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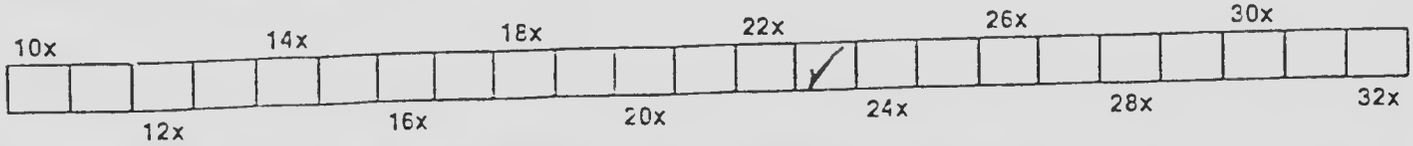

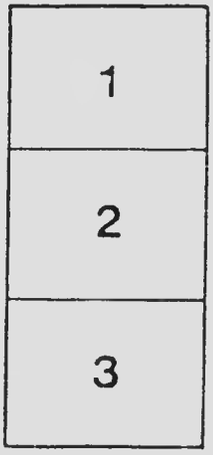

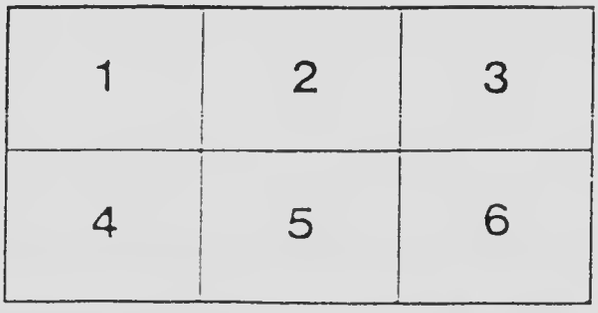

The Protection of Vertical Openings and Other Fire Hazards

By JOHN B. LAIDLAW

Member National Fire Protection Association
Member British Fire Prevention Committee

TWENTY - FIVE CENTS

The Monetary Times, Toronto

THE

PROTECTION

OF

VERTICAL OPENINGS

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Member National Fire Protection Association.
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STANDPIPES AND HOSE
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AUTOMATIC TRAP DOORS FOR STAIRWAYS AND STAIRWAY ENCLOSURES
AUTOMATIC TRAPS FOR ELEVATORS
SKYLIGHTS

THE MONETARY TIMES, TORONTO

INDEX OF CONTENTS

THE PROTECTION OF VERTICAL OPENINGS IN MERCANTILE BUILDINGS.

IT IS HOPED that the suggestions made in this publication will be found of value to property owners, merchants and architects, as well as to officials and agents of fire insurance companies.

While the present enormous amount of the annual losses by fire in the United States and Canada continues, there cannot be much hope held out for reduction in fire insurance premiums.

The cost must be brought down before the price can be reduced.

The losses in the United States during 1904 have amounted to about $225,000,000, and in Canada for the same year, to more than $25,000,000.

These are much above the normal amounts for several years past, as can be seen from the following table:

LOSSES BY FIRE IN THE UNITED STATES AND CANADA.

Year.	Losses in Canada.	Losses in United States.	Total Losses.
1893.....	$6,232,530	$150,213,345	$156,445,875
1894.....	6,234,730	122,011,[illegible]	128,246,400
1895.....	8,873,875	120,965	129,839,700
1896.....	6,835,980	108,819,[illegible]	115,655,500
1897.....	7,240,200	103,079,[illegible]	110,319,650
1898.....	9,617,640	110,032,860	119,650,500
1899.....	6,100,000	130,673,200	136,773,200
1900.....	16,000,000	147,362,250	163,362,250
1901.....	12,[illegible]00	[illegible]47,450	1[illegible]47,450
1902.....	9,[illegible]90	[illegible]260,850	149,260,850
1903.....	11,000,000	145,195,700	156,195,700
1904.....	26,273,200	225,690,850	252,364,050

The fire losses in the United States and Canada are several times as great as in Great Britain or on the Continent of Europe, whether the comparison be made on the basis of loss per head of population or on the percentage of loss to values.

The figures given of the annual fire losses represent only the value of the property actually destroyed.

To these figures, large as they are, should be added a very considerable sum to cover the many and varied indirect losses, not merely to the individual who owned the property destroyed by fire, but in the derangement of his business, in losses to dependents, to clerks, warehousemen and other employes, to his creditors, and also to the municipalities through the destruction of taxable property.

A large proportion of the present annual fire loss can be prevented by improved arrangement of the interior of mercantile premises.

Careful investigation of the causes which have produced the results which all must deplore, indicates that among the greatest of the contributing causes (if it be not in fact the greatest of all) is the unprotected vertical opening in modern mercantile premises.

TYPICAL STORES FIFTY YEARS AGO.

The majority of stores in our cities fifty years ago, and perhaps even more recently, were seldom over 50 feet frontage, rarely over 150 feet in depth, or over 3 stories in height, while in nearly every case the merchant used only the ground floor and cellar for his business, the upper floors being used as a residence, with a separate entrance and stairway leading from the apartments to the street. It was usual to have a door from the private hallway into the store, but that was closed save when used by the proprietor or a member of his family. As a rule there was no other communication from the store to the upper part of the building.

THE MODERN BUILDING.

Times have changed, however, and in central portions of the cities in the United States and in Canada one will now find very few business premises similar to that described. On the contrary not only has the average ground floor area of mercantile premises been considerably increased, but the buildings are seldom less than 3 stories high, and more often rise 5, 6, 7 or more stories above the ground.

A still greater change has been made in the internal arrangements. The old-fashioned mercantile building was used as such only on the ground floor and cellar. The modern mercantile

building is so used from cellar to garret, while to facilitate the business carried on there are open stairways and an elevator from cellar to roof, chutes to carry small parcels from one flat to another, and frequently a large well hole to give light to a long building in a block. Sometimes the well hole is found in a building erected on a street corner, with the intent apparently that the large light well may impress the customer by enabling him to see at a glance how many stories rise from the ground floor on which he enters.

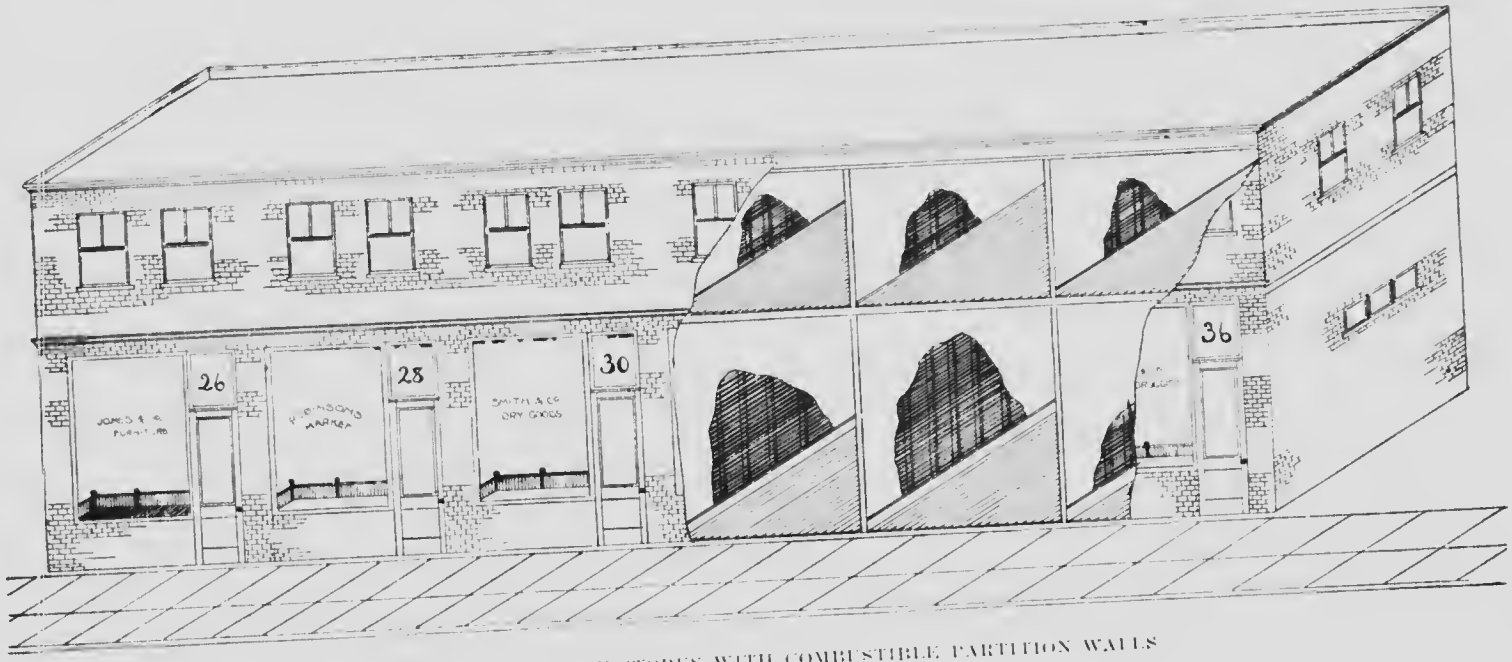
FIRE PREVENTION BY BUILDING REGULATIONS.

For many years, indeed for several centuries, there have been regulations in most if not all of the cities in Europe and America, which required that anyone erecting a building should construct side walls, or party walls as they may be called, in a solid and substantial manner and that these walls be carried to a certain height above the roof to form a parapet, the intent of the regulation being to prevent a fire in one building communicating to others alongside.

There have also been in some cases, regulations preventing a building being erected over a certain height, but this latter seems more often to have been dictated by such considerations as that of danger to life of tenants of a high building, or because there would be a lack of air and sunshine in their shadow, than that the danger of a high building setting fire to others about it had been recognized.

We have all doubtless witnessed the erection of a block of say 6 stories, nominally a brick building in that the end and rear walls were of brick, and that there were brick piers in front dividing the store fronts, and some bricks surrounding the numerous and generally large window openings in the first or second stories, but with the interior walls which divided the building into 6 stores, constructed merely of studding, to be covered with lath and plaster.

Such a building would be say 40 feet from ground to roof, 100 feet long and 75 to 100 feet deep. We have probably all said to our neighbor as we passed that it was a shame to allow



A. TYPICAL BLOCK OF STORES WITH COMBUSTIBLE PARTITION WALLS

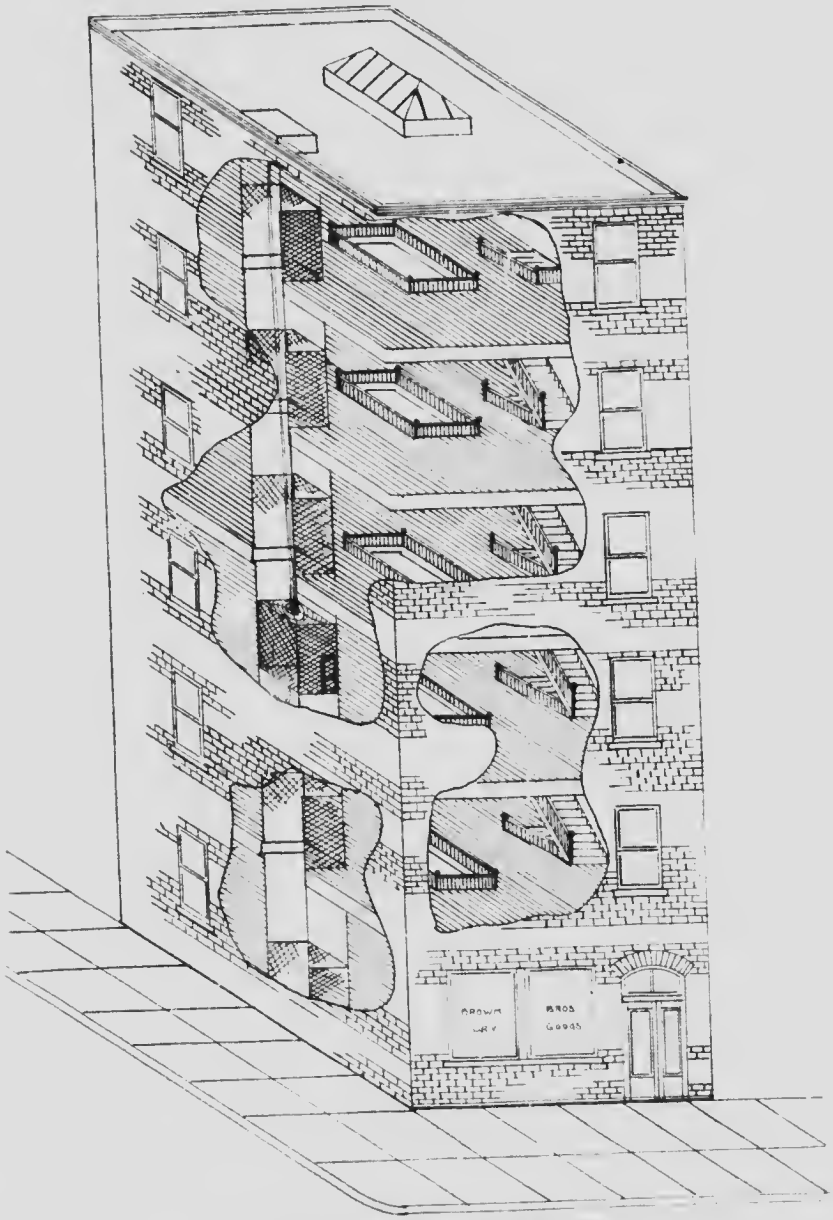
such a building to be erected, and wondered what kind of building laws we had which permitted it, or what the city building inspector was thinking of when he did not stop it. We have all agreed that such a structure was a "fire trap."

But suppose we now turn this block of stores, whether it be of 1, 2 or 3 stories in height, on end, so that it now becomes a building say 40 feet wide, 75 to 100 feet deep, 100 feet high and of 6 stories; also that we proceed to cut the former dividing walls which have now become the floors of the building in its new position, to permit the insertion of wooden stairways from floor to floor, that we introduce a chute or two for parcels, a freight and passenger elevator, a well hole down the center, and place a skylight in the roof, and when we have done all this, have we not a building (see illustration *E*), which it has been the habit of the ordinary "man on the street" to tell his friends about, as the fine new warehouse "Brown" has erected, and to show it off to the stranger within the gates? *It is not necessary to tell either insurance men or business men that fire will travel more rapidly upwards than horizontally, but have either insurance men or business men as yet realized how much easier a fire secures headway in the modern building than it could in the old-fashioned one?*

FACILITIES FOR SPREAD OF FIRE.

The modern building has been so constructed that every possible facility has been afforded to fire to spread rapidly from its point of origin both up and down, so much so that in a great many cases, when the fire department arrives on the scene and can get its apparatus to work, the building is burning fiercely on several if not on all of its floors, and often the flames have secured such a hold upon it that no fire department, however efficiently equipped or well officered, could do more than save the adjacent buildings.

Fires occur from a multitude of causes and no amount of care exercised by an individual can absolutely insure that a fire will not break out in his premises, but the individual can so construct his building, or can so alter his premises if built, that when a



B. TYPICAL MODERN WAREHOUSE.

fire does break out there is a reasonable probability that for at least half an hour it will not have spread beyond the floor on which it originated, and there will then be some probability that the fire department will prevent it spreading throughout the building.

It is hoped that this publication will assist in accomplishing such a result.

FAULTY CONSTRUCTION HAMPERS FIREMEN.

When a building is constructed with open or unprotected vertical openings, the smoke from a fire will often fill the building from cellar to garret before the firemen arrive. The man who discovered the fire and gave the alarm may not always be on hand to tell the firemen where it was burning when he discovered it, or he may have given the alarm simply because he saw or smelled smoke.

The firemen, however, cannot tell on what floor the fire is burning, and waste precious minutes in trying to locate the blaze, and before they do, the flames have secured a hold on several floors so that the firemen are driven out and must try to drown the fire in a hap-hazard way by pouring water into every floor.

Had the vertical openings been closed when the firemen arrived they could have seen at once on what floor the fire was burning and by concentrating their entire apparatus on that point would probably have extinguished the blaze in a few minutes.

In the open building a fire once started will burn very rapidly, while on the contrary, with each floor cut off from the other, it will be deprived of the assistance of any draft and be in comparison very slow in spreading.

The business man may say, "That's all very fine in theory, but I am in business and I must have my business premises adapted to my purposes and I cannot cut off one floor from the other. If I did I might as well go out of business."

The effort will be made to show in the following pages by description of what has been done by other business men, and by suggestions of what may be done under a variety of conditions, that such an assumption on the part of the business man is incorrect, and that without any disadvantage to his business

methods, possibly indeed in some cases with a positive advantage, he may arrange his premises to accomplish the end desired.

In so doing he will not merely reduce the chances of a fire with its manifold inconveniences as well as losses over and above the actual value of goods destroyed, for which only he will be indemnified by the insurance companies whose policies he holds, but he will probably save in insurance premiums very much more than the alterations will cost.

The protection of each building is a problem by itself, and while in its solution much may be learned from what others have done, and possibly something from the suggestions to be made, it must always be kept in mind that they should not be followed in any slavish spirit, but be adapted to the conditions as found, always remembering what it is desired to accomplish, viz., that there be no opening left from floor to floor by which smoke and flames can easily penetrate from the point of origin throughout a building.

DANGER OF VERTICAL OPENINGS.

It can be shown that nearly all of the most serious conflagrations in the mercantile districts of cities have been largely due to the fact that the building in which the fire broke out had unprotected openings from floor to floor.

If the reader will recall the circumstances of any conflagration with which he is familiar, he may possibly find that the building first to burn was over 3 stories high and had unprotected vertical openings, that when the firemen arrived it was on fire from top to bottom, that whether there was a smoke explosion or not, the combustion at once of all the goods on each floor of the building, as well as the building itself, generated such a quantity of gases and heated air that the flames belched out from every window a distance of 30, 40, 50, and sometimes over 60 feet, setting fire to any building within that radius and setting fire, too, not merely to one floor or one window of the neighboring building, but often to all the windows on two or more of the floors, so that when set on fire in this way they burned so rapidly as to cause a repetition of the phenomena of rapid combustion previously re-

ferred to, with the result that in a few minutes the fire was entirely out of hand.

No reasonably minded property owner would care to think that his building was a constant menace to those of his neighbors, but the experience of the past shows most conclusively that any mercantile building of over 3 stories in height and with free communication from floor to floor, is a most decided menace to every adjacent building having any windows looking toward it.

Civic building laws lay great stress upon the construction of solid division or party walls, and sometimes upon the adequate protection of window openings in adjoining buildings.

Just as much if not more attention should be given to the internal arrangements of mercantile buildings, so that each floor be constructed in such a manner as to prevent a fire spreading upwards or downwards, in the same way that a division or party wall is intended to prevent the fire from spreading horizontally.

The insurance companies will assist in this by the system of specific or schedule rating, under which charges are made for all defects in the construction of a mercantile building or reductions in rates when the conditions are improved.

GOOD CONSTRUCTION IN FOREIGN CITIES.

While some friends of the writer were in Rome recently they heard a commotion in the street when at dinner one day, and looking out, discovered a crowd assembling to watch the firemen who were leisurely preparing to attack a fire which was burning fiercely in a store or shop occupying the ground floor of a building almost across the street. They were greatly surprised, however, to see two elderly ladies leaning out of the windows of the third story above the store which was on fire, quite unconcerned apparently about the blaze underneath them, and taking quite as much interest as any one else in the crowd which was gathering, and in watching the movements of the firemen.

When the vertical openings in buildings in the United States and Canada are as well protected as were those in that building in Rome, there will be a great diminution in the annual loss by

fire and an almost entire cessation of loss of life in the upper floors of a modern building on fire.

SOME ADVANTAGES FROM PROTECTION OF VERTICAL OPENINGS.

Safety to Life. When stairways and elevators are enclosed, the occupants of the floor above that on which a fire occurs can descend with perfect safety past the floor on which the fire is burning.

Control Over Heating. Each floor can be heated to the temperature desired; some floors may not be required to be heated save in the coldest weather.

Control of Occupation. Instead of using the top floor as a workroom, causing employes to climb several flights of stairs or be elevated at considerable annual cost, the second floor could be used as such, with a separate entrance for the factory hands, the higher floors being used as showrooms.

There would also in many cases be a considerable saving through lessened handling of stock.

TOWERS FOR ELEVATORS AND STAIRWAYS.

The best arrangement to provide access from floor to floor in a mercantile building is to have a stair and elevator tower, built of brick, with fire resisting doors upon the openings into each floor.

It is comparatively easy to cut off floor from floor when a new building is being erected; and that is a problem which a competent architect can easily solve.

It is not so easy, however, to correct the faulty construction found in so many mercantile buildings, the results of careless construction and entire oversight of danger. In such cases it is hoped that this publication will give some assistance to owner or architect.

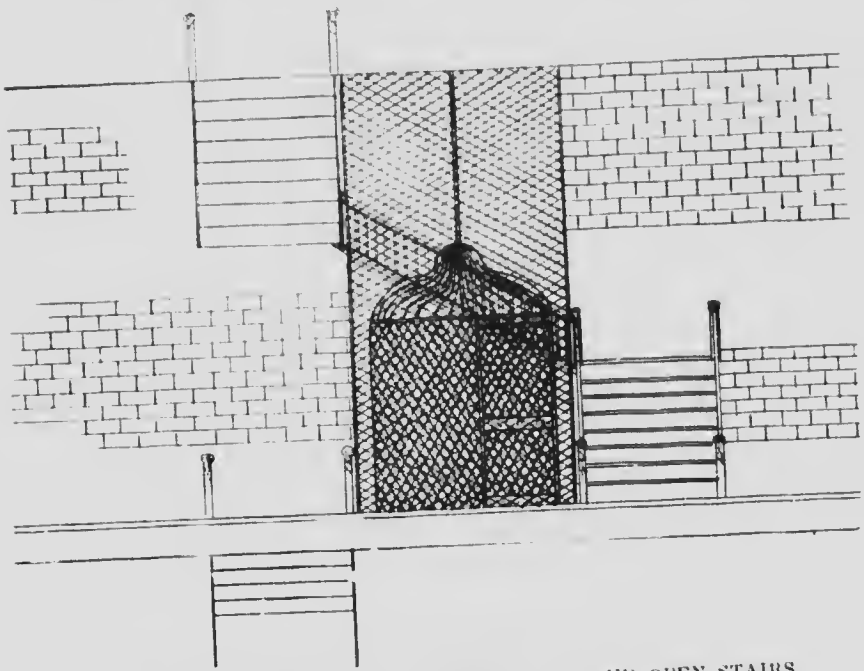
The Gutta Percha Rubber Company's office building, corner of Wellington and Yonge streets, Toronto, has recently been remodeled, as shown in illustration *C*, which has been furnished by Messrs. Darling & Pearson, the architects in charge of the alterations.

C. PLAN OF AN OFFICE BUILDING IN TORONTO AS REMODELLED.

ELEVATOR PROTECTION.

In many buildings the stairway winds about an open elevator, enclosed by wire netting only, as shown in illustration *D*.

This arrangement is not only unsafe, it is positively ugly.



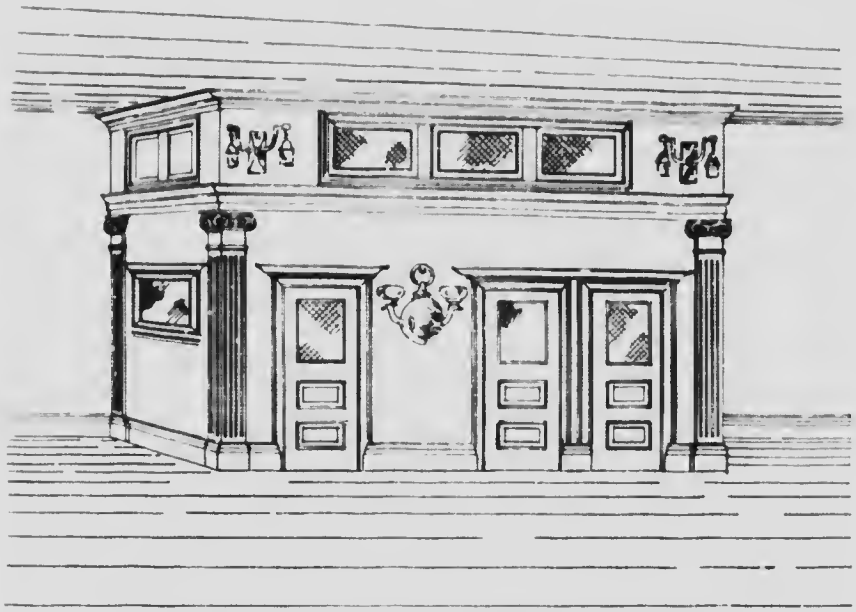
D. WIRE NETTING ELEVATOR ENCLOSURE AND OPEN STAIRS.

An open elevator can be enclosed by an incombustible partition of metallic lath covered with plaster, with wireglass inserted for light, and with doors of metal with wireglass inserted in the upper half of the door.

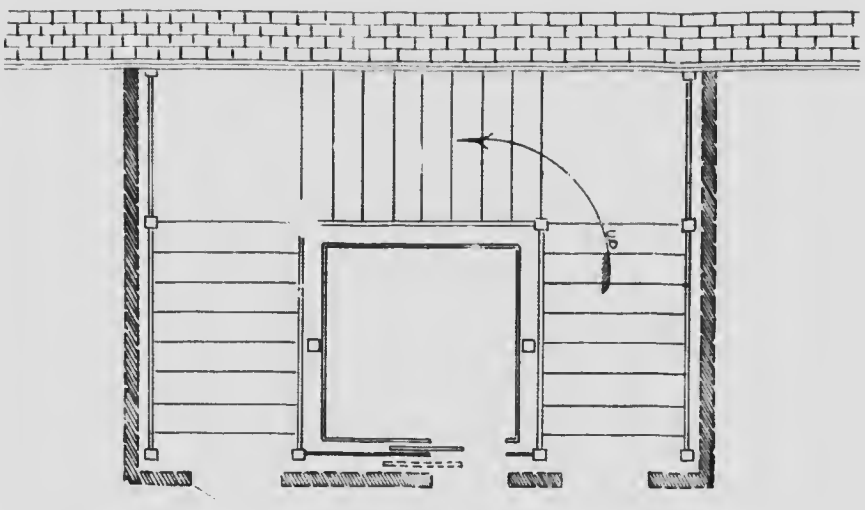
The enclosure walls should be double, with an air space of at least 1 inch between the sheets of metallic lath.

Such an enclosure can be constructed in an ornamental manner, as shown in illustrations *E* and *F*.

Where glass is shown in the illustration, wireglass must be used.



E. EXAMPLE OF INCOMBUSTIBLE ELEVATOR ENCLOSURE.



F. PLAN OF INCOMBUSTIBLE ELEVATOR ENCLOSURE

Porous terra cotta blocks are highly recommended for the enclosure walls.

Where the staircase winds about the elevator, the enclosure of metallic lath and plaster should be placed outside the staircase, in that way making a stair and elevator tower.

The elevator should *never* be enclosed by a wooden partition.

Failing an incombustible partition, it is better to have no enclosures, but to provide automatic traps at each floor, with a curtain board around the opening at the ceiling on each flat, as shown in illustration *G*.

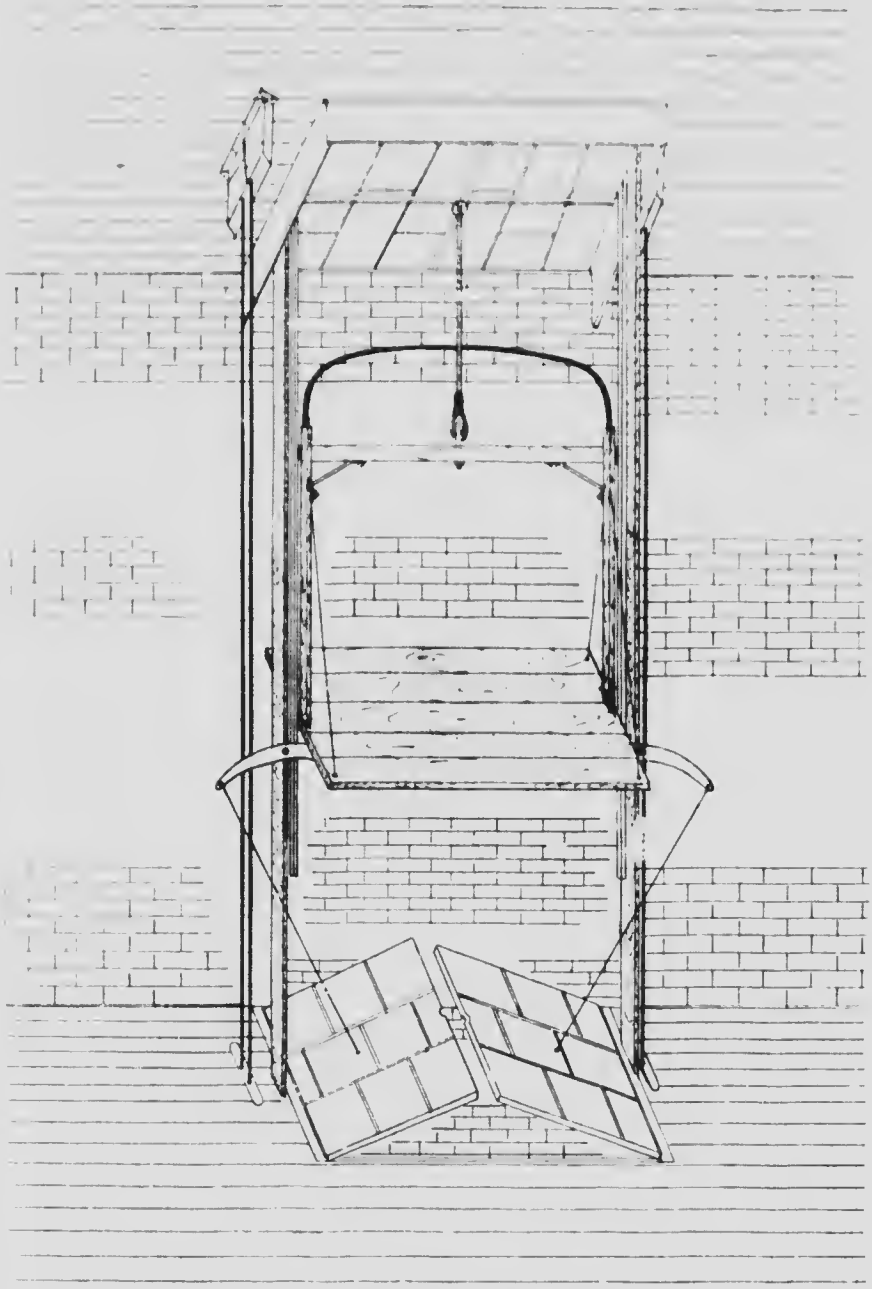
CABLES ABOUT ELEVATORS.

The holes made in the floors for these are small, but they require to be carefully protected.

This can be done by a sleeve of metal surrounding the cable attached to the ceiling and descending about 2 feet therefrom operating as a curtain board. Or two strong wooden uprights can be placed in front and behind the cable and metal placed around them, making a tight conduit from floor to ceiling, within which the cable runs.

Weights for Elevators. The weight to counterbalance the elevator and its cable should be enclosed in a tight partition of metal. Doors can be inserted to provide easy access to such whenever desired.

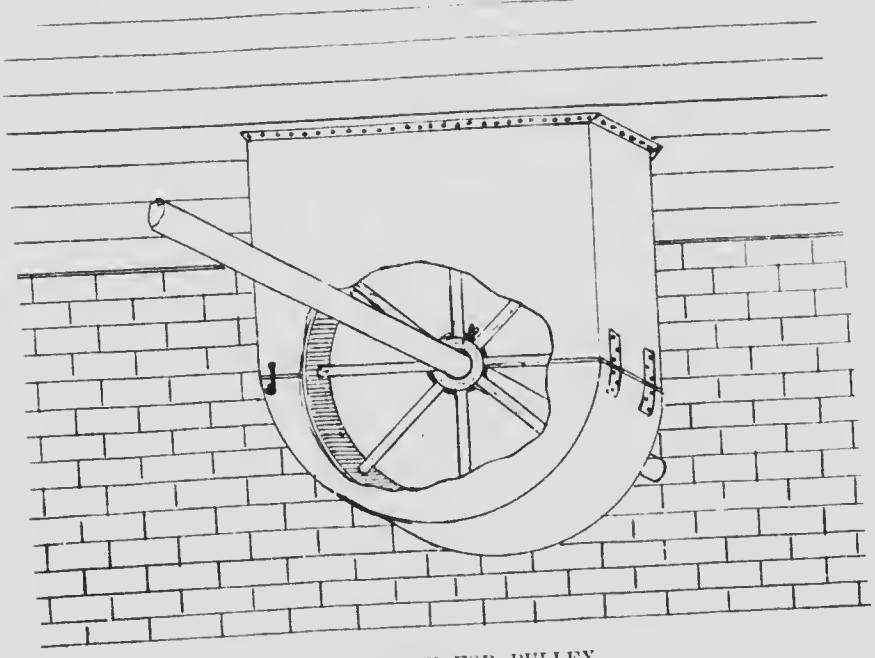
Sometimes the curtain board can be placed outside the cable openings and so protect those openings as well as the main elevator opening.



6. AUTOMATIC TRAPS FOR ELEVATORS, ENCLOSURE FOR CABLES AND CURTAIN BOARD AT CEILING.

Belt Holes in Floors. Floors are frequently cut to bring the belting from a line shaft on the floor below to operate a special machine.

A metal covering should be placed around the pulley, such covering to be attached to the ceiling below the opening. This can be made with a hinged portion easily opened to permit ready access to the shaft or belt when desired, as shown in illustration *II.*



II. ENCLOSURE FOR PULLEY.

CHUTES.

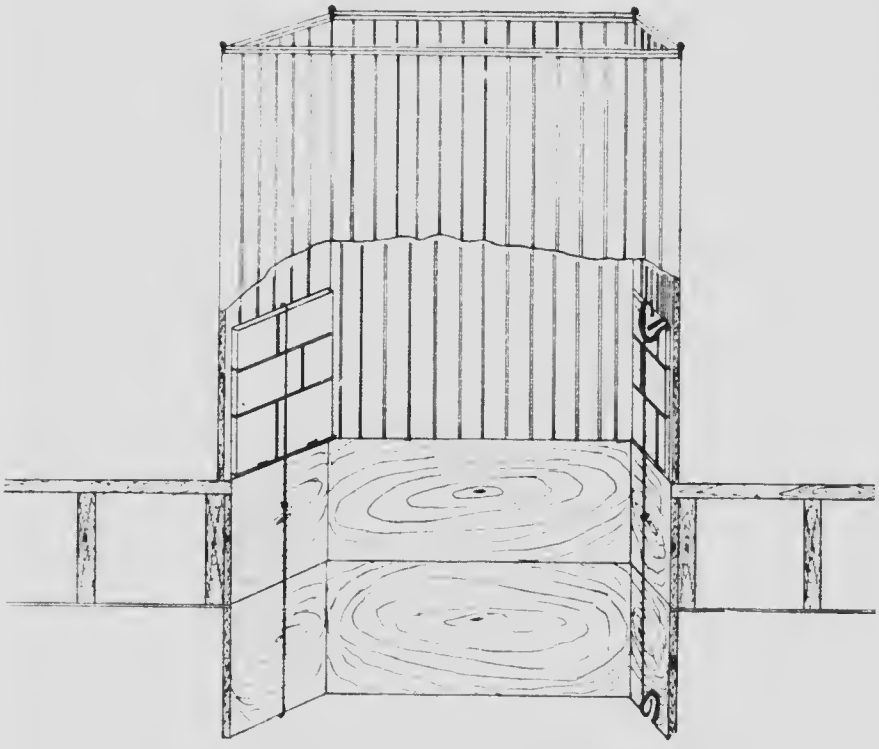
These are frequently found in mercantile buildings, being used to transmit small parcels from floor to floor.

They are small, but are quite large enough to carry smoke and flames through a building, and require very careful attention.

There should be a deep curtain board around *each* opening at the ceilings, also a trap door on the opening itself, to be kept open by a cord, which would burn quickly if a fire occurred. The

cord should be carried down and fastened behind the curtain board so as to ensure its being burned and the trap door released as soon as the flames reach the opening. A strong spring should be placed behind the trap door to shut it quickly when the cord has burned.

Often to make a proper cut off, there must be two trap doors, one on each side of the opening, as shown in illustration *I*.



I. CHUTE ENCLOSURE WITH DOUBLE TRAP DOORS.

STAIRWAYS.

Stairways are usually constructed one immediately above the other, and when so built they can be enclosed very easily and at a moderate cost, as shown in illustration *J*.

For the enclosure metallic lath covered with plaster is recommended. Such an enclosure is thin, takes up little space and is incombustible. The partition should be double, with an air space of at least 1 inch between the sheets of metallic lath.

Porous terra cotta blocks covered with plaster are also highly recommended for the enclosures.

Where light is desired within the enclosure, use wireglass in metallic frame. The sash containing the glass must be fixed. Swinging windows are not allowed.

The doors on such an enclosure should be of metal—such can be now procured of moderate weight and of pleasing appearance. If light is desired in the door use wireglass set in metal frame.

If a wooden door is used it should be of solid construction, and must fit closely to the door frame.

The door should have a spring or automatic device to keep it closed. Also a hook provided with fusible link to be used to fasten it open when it is absolutely necessary to do so for a short time.

Such doors must never be wedged open.

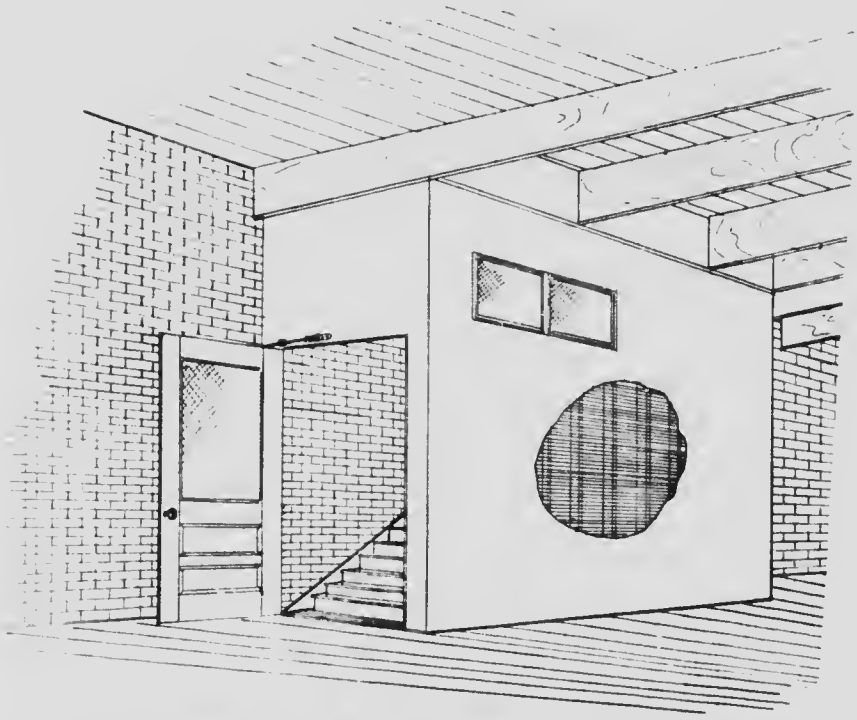
Attention is drawn to the fact that an enclosure on every second floor will cut off each floor from the other, as shown in illustration *K*.

This permits an ornamental open staircase on the ground floor, an arrangement desired by many business men.

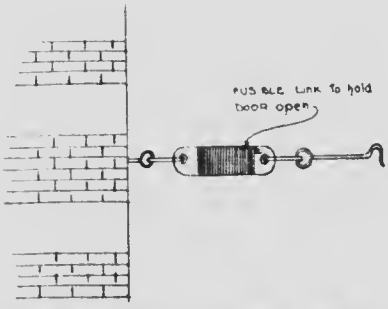
On the floors on which there is no enclosure there should be a curtain board around the stairway opening in the ceiling.

Stairways are sometimes built around an open elevator.

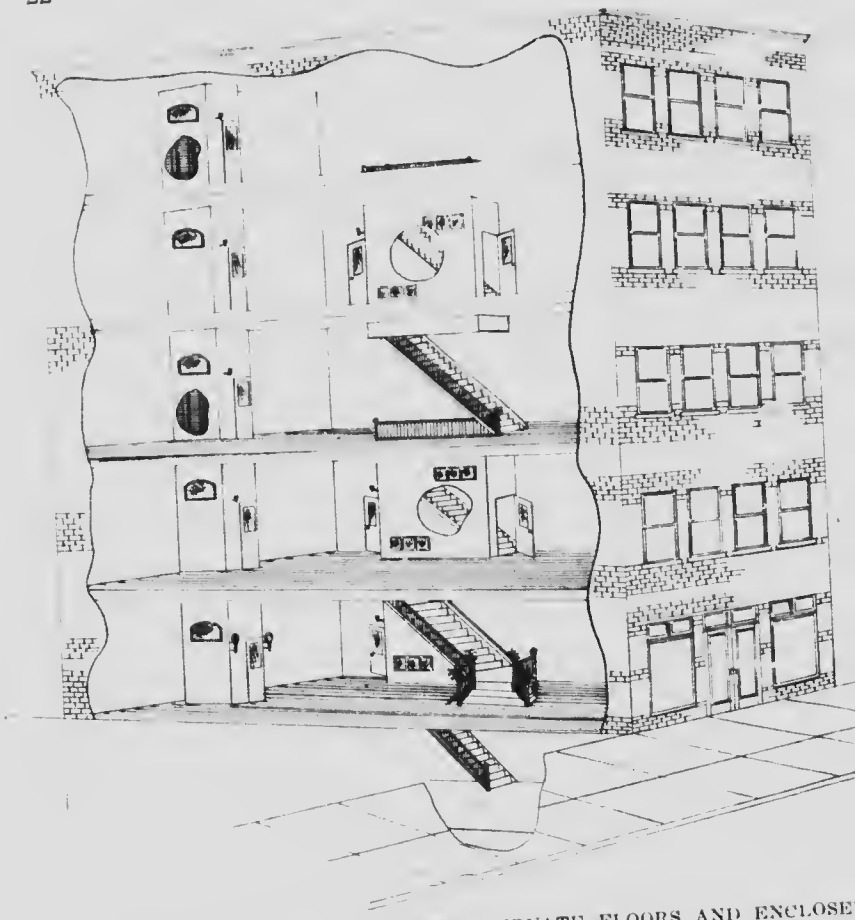
In such cases the fire resisting enclosure should be built outside the staircase, making in that way a stair and elevator tower. See illustrations *D*, *E*, *F*.



J. STAIRWAY ENCLOSURE WITH AUTOMATIC DOOR HELD OPEN BY FUSIBLE LINK.



DETAILS OF FUSIBLE LINK.



K. STAIRWAY ENCLOSURES ON ALTERNATE FLOORS AND ENCLOSE
ELEVATOR RUNNING THROUGH BUILDING.

TRAP DOORS FOR STAIRWAYS.

These are not recommended, as the trap door is likely to
wedged open by ignorant or careless employes and not notic
by the proprietor so easily as would be the case with an enclosu
and upright door.

Where used they should be constructed as shown in illust
tions *L* and *M*. A curtain board should also be provided in
cases, as indicated in the illustrations.

ENCLOSED

likely to be
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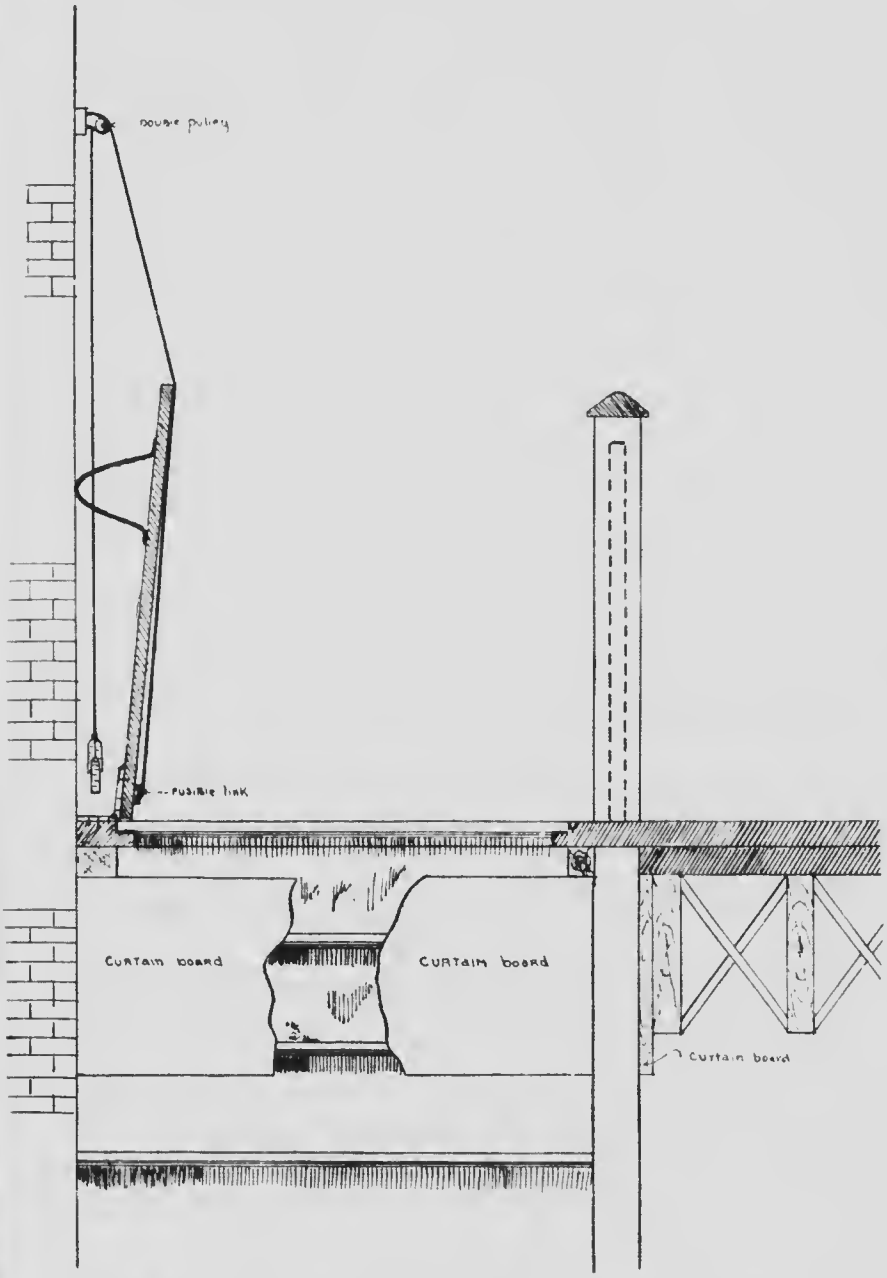
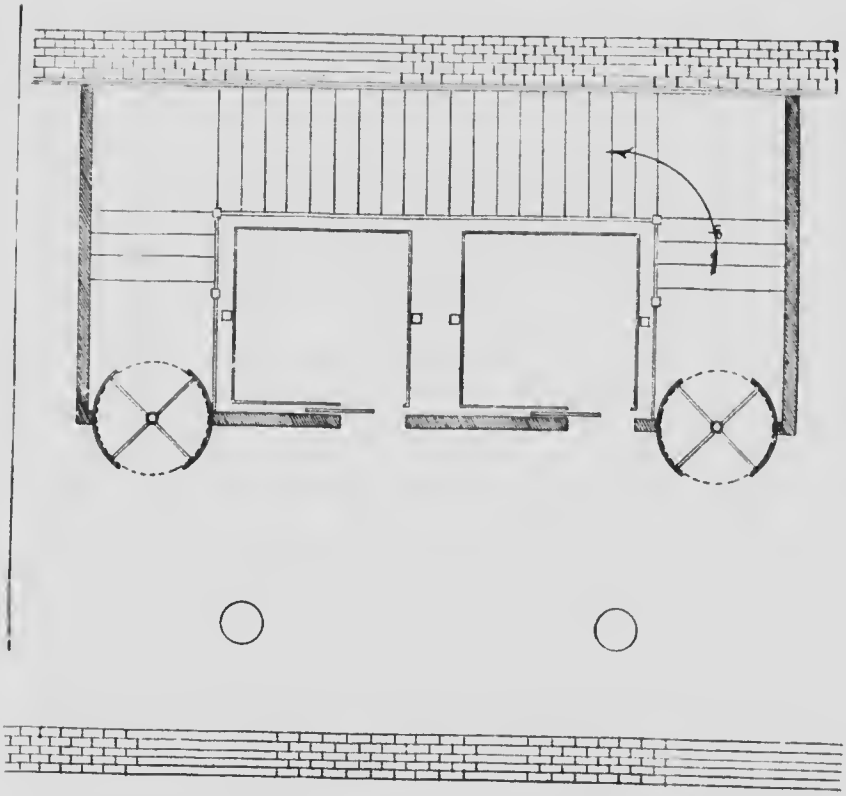


L. SECTIONAL VIEW OF TRAP DOOR AT TOP OF STAIRWAY.

RAP DOOR AT TOP OF STAIRWAY, HELD OPEN BY FUSIBLE LINK.



O. REVOLVING DOORS AT OPENINGS FROM STAIRWAY ENCLOSURE.

REVOLVING DOORS.

Revolving doors can be often used with advantage upon openings into a stairway enclosure or elevator tower in a mercantile building where there are a large number of customers, such as large dry goods stores or department stores. See illustration *O*.

The revolving door should be of metal or heavy hard wood with wireglass used in the upper half of each quarter section.

LAP DOOR AT TOP OF STAIRWAY, HELD OPEN BY FUSIBLE LINK.

WELL HOLES.

It has been said that the only good Indian is a dead Indian, and it may be said that the only good open well hole is a closed one.

If there be a well hole in a building it must be closed, if there is to be a cut off from floor to floor.

In a 3-story or 4-story building, the ceiling of the ground floor (floor of the second floor) could be filled in by metal girders with wireglass between to give light to the ground floor. Then leave the well hole open to the roof, but close it from the third and fourth floors by a perpendicular partition surrounding the well hole opening from floor to ceiling on those floors.

Wireglass can be used in the perpendicular enclosure to give light from the well hole to the second and third floors, if such be required. See illustration *N*.

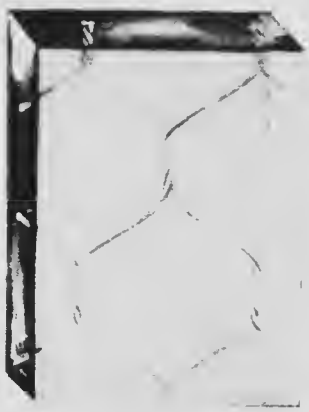
THE SPREADING OF FIRE.

Means for the protection of vertical openings do not always imply a guarding against the contribution of fire within the walls of a building itself. Where each individual floor is thoroughly isolated from contiguous floors a condition is brought into being which has been aptly termed "auto-exposure." This means the likelihood of fire being contributed from one floor through outside windows and in again to floors above or below in the same building. This hazard is in a measure segregated from what is generally accepted as the "exposure hazard" and is largely dependent upon the completeness with which each floor is isolated from its neighbors.

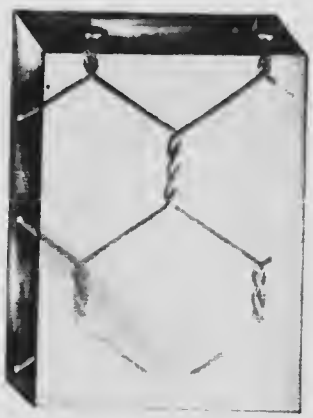
Perhaps no better example of such conditions has been had than was exemplified in the burning of the Engs Building, New York City, in August, 1903. In commenting upon this fire *The Insurance Press* said: "To make a long story short, the fire burst into the light shaft, gaining access to the upper and lower floors of the Engs Building. The conclusion seems inevitable that such protection as is afforded by wireglass window equipment would have saved a large proportion of the loss by this fire."

As indicating that the information gained through the Eng

and many similar fires has not been lost, reference is pertinent to the model factory buildings now in course of construction for the Bush Company, and which will eventually cover the water front of South Brooklyn from Twenty-fifth to Thirty-sixth streets. These factory buildings will each occupy a city block and will be constructed entirely of concrete and wireglass. In view of the type of construction and the area covered by this group of structures, the exposure hazard from one building to another is not excessive, but as each floor of each building is completely isolated the auto-exposure came largely into evidence, hence, principally, the installation of "Mississippi" wireglass in all windows of all buildings.

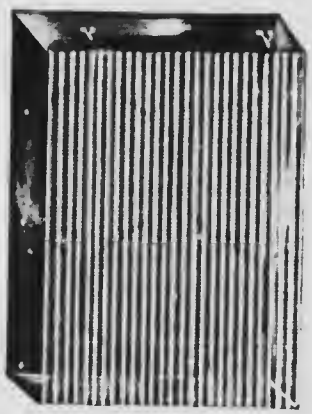


ROUGH.

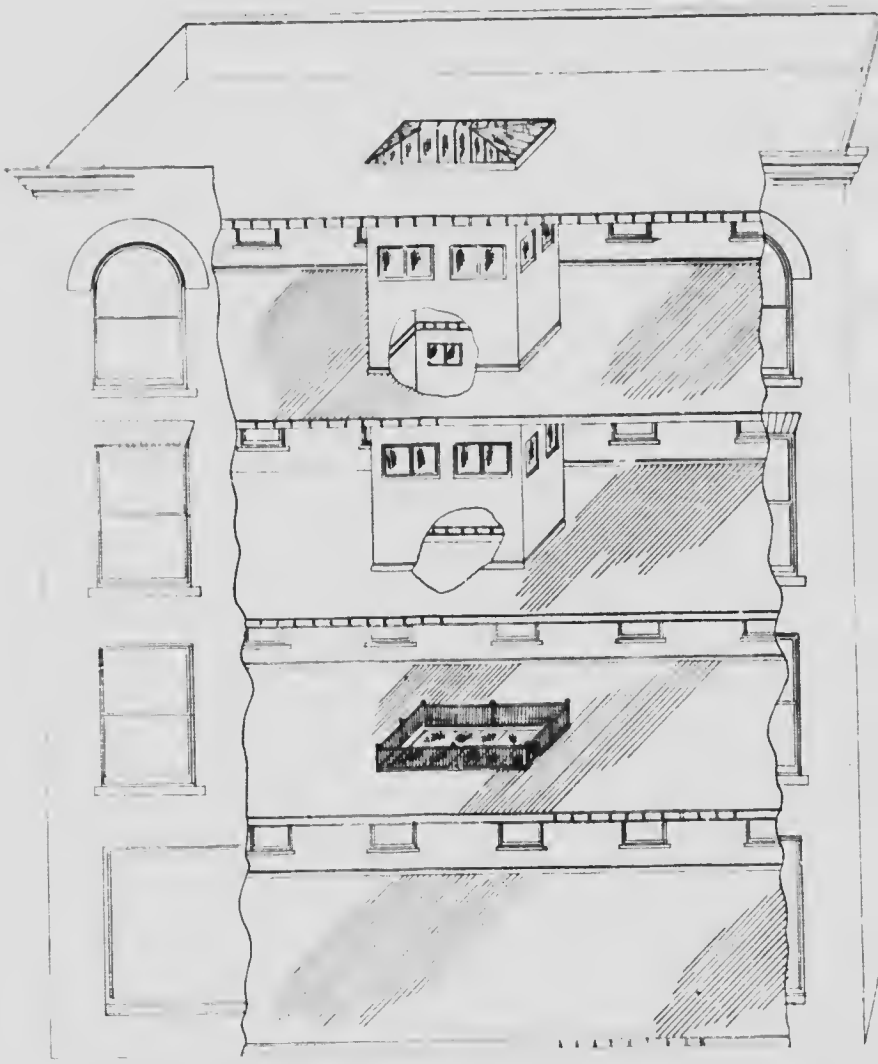


POLISHED.

MAZE.



RIBBED.



N. WELL HOLE CLOSED HORIZONTALLY WITH WIREGLASS AT SECOND FLOOR. PERPENDICULAR ENCLOSURE ABOVE.

SECOND

CURTAIN BOARDS.

A curtain board is a piece of metal or heavy wooden plank projecting downwards for at least 15 inches and around the opening in a ceiling for stairway, chute, open elevator or cable for elevator. It is intended as a draft breaker and smoke arrester.

Smoke will ascend to and travel along the ceiling until it reaches a vertical opening. The curtain board will hold it for a few minutes until the smoke has so accumulated under the ceiling as to overflow the curtain board.

This device should always be used where conditions are found such as indicated above. See illustrations *G, I, K, L.*

ROOF SPACE.

In many buildings the top of the elevator shaft communicates freely to the space between the ceiling of the top story and the roof proper, generally called the "roof space."

Great care should be taken that there be no opening of this kind.

Once fire has entered a roof space, in nine cases out of ten the roof will be destroyed and possibly the entire building also.

The trap door in a ceiling giving access to a roof space is often found open.

It should always be closed and kept in position by hooks.

BROKEN CEILINGS.

Any place in a ceiling where plastering has become broken or other ceiling covering removed, should be repaired and made tight at once.

When fire gets into a concealed space between a ceiling and floor it is very hard to extinguish.

SMOKE DAMAGE.

A small fire will often generate a great deal of smoke, which will fill a building and damage all the stock if there be vertical openings by which it can pass from floor to floor.

The closing of all vertical openings would greatly lessen the losses from this cause.

WATER DAMAGE.

Water poured into a building to extinguish a fire will damage the stock or machinery on the lower floors as well as the building itself unless provision has been made to carry the water off to the sewers.

All floors should be "scuppered," that is, drained by vents placed in the floor for the specific purpose. The location of these and their number will depend on the size and general arrangement of the building.

The damage by water often exceeds by many times the value of the property actually burned. Most of the damage could have been prevented if the floors had been "scuppered."

There are numerous instances where the weight of the water poured into the upper floors of a building, which could not get away quickly, overloaded the floors and caused the collapse of the entire building.

FIRE RESISTIVE ROOM.

If oils cannot be kept outside, or a hazardous process carried on in a separate building, a specially constructed room should be provided.

Use a corner, if possible, but that is not absolutely necessary.

Construct a room with walls of porous terra cotta, cement or metallic lath (with air space between the sheets of metal lath) and plastered.

Cover the floor with cement, and the ceiling with metallic lath plastered. Use metal covered door on the opening, and wireglass, if any glass is required in the partition. Such wireglass to be in double sash with air space between the sheets.

Have window in room to give good light, but be careful to protect windows above by use of wireglass.

If possible have a vent to the chimney, near the ceiling.

Provide a good-sized drain in floor.

FIRE PROTECTION.

Some simple appliances should be provided in all buildings so that if a fire breaks out the employees who discover it may have something at hand readily available for its extinction. For this purpose the simplest method is to provide a solid cask of water, with some pails upon a shelf placed over it. In many mercantile establishments the appearance of such a cask is objectionable, but there can now be procured a handsomely painted metal cask with hinged lid and with a nest of six pails resting in the liquid with which it is filled. Each pail as pulled out will be filled to the brim and when all have been removed there will still be a considerable quantity of liquid left in the cask as a further supply if prepared.

The makers of these casks or Safety Fire Bucket Tanks frequently provide a chemical solution to be placed in the water, which is effective as an extinguishing agent and keeps the water sweet as well as prevents freezing.

CHEMICAL EXTINGUISHERS.

Several well constructed chemical extinguishers can now be procured, but any intending purchaser should see that any extinguisher offered has been tested in the laboratories of the National Board of Fire Underwriters at Chicago, and received their endorsement. All chemical extinguishers require to be refilled from time to time, and it would be well for any one making use of them to fix a certain date or dates for this purpose, attaching a card to each extinguisher, upon which the dates when tested and when refilled can be written.

Dry powder extinguishers are not recommended, because it has been found from experience that they cannot be used to advantage under as many varying conditions as a pail of water or a chemical extinguisher. Where it is not possible to have either the cask of water or the chemical extinguisher, such as in a building which is not heated in the winter time, it would be well to provide a supply of powder extinguishers.

STANDPIPES AND HOSE.

A standpipe from the street mains should be carried up through the building with a sufficient quantity of hose attached on each floor to reach any portion of the floor. If the building is a large one, there should be two or more standpipes. The hose should be of 2½ or 2⅝ inches in diameter. There should be a separate connection from the city main to the standpipe, and there should be a valve placed outside the building, from which the water could be shut off from the standpipe if the fire should gain such headway as to drive the occupants out of the building, otherwise a large amount of water will run to waste and seriously reduce the pressure on the street mains. There should also be a siamese connection to the standpipe placed outside the building at the street line, into which the steamers of the fire department can pump water at high pressure, thus very materially increasing the value of the standpipe to fight a fire on the upper floors, or to protect the building from an exposure fire.

ROOF HYDRANTS.

The standpipe should be carried above the roof and a small shelter provided with skeleton wooden frame covered with metal, in which a length of hose could be kept. The valve to supply the roof hydrant should be below the ceiling of the top floor, so that there would be no danger from freezing.

It has been found that standpipes and roof hydrants are of very great value in saving a building when the adjoining premises are on fire. The area of the Toronto conflagration would have been very greatly reduced if a number of the buildings had been provided in this way; in several cases standpipes and roof hydrants assisted very materially in stopping the further spread of the conflagration. See details in regard to size of standpipe and of hose, steamer connections and valves, incorporated in the building code prepared by the National Board of Fire Underwriters in appendix.

WATER CURTAIN, OR OUTSIDE OPEN SPRINKLERS.

A very effective method of protecting windows from fire in adjacent buildings is to have a system of pipes carried up outside the building with lateral arms upon which open sprinkler heads are placed over each window. When a fire occurs, water is turned on and sprays from the heads upon the glass and frame of each window. It is not automatic, but must be turned on when required, either by the property owner or by the fire department. When a water curtain is provided, the fire department should be requested to visit the premises and become familiar with the location of the valves required to operate the system. Full details in regard to the size of pipe and other requirements in connection with the installation of such a system will be found in the report of the National Fire Protection Association on open sprinklers in appendix.

PROTECTION OF WINDOW AND DOOR OPENINGS.

There are a number of devices of more or less value for the protection of the window openings in buildings from the danger of fire which may occur in adjacent premises, and for the protection of doorways made in walls separating adjoining buildings. The full report of a committee of the National Fire Protection Association is printed in appendix, to which the reader is referred for details. The following extract is from the report in question:

"Methods and materials are still being commonly used and approved which are unsuited for the purposes for which they are intended.

"The fire protection engineer and the insurance man may be partly to blame for this condition of affairs, but a large proportion of the blame must be attributed to the failure of the manufacturers to make progress in the advancement of their craft by the development of devices which will withstand actual fire service conditions rather than to rely alone on those which appear well under theoretical analysis. Costly experience has too often shown a lack of proper foresight in the failure to conclu-

sively demonstrate the fire resisting qualities of such devices before introducing them in service.

"The recommendations which we have to submit at this time are confined mainly to certain alterations and additions to the present standard requirements and to such rules for the construction of devices as seem to be warranted by the results of tests or by experience in the field."

THERMOSTATS.

These are electrical devices placed a few feet apart upon the ceilings of a building, and so constructed that a rise in temperature will establish an electrical contact which will ring a bell in the office of the building so protected and in a central station connected with the thermostat system where men are on duty at all hours who, when an alarm is received, investigate the cause and notify the fire department. When carefully installed and regularly looked after, this is a very excellent device.

AUXILIARY FIRE ALARMS.

These consist of stations on every floor of a building, every one of which is in effect a duplicate of the nearest street fire alarm box. Instant communication is thus provided between interiors of premises and the public fire department. Serious losses are constantly occurring because when an alarm station is at all remote, the discoverers of fire frequently try to control it before sending in the alarm. It is always safer to send the alarm instantly, and then endeavor to extinguish the fire before the arrival of the department.

VERTICAL OPENINGS IN HOTELS.

A prominent feature of each of two new hotels in New York, the Hotel Gotham and the Hotel Astor, described by Perez M. Stewart in an article that appears in *Insurance Engineering* for November, 1904, is the precaution taken by the architects to prevent the spreading of fires from one floor to another. In the one case Mr. Stewart says:

"All elevators are enclosed in terra cotta shafts with doors to the freight elevator of kalameined or metal covered wood, and to the passenger elevator of iron and wireglass. Electric conduits are also enclosed in terra cotta shafts with kalameined doors at each floor; this also applies to other shafts throughout the building. All shafts have ventilating skylights with thin glass at the top.

"All stairways are enclosed in fireproof shafts, with doors of kalameined wood and wireglass. These doors open inward and will generally be held open by an electric catch controlled from the office. At any alarm the pressing of a button in the office releases this catch, and the doors are closed by a check spring, but of course not locked or latched. They will still open at a push."

SERIOUS ERROR IN MILL CONSTRUCTION AND ITS RESULTS.

(*From Insurance Engineering, January,* 1903.)

An example of the danger of unprotected vertical openings:

An instructive fire was that in the shoe factory of William Lane, located on Second avenue, extending from Forty-fifth to Forty-sixth streets, South Brooklyn, on the night of December 20, 1902. The observations submitted are:

In the hope that greater emphasis may be placed upon that vital defect in the construction of this building that contributed so much, if indeed was not entirely responsible for, its almost total destruction, namely, floor openings.

The building was 50 feet wide and 200 feet long, four stories and basement in height, 10,000 square feet ground area. The walls were of unusual thickness, reinforced by numerous piers, corbeled out from which were ledges capped with stone to carry ends of girders and beams.

In the common acceptation of the term, it was called "mill" construction.

All columns, girders and beams were of wood.

Floors 6¾ inches thick, composed of three sections—3½-inch splined plank, 2-inch plank and 1¼-inch surface flooring. Four rows of columns longitudinally forming 9-foot to 10-foot bays.

The elevator was located in southeast corner of building, in a brick shaft, with iron doors at each landing.

An open stairway from first to fourth floor was located near the center of the building, and another open stairway near southeast corner of building.

As stated before, the ground floor area was 10,000 square feet; these floor openings increased it to 40,000 square feet, by connecting vertically all floors.

The fire is reported to have started at the north end of the factory on the first or ground floor, and was discovered by the watchman. The statement of the first firemen to arrive was that the fire was coming out of the east windows on all floors before they got the first stream on. It is reasonable to expect that with such heavy floors, had they been intact without openings,

the fire would not have extended beyond the floor where it originated. With open stairways the expected happened.

It is held by some that the slow-burning features found in this building are desirable even with floor openings. In this case the result is the same as it would have been with ordinary joisted construction.

Doubtless it was slower burning, and required the twelve engines in commission to pump a few hundred thousand gallons more water than would otherwise have been required.

Nothing in this article should be construed to represent the writer as opposed to "mill" construction, for true "mill" construction has no stronger advocate. It is a fact, however, that so-called mill construction, unsprinklered, with one or more vital defects existing, has proven a delusion in more than one instance and unworthy of more favorable consideration than many good buildings of ordinary construction without such defects.

The lesson is plain—let all who are interested in reducing the fire waste of the country unite in a crusade against unprotected floor openings, and the result will amply compensate for the trouble and the insurance companies and the public by lower premiums will be benefitted in the way of reduced losses.

THE FIRE RISK OF DEPARTMENT STORES.

"The danger provided by the light well, which is so prominent a feature of the modern department store," remarks the *Dry Goods Economist*, "is the theme of an article by Everett U. Crosby in *Insurance Engineering*. Mr. Crosby admits the advantages in the way of light and ventilation which such immense shafts afford, but he points out that they render impossible the confining of fire to one floor.

"The number of elevators, frequently unenclosed, employed in a big store, the use of wooden joists, lath-and-plaster-finished walls and concealed places under roofs greatly intensify the risk.

"To these factors of construction must be added the inflammable nature of the merchandise.

"Then, too, there are the decorations, often composed of flimsy material, and frequently most elaborate in the draught-creating light well.

"Even the so-called fireproof construction is no safeguard beyond a certain point. True, the steel frame, if properly insulated against heat, is largely indestructible, but the contents of the store cannot be protected, and so long as the light well exists the fire cannot be confined to one floor after it has once got a good start."

PROTECTION OF VERTICAL OPENINGS.

THE MODERN DEPARTMENT STORE.

(*From Insurance Engineering, March,* 1903.)

The Macy store is situated on the west side of Broadway, occupying practically the entire block from Thirty-fourth to Thirty-fifth streets, running back 455 feet on the former street and 380 feet on the latter, and covers a total area of 81,230 square feet.

The building is nine stories high, with basement and sub-basement, besides vaults and mezzanine floors, there being all-told over twenty-four acres of floor space. This establishment gives employment to about 4,000 people.

What distinguishes this from other stores used for similar purposes are its design and construction, as planned with reference to reducing the dangers from fire and the safety of life. Being 150 feet high above the sidewalk, and of unusual dimensions, it became incumbent to make special provisions for the safety of the employes and the public, and it was therefore decided to abandon the common feature of an interior court and to have unbroken floor areas.

The frame of the building is of steel, and throughout this is protected by the "Roebling" system of fireproofing. Most of the columns, excepting those which carry concentrated loads at the big girders over the driveway, are of cast iron and protected by reinforced wire lathing, inclosing a coating or filling of Portland cement, there being a two-inch air space between the plaster and the columns.

With the exception of the stairways leading from the center of the main floor up to the second floor and down into the basement, all stairs and elevators are inclosed by fireproof partitions, making each stair a fire escape, and each floor is divided into a front and rear part, separated by 12-inch fire walls with automatic double kalameined fire doors at the openings. The fireproof partitions are eight inches thick and built of iron, marble and plate wireglass. The openings from the sales floors out into the stair and elevator wells are protected by automatic closing doors, as also by rolling shutters.

All openings in the rear wall facing on the alley are furnished with "Lucknow" double wireglass windows. Wireglass in the form of windows, partitions and skylights plays an important role in the fireproofing of the Macy store, more than 30,000 square feet being used, of which nearly half was polished.

In addition to stairs and elevators, escalators or moving stairways connect the first floor to the second, third, fourth and fifth floors, and also these have been provided with fireproof partitions and rolling shutters in a similar manner, as provided for the elevators.

To properly supplement the superior construction and layout of the building, it is protected everywhere by an up-to-date system of "Grinnell" automatic sprinklers. Besides, there are four siamese connections on the street for the use of the city fire department.

Outside of the automatic sprinklers, protection is afforded on every floor by thermostats, standpipes with hose attached, safety bucket tanks, fire poles and axes, mounted chemical extinguishers and special fire alarm boxes. The store's private fire department includes a superintendent, chief engineer, the superintendent of each floor, and a chief of battalion, who is also drill master. The department is organized on the basis of a separate company for each floor. There is a perfected system for sending alarms to any part of the building desired.

FLOOR OPENINGS IN MERCANTILE BUILDINGS.

Mr. F. W. Fitzpatrick, of Washington, D. C., secretary of the International Society of State and Municipal Building Commissioners and Inspectors, says:

"Beginning with the 'Building Laws and Ordinances,' as suggested by the National Board, I would submit that as far as stair and elevator enclosures go, the suggestion is not far-reaching enough. All such openings through the floors should be enclosed with fireproof partitions in any building where large numbers of people assemble, not alone in stores or warehouses, and fireproof buildings exceeding three stories in height. The vertical ducts through buildings are the greatest aids and abettors of serious conflagrations. The idea of continuing such stairway enclosures to the main exit of a building is most excellent; people in hotels, stores, offices, apartment houses and all such places, in case of an emergency, or the alarm of fire, are bound to make for the usual means of exit first, and if that means be thoroughly protected in every such building there will be but little necessity for exterior fire escapes that, after all, are so often but a delusion and a snare. Even in a three-story building an open wooden stairway, on fire or filled with smoke, is as dangerous and as much of a death-trap as is a seven and eight-story stairway. Not only should this enclosing of elevators and stairs be compulsory in new buildings, but it should be insisted upon in all the old ones."

BALTIMORE CONFLAGRATION.

The committee of experts in insurance engineering appointed to report on the Baltimore conflagration, said:

"The building in which the fire started was six stories and basement in height, with floors of double boards on wood joists, supported by unprotected steel beams and girders on unprotected cast iron columns. Ceilings were wood sheathed and painted. Near the center of the building was an unenclosed well hole about 14 feet square from basement to sixth story, containing a stairway and passenger elevator. There were also two freight elevators in other portions of the buildings trapped and enclosed in light wood partitions. The ground area of the building was about 13,000 square feet, somewhat above the average for this district.

"The cause of the fire has not been ascertained, nor has sufficient information been obtainable on which to base any reliable conject The following facts are of interest, as showing the way in which it spread through the building:

"At 10:48 a. m., Sunday, February 7, the automatic fire alarm system registered an alarm for fire in the basement of the Hurst building, calling out the fire insurance patrol, Engine Company No. 15, one hook and ladder company and the district chief. The fire patrol and engine company being located within two blocks responded very promptly, and immediately took a line of small chemical hose into the basement through the first story from the German street side of the building. At that time no fire was visible on the first floor, and, according to the statement of the firemen, no smoke or heat was apparent. In the basement they found some fire, which increased rapidly, and in a moment or two drove the firemen out. The fire spread up the passenger elevator shaft in the hall, and in about seven minutes from the time the automatic alarm was registered a violent explosion occurred, apparently coming from the upper floors. This explosion blew out practically all of the windows in the Hurst building and many others in neighboring buildings, but did not rupture any of the walls. Immediately following the explosion, the en-

tire building was seen to be ablaze, the flames coming from all the windows and extending across the street, where they ignited several buildings. The exact nature of this explosion is still a matter of doubt.

"The early press statement that gasolene was used is denied by the occupants, and it is claimed that no gas was used in the building, although it was piped and ready for use. The most plausible theory is that the smoke and gases from a smouldering fire ascended the central elevator and stair opening, accumulated in the upper portion of the building and were finally exploded when reached by the flames. An alarm from the street box was turned in at 10:55, about the time the explosion occurred and a general alarm immediately followed this."

TORONTO CONFLAGRATION OF APRIL 19, 1904.

Fire broke out at 7:30 p. m., on Tuesday, the 19th of April, and was not under control until 5 a. m. on the 20th. It originated in a building four stories high, occupied by Currie & Co. for the manufacture of neckwear. The elevator was not fitted with automatic traps at each floor, and the stairway was open, and when fire broke out it spread rapidly throughout the building. When the firemen arrived it was impossible to enter the Currie premises. The building was separated by a lane 12 feet wide from a six-story building occupied by Ansley & Co., wholesale hats and caps, and by the Gillespie Fur Company, wholesale furriers. The chief of the fire brigade endeavored to prevent the flames crossing this lane by taking the hose through the Ansley building and fighting the fire from the room, but the spread of the flames across the lane was so rapid that the retreat of the firemen was cut off and they had to use the hose as a fire escape by which to descend to the street level. Fanned by a high wind (about 30 miles an hour) the flames then spread from building to building until within an hour at least a dozen separate structures were ablaze and help was being summoned from neigh-

boring municipalities. The fire soon crossed Wellington street, 66 feet wide, and swept in a very short time from end to end of the warehouse and book bindery of Brown Bros. & Co., and the lithographing establishment of Ralph Smith & Co., then going south across Piper street and courtyards about 40 feet in width, to the warehouses on the north side of Front street. After securing a firm hold upon these warehouses it crossed Front street, 80 feet wide, and rapidly destroyed every building between Front street and the Esplanade. The flames then started to travel to the east, crossing Bay street below Front, and to the Barber & Ellis envelope factory and stationery warehouse two doors above Front street.

From the Barber & Ellis warehouse the fire spread north and south and east until nearly all the buildings in the block from Wellington and Front, and east to Bay, towards Yonge, were burning, at the same time working up the west side of Bay street in the direction from which the fire had started. When the fire reached the warehouses on Wellington street east of Bay, as it was going against the wind the firemen were able to make a stand and prevent the conflagration crossing, but not without considerable damage to the buildings on the north side of that street.

The fire was finally controlled at the envelope factory of Kilgour Bros., which was equipped with automatic sprinklers on each floor and also had open sprinkler heads at the windows. The roof of that portion of the premises fronting on Wellington street and extending 200 feet to the south, was completely burned off, with serious damage at every window, but the sprinklers within these premises prevented the conflagration securing a firm hold upon it, and the only portion completely destroyed was that fronting on Wellington street and extending back about 50 feet. Adjoining the rear portion was an addition five stories high, 50 by 75 feet, which was also protected with water curtains on the windows overlooking a warehouse used by the Simpson Company for storage of furniture. Although this furniture warehouse was completely destroyed and the heat from its burning must have been intense, only a few panes of

glass were broken in the Kilgour warehouse. This building also diverted the flames so that they beat on the side instead of the rear of the Minerva Manufacturing Company on Front street opposite the Custom House. This fact enabled a stand to be made to protect the rear windows of the Minerva building, while the west wall of the structure rising two stories above the adjoining buildings on Front street also afforded a good vantage ground. They did secure a hold on the roof, but only for a short time. At these two points the conflagration may be said to have been held.

The lesson to be learned is the great danger from elevators and open stairways or well holes which allow communication of smoke and fire from floor to floor throughout the building.

The next lesson is that all openings towards adjacent buildings should be carefully protected. There is no doubt that the immunity from fires in Great Britain and on the Continent as compared with the United States and Canada is due to the fact that great attention is paid to the erection and maintenance of proper fire walls dividing adjacent premises. The greatest carelessness, and even recklessness, is often shown in regard to this very matter, fire walls being cut to oblige a tenant, when such should under no consideration be allowed.

Ninety-eight separate buildings were burned, every one built of brick, with first-class roof.

Area burned over was 1,200 feet from north to south and 900 feet from east to west. About 20 acres.

APPENDIX.

REQUIREMENTS FOR STANDPIPES.

(From the new Building Code proposed for universal adoption by the National Board of Fire Underwriters.)

In every existing building exceeding fifty-five and not over 100 feet in height, unless already provided with a 3-inch or larger standpipe, and in all buildings hereafter erected exceeding fifty-five and not exceeding 100 feet in height, there shall be provided a vertical standpipe of not less than 4 inches in diameter.

In every existing building exceeding 100 feet in height, unless already provided with a 4-inch or larger standpipe, and in all buildings hereafter erected exceeding 100 feet in height, there shall be provided a vertical standpipe of not less than 6 inches in diameter.

These standpipes shall be of wrought iron or steel galvanized, and, together with fittings and connections, shall be of such strength as to safely withstand at least 300 pounds water pressure to the square inch when installed and ready for service; also to stand such a test without leaking at joints, valves or fittings.

Standpipes shall be located within fireproof stairway inclosures where the latter are of such construction, and as near stairways as possible where they are not so inclosed.

In buildings exceeding 100 feet deep fronting on two or more streets there shall be a standpipe at each end of building, and in large area buildings there shall be one standpipe at each stairway, or within each stairway inclosure.

Where more than one standpipe is required in a building they shall be connected at their bases by pipes of size equal to that of largest standpipes, so that water from any source will supply all the standpipes.

Standpipes shall extend from the cellar to and through the roof, with a hose connection located from 4 to 6 feet above floor level fitted with approved straightway composition gate valve in each story, including cellar, and a hose connection provided above the roof with the valve controlling latter, located in the standpipe under the roof and arranged to be operated both from above and below the roof. A suitable ¾ inch drain pipe and valve shall be provided under the roof for each roof connection.

Hose sufficient to reach to all parts of the floor shall be attached to each outlet in the building, and hose for roof-hydrant may be placed on rack in top floor near the scuttle leading to the roof. Hose shall be 2½ or 2⅝ inches in diameter, in 50-foot lengths, and provided with standard couplings at each end, all couplings to be of same hose thread as that in use by the local fire department.

Hose to be approved linen, cotton rubber lined or rubber made under specifications recommended by the National Board of Fire Underwriters.

Each line of hose shall be provided with washers at both ends, and be fitted with play pipe or nozzle of Underwriter pattern, having handles at the base and with discharge outlet not less than ¾ inch in diameter. One spanner to be located at each hose connection throughout the building.

All standpipes shall be provided with a siamese steamer connection, located on the outside of the building about 1 foot above the curb level, and where a building fronts on two or more streets, a connection to be provided on each street front. Inlet pipe from steamer connection to standpipe to be not less than the diameter of the largest standpipe. The thread on the siamese connection shall be uniform with that used by the local fire department. Siamese steamer connection shall be provided with check valves in the "Y," and substantial caps provided to protect thread on the connection. The steamer connection fitting should be adjusted looking down at an angle of forty-five degrees. A suitable iron plate with raised letters shall be secured to the wall near steamer connection, reading—"To Standpipes."

In each connecting pipe just inside of the building, in a horizontal section shall be placed a straightway check valve, but not a gate valve. A drip pipe with valve to same, shall be placed between said check valve and steamer connection to properly drain this section to prevent freezing.

In addition to the provision made for steamer connections to standpipes, the water supply may be from city water where pressure is sufficient, automatic fire-pump of 500 gallons or more capacity per minute, elevated tank or steel pressure tank of not less than 5,000 gallons capacity.

In all buildings coming under these regulations as to height which are occupied for living or sleeping purposes, such as hotels, lodging houses, hospitals and asylums, the standpipe system must have at least one of the approved automatic supplies before described.

Where a standpipe is connected to a tank there shall be a straightway check valve in a horizontal section of pipe between the first hose outlet in connecting pipe and tank, and said tank must be filled by a separate pipe, and not through the standpipe.

Where pumps constituting a supply to standpipes are located in the lowest story of a building, they shall be placed not less than two feet above the floor level, and boilers upon which pumps depend for steam shall be arranged so that flooding of fires under same will be impossible.

In every building exceeding 100 feet in height, at least one passenger elevator shall be kept in readiness for immediate use by the fire department during all hours of the night and day, including holidays and Sundays.

WATER CURTAINS, OR OPEN SPRINKLERS.

(Standard Adopted by the National Fire Protection Association, 1905.)

"Numerous tests were made on pipe sizes, with the conclusion that with a branch line of six heads we could afford to allow a reduction in pressure from the riser to the end head of approximately one-third, assuming a pressure of ten pounds at the end sprinkler, this with the upper line of ⅜-inch orifice. With the lower lines we feel that we could allow a somewhat greater reduction in pressure, as such lines would always be operated on heavier pressures than the upper line. The reduction in pressure in the smaller orifice branch lines are not, however, materially greater than the one-third mentioned. We feel that some, if not all, of the open sprinklers now on the market are unsatisfactory as to distribution, and that each of the sprinkler companies should be requested to forward samples to the laboratories for tests, with the intention of ultimately issuing an approved list of open sprinklers the same as for automatic sprinklers."

Window Sprinklers.

1. **Discharge Capacity.**—Where there is but one horizontal line of window sprinklers, each head to have a smooth bore tapering outlet, with an unobstructed orifice ⅜ inch in diameter. Where the conditions call for more than one line, the following size orifices to be used:

	2 Lines.	3 Lines.	4 Lines.	5 Lines.	6 Lines.
Top line	⅜	⅜	⅜	⅜	⅜
Next lower	5-16	5-16	⅜	⅜	⅜
Next lower		¼	5-16	5-16	5-16
Next lower			¼	5-16	5-16
Next lower				¼	¼
Next lower					¼

Where there are over six horizontal lines of windows it may be preferable to omit sprinklers on the first story or possibly even on the second story, but if over six lines are used, the system to be divided horizontally with independent risers, and in some cases this may be desirable even where six lines or less are used. Thus where eight lines would be required the four upper lines to be on one riser according to the above table and the four lower lines similarly arranged on another riser. Where over six lines are used, size of orifice to be left to the underwriters having jurisdiction.

2. **Pipe Sizes.**—No branch line to have over six sprinklers where central riser system is used. Where gridiron system (i. e., a riser at each side with sprinklers located on the connected pipes) is used, the lines between side risers to have not over twelve heads. Branch line pipe sizes to be as follows, this applying with either central riser or gridiron system. With the gridiron system the end head is considered as being the one directly in the center (or on either side of center if the number on line be even).

(a) For ⅜-inch orifice: one head on a ¾-inch pipe; two heads on 1-inch pipe; four heads on a 1¼-inch pipe; six heads on a 1½-inch pipe.

(b) For 5-16-inch orifice: one head on a ¾-inch pipe; three heads on a 1 inch pipe; six heads on a 1¼-inch pipe.

(c) For ¼-inch orifice: one head on a ¾-inch pipe; five heads on a 1-inch pipe; six heads on a 1¼-inch pipe.

(Note—Where heads are over twelve feet apart special pipe sizes in excess of the requirements given below to be used.)

3. **Risers and Feed Mains.**—Central feed risers

1½ inch. Not over 6 heads.
2 inch. Not over 10 heads.
2½ inch. Not over 20 heads.
3 inch. Not over 36 heads.
3½ inch. Not over 55 heads.
4 inch. Not over 72 heads.

For gridiron side feed risers, use the same sizes counting to the center of each line. If number on line is odd the center head may be neglected in figuring size of side risers, except that pipe feeding both risers must take into account all sprinklers which it feeds. Where feed main (including risers to the first branch line) is over twenty-five feet in length, feed main to be at least a size larger than the tables require. Where there is more than one riser size of feed mains to be determined by the Underwriters having jurisdiction but never to be less than the full equivalent of the two largest risers.

4. **Pipes and Fittings.** Galvanized wrought iron or other approved pipe and fittings to be used for the equipment as far back as the cast iron pipe. All galvanizing of pipe to be done in a careful and thoroughly workmanlike manner.

5. **Valves.** Where central feed risers are used, each to have a controlling valve. Where side feed risers are used they are to be connected together at bottom, and one valve so located as to control the two risers. Valves to be approved type as required for automatic sprinkler systems. Valves to be tagged to designate clearly the systems they control. Tags to be of brass, with black letters not less than ½ inch high. Riser valves to be located so as to be easily accessible, preferably in first story.

6. **Drainage.** All pipes and fittings must be carefully arranged and pitched so as to thoroughly drain the entire system as far back as the inside riser controlling valve. Drip pipes to be the same size as for automatic sprinklers.

7. **Location and Number of Sprinklers.** For windows not exceeding five feet wide one sprinkler to be placed at center near top, so located that the water discharge therefrom will thoroughly wet the upper part of the window frame and by running down over the entire window sash and glass wet to the greatest extent the entire window. Where windows are over five feet wide or where mullions interfere, two or more heads to be used, this together with size of orifice to be left to the underwriters having jurisdiction, it being understood that two ¼-inch heads are approximately the equivalent of one ⅜-inch.

Note.—For windows five to six feet wide one sprinkler may be used by special consent of the underwriters having jurisdiction.

8. **Water Supply and Control.** Supply to open sprinklers to be town water works, standpipe, pump or steamer connection, but never pressure or gravity tank used to supply automatic sprinklers, except by special consent of the underwriters having jurisdiction. Where water supplies feed other fire protective appliances, such as automatic sprinklers or hydrants, system to be so arranged that there is no danger of impairing the efficiency of such other devices and water supply to be of sufficient capacity to adequately feed such appliances even with the open sprinklers in operation

Supply to be of sufficient capacity to feed all sprinklers designed to be operated at one time, and maintain not less than 10 lbs. pressure on top line. Where steamer connections are used they shall be located so as to be safe from the exposing fire, as in the rear of building if exposure is on the front. Where other water supplies are used, and it is desirable or necessary to save such supplies for other service, in case the open sprinklers are ineffectual, locate a controlling valve or valves outside the building itself and accessible as regards the exposure fire. Such valves may be located in properly cut-off valve rooms or pits by special consent of the underwriters having jurisdiction. Underground controlling valves to be in approved pits, with manhole, or to be fitted with approved post indicators.

9. **Sprinklers.** Only such types of window cornice, side wall or ridge pole sprinklers to be used as have been approved for such use by the National Board of Fire Underwriters.

10. **Pressure Gages.** A standard make 5-inch oval spring pressure gage to be connected to the top of each riser and just below each riser controlling valve.

Cornice or Side Wall Sprinklers.

(For use in protecting frame buildings, mansard roof, etc.)

11. **Location, Size of Office and Number.** Where one line only is required, as for the mansard roofs of a brick building or for low frame buildings, the heads to be not less than 3/8 inch orifice and not over eight feet apart on the line. Pipe sizes and arrangement to be same as for window sprinklers. Where the number of sprinklers and water supplies admit, it may be desirable to use 7-16 or 1/2 inch orifice, with pipe sizes not less than the following: 1 on 1 inch; 3 on 1¼ inch; 5 on 1½ inch; 8 on 2 inches. Where frame buildings are over two stories high it will be generally necessary to have two or more horizontal lines, preferably one line at each of the upper stories, beginning at the eaves line, the heads located over each vertical row of windows where windows are not over eight feet center to center. Size of orifice and pipe sizes to be same as for window sprinklers, except by special consent of the underwriters having jurisdiction. The value of open sprinklers for frame buildings is much enhanced by the use of wood shutters at all window openings.

PROTECTION OF WINDOW AND DOOR OPENINGS.

(Extract from report of Committee on Fire Protecting Coverings for Window and Door Openings, National Fire Protection Association, regarding the more important desirable qualities which should be embodied in fire retardants for the protection of door and window openings.)

(1) They should he made of non-flammable material.

(2) They should be a good non-conductor of heat.

(3) In addition to their fire retardant qualities they should be able to resist the shock and force of fire streams.

(4) They should he so constructed and mounted as to effectively cover the opening protected.

(5) Their ultimate fire resisting point should he nearly if not quite equal to the fusing point of the materials of which they are made.

(6) They should be capable of withstanding the expansion due to heat and contraction due to rapid cooling.

(7) They should be capable of resisting all reasonahle blows from falling members.

(8) They should be easy to operate, capahle of being made automatic, acceptable in appearanee and should not be prohibitive in price.

Your committee desires to call your attention to the fact that the present standards are intended to apply only to the particular patterns of such appliances as are referred to therein. This explanation is made in view of the fact that certain forms of fire stops for window and door openings have appeared on the market made of materials and embodying forms of construction not at present recognized by the rules, and in fact differing widely from the patterns referred to in the present specifications. This fact is referred to in the report of the Committee on Devices and Materials and the cards giving information as to the results of tests of certain such appliances which that committee has issued to members.

That it may be made wholly clear that the rules on fire doors and shutters cover only wooden, tin-clad and plate metal on angle iron frame patterns, and are not intended to specify construction in other forms of appliances, nor to limit the use of forms of construction and materials proven to be the equivalent of those covered by our detailed specifications, we suggest the insertion of an explanatory note in hoth the rules on fire doors and shutters and the rules on wired glass windows and their frames, as follows:

"These rules cover only an outline of requirements for certain patterns of these appliances most commonly used at this time. Any other forms of construction or materials which are judged to have merit should be submitted for examination and test and if found to be efficient as fire stops they will receive recognition accordingly."

RULES FOR THE CONSTRUCTION OF STANDARD TIN-CLAD FIRE DOORS.

1. **Openings in Wall—**

To be as few and made as small as the nature of the business will permit, hut in no case to exceed 80 square feet. Walls to present smooth masonry surface without any wood trimming.

2. **Sills—**

a. To be of wrought iron or steel plate not less than ¼-inch in thickness, on brick or concrete support, built into wall at least six inches

at each end. Brick or concrete support, as well as steel plate, to extend under and flush with the outer surface of the door.

b. To be of concrete placed between suitable angle iron and made flush with their upper surfaces. This angle iron to be placed on each side of the wall, to be not less than ⅜-inch in thickness, to have faces of equal width, to extend six inches beyond the opening at each end, to be held in place by ¾-inch bolts run through the wall and to have its horizontal face extend under and its edge flush with the outer surface of the door. The steel plate specified above may be installed on the angle iron and concrete sill.

It is of particular importance that the workmanship be first-class when the plate or angle iron sills are used. No wood or other combustible material to be laid over any sill.

Raised sills are desirable.

3. **Lintel—**

Preferably to be brick arch, but subject to the approval of the Underwriters having jurisdiction. Stone or tin-clad wood lintels not approved.

4. **Size and Shape of Door—**

a. Each side of the wall at every opening in an interior fire wall to be provided with a standard fire door.

b. Sliding doors to overlap sides and top of opening four inches. Top of door to conform to incline of rail, ¾-inch to one foot.

c. Swinging doors to shut into a brick rabbet in wall or into 2½x2½x¼-inch angle iron rabbet secured on each side with ¾-inch bolts through the wall or into an approved door frame of iron. NOTE.—The rabbets may be omitted provided the door overlaps the brick work 4 inches at the side and top.

5. **Woodwork—**

a. Stock to be sound, well seasoned white pine, or similar non-resinous wood, dressed, tongued and grooved boards not over 6 inches in width.

Wood containing sap, pitch or moisture of any kind is liable, when heated, to generate gas, which, if combined under the tin casting, may gather sufficient force to burst open the covering, thus exposing the woodwork to fire and rendering the whole door liable to destruction; for this reason, only clear dry stock should be used.

b. Door to be made of three thicknesses of ⅞-inch boards, the outside layers to be vertical and the inner layer horizontal.

c. Layers to be securely fastened together by wrought iron clinch nails driven in flush and clinched so as to leave smooth surfaces on both sides of the door.

d. Care should be taken to have all edges and corners smooth and square.

6. Tin Covering—

The fire-resisting value of a wood door encased in tin depends upon the exclusion of oxygen from the wood, thereby retarding or preventing combustion. To obtain this result the covering must be so applied that during exposure to fire it will present the greatest possible resistance to bulging or opening up at seams. In covering the door follow carefully every specification given below.

a. Use "IC" bright charcoal plates, 1A, 14 by 20 inches, 107 pounds to the box of 112 sheets.

The best grade is cheapest in the end. Never use zinc to cover a fire door. Use no solder.

b. When the door is to be exposed to dampness use "IC" charcoal "terne" plate, 14 by 20 inches, 120 pounds to the box of 112 sheets. NOTE.—These plates are commonly known as roofing plates.

c. All joints should be locked ½-inch and nailed *under seams* (except on edge of door), as illustrated.

d. Cover four corners first. For each corner of door use a whole sheet of tin without cutting, making a mitre fold, instead of a mitre joint or seam, driving two nails under each fold.

e. Next cover the edges with sheets of the same size (or long strips, if preferred) and lock into corner pieces but without nail.

f. Then apply side sheets, starting with first sheet at right hand lower corner.

g. Complete the tinning of one side before beginning the other side.

h. Nails to be barbed 1½ inches long for 2½-inch doors, and 1¼ inches long for 2-inch doors, flat heads. Use five nails on each side and four on each end of each sheet.

i. Care should be taken to have sheets as flat against door as possible in order to avoid air spaces.

7. Hardware for Sliding Doors—

The rules for hardware cover only a partial outline of requirements for certain patterns most commonly used at this time, and are not intended to prohibit the use of other forms, which, after examination and test, may be found suitable for the uses intended.

Hardware not to be attached before the tinning is completed. (See Rule 9.)

a. Track—To be of best quality flat rolled steel, ⅜-inch thick by 3½ inches wide and bolted every 2½ feet with ¾-inch bolts running through the wall, having nut and flanged washer on the opposite side. NOTE.—Tyre steel or steel having rounded edges is recommended, as it presents less resistance to the operation of the door. Care should also be taken to locate one track bolt at each hanger. (See Rule 11a.) When the door is closed the track bolts should be under the hanger.

b. Hangers—To be of wrought metal, ⅜x3½ inches, and attached by not less than ½-inch bolts. Wheel to have not less than 1½-inch bearing on axle, roller bearing, and to be of malleable or wrought iron.

c. The long end of hanger to be not less than 18 inches, and to be drilled for not less than two ½-inch carriage bolts. For doors less than 6 feet wide two hangers are sufficient; for doors over 6 feet wide, three hangers to be used.

d.—Binders—Wrought iron binders, ⅜-inch x 3½ inches, drilled for ¾-inch bolts. Each binder to have an angle flange at back end, 1 inch deep to notch in wall, or to have two bolts, to prevent sagging. Two binders are required, one at side near floor, and one at same side near top, into both of which the door closes. A roller guide to be located near bottom of door at opposite side from binder stops. Guide to be of wrought metal, ½x2 inches, the base to be U shape, countersunk in floor and wall and bolted to wall.

e. Chafing Strips—Each door to be provided with at least two ¾-inch oval chafing strips on the side next to the wall. Strips to be parallel with the door track and located one-third of the distance from the top and bottom of the door and bolted through to a 1 by ⅛-inch strip on the oppo-

site side. Bolts to be ¼-inch, spaced 9 inches apart and provided with countersunk heads. Ends of strips to be 6 inches from each edge of the door.

f. Handles—Two required. One large, heavy, wrought iron, bow-shaped handle to be bolted to front of door. One on back to be countersunk flush with surface of floor. The two may be attached by the same through bolt.

g. Bumper Shoes—Three made of 1-16-inch plate iron, placed on door where it strikes the hinders in closing and where it strikes the stop in opening.

h. Automatic Doors—To be specified by the Underwriters having jurisdiction. To be operated by at least one link placed above the door and near but not in contact with the ceiling. Where desired the door may be arranged to close by the fusing of an additional link placed near the top of the door opening. Fusible links to fuse between 160° and 165° Fahr. Cord to be hard plaited, not twisted.

8. Hardware for Swinging Doors—

See remark following Rule 7, also Rule 9.

a. Wall Eyes—Wrought iron for ¾-inch pin, built in wall or bolted through wall with ¾-inch bolt, with 3-16-inch iron washer each side. Bolts should always be put through brick work far enough from edge of opening to prevent weight of door loosening the masonry.

b. Hinge.—Wrought iron, ⅜-inch x 2½ inches, bolted to door with four ¾-inch bolts, hinge to extend three-quarter way across door. Doors in excess of 7 feet in height to be provided with three hinges.

c. Latch or Lever Bars—Doors to be secured by at least three lever bars of 1½ by ⅜-inch iron, working together. Upper and lower lever bars not to exceed 12 inches from upper and lower edges of the door opening.

d. Latch—To be operated from either side of the door, to swing freely on ¾-inch bolts through the door, to be provided with proper keepers bolted through the door and with a spring to insure latching.

e. Latch—To freely enter catches made of wrought iron built in wall or bolted through.

9. Fastening Hardware to Doors—

All hangers, hinges and latches to be secured by machine screws or carriage bolts passing through the door. Heads of machine bolts to rest against washers next the tin, the nuts being against the wrought iron. Do not use screws to attach any hardware except chafing strips, bumpers and automatic attachment.

Do not use builders' ordinary cast iron hardware. Use only best quality of bolts.

10. Approved Door Frame of Iron—

a. Jambs—To be made of rabetted 2½-inch angle iron ¼-inch thick and held firmly in place by at least three ¾-inch bolts each side, passing through wall. NOTE.—An angle iron door frame made of 2½ by 2½ by ¼-inch angle iron set into rabbets in the brickwork on each side of the wall and connected by 1¼ by ¼-inch bars, spaced not over 24 inches apart all around, may be used if desired.

b. Metal Sill—(See Rule No. 2, b.) To be well secured to the iron frame.

c. Catches for latches, also the pin blocks to receive the hinges, to be of heavy wrought iron and properly riveted to the iron frame.

11. **Setting Up or Hanging of Doors—**

Do not hang door from wood frame even if frame is tin-clad. Do not plug the wall with wood or lead to which to fasten door or shutter supports. Do not use screws of any kind to hang the door.

a. **Sliding Door**—Stand door on sill in its proper position when closed and slip under door a strip of wood ¼-inch thick. Bolt the track in place at an incline of ¾ of an inch to the foot. Distance between the top of door and bottom of track should not exceed ¼ of an inch. Place the hangers on the track and mark location of bolt holes on the door, locating hangers over track bolts. Bore holes *exactly where marked* and then bolt hangers to door. Care should be taken to prevent sagging of door so it will not chafe on sill when it closes.

Next apply trimmings to door and adjust binders and catch, then the automatic appliances.

When necessary, a light framework of slats should be built outside of sliding doors to prevent piling of stock, etc., against them.

b. **Swinging Door**—In locating holes for the hinges, the front of door should be raised a little higher to avoid sagging against floor, otherwise follow directions for sliding door.

12 **Vertical Door—**

Arranged to avoid accidents.

a. Under special conditions where swinging or horizontally sliding doors cannot be used, an automatic vertical door may be arranged. (See Fig. 31.)

b. The construction of the door proper to be the same as that of other fire doors, but special hangers and trimmings are necessary.

c. The cord connecting with fusible links is attached to lower part of door passing over its proper pulley to the left and supporting the smaller weight. Cord to be provided with a fusible link at the bottom of the door and also one near the ceiling when the door is open. The heavier weight is permanently connected by a wire cable to the upper loop at top of door, and is adjusted to prevent the sudden dropping of the door, but allowing it to close when link fuses.

13. **Painting—**

Bright tin fire doors resist fire better than if painted.

Do not paint the doors unless it is necessary and not until they have first been given a coat of asphaltum. A light colored paint does not absorb heat so readily as dark colored paint.

14. **Care and Maintenance—**

a. Fire doors should be ready for instant use at all times, therefore it is necessary to keep the surroundings clear of everything that would be likely to obstruct or interfere with their free operation. They should be kept closed and fastened at night and on Sundays and holidays, and whenever the openings are not in use.

b. Never tack any tin on a tin-clad door. When tin becomes worn substitute new sheets in the same manner as when covering a new door.

15. **Placard—**

NOTICE.—Watchman will please see that this door is kept closed at night and when factory is shut down, and that it is in perfect working order.

RULES FOR THE CONSTRUCTION OF STANDARD TIN-CLAD FIRE SHUTTERS.

16. **Tin-Clad Fire Shutters—**

a. To be hung next to masonry, either over-lapping window opening 4 inches or fitting close inside opening.

b. Construction to be same as for fire doors, except that only two thicknesses of ⅞-inch boards are required, layers of boards to be at right angles.

c. When made in pairs, the edges coming together should be flush (not rabbetted). NOTE.—Joints between shutters may be protected by a ¼ by 2¾-inch iron astragal bolted to one shutter by carriage bolts spaced 10 inches apart.

d. The coverings to be the same as for fire doors.

e. Hinges to be wrought iron 5-16-inch x 1¾ inches. Same to be secured by bolts passing through shutter with washers under bolt heads.

f. Substantial wrought iron pin or eye blocks to be securely set in wall or bolted through wall.

g. Shutters to be secured shut by an iron bar ⅝-inch x 1½ inches, same to be bolted through shutter and at least one in three on each floor above the first to be constructed so that it can be operated from both inside and outside. Catches to be bolted to shutter.

h. When sliding shutters are used outside (should not be if avoidable), metal shields should be provided to prevent accumulation of snow or ice on the track.

17. **Painting—**

A light colored paint is recommended for fire shutters, but first give them a coat of asphaltum.

18. **Care and Maintenance—**

a. Fire shutters should be ready for instant use at all times, therefore it is necessary to keep the surroundings clear of everything that would be likely to obstruct or interfere with their free operation. They should be kept closed and fastened nights, Sundays and holidays and whenever the openings are not in use.

b. Never tack any tin on a tin-clad shutter. When tin becomes worn, substitute new sheets in the same manner as when covering a new shutter.

RULES FOR THE CONSTRUCTION OF SPECIAL FIRE DOORS FOR NECESSARY SHAFT AND BELT OPENINGS IN FIRE WALLS.

19. **Shaft Openings—**

Special device for preventing spread of fire through necessary shaft openings in fire walls.

a. To be made of two thicknesses of ⅞-inch narrow, matched, thoroughly seasoned boards, put together at right angles and securely nailed with wrought iron clinch nails.

b. To be covered with heavy tin plates, locked joints, nailed under seams, as per specifications for Tin-Clad Fire Doors. (See Rule 6.)

c. To be hinged to single stud bolt in wall and retained at bottom by proper reverse angle iron securely bolted to the wall.

20. **Belt Openings**—

Double Door to protect belt openings through wall.

a. To be made of two thicknesses of ⅞-inch boards. Otherwise follow specifications in Rule 5, and, so far as possible, in Rule 6 of specifications for Tin-Clad Fire Doors.

b. To be provided with [illegible] suitable hooks and staples for holding doors closed.

c. To slide in upper and lower guard rails or channels retaining the doors in place. Channels to be made of 2¼ x 2¼ x ¼-inch angle irons securely riveted together and [illegible] by ¾-inch bolts through the wall. Angle bars of proper dimensions may be used if obtainable. Channels to be long enough to retain doors when open.

d. A metal hood may be used, securely fastened to the wall. Hood should be constructed of [illegible] galvanized iron, without the use of solder.

Metal hoods are inferior to the double doors and should be used only when the doors are not practicable.

RULES FOR THE CONSTRUCTION OF AUTOMATIC TRAP DOORS FOR STAIRWAYS AND STAIRWAY ENCLOSURES.

21. **Automatic Trap Doors for Stairways—**

Occasionally it is necessary to have an open stairway and in such cases an automatic trap door.

a. If the floor is not more than 1¼ inches thick the door shall be made of 1¼-inch sound, well-seasoned, narrow, matched boards, with battens screwed on.

b. If the door is more than 1¼ inches thick, the door shall be as just described, and shall have standard lock-jointed tin covering as required for fire doors, on the under side, the tin extended over the edges and nailed on the upper side of the door.

c. Hinges to be of heavy wrought metal with straps extending well onto the door.

d. To be balanced with a weight on a cord running over double pulley on wall, a fusible link being inserted at point where cord is fastened to the door, so that door will close automatically in the event of fire.

If door is heavy it should have a balance weight attached by wire cable to prevent accident, and a gravity catch to hold the door when closed. (See Vertical Fire Door Specifications.)

e. To be provided with a wrought metal bow high enough to form a stop which will prevent the door being raised to a vertical line, thus keeping it in such position that it is sure to drop when link melts. Bow to be securely fastened to the upper side of the door so that it will serve as a handle.

22. **Stairway Enclosures—**

(Buildings of ordinary construction.)

a. Stairways to have separate enclosure for each flight not less than 1½ inches thick, made tight and kept in repair. If approved fire-proof material is not used, enclosure to be made of two thicknesses of matched boards, or of tongued and grooved or splined planks.

Double boarding is preferable to single planking, as it is not so liable to warp and open up at the seams.

b be provided with door at each flight, preferably bottom.
c ors to be less than 1¾ inches thick and unless ndard Iron or tin , to be constructed o thicknesses of matched boards or of tongued and grooved ks. Heavy wrought iron hinges, latches and cat be by bolts.
d. Doors t kep nd latched when not in use. It is preferable to attach a ount spr to all doors to keep same closed automatically and ors whi re t open during working hours to be so link located as high on door as con- (See Fig 8)
if n r losure or door, to be fixed swi ppr ly set.

23. Enc —
ings Pr uction.)
Sh ings i ldi ction not "cut off" In roof n vi ent principle of such
Whe , bo nclos by a fire-proof material

OR CONSTRUCTION OF TOMATIC OR TRAPS.

Aut aps—
and hatchways shall be provided at each floor r which opens and closes as the elev r passes
b the floo of ordinary construction, or not more in the oor shall be made of 1¼-inch sound, well nat be with bat ens screwed on.
the ill construction or more than 1¼ inch he ust described. and shall have standar inted tin red for fire doors, on the under side, xtended ov uding hole, if any, for cable, and nailed per side ole for cable, if any, shall be as small as p
W loor is closed it shall extend beyond the opening or side
Elev ft at a landing shall not be accepted in lieu of a trap loor
rap ed and closed by the moving elevator is regarded as dis- superior to other devices and should be generally used. However. oyed, owing to high speed of elevator or other causes, auto- ic should he placed at each floor. They should he constructed ed by stout wrought iron hardware attached by bolts; be l ible link located on shaft side of door; be actuated from hin pring which upon fusing of the link will push trap beyond vertic tion so it will close by gravity; and be kept closed except ring w g hours.

STANDARD FOR SKYLIGHTS.

Construction. To be built of metal, with heavy glass, watertigbt and first-class workmansbip.

Curb or Base. To rest on double joist, and to be built of double thickness of sound, well seasoned white pine, or similar non-resinous wood, dressed, tongued and grooved boards not less than ⅞-inch thick, and not over six inches in width, to be laid at different angles. To be covered on the outside with I.C. tin plates 14x20 inches, double lock jointed.

Frames or Ribs. To be built of galvanized or wrougbt iron, ribs not to exceed 24 inches apart.

Glass. To be prismatic style not less than ¼-inch thick, or approved wire glass. To be put in securely with putty or held in place by fitting cap over ribs. Unless made of wired glass, skylights sbould be protected witb standard guard or netting.

Wire Mesb for Guard or Netting. To be of best grade of steel galvanized, not smaller than No. 12 B. & S. gauge. Where No. 12 is used, mesh should not be larger than ¾ inch. Where No. 11 wire is used, mesh should not be larger than 1 inch. Where No. 10 wire is used mesh should not be larger than 1¼ inch. Mesh should in no case be larger than 1¼ incb.

Frame. Iron for frame not to be smaller than 7-16 inch round iron rod.

Braces or Supports. Not to be smaller than 1 inch by 3-16 incb flat bar iron.

Width. When guards are made up in one piece and are more tban 3 feet in width, there should be a brace of 7-16-inch iron for every three feet additional over three feet.

Height. Guards to be raised at least 6 inches above glass and to extend 6 inches beyond glass. For skylights exceeding 12x8 feet area special designs and specifications should be submitted. All skyligbts should be protected, whether exposed to a falling wall hazard or not, for in case of a neighboring fire fanned by a high wind, heavy brands or embers are liable to be carried and dropped upon an unprotected skylight witb enougb force to break through and communicate the fire to the interior of the building. Wire glass has proven effective for skylights, and is generally more desirable than ordinary glass protected by a wire screen. It is more readily cleaned and kept in serviceable condition, while it acts as a splendid retardant to flames which have reached the roof. Where ordinary glass will crack and fall because of heat, wire glass may crack, but it will remain in place, held by tbe wire meshes, and will perform excellent service in preventing the entrance of flames.