cables suitable, but poorly equipped at terminals. Overhead circuits good, but frequently on poles with high-tension circuits. Wiring in fire stations and in headquarters poor, and a menace to the reliability of the system. Tests as good as present arrangements permit. Records and plans mainly good.

**Fire Department Auxiliaries.**—Well equipped salvage corps covers the entire city. Fire marshal's duties well performed. Co-operation of the police department and public service corporations at fires satisfactory. The many automatic fire alarm, central station watch service and sprinkler supervisory systems and the private fire apparatus add to the general protection in parts of the city. Powerful assistance could be obtained in two hours.

**Summary.**—Water supply adequate and reliable; quantities available generally ample. Fire department efficient and well equipped, but companies undermanned. Fire alarm system unreliable because of location of headquarters and poor type of box.

## STRUCTURAL CONDITIONS AND HAZARDS.

**Building Department.**—Laws good in regard to limitation of heights and areas, but deficient in numerous respects, especially fireproofing and reinforced concrete construction and in permitting congestion of high frame tenements. Enforcement fairly good. Fire limits district too small; no restrictions of shingle roofs outside these limits. Structural conditions mainly weak in congested value district; new construction mostly fireproof. Amendments to building code to restrict frame construction being considered.

**Explosives and Inflammables.**—Laws pertaining to explosives good; those pertaining to inflammable fluids deficient. Enforcement in the hands of several officials. Inspections by fire department officers frequent and effective. Local conditions good, except for handling of inflammable fluids.

**Electricity.**—Good municipal control over electrical construction. Underwriters also inspect interior work and secure the removal of defects in old work. Laws embody National Electrical Code.

Underground district of good extent and provisions made for extension annually. New wiring in good condition; old work fair. Trouble from electrolysis being given constant attention by those concerned.

**Conflagration Hazard.**—Recent construction has brought about some reduction in the conflagration hazard in the congested value district; however, the hazard is still marked, owing to the weak structural conditions in the older buildings, poor block interior accessibility, frequent unprotected vertical and horizontal openings, and narrow streets. The most important section, from the standpoint of values and conflagration hazard combined, exposes other parts of the district. For the district as a whole, the hazard is moderate to serious, considering that, although the water supply is adequate, the fire department is not sufficiently strong in men to handle serious and simultaneous fires with hose lines supplied from engines.

Outside of the congested value district, the hazard, not including the residential portions, is largely local, except under adverse conditions.

The congested frame residential sections present conflagration possibilities varying from moderate to serious; under adverse wind conditions, the hazard would be high for many sections.