SCIENTIFIC AMERICAN

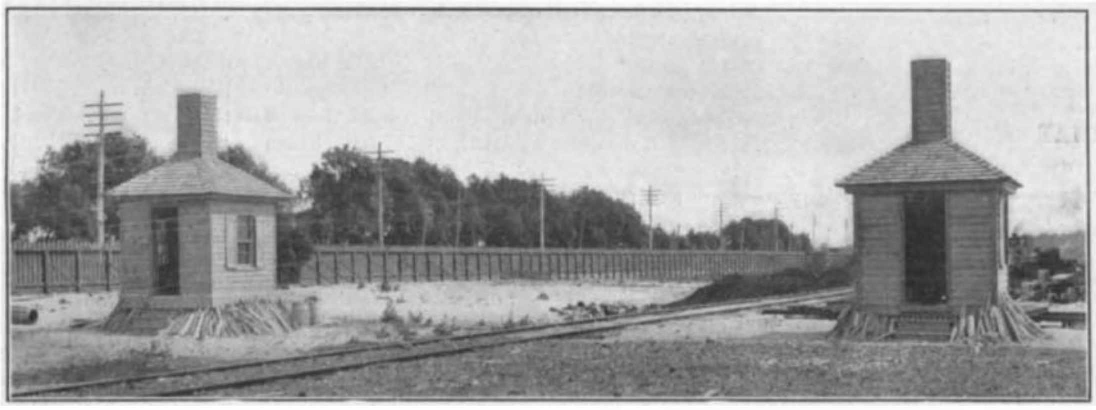
A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXXXIII.—No. 4. ESTABLISHED 1845. | NEW YORK, JULY 28, 1900. | $3.00 A YEAR. WEEKLY.

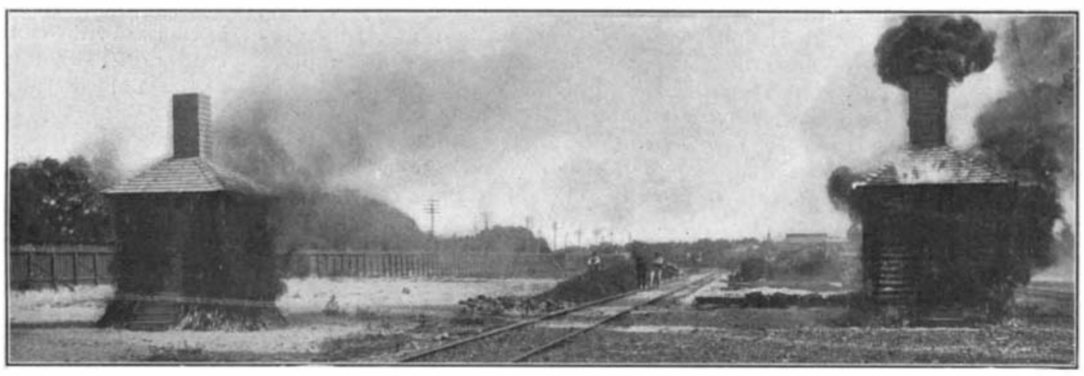
FIREPROOFING WOOD.

During the past few months numerous tragedies, due to destructive conflagrations, have given indisputable evidence of the value of any system of fireproofing that will retard, if not entirely prevent, the wholesale loss of life and property by fire. It is, perhaps, for the reason that naval and military matters always exercise a powerful controlling influence on commercial affairs, that the swift destruction of the Spanish squadron at Santiago did more to stimulate the search for a thorough and reliable fireproofing process than some greater conflagrations that had preceded Santiago. Be that as it may, the last two years have seen an unusual amount of research carried on in the matter of fireproofing, and some of the processes which have been devised have received full description in our columns. The recent tragedy at Hoboken, in which the docks and three of the vessels of the North German Lloyd Company were destroyed and several hundred lives lost by fire, has emphasized the urgent need for the application of fireproof methods, in constructing both the docks and wharves themselves and the ships which make fast to them; for one of the most important lessons of this disaster is that, if the docks and pier sheds had been of masonry and steel construction, or even being, as they were, of wood, had they been thoroughly fireproofed, the loss of life and property would have been greatly reduced.

The present article will be devoted to a description of the latest method of fireproofing wood, which has been invented and developed by Mr. Joseph L. Ferrell, of Philadelphia, and which for some time has been in successful operation in his hands at the plant of the United States Fireproof Wood Company, at 2220 Race Street, Philadelphia.



READY FOR FIRING.



AFTER TEN MINUTES' BURNING.

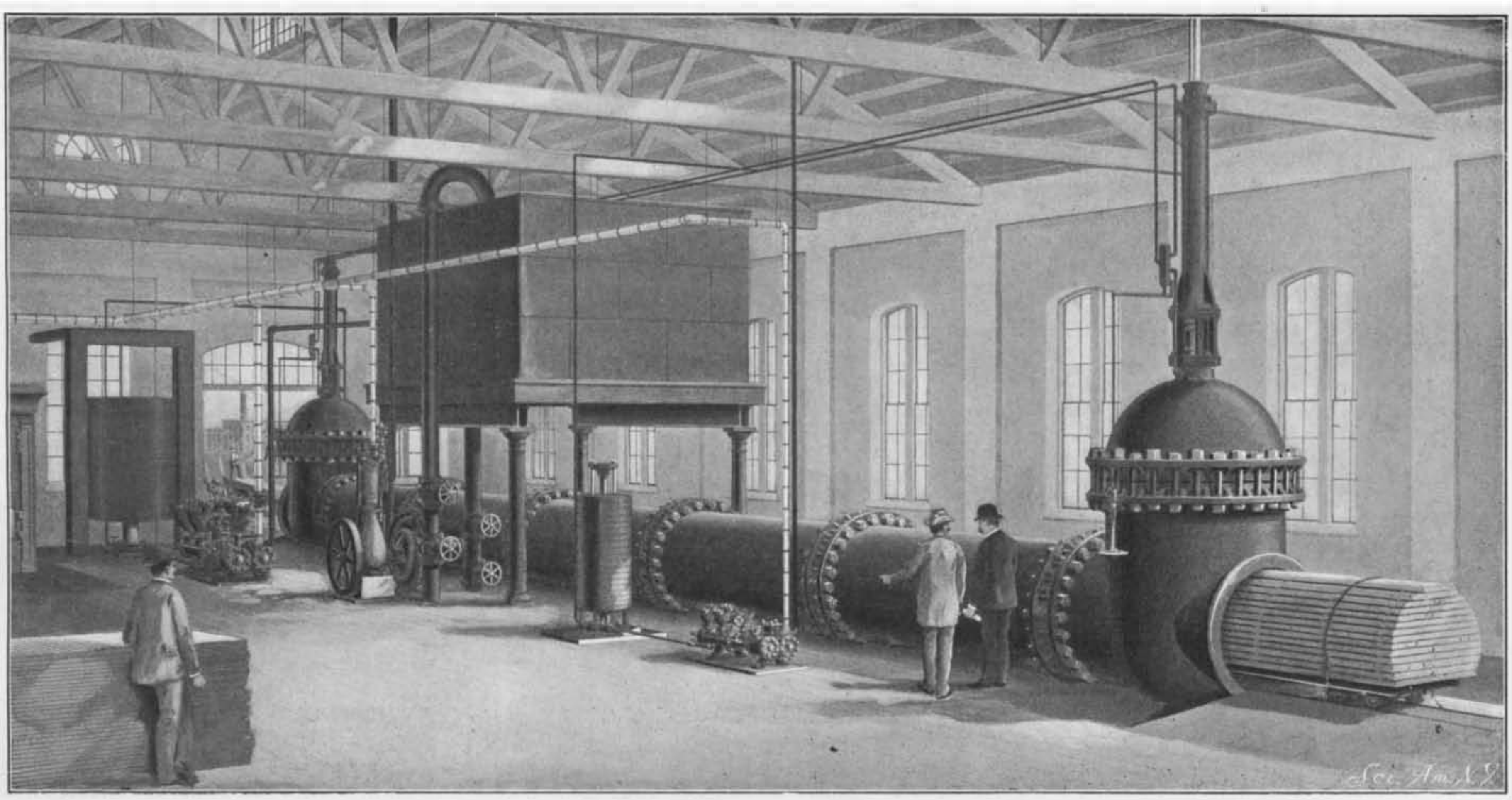
AFTER SIXTEEN MINUTES' BURNING.

Comparative Test of Fireproofed and Non-Fireproofed Wood.

The process differs from those which have preceded it chiefly in three important particulars. First that the wood is not subjected to any steaming or vacuum process for the purpose of emptying the cells of the wood by withdrawing the sap, preparatory to injecting the fireproofing liquor. Second, that the fireproofing liquor is forced into the wood under a much greater hydraulic pressure than has heretofore been used, or even attempted, with the result, as claimed by Mr. Ferrell, and it seems to us very properly so, that the fireproofing is not only accomplished with the least possible alteration of the physical properties of the wood, but owing to the extremely high pressures used, it is accomplished much more rapidly and with more perfect saturation. And, third, that by the intervention of the hydraulic accumulator an enormous pressure for the purpose of assuring heat treatment to hardwoods of all sections is communicated as beneficently to the wood as a very low pressure can be without the accumulator, besides ensuring great rapidity of saturation. Incidental to these improvements are certain mechanical improvements in the fireproofing plant, particularly in the design and operation of the gate of the receiver.

Although the working plant at Philadelphia was designed as a model plant to demonstrate the working of the new pro-

(Continued on page 55).



Single-Cylinder Plant, with Capacity of 15,000,000 feet per annum.

FIREPROOFING WOOD.

FIREPROOFING WOOD.

(Continued from first page.)

cess, it is of such dimensions that it is capable of treating full size specimens on a commercial scale and has been for some time in continuous daily operation. It consists of a charging tank, a receiver 18 inches in diameter and eleven feet long, and the boiler, pressure and circulation pumps, and accumulator necessary for operation. In all the existing methods of fireproofing wood the principal element is the receiver, which usually is built up of a certain number of lengths of massive cast or wrought iron pipe, and closed at one or both ends by gates which are made extremely heavy to enable them to withstand the heavy hydraulic pressure that is necessary in the process. Owing to the large diameter of the pipe the accumulated pressure on these gates amounts to a great many tons, and extreme difficulty has been experienced, even with the lower pressures that are used in other processes, in preventing leakage. The doors are usually closed by a system of multiple-locking devices, and considerable time is taken in closing them and securing a water-tight joint. Difficulties that were considerable when pressures of 120 pounds to 170 pounds to the square inch were used, would have become insuperable in Mr. Ferrell's process, where pressures of from 200 pounds to 750 pounds to the square inch are ordinarily used, and where, in the treatment of some of the hard woods, it may be necessary to run the pressure up to 1,500 pounds to the square inch. Realizing that the hinged gate would be impracticable, it was decided to make use of a gate inserted within the pipe a few feet from its outer end, and the form of gate shown in the accompanying illustration of the one-cylinder plant which is now being constructed at Long Island City was adopted. Near the end of the receiver is bolted a massive gate housing, which consists of a cast iron chamber with a dome cover bolted upon it. Within this chamber the gate moves vertically, with a slight clearance, between vertical guides, its stem passing through a stuffing box in the top of the dome and carrying a small piston which works within the vertical hydraulic cylinder shown above the dome. When the gate is closed its outer face is in close contact with a seating of phosphor bronze. When the liquor is pumped in and the hydraulic pressure accumulates within the receiver, this pressure, it will be seen, forces the gate into closer contact with its seating, any increase in pressure tending to secure a tighter joint.

In the plant which we inspected at Philadelphia, the opening or closing of the gate is accomplished in from five to seven seconds, and it was noticeable that under a pressure of 400 pounds to the square inch the joint was perfectly tight. The wood to be treated is placed within the receiver, the gate is closed, and the fireproofing liquor is allowed to fill the receiver by gravity, flowing into it from the filling tanks. As soon as the receiver is full, the pressure is increased by a Worthington high-pressure pump, the discharge pipe of which is connected to an accumulating cylinder that serves to cushion the shock of the pumps and prevent the wood under treatment from being bruised or otherwise damaged by the impact of the inflowing liquor. This accumulator was found to be an absolutely essential feature in the process, for Mr. Ferrell informs us that when pumping under pressures approaching 1,000 pounds to the square inch, without the accumulator the shock of the pump was sufficient, at times, to bruise the wood and even to split it asunder. The pressure in the receiver is allowed to rise to the predetermined point at which the saturation of the wood is to be accomplished. In the case that came under our personal notice, two planks of white pine, each measuring 1 inch by 8 inches by 13 feet, were placed in the receiver, and after the pressure had been run up to 400 pounds to the square inch, they were subjected to treatment for exactly ten minutes. The liquor commenced to penetrate the pores of the wood as soon as the pressure reached this point, and as it entered the supply of liquor was replenished by the action of the pumps. The extraordinary amount of injection that was taking place was shown by the sudden drop of the accumulator when the liquor first forced its way into the wood. After ten minutes' treatment the pressure valve was closed, and the liquor remaining in the receiver was pumped back into the tank. The receiver gate was then opened and the treated wood removed. The wood before its admission to the receiver weighed just 35½ pounds dry. On being withdrawn from the receiver, it was again placed on the scale and showed a weight of 69¾ pounds, making an absorption of practically 100 per cent in ten minutes.

After the wood has been treated, it is kiln-dried, the moisture being evaporated and the salts deposited upon the walls of the cellular structure of the wood in the form of extremely fine salt crystals. When the kiln-drying is completed, the gain in the weight of the wood will be from 5 to 10 per cent, according to the treatment and the quality of the wood itself. The high pressures under which the saturation is carried out, render it possible to secure saturation to the very heart of the wood, even when large sizes, up to 12 by 12, are being treated. This is, of course, an important feature, and, contrary to what might be expected, the enormously high pressures to which the wood is subjected do not appear to injure in any way its physical properties. Indeed, as a matter of fact, the laboratory tests show that the compressive and bending strength of treated wood is appreciably increased, while treatment does not in any way impair the ability of the wood to properly take paint, varnish, or polish, the specimens that were submitted retaining the native color of the wood and the varnished surfaces being fully equal to those of untreated specimens. The fireproofed wood is no harder to work with tools, although, as might be expected, the tools require more frequent sharpening.

The fireproofing liquor is non-corrosive, it is not volatile, and it is not hygroscopic; once the salts are distributed throughout the body of the wood and deposited on the walls of the cells they are, as far as exhaustive tests would indicate, indestructible and not removable. Specimens have been immersed for months in water, and exposed to the weather without losing their fireproof qualities.

The large plant which is illustrated on the first page of this issue is now being erected at 401 Vernon Avenue, Long Island City. The receiver, in this case, is 50 inches in diameter and 116 feet in length. It is built up of cast steel cylinders, whose walls are 2 inches in thickness. The cylinder bolts are 3 inches in diameter and the bolts fastening the dome to the receiver are 3¼ inches in diameter. At the far end of the building is seen the pump for feeding the receiver, the liquor being delivered against the pressure of an accumulator. At the center of the building stands a centrifugal pump that is utilized for returning the liquor from the receiver to the tank, while in front of it is a small Worthington pressure pump that is used for operating the lifting cylinder that raises the gate. This new plant will have a capacity for treating 15,000,000 cubic feet of lumber per annum.

With regard to the cost of fireproofing, we have before us the figures for some structures in which fireproof wood has been used exclusively. In the case of a framed cottage at Sea Isle, whose total cost was $3,000, the cost of the wood $645, and the cost of fireproofing the same wood $1,050, making the cost of fireproofing 35 per cent of the total cost of the house. In the case of a colonial stone house at Germantown, which cost $14,000, the cost of fireproofing represented 18 per cent of the total cost; while the fireproofing of the wood in a nine-story office building, whose total cost was $400,000, was only 1·7 per cent of that amount.

A few simple experiments with the blowpipe suffice to prove beyond question the absolutely fireproof qualities resulting from this process. If a bunch of shavings of fireproofed wood are exposed to the flame of a Bunsen burner for ten or fifteen minutes it is found that, while they are charred, they have not crumbled away, and that while the Bunsen flame will make a piece of treated wood glow to a cherry red, the instant the flame is removed the glow is extinguished under the action of the ammonia fumes from the salts. Shavings and sawdust of fireproofed wood may be soaked in benzine and ignited. The benzine will burn away, leaving the substance of the wood practically untouched. In fact, one might as well attempt to burn a bundle of asbestos as to burn a bundle of these fireproofed shavings.

We present a series of illustrations of a remarkable test made on two small wooden buildings, which was carried out at the shipyard of the New York Shipbuilding Company, Camden, N. J. The two structures were identical in size and construction, one, however, being built of untreated wood and the other of wood fireproofed on the system above described. A considerable pile of resinous pitch pine was built around each structure and ignited. The progress of the fire is shown in the illustrations. It is sufficient to say that at the end of 16 minutes the untreated building was in ashes and the fireproof structure was practically uninjured. The fire was allowed to burn for 18 minutes more under the remaining structure, and it was then put out by means of a chemical engine. The door was opened and a box made of 1½-inch treated wood, and measuring 12 inches by 20 inches by 12 inches in depth, was placed in the middle of the floor. It was filled with a number of pamphlets and manuscripts, and the cover was screwed securely down. Sticks of pitch pine were then piled over it and the whole saturated with oil and ignited. At the end of 23 minutes' time the box was pulled out and opened, and the contents were found to be not even scorched. The wood of the box was charred only to a depth of about ⅛ of an inch, while the experimental house itself was not only intact but was very little charred. These tests confirm the thorough nature of this system of fireproofing as demonstrated by the smaller tests of the laboratory.

THE telectroscope of Szczepanik is not in evidence at the Paris Exposition, which is not a very great surprise, as his plan was regarded as visionary by physicists.

Electrical Notes.

The Baltimore and Ohio Railroad Company has decided to install the third rail system in their tunnel at Baltimore.

Electric cars operated by storage batteries will be used on the Thirty-fourth Street cross-town line of the Metropolitan Street Railway Company, of New York city. There are few cities in America where horse cars are still in use, but there are fifteen such lines in New York city.

A project has been formed to construct an underground system of electric railways in Berlin; for this two different routes are proposed: the first is to prolong into the city the Siemens & Halske lines, and the second favors a complete independent system; the latter project is the most likely to be carried out, as it will require the construction of underground lines, assuring the greatest speed with a maximum security. The proposed system consists mainly of a circular line, which will unite the principal railroad stations, two lines going north and south and connecting with a third line in the southern part of the city, and two lines extending east and west.

A few days ago Mr. Algernon H. Binyon read a paper on "Electric Traction" before the Society of Engineers in London. He said that no less that 309,000,000 passengers were carried by the tramways of London every year; the omnibuses conveyed 248,000,000; and the underground railway, 128,400,000. By this it will be seen that the tramways were the most favored means of transit, since they carried no less than 45 per cent of the total traffic. With reference to the introduction of electric traction in connection with the London tramways, he contended that the overhead system, such as was employed in the majority of the English towns, was the most efficient and economical. He specially favored the side trolley system, since that form dispensed with the unsightly necessity of long brackets. In combining lighting and tramway plant he suggested the employment of separate mains and dynamos. He also remarked that it would be a decided advantage if the cars were equipped with meters, since by this means it would be possible to reduce the amount of waste, through careless handling of the controllers by the drivers, by 30 per cent.

The transatlantic liner "Oceanic" furnishes a remarkable example of the application of electricity in modern steamships. There are two separate dynamo rooms, each forming a water-tight compartment that can be isolated in case of accident. Each plant contains two double cylinder engines, each of which drives directly a 100 horse power dynamo at 240 revolutions; each dynamo can supply 1,000 lamps of 16-candle power. Two switchboards are provided, one in each room, and these are arranged so that the dynamos may work separately or in parallel. The installation feeds 1,975 lamps, including the signal lights; these latter are provided with an automatic device by which, when a lamp is broken, another is placed in the circuit; at the same time an alarm is given. A complete system of electric heaters is provided, these taking the form of radiators placed in nearly all the cabins; they consume about 1½ horse power each, and will give three different temperatures. The ventilating system is also very complete; four large ventilators are driven by electric motors. In the kitchen an electric heating and cooking apparatus has been installed, and electric bells are used in great number, as many as 1,130 in all; these are arranged to give a single stroke during the day and a vibrating stroke at night. There are also 15 different annunciator and indicating boards. The fog-sirens are worked by a relay magnet and clock movement, by which they are blown for several seconds at regular intervals.

The Metropolitan Underground Railway of London is making a number of experiments with a view of substituting electric traction for the present system of steam locomotives. The tests are being carried on under the supervision of a committee of experts, among whom Sir William Preece occupies a prominent place. The train used in the trials is made up of six electric cars weighing 180 tons each; the cars are provided with an eight-wheeled truck at each end, carrying four motors, the total weight of each truck being 54 tons. The motors have a capacity of 200 horse power each, or 800 for each truck, but in starting they will develop 950 horse power with a load of 970 tons on a 2 3 per cent grade. The wheels have a diameter of 45 inches and the train is 225 feet long. By using the electric system the speed of the trains may be increased from 11 to 15 miles an hour and the frequency of the trains by at least 30 per cent. The stations on this line occur at short intervals, and the stops are of such frequent occurrence that the trains are not able to keep a uniform speed, but are continually starting and slowing. Under these conditions the electric system is far superior, as it permits the train to start quickly and to stop within a short distance. In the tests recently made the new train reached a speed of 20 miles an hour within a distance of 180 feet, and when running at this speed came to a stop within 120 feet, or about one-half its length.