ON FIRE PROTECTION AND EQUIPMENT.

In Both, Promising Advances Have Been Made of Late—Attention Has Recently Been Given by Inventors in This Field to Things Long Considered Negligible Quantities.

This series was started some time back, with the view of keeping Tribune readers, the most important owners of the vested interests concerned, informed as to the state of the art in fireproof construction and fire protection, and it is hoped that the papers which have appeared from time to time have proved both instructive and interesting, and, therefore, of value. That they have made their appearance at irregular intervals and have failed to treat the various subjects sequentially has been due to the fact that the exponents of these have not presented themselves in such order, the inventive genius of the country having originated improvements without regard thereto. Thus improved roofs have presented themselves in advance of things which, in construction, they follow; and improvement in exterior fire protection has outstripped that for interiors.

It has, therefore, not been found possible in an up-to-date newspaper to simulate the orderly arrangement of textbooks designed as authorities on such subjects, since, as is too often the case, even with the latter, many of the things would have become obsolete, so rapid is the progress of invention, had their presentation been delayed to give them their proper places in the series.

So it was thought best to present the various inventions as they made their appearance, and without regard to any systematic arrangement. Thus the descriptions of the approved systems of construction of land structures and of their protection from fire, have been interrupted by like descriptions in the marine, and the story has then harked back to the former, as in this article, where an endeavor is made to, as it were, pick up the stitches by treating of some of the features left untouched upon, and, therefore, the state of the art in them not shown.

These do not properly belong to the fireproof construction of buildings, heretofore most extensively dwelt upon, but to their fire protection and equipment; and they may, therefore, be considered to appear somewhat as a sequel.

That they are of equal importance has been proved, time and again. The difference between good and bad electrical installation has often determined the fate of buildings, otherwise safely guarded against the outbreak of fire; the lack of proper firestops in the shape of doors has frequently facilitated the lateral spread of fires; the exposed hinge has no less often caused the failures of these firestops; the absence of the watchman's clock, which keeps the watchman at his work, has, time and again, enabled a fire, that, in its incipiency, might easily have been extinguished, to gain an uncontrollable sway, and many a building has succumbed to external attacks of fire it could easily have resisted if it had been clothed in the invulnerable armor of the water curtain. And think of the appalling loss of life that might have been prevented if adequate means of escape had been provided—such, for instance, as the salamander-like elevator hereinafter described.

DOORS A VEXING PROBLEM.

A building, no matter of what character, will, of necessity, contain more or less inflammable material. Be it ever so carefully guarded, fire will occasionally break out and feed on this material, whether curtains, trim, furnishings or ordinary merchandise. It is easy to extinguish a small flame; large ones usually get beyond control. Means of preventing the small flame from developing into a larger and finally into an uncontrollable one, are, therefore, a cardinal provision demanded in the planning of a building. A structure in which an incipient fire can be confined to its place of origin is a comparatively safe fire risk. It is, of course, necessary to provide openings for entry and egression; these are closed up with doors of some kind. Where they are of wood, or other inflammable material, an undiscovered fire passes swiftly on from room to room. The knowledge of this has prompted the many and great efforts that have been made to produce doors that could be relied on to block the path of fire.

O. C. Reinecke, a building trades expert, and for thirty years in close touch with architects and engineers, says:

"There have been innumerable attempts to produce doors which would prove effective fire stops; but while some of these have been more or less successful in that particular, all have been open to objections that have caused them, one after the other, to be discarded. Where they have not failed as fire stops, they have proved either too unsightly, too weighty, too expensive, or to have lacked endurance—not a few have possessed all these shortcomings. For example, kalameined metal covered wood proving unsatisfactory, terne plate and tin were substituted; but these last exhibit the other defects of the first—unsightliness and ineffectiveness. As thin metal has to be employed, it buckles and wrinkles. The contraction and the swelling of the wood core strain the joints and cause them to become uneven and present a more or less wrinkled surface. These doors cannot take a high grade finish and are, therefore, not seen in places where elegance is a feature. Chemically treated wood doors, next tried, aroused the bitterest kind of antagonism in the building trades, in which a movement against their compulsory use is now on foot. The many 'composition doors' are all open to the grave objections that in them cannot be secured uniformity of composition, that they are brittle, and, above all, that they are enormously heavy."

AN ADEQUATE FIRE STOP.

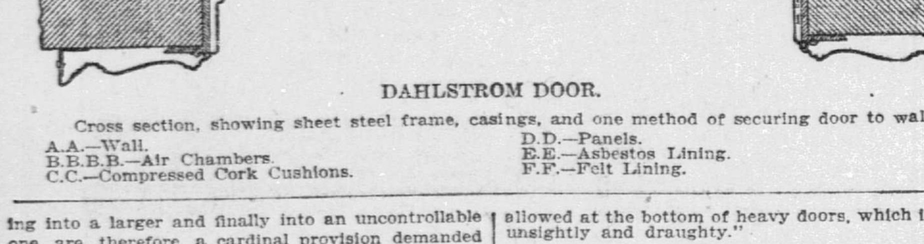
At this time, when architects and builders are striving to discard chemically treated wood, and when they are casting about for other material, there has appeared on the market a fireproof door constructed on strictly mechanical lines. A door to which none of the objections to present doors can be applied. It is manufactured by the Dahlstrom Metallic Door Company of Jamestown, this State, which has branches in various cities, their New-York office being located in the Barclay Building, No. 299 Broadway.

It was this urgent demand for a really fireproof, and at the same time artistic, door—one which would possess none of the defects and disadvantages of existing doors—that offered the inventor, Mr. Dahlstrom, the incentive to put his genius at work on the difficult problem. His beautiful, mechanically perfect and fireproof door is the result. Although of steel, it has no metallic sound, presents a finish equal to that of the best furniture, and, as it is protected inside and out with heavy enamel—baked on—it cannot rust. The closest scrutiny cannot detect any joints. Even the large single panel doors present a uniformly smooth surface. The ingenious arrangement for inserting locks and hinges secures the greatest strength and admits the use of almost any kind of locking devices demanded by underwriters, city authorities or architects and owners. Each side of the door proper is formed of a single sheet of No. 20 United States gauge best open-hearth, re-annealed, bevelled lined and pickled steel, the sheets being vertically interlocked at one edge of panel on opposite sides of door. The upper and lower rails are each formed of a single piece of sheet steel, bent into the form of a channel, besides being separated to conform to the thickness of the "stiles." These pieces are slipped over the panel, at top and bottom, and are fitted and finished flush with the stiles, they are held in position by small screws into the panel and small rivets at each stile, on each side. The rails do not act as essential structural members, but serve, mainly, to complete the panel formation on the door. Cushions of compressed cork are inserted in the stiles as sound deadeners. Hinges are let in from the side of the door, and are fastened to its edges by means of a reinforcing strip of band steel.

The door was tested at the Underwriters' Laboratory, under the direction of the National Board of Fire Insurance Underwriters, at Chicago, in October, 1904; and, in a report, made in January, 1905, by the committee having tests in charge, it fully approves it in the statement that—after the usual one hour fire and water test—"the door was securely in position at the end of the test, and afforded an effective fire stop." This door has also been approved by the Manhattan Buildings Department and by the Tenement House Commission.

Among buildings where this company is now putting in "Dahlstrom" doors are the Hispanic Society Museum, at 155th-st. and Broadway; Varuna apartment house, at northeast corner Broadway and 90th-st. And, although it has only been in existence a little over one year, its product is being specified by the best architects here and elsewhere, over the entire country, for almost every class of structures, such as large, high grade office buildings, erected by prominent trust and insurance companies, first-class apartment houses, store and loft buildings, county courts, insane asylums, hospitals, theatres, hotels and private residences—it is, in fact, used wherever a handsome fireproof door is appreciated. As it has been on the market so short a time, this universal appreciation of it is the best endorsement it could receive. The increase in the demand has necessitated the company's making provision for expansion in manufacturing facilities. It has purchased an eight-acre tract of land, including water rights, etc., and a modernly equipped factory, including water turbines, electric generators and motors, is now nearing completion. In the mean time it is working its present factory to its full capacity.

In connection with the door business this company has developed a new method of producing sheet steel mouldings. These were originally designed for its own casing, door, chair and picture moulding work only, but it has had a great demand for these mouldings from the larger ironworkers, who are now using them in place of the heavier hot rolled iron mouldings. They have been largely used in the public school buildings in New-York City.

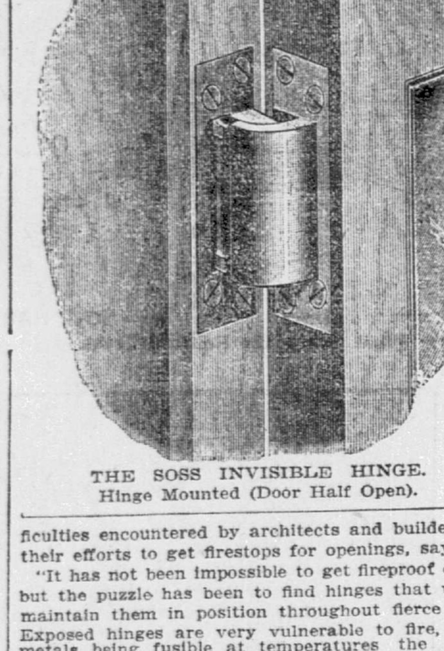


DAHLSTROM DOOR.

Cross section, showing sheet steel frame, casings, and one method of securing door to wall.
A.A.—Wall.
B.B.B.B.—Air Chambers.
C.C.—Compressed Cork Cushions.
D.D.—Panels.
E.E.—Asbestos Lining.
F.F.—Felt Lining.

EXPOSED HINGES VULNERABLE.

J. E. Moyer, who has been handling builders' hardware for some twenty years, during which time he has had ample opportunity of learning the difficulties encountered by architects and builders in their efforts to get firestops for openings, says:


THE SOSS INVISIBLE HINGE.
Hinge Mounted (Door Half Open).

"It has not been impossible to get fireproof doors, but the puzzle has been to find hinges that would maintain them in position throughout fierce fires. Exposed hinges are very vulnerable to fire, their metals being fusible at temperatures the doors themselves can withstand; besides, they are obstacles to thoroughly good door fitting and to the securing of harmony in decorative effects. Then, leaving such wide 'cracks' when open, they waste space—a serious objection in these days, when it is so necessary to economize the latter. Again, on account of the leverage on the screws, heavy doors will sag, and so too much space has to be allowed at the bottom of heavy doors, which is both unsightly and draughty."

HINGE FIRE CANNOT REACH.

Mr. Moyer is the manager of The Soss Invisible Hinge Company, of No. 150 Nassau-st., which, after several years of patient and ceaseless experiment, has succeeded in producing a hinge that bids defiance to the attacks of fire, renders a close fitting door possible, does away with the space wasting wide crack, prevents sagging and does not introduce a jarring note into decorative effects. It will support a weight of door that would cause the old fashioned hinge to break down utterly, even though 'twere twice as large and heavy as the Soss, as has been demonstrated in actual tests.

Its manufacture requires special machinery, the devising of which has called for quite as much inventive genius as has the product itself. The latter is so constructed as to be, when in place, effectually concealed in the door and jamb, its bearings centering there.

This Soss hinge is being put in the Schwab residence, in Riverside Drive, and in that of Mr. J. A. Bailey, at Mount Vernon. They are used in all Pullman cars also. Owing to their very recent introduction, they have not as yet been employed extensively in office buildings or on vessels—except a few yachts. It need hardly be said that it is an ideal hinge for marine service, since, not being exposed, it cannot suffer from the corrosive effects of sea air nor present dangerous protuberances in the passenger compartments of rolling and pitching craft, or that its weight carrying and space economizing capacities will likely cause it to displace the old hinge in all land structures. In all situations it makes of the fireproof door an actual, instead of merely a possible, firestop.

THE INTERIOR FIRE ESCAPE.

As has been frequently pointed out, in the course of these articles, "fireproof" is a free translation of what is technically known as "fire retardent"; nothing used in building construction is indestructible by fire save asbestos. It goes without saying, then, that a "fireproof building" can take fire; and, in any case, it has a quantity of combustible material in the furnishings, paraphernalia or goods with which it is appointed, equipped or stocked. The danger from fire to which these are ever subject, through the carelessness or ignorance of inmates or occupants, cannot be exaggerated; it is this which, more than all things else, renders it necessary for owners of skyscrapers to offer the extra inducements of less rentals than are charged for their lower stories in order to fill their upper—timorous people are afraid of being cut off from all avenues of escape and from rescue, so far from the ground, in case fire breaks out in such lofty buildings.

How vitally necessary it is, then, that the building's elevators shall be able to resist the attack of fire, and render adequate service to the very last—and by "adequate service" is here meant to safely empty the building of all its occupants in the shortest possible time.

An investigation of the various types of elevators should disclose the merits and demerits of each, and should determine which is best fitted to meet the requirements of the lofty structures.

E. S. Matthews, M. Am. Soc. M. E., who has had a quarter of a century's experience in the service of the several great elevator companies, and in all branches of the business, gave this interesting résumé of elevator history and the accompanying informing descriptions of the various types:

"Otis and Tufts," said he, "were the pioneers in the industry, starting in to build and install elevators about 1860. The first elevator was of the 'screw type,' an example of which was that placed in the Fifth Avenue Hotel in the early 60's. It was the first in New-York. In that type the element of safety, rather than those of efficiency, was sought. For even the earliest elevator designers recognized that the former was the essential, to secure it, they supported the car. But the 'screw elevator' proved too clumsy and slow, and too expensive in installation and operation; besides, it occupied entirely too much space.

"The 'screw' was succeeded by the cheaper and speedier suspended-car elevator, Otis and certain others coming to the front with the steam machine. In the days of its earlier installation, this utilized a 'drum,' upon which the cable used to hoist the car was wound, this drum being operated by a steam engine. This type was considered, then, the elevator par excellence, and numbers of them were installed in the fine buildings of those days, but they have now entirely disappeared. It cost too much to run them; their cables were given to tangling on their drums; they had a very limited speed, and too much vibration, and their complex construction rendered them anything but easy to operate.

"The next in the field was the hydraulic elevator, of the vertical type, introduced by William E. Hale, of Chicago, in the early 70's, who soon demonstrated that his machine was more economical to operate, was safer, faster and gave better service in every way than the steam elevator.

"Shortly after, Richard T. Crane, of the same city, brought forward the horizontal type of suspended hydraulic elevator, to which he later added a controlling device superior to any then in use, and the essential features of which are retained in all modern controllers.

"For a long period of time these two hydraulic types were considered the high water mark in elevator achievement.

"The utilization of electricity for motive power in the 80's caused special types of elevators to be introduced. Frank J. Sprague, with Charles R. Pratt, invented the horizontal screw, suspended-car electric elevator. This had many excellent features, and more nearly imitated the performance of the hydraulic type than has any other electric elevator. High anticipations as to the future of this type were cherished, it being believed that it would revolutionize the elevator business, and, in course of time, many were installed in the finest structures, such as the Waldorf-Astoria and the Chicago Board of Trade Building. But it 'went up a rocket and came down a stick,' for the cost of keeping it in running order was simply enormous. Besides, it was, is, and always will be uncertain of operation, and wanting in the element of safety; it was always getting stuck between floors, or falling down. It has been abandoned. The electric type now in use is built in the same manner as the old steam drum elevator, and merely substitutes the electric motor for the steam engine—it has all the faults and weaknesses of the latter type, and develops other and characteristic ones, of its own, growing out of the unreliability of electric contacts.

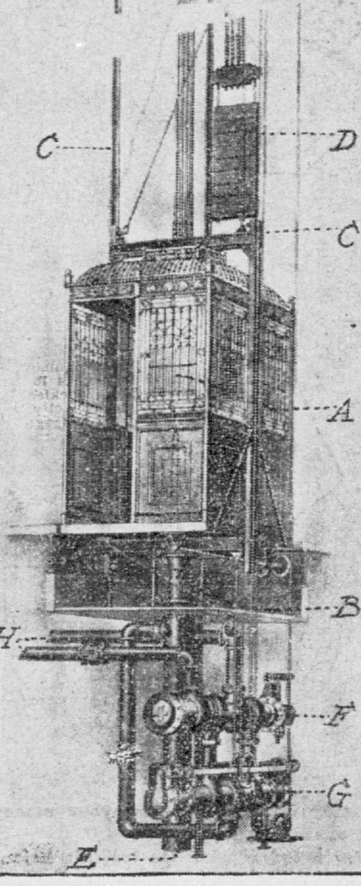
"About this time Crane and Otis turned their attention to high water-pressure, in order to carry on lines of advance; they adopted a pressure somewhere in the neighborhood of 1,000 pounds per square inch, and expected to derive great benefit from its employment. Crane, after installing many plants of this type and so acquiring a thorough knowledge of its advantages and disadvantages, seemed to have determined that the latter preponderated, for he practically abandoned it and devoted himself—until his retirement from active business—to the development of a medium pressure hydraulic machine. But others are still experimenting with high-pressure, the chief trouble with which is that niceness of control, such as characterizes the exponents of the state of the art, is impossible of attainment.

"It is sad to think how these great promoters of elevator development departed, and gradually got farther and farther away, from the vitally essential principle of safety—how they came, eventually, to sacrifice everything to the thoughtless demands for convenience in elevator service!"

A THOROUGHLY EFFICIENT ELEVATOR.

All this while, fortunately, the supported elevator was quietly going through a process of evolution; and, instead of by a screw extending up through the car, the latter is now supported by a steel plunger from beneath—this plunger, pushed up and down by water pressure, not only efficiently operates the car, but forms an ever safe and sure support for it. The water displaced by the descending plunger has to be squeezed out at the top of the cylinder, through the annular space around the plunger; therefore the latter cannot drop, but must make a more or less gradual descent.

In making a safety test the manufacturers of pany, of No. 1 Broadway—broke out all the supply and discharge piping to see what effect this damage, about the worst that could happen to the machine, would have upon the plunger's movements;



STANDARD PLUNGER ELEVATOR.

A—Passenger Car.
B—Steel Plunger.
CC—Steel Guides.
D—Counterweight.
E—Cylinder Containing Plunger.
F—Controlling Valve.
G—Automatic Terminal Stop Valve.
H—Supply and Discharge Water Pipes.
J—Counterbalance Sheave.

this left the car to be supported only by the water cushion in the cylinder, at the same time that it gave the water an unobstructed avenue of escape. The result of this test was eminently satisfactory, for the car came down on to the spring buffer, at the lower landing, without perceptible shock—it did not fall; it merely made a swift descent. It is safe to say that a suspended car, under like conditions, would have come down with such appalling speed its occupants could not have escaped serious, if not fatal, injuries.

It is generally conceded by the well informed in elevator history that to the faithful, undaunted and untiring efforts of Frederick A. Jones, now the general manager of the Standard—efforts courageously and intelligently persisted in despite the passive opposition of ignorance and unbelief on the part of the general public, and in the face of the more powerful, because active, and shrewdly directed antagonism of the adherents of other types—is entirely owing the present general acceptance, by professional people and by laymen, of the plunger type as the exponent of the state of the art in elevators.

EQUAL TO FIRE EMERGENCIES.

In case of fire, other types of elevators are apt to be put out of commission much more easily and quickly than the plunger. The lighter cables of the suspended car hydraulic elevator would more or less quickly succumb to a fierce fire draft, as would its power cylinder, which is above ground and exposed. A moderate degree of heat would speedily destroy the insulation of the electric elevator, and the introduction of water would soon cause a short circuit, and thus deprive it of motive power. In the plunger elevator, the counterbalance cables are very much larger and heavier than the cables of any of the suspended car types, and they would, therefore, resist the attacks of fire for a correspondingly greater length of time, but when they did part no very serious interruption to the service would result, for the elevator would run as well as before, except that it would have diminished lifting, and accelerated descending, capacity. The plunger itself being hollow, has an air cushion within it, and, a portion of its length being always in the cylinder, it receives a constant water bath, so fire could hardly affect it.

But the human equation must be allowed for, and it is very human to accept with readiness the proposition that all sorts of disasters may overtake the other fellow and his belongings; but people are slow to realize that they, and theirs, are not immune. And owners are no exceptions to this rule; so, while readily admitting that the buildings of others may be subjected to the assaults of the fire fiend, they seldom stop to think that their structures are quite as likely to be attacked. Therefore, it is necessary that some other arguments be presented to secure their adoption of a particular type of elevator, than those which seek only to establish its reliability in fire emergencies. To that end it may be well to call attention to the additional reasons for adopting the plunger rather than any other type, the main thing being to have owners install the elevator that will in times of peril most efficiently render life saving service.

QUALITIES ELEVATOR SHOULD POSSESS.

The desiderata for an elevator are, considered from the viewpoint of the owner, inexpensive power consumption, small cost of operation, and infrequent necessity for repair—the stopping for this is alike costly to himself and his tenants; to the occupants of the building, speed and safety, which saves their time and reduces to a minimum at least one of the risks to which life in the metropolis is subject; to the operative, nicety and ease of control, which enables him to escape the criticism that always follows his failure to start promptly and to make a good stop at designated floors; and to the companies that guarantee the elevator, the easiness and quickness of inspection, which means to them a saving of expense in the time of their salaried employes.

Therefore, it may be well to look more particularly into this elevator, to investigate its claims, to consider its construction, and to learn what experts have to say of it.

If it has not superior speed, if its safeness is not established beyond a question, if its operation does not prove it the handiest elevator in use, if owners do not find it the most economical in service, and guarantors the quickest and easiest to inspect—in short, if its good points do not surpass and outnumber those of other elevators, and its shortcomings prove a more negligible quantity, the fact that it possesses certain of these virtues will not compel its adoption.

It might be considered that the plunger's case is amply proved by the fact that it has substituted other well known makes in such important structures as the Waldorf-Astoria, the (old) Times Building, the Tribune Building and the Woodbridge Building, in New-York City; the Prudential Life Building in Buffalo, and the Park Building in Pittsburg—where a most damaging elevator wreck necessitated the installation of an entire new plant—also by the fact that it has been installed in such other representative structures as the Trinity Building here, the Washington Trust Building in Boston, the Mutual Benefit Life Building in Newark, the Diamond National Bank Building and Wabash terminal station in Pittsburg, the Brevoort Hotel in Chicago, the May Department Store in St. Louis, and the Bellevue-Stratford Hotel in Philadelphia; and that one hundred and ten of them are being placed in the Wanamaker stores, here and in Philadelphia, is but added acknowledgement of the plunger's superiority. Especially when these practical indorsements are taken in connection with the statements, concerning the plunger's efficiency, made by the individual and syndicate owners of these structures, by their lessees and managers, and by leading architects, engineers and construction companies, from the list of which may be quoted E. C. Bingham, chief engineer of the Waldorf-Astoria Hotel Company, who says of the seventeen plungers in the Bellevue-Stratford and the two in the Waldorf-Astoria, that "they have been satisfactory in every respect, and the cost of repairs is a mere nothing—those in the Bellevue-Stratford have now been running over two years, and so far have not cost us $10 for repairs"; T. M. Hilliard, the manager of the Waldorf-Astoria, who says, "We have found them to be in every way perfect, the plungers with which we replaced two elevators in this hotel last year are working beautifully. The points that appeal to me most in them are that they are cheap in operation, and apparently perfectly safe."

So competent an authority as G. W. & W. D. Hewitt, the eminent Philadelphia architects, have this to say of the Standard, "We have had installed about thirty of these elevators, varying in rise from twenty feet to two hundred and eighty-five feet, with a speed of 600 feet per minute. In all cases the installation of this type of machine has proved entirely satisfactory to owners, both as to efficiency in service and economy of operation, with a minimum cost for repairs."

The George A. Fuller Company, through its president, Paul Starrett, gives this expression of opinion concerning the work done for it in the Trinity Building, New-York, by the Standard Plunger people: "We think the plant they installed for us in the Trinity Building is one of the finest elevator plants in the country."

R. H. Dana, trustee of the Washington Building, Boston, says of the Standard Plungers installed therein, "They fully came up to all the promised tests; indeed, I have never been so pleased with any kind of elevator plant before. I speak from my experience as a trustee of building syndicates."

L. L. Banks, agent of the Park Building, in Pittsburg, which requires the services of six elevators to handle its traffic, describes a very embarrassing situation—which arose when four of a type in use there were replaced by plunger elevators—in these words, "Strange to say, our tenants practically refused to use the remaining rope (suspended car) machines, thereby throwing all of the work on the four plunger elevators. Therefore, of six elevators, we have practically but four that are of use to us."

THE PLUNGER TYPE DESCRIBED.

But let the Standard Plunger elevator speak for itself. This the following description will enable it to do, and convincingly, for it requires no mechanical training to enable the reader to understand and appreciate its simple construction, or to see that the latter must insure speed, comfort and safety, and consequent saving of time and damage suits; ease and surety of operation, which means running without the familiar disagreeable vibration, starting and stopping, and making landings with certainty, instead of overshooting, or falling short of, them and having to find them through the series of distressing jerks to which passengers have been subjected ever since the suspended car first appeared upon the scene; economy to owners of repairs and of power, and such time-saving for the employes of guarantee companies as will render their inspection service much less expensive and decidedly more efficient.

Perhaps before proceeding with the description of the Standard Plunger, however, it might be well to enter into a brief explanation of this matter of elevator inspection: The suspended elevator cannot be thoroughly inspected without taking it apart, because of the fact that the apparatus securing the suspending mechanism is inside of the machine cylinder, and is, therefore, not subject to quick inspection. It is said that, to take apart and properly inspect the suspended car elevator would occupy four days' time. Now, as the responsibility of the elevator manufacturers—for accidents—ends after the first inspection made by an insurance company, and as the latter is forced to give a more or less superficial inspection, owing to the fact that a structure of sufficient importance to have elevators installed generally has too much traffic to permit of each of its elevators being, in turn, put out of commission for days at a time, at regularly recurring intervals, it is not to be wondered at that, as has been reported times without number, in the daily press, elevator accidents have occurred immediately after they have been inspected, and certified, by the guarantors. An inspection of the plunger elevator can be made in brief time, for it has no hidden parts.

The principle adopted to furnish power for the plunger type is identical with that now employed by up-to-date engineering science to raise and remove ponderous old bridges that span waterways and place in position new structures—the irresistible and tremendous lifting power of rising, and the safe and certain operation of subsiding, waters; the only difference is that the flowing and ebbing tides are artificially simulated. The power thus obtained, as in the case of its prototype, is greatly in excess of the demands upon it. This excess provides a reserve with which to meet unforeseen, but possible, exigencies—for example, it will enable the elevator to safely carry, in fire panic, numbers and weights beyond those for which it was originally designed. In like emergencies, other types would probably fail in this, for their capabilities are definitely calculated to meet little beyond the demands of normal traffic.

In the Standard Plunger elevator the car (A) running between the guides (CC) is supported from beneath by the steel plunger (B); the combined weight of car and plunger is partly offset by that of the counterbalance (D), which is suspended by a number of heavy cables passing over the sheave (J) and attached to the car. The plunger is contained in the cylinder (E), and is sustained and moved by water surrounding it and confined within the cylinder, which is somewhat longer than the plunger itself, the latter having a length a little greater than the travel of the car. Water under pressure passing into the cylinder through one of the pipes (indicated in the drawing by the letter H) lifts the plunger. When this flow of water ceases the car stops; and when the water is permitted to escape from the cylinder, through the other one of the pipes (H), the car descends. Its movements are controlled by the valve (F), the valve (G) furnishing an automatic stop at terminals.

CONSTRUCTION AND INSTALLATION.

The plunger is an accurately finished and polished hollow steel column, of uniform diameter. The cylinder which incloses it is, in turn, encased in a small steel caisson of slightly larger diameter, until bed rock is reached, when the latter affords sufficient protective casing for the cylinder, besides giving it a stable support, the absence of which in the soil above rendering the steel caisson a necessity there. Three inches of space is allowed between cylinder and rock, and this is filled in with soft, dry sand.

The sinking of the cylinder to such considerable depths involves the expert solution of several problems. First, the securing of an absolutely true perpendicular; second, the preparing of so deep a chamber for the cylinder without disturbing and endangering the foundations of the building, for, of course, it is not only the new ones—in which all preparations for cylinder casing could be made synchronously with the laying of foundations—that install the Standard; and, third, the executing of such work at a cost that would not prove prohibitive. These difficulties are met, and readily overcome, by the Standard company's improved drilling apparatus.

The cylinder is closed at the bottom by a welded end, and at the top by a stuffing box with an improved packing, through which the smooth plunger passes. The oily character of this packing keeps that portion of the plunger, which is of steel, from rusting; that which is always under water is of bronze, and, therefore, cannot rust, while the cylinder itself is protected by an insulating material. Both cylinder and plunger are of a strength calculated to resist any strain they are likely to encounter.

It goes without saying that the cylinder must be true and plumb, in order that the tremendous lengthy steel plunger may work easily and smoothly, without unnecessary friction. The plunger in the Trinity Building, for example, travels 304 feet, and that in the Waldorf-Astoria 289 feet. The first named building has the highest plunger elevator in the world. The plunger does not come in contact with the cylinder itself, the annular space between them being two inches wide.

The car is fastened to the top of the plunger, through a platen, by means of a flanged joint on the plunger itself, which is also firmly keyed to the car's platform through the platen. Although this would seem to make an indestructible bond between car and plunger, the company takes no chances, and so a cable is independently connected to the platform from the lower end, and through the interior, of the plunger. Literally, the only working joint of this apparatus is at the packing, in the stuffing box, at the top of the cylinder, and no water can pass above this level.

Thus, as the water cannot escape through the annular opening around the plunger, and the stuffing box, with any great speed, the car cannot make a dangerous descent; it cannot, in any sense, "fall," for there is always left in the cylinder water sufficient to serve as a cushion. Even the bursting of a cylinder would not render it possible for the water to instantly escape through the apparatus, from the space between casing and cylinder, which is closed at the top, and only this physically impossible action could cause the car to fall.

HOW IT IS OPERATED.

The conductor uses a controlling valve to operate the elevator; this valve performs the triple service of admitting water into the cylinder, to cause the plunger's ascent; of discharging it, to permit its descent; and of confining it, to bring the car to a stop. The company's double ported controlling valve, with its differential safety pilot valve motion, so governs the flow of water as to secure absolute smoothness and freedom from the slightest vibration, or bounding, at all speeds, and at every change of motion; while its automatic limitation stop valve, located directly at the cylinder, can always be relied upon for efficient service, even though other valves or apparatus should become disarranged.

The counterbalancing of the elevator is a nice mechanical problem. How the plunger elevator solves it is best described in the very lucid explanation contained in a treatise on same issued by the company. "It would seem, from a casual consideration of the plunger elevator, as if great loss of power must result from diminution of water pressure as the elevator ascends, and also from the weight of the plunger itself. This, however, is not the case, owing to the method of counterbalancing, which is largely accomplished by the water within the elevator cylinder, for its buoyancy furnishes all the counterbalancing desired at the lower landing. The necessary additional counterbalancing is accomplished, in the ordinary manner, by a counterweight attached to the car by cables, the combined weight of which—per foot—is exactly equal to one-half the loss of buoyancy in the plunger as it ascends, thus equalizing the lifting capacity and speed, at all points of elevator travel, in a manner simpler and more efficient than any other."

IT MAKES FOR ECONOMY.

It may be remarked that size and strength of these cables, which are excessive, the service demanded of them being considered, should enable them to wear well; indeed, it is said that it has never been found necessary to renew the cables of plunger elevators. The small costs for repairs in this elevator are not solely due to the fact that these are rarely required to be made, but also to the easy access which can be had to all the working parts of the apparatus; even a cylinder can be removed—although no such necessity has ever presented itself—and replaced with a new one, with little trouble, for it is at the bottom of an open elevator shaft, which furnishes the necessary and convenient room for handling.

But, owing to its design and construction, no part of the Standard is subject to undue strain, or is likely to deteriorate from wear or any other cause, humanly speaking; the fact that there are plunger elevators, of other types, which have been in daily use for over thirty-five years, should be considered substantial evidence that the more modern Standard will prove long lived.

In the matter of power consumption the Standard is quite economical, owing to the fact that the power is directly applied. This enables it to raise a greater maximum weight, at a higher speed, with the use of less power than is required by other kinds. And it is said that some of the earlier plunger machines, which have been superseded by the Standard, and which were operated by water from city mains, used directly in their cylinders, and paid for by meter measurement, were very much more expensive; also that the records of the water departments of Providence, R. I.; Springfield, Mass., and certain other cities, which have substituted the Standard for these older machines, show a saving of hundreds of dollars annually, amounting in some cases to as high as 50 per cent. Of course, too many and various conditions are incidental to elevator service to admit of the establishment of a standard of comparison.

A description of this elevator's source of power will disclose still another economical feature. In large plants, a tank system furnishes it, an automatically regulated steam or electric pump forcing a limited supply of water continuously from one to another of these. As the more economical the form of the elevator the less is the cost of pumping, the use of the Standard must make for economy in this particular; besides, as steam is generally used for pumping, its exhaust can be used for heating purposes, and thus reduce the expense for elevator power to a nominal figure—at least, for two-thirds of the year. The plunger elevator, however, might be objected to on the score that its cost of installation greatly exceeds that of other types; but, then, its greater economy in every other regard, which has been pointed out, in the foregoing, more than evens this up. The greater sense of security it gives the passengers enables owners who employ its service to rent much more readily than can those whose buildings handle such traffic with other types; but, even if the Standard's absolute safety did not prove a superior inducement, its greater speed, convenience and comfort could be relied on to do so, for people to-day place a higher value upon these qualities than did those who first rode in elevators, and who only demanded of them that they should be safe.

ITS SAFETY OFFICIALLY RECOGNIZED.

From among the essential features of elevators its freedom from repairs must be selected, by reason of its vital importance, as most highly recommending the Standard, and that not merely because of its reduction of costs; it is generally conceded, for instance, that a suspended elevator out of repair, or rather not in first class repair, is a menace to human life. The fact that the law requires such type of elevators to be equipped with safety appliances establishes the truth of the foregoing, while the exemption of the Standard from such necessity is a recognition that with it nothing can happen to endanger passengers.

Under date of June 22, 1905, Isaac A. Hopper, Superintendent of Buildings here, addressed the following to the Standard people:

"Upon report of inspector of this bureau who witnessed the test demonstrating the ability of your Standard Plunger elevator at your testing tower, Worcester, Mass., on Wednesday, the 14th inst., I herewith approve the use of same in this borough on condition that you comply with all the rules and requirements of this bureau affecting elevator service in this borough, excepting Section 12 (this section demands the safety appliance), and with the understanding that the material and workmanship in each case be as complete and as perfect in all respects as that presented at the test above referred to."

IT ECONOMIZES SPACE.

But the question of economy "will not down," for it will always be the one most considered by owners, especially owners of the finer class of buildings wherein every inch of space counts. The Standard, which takes up comparatively little room, should strongly commend itself to these. As a matter of fact, the machine robs the building itself of no space, for its compact valves are placed in the hatchway, under the cars, and so no outside accommodation need be furnished for the apparatus; even if it be considered desirable to place the valves beside the hatchway, they would take up very little room—and that in the basement. It should be noted, too, that, as the Standard's economy of power minimizes the capacity of the tank system, a saving of space is made here likewise.

IT SAVES DAMAGE SUITS.

There is yet another form of economy which should invite the attention of owners and which has thus far only been hinted at—they are liable, as common carriers, to damage suits; and not infrequently the amounts awarded plaintiffs will far exceed the entire amount of insurance that can be carried upon an elevator. And it must be understood that no "manufacturer's liability" steps in to relieve the owner of his burden. This was shown in The Tribune of February 3, 1904, in which an official of an elevator company, one of the machines of which had just been wrecked in a nineteen story office building on lower Broadway, was reported as saying, among other things: "As far as the responsibility for accidents go, ours ends after the first inspection made by an insurance company; we do not inspect elevators. The insurance company does that." Taken in connection with the explanation hereinbefore made, of the facility with which the Standard Plunger elevator can be inspected, this renders it easy to understand why the latter should be insured at less cost than others.

Space will not permit the enumeration of all the causes that produce elevator accidents, but the more fertile ones may be mentioned, though it is difficult to determine to which of these should be given precedence by reason of its record, all having a great number of bad accidents charged against them. Accidents at landing frequently result from the uncertain operation of the apparatus when approaching or leaving them, and from lack of absolute control of the car when at rest. One of Cincinnati's most prominent citizens lost his life through the jumping of an elevator, which was supposed to be at rest for receiving passengers. The failure of cars to be stopped independently of the operator, and of the regular controlling mechanism, at terminals, has, with at least equal frequency, resulted in great damage from overrunning. Such an accident to a suspended electric elevator, at St. Louis, tore the cables from the car and precipitated the latter to the basement. Such accidents could not occur to the Standard; it could not be "precipitated" at all, and it is prevented from overrunning by its competent controlling mechanism, while safety at terminals is secured beyond peradventure by the company's automatic limitation stop valve, and by the "buffers" before described, both of which are to be relied on to prevent collision.

Devices innumerable have been brought forward, to insure the safety of its human freight when the suspended car falls. The most promising of these have probably been the air cushion, or air chamber at the bottom of the elevator; but that they do not afford absolute security is shown by the fact that both Jones and Ellithorpe, experts, died from injuries received in their own air cushions, while testing them for purchasers.

Authorities say that a fault inherent in most safety devices, and one which sadly interferes with their efficiency, is to be found in their adjustment, which may conceal a disarrangement quite sufficient to render it worthless, and which would not declare itself until a wreck occurred; and they cite such instances as that of a falling passenger elevator in an eighteen story office building, in Chicago, where a qualified expert, who afterward examined the apparatus, found that the safety device was inoperative, although it appeared to be in good order; and as that of a wreck, from the falling of a suspended elevator, in an equally prominent building in Detroit, where subsequent examination discovered that part of the safety apparatus had been removed. The truth seems to be that it is an extremely difficult matter to insure the suspended elevator against falling, owing to the fact that safety devices must leave the car absolutely free to travel in a normal manner.

OBJECTIONS TO PLUNGER ANSWERED.

An ill-founded objection, which long obtained, was that a steel column, of so small a diameter as six to nine inches, and of the great length of, say, three hundred feet, could not sustain any very heavy load—at least, without buckling under it. This has been proved, in actual practice, to be fallacious. As a matter of fact, much of the plunger is counterbalanced and is, therefore, not subject to buckling strain. The variable thickness of material employed, and the character of the joint used, produces a variable moment of inertia of cross section, which is at a maximum where the greatest bending could occur, and the plunger is rigidly supported where it is attached to the car, and, also, where it passes through the stuffing box at the head of the cylinder. It is claimed that no deflection of bending, or buckling, or deviation from the vertical, of a long plunger is noticeable to the eye, when it is under load, and in operation; which shows that it is subject to strain only to the extent of a slight thrust, and that if it were artificially deflected at its centre, sufficiently, even, to bring it over to the wall of the hatchway, the material would not be subjected to destructive stress, and the plunger would return to its vertical position the moment it was released.

The plunger is constructed in sections of steel tubing, turned and straightened to uniform size and polished. A special joint, more than equal to the strength of the steel tubing, unites these sections in a uniform column with strength sufficient to resist cross-breaking, or buckling, maximum strength in the plungers of high rise elevators being obtained by constructing these sections, which sustain the greatest strain, of heavier and stronger material than is used in those subject to less; this secures a plunger superior to one made of one piece—if it were possible to make such an one. This joint and its workmanship preserves absolute smoothness and continuity in the plunger—it is almost impossible to see where it occurs.

The cylinder is of steel tubing in sections, squared up and "threaded" in a lathe—when joined by couplings it is perfectly tight and straight. It is afterward tested by hydraulic pressure, and then coated with a preservative preparation. The remaining details have already been presented.

It was for long deemed an extremely difficult feat—by many an impossible one—to provide a perfectly plumb "well" of sufficient depth for the cylinder, even under the most favorable conditions. But the company found a method of sinking which overcame all difficulties and which, as before said, obviated all dangers to foundations of buildings. It has successfully sunk cylinders to a depth of three hundred feet. Thus have been answered the most important objections of architects and engineers; their prediction that it could never become a practicable machine, because it could not be made to stop at floors at high speed, has been proved in actual tests to be as ill founded as were their early expressed fears of the plunger's buckling, and failing to offer necessary support to loads.

SOME CONVINCING TESTS.

In a test made, in the presence of many professionals, at the Bellevue-Stratford Hotel, in Philadelphia, in 1903, by the George A. Fuller Company's engineer, Mr. Herschman, the Standard made an ascent at the rate of 613 feet a minute, and a descent of 634 feet in the same time.

A series of tests made, later, in New-York City, by the same engineer, affords an interesting comparison between the possible speed of suspended car elevators and that of the Standard Plunger. The conditions of the test were that the elevators should be run at full speed and make six stops on both the up and down trips, these stops to be made within three inches of floor level, and the inclosure doors to be opened and closed at each. The buildings chosen for the tests of the suspended car elevators were the twenty-one story Flat-Iron, the Broad Exchange and several others—the running being, practically, 600 feet. The best time made by any of the "rope" machines was three minutes and thirty seconds for the round trip. The Standard Plunger test was made under similar conditions in the lofty Trinity Building; it took this elevator just two minutes and fourteen seconds to make the round trip.

ITS MERITS HAVE TOLD.

The history of the plunger elevator is a record of twenty years' bitter, though always winning, fight for recognition. Even the company that introduced it as a passenger elevator seems to have lacked prevision; it had so little conception of the plunger's possibilities that, when it received the earliest order for the installation of a plunger elevator in a high building, in Providence, it actually refused to accept it; and yet that plunger was to be only 132 feet long. But for the courage and confidence of the company's then manager, Frederick A. Jones, mentioned earlier in this article, its higher officials would have persisted in turning down the order. No little of the credit for its final acceptance, however, must be given to the owner of the building, who put such faith in Mr. Jones's judgment that he offered to furnish the money, and take all the risks, rather than do without the plunger elevator. To-day there is practically no limit to the height of travel the plunger elevator can attain.

It is interesting to note that, whereas, when Mr. Jones began his long fight for the plunger, there was not a single elevator of that type in Providence, which had then 74 suspended-car elevators; there are now 143 plungers, and only 28 of the "rope" machines. These figures, and the fact that the Standard Plunger Elevator Company, it is estimated, is now doing 80 per cent of all the hydraulic elevator business in New York, show that it has at last "arrived." That it has been able to push itself to the front, against all the tremendous opposition brought to bear, is ample vindication of its merit.

It is thought that, were a law enacted compelling the owners of lofty structures to use the supported-car elevator, there would be no more elevator accidents, and consequent injuries and loss of life, to report.

ELECTRICITY IN BUILDINGS.

L. K. Comstock, E. E., in the following interesting and instructive interview, illumines a subject of much importance to owners and occupants of buildings, and, indeed, to the trades engaged in the construction and equipment of the latter. He says:

"Many difficulties arise from conflict of authority. The National Board of Fire Underwriters require work to be done a certain way, failing which owners will be charged higher insurance rates. The rules and regulations of the Water, Gas and Electric Supply Department of New York differ from those of the underwriters in some particulars; the city of Baltimore and the city of Chicago have their special rules and regulations, which differ again, and all through Pennsylvania the rules and regulations differ materially from those of the underwriters. As you will see, electricians are thus confronted with conflicting requirements; to satisfy employers, who, of course, keep their eyes on the insurance rates, when the buildings are such as to require insurance, contractors adhere to the underwriters' rules, which, naturally, breeds trouble.

"The American Institute of Electrical Engineers is desirous of establishing unity, of harmonizing all these different sets of rules through official action. The Electrical Contractors' Association is interested in the same direction. This whole question was discussed with much particularity at a meeting, in which I took part, at Columbia University, in the rooms of Prof. Sever, who was acting as electrical expert for the Commissioner of the Department of Water, Gas and Electricity. A line of policy was outlined which, it is hoped, will prevail.

"This meeting was the consequence of an attempt, of the Board of Aldermen, to incorporate an ordinance, in the municipal laws, requiring the observance of the rules and regulations of the Department of Water, Gas and Electricity of New-York City. Very naturally, electrical contractors do not want any law passed which will conflict with the rules and regulations of the National Board of Fire Underwriters, these being in themselves an economic law. The conflict is an injury to every one concerned." Mr. Comstock commented severely on the "free lances," and on the necessity of devising some recognized means of establishing a man's authority for installing electric plants. "The 'jack-legs' are the chaps that are the real causes of electric fires. Cheap, careless, or ignorant work is what does the damage."

He called attention to "the tendency of owners to huddle electric generating plants into remote places—such as have no rental value. The desire to economize, which leads owners to pack these off into obscure places, at great distances from the steam plant, makes it difficult to generate electricity with any measure of economy. If they will make," he suggested, "an intelligent effort at investigating the cause of the failure of some commercial buildings—as money earners—they will probably conclude that electric generation plants, taken in connection with entire mechanical plants, have a higher earning power for space occupied than any other things that occupy equivalent area; which is to say that, properly managed and installed, they will do more to draw desirable tenants, and to keep buildings filled, than any other inducements the said buildings have to offer." He recommends the location of an electric plant with reference to the steam plant, and to its general accessibility; and he, also, stipulates for cleanliness. He says, "The more dirt, the more