which the boiler inspector, making his semi-annual inspection, would be unable to see.

Chief Electrician Millard said he had examined the boiler on October 5th last, and that it was then in good condition. It was carrying 80 pounds of steam, and any repairs made were of a simple nature.

In returning their verdict the jury place no blame upon anyone. The explosion had been caused by a defect in the boiler, which could not be seen unless the whole boiler was taken to pieces.

THE HISTORY, DESIGN AND CONSTRUCTION OF ELEVATORS.*

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There are several designs of elevators, but only three types operated by either steam, water or electricity, steam being the earliest power used in the lift, as it is called in the old lands. The first used for passenger service was at the Crystal Palace in London about 1851, it being a very crude affair, with chains instead of wire cable from drum to car. The first hydraulic machines used in America were invented by the late Charles Otis about thirty-five years ago, from which we have the different designs now in use, and of which the plunger is the best.

By way of explanation, a plunger elevator is a new thing for the skyscraper. Yet it is the oldest kind of elevator in the world, but very few engineers ever thought it would be introduced into the twenty-storey office building. After having been proved a great success in other cities, it is coming to New York very fast. The method of boring the shaft is one of the marvels of the modern engineering age.

A shaft is started by setting up a short section of compressed steel piping. This is notched on one end, like a saw blade. It is attached to an electric motor and set revolving. As it cuts down into the earth steel shot are poured down and allowed to settle around the saw teeth on the end of the steel piping. A stream of water is then forced down to assist the grinding, and gradually the revolving pipe, with its saw-like teeth, assisted by the steel shot, bore deep into the earth. The hardest stone can be penetrated. In fact, any hard substance can be cut through with apparent ease. When the first section of piping has been sent down another is screwed on, and so the circular shaft is sunk. The core, whatever it may be—stone, clay, sand or water—comes up through the piping or caisson and is carried away.

It was while sinking one of these shafts the Otis Elevator Company encountered at 47 Maiden Lane, where the S. F. Myers building is in course of construction, a very thick layer of hard granite. When the core was finally pulled out of the caisson it was found to be 16 feet long. This is the longest solid rock core ever taken out in Manhattan, and it goes to show that the thickest layer of rock forming the foundation of Manhattan Island is in the down-town district of New York.

The Standard Elevator Company have eleven plunger elevators in the Trinity Building. These are the longest plunger elevators in the world. Eleven shafts, each 285 feet, have been sent down below the graves in Trinity Churchyard. They are used to support the cars of elevators which supply the big office building, and if they prove successful the superiority of the plunger elevator over the cable elevator will probably be established not only to the satisfaction of the engineers, but to the capitalists who furnish the money to build the modern skyscraper.

There are two designs of elevators that cannot be overlooked: First, the Sprague screw machine, which is in common use; and second, the Duplex or Fraser differential elevator.

The former is much like the horizontal hydraulic machine in operation, having no drum. The motor revolves on a long screw, on which travels a ball nut, and this nut moves the travelling sheaves. The operation of this elevator is very smooth, but the cost of repairs has to a large extent prevented its success.

The Duplex machine, on the other hand, might be said to be in its infancy, as only a few of them have been installed so far. It consists essentially of two motors, mounted one above the other, each having a driving pulley or sheave on the end of its shaft, around which the driving ropes run. The car is suspended from cables, which, after passing over the main overhead sheaves, are attached to the counter-weight. From the top of the counter-weight frame ropes are carried over another overhead sheave and down to counter-weight device, on which is mounted the tension sheave. The driving ropes run from the upper driving sheave over a sheave attached to the bottom of the counter-weight, thence around the lower driving sheave and over tension sheave and back to upper driving sheave.

The driving ropes are continuous, and as long as the two motors run at the same speed the various sheaves revolve in their places and the car stands still. As soon as the relative speed of the motor changes, the counter-weight is raised or lowered, and the car moves correspondingly. This kind of elevator can attain the high speeds of the hydraulic elevators, as the motors are not stopped in stopping the car. The car-switch controls two rheostats, one in the field of each motor, and the field of one is weakened while the other is strengthened as the car-switch moves away from the central position. In the central position of the switch both fields are alike, and the motors run at the same speed. The ease and rapidity with which these elevators are started and stopped is wonderful. In this respect they are superior even to hydraulic elevators. Of course, the continuous operation of the motors means a greater power consumption, but this is largely offset by absence of starting current and the time saved in handling passengers. You may notice that I have not mentioned either automatic residence elevators or alternating current elevators, but the omission is intentional. The automatic, with push-button control, offers an interesting study, but is used, of course, almost exclusively in private houses, and hence you would have no occasion to deal with it.

In regard to alternating current elevators, there are some inherent faults which have not yet been overcome.

In an office building which I visit there is an alternating current elevator, which manages to keep running and carry passengers, but the tenants all know when it starts. It emits first a low groan, which rises rapidly to a high-pitched humming sound, and maintains this until the car stops.

Of the first importance in connection with elevators are the safety devices. On the high-grade drum type machine we have, first, the main brake, which is raised by a solenoid, and consequently acts not only when released from the car-switch, but whenever current fails from any reason what-

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