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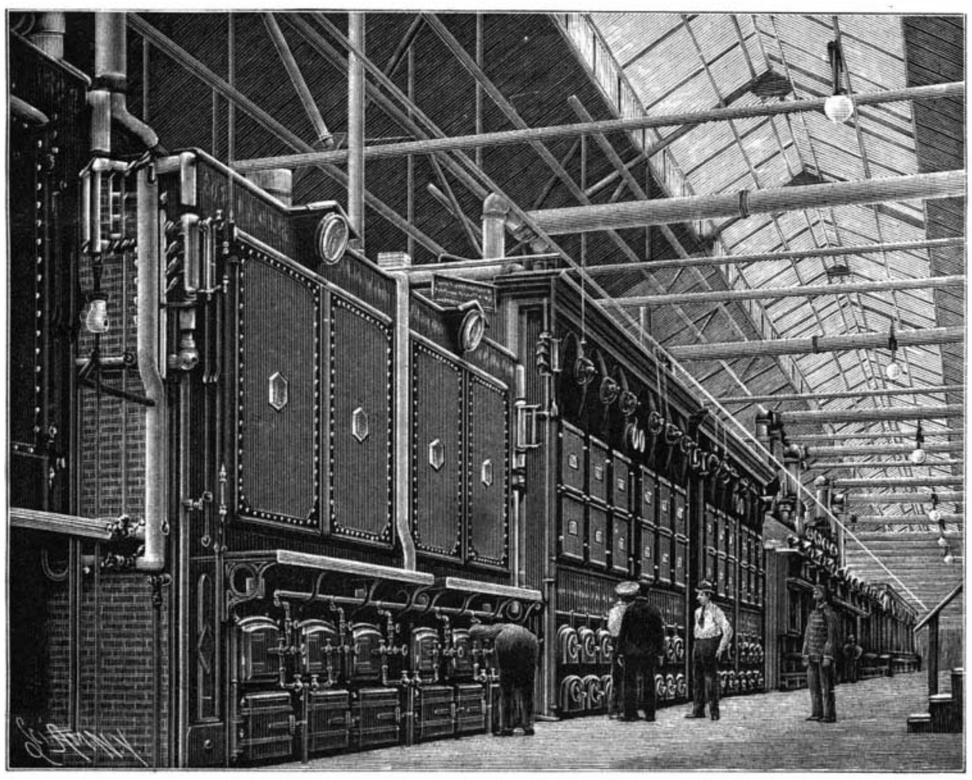
OIL FUEL AND BOILERS AT THE GREAT EXPOSITION.

The motive power for the great Exposition at Chicago is chiefly supplied by a great assemblage of water tube boilers—the greatest in number and operating power ever before collected in one locality. The fuel used is oil. We present beneath in our first engraving a view of a portion of the great boiler house, which in fact forms a part of the Palace of Machinery. Our second view shows the type of burner used for the combustion of the oil; the operation of which will be readily understood by a glance at the picture. The burner consists simply of a tube which enters through the front of the boiler into the combustion chamber. The oil, under a pressure of 6 pounds to the inch, rises through the pipe marked "oil" into the burner, and is atomized and blown into the combustion chamber in the form of a fine mist, by means of a steam pipe, which passes centrally through the burner, and delivers its steam jet at the extreme end of the burner tube as shown. A great flame of gas is thus produced, with intense heat. The handling of coal and ashes is thus avoided, while economical results of the most satisfactory nature are attained. These oil-burning boilers attract much attention from engineers.

Other interesting exhibits pertaining to the use of oil are the oil engines, in which vaporized oil takes the place of steam in driving the pistons of engines, thus doing away with the steam boiler. Some of these exhibits form the subjects of illustrations which we present on another page. Returning now to the great boiler room, or main power plant, there are fifty-two boilers, which generate steam for eighty-three engines. One of the best descriptions of this plant is that recently given in the Chicago *Tribune*, and from it we make the abstracts that follow:



OIL-FIRED BOILERS AT THE GREAT EXPOSITION.

The boilers have a rated horse power of 20,500, but they are capable of developing a horse power greatly in excess of the rating within the limits of economy. They evaporate about 750,000 pounds of water per hour and burn about 50,000 pounds of oil in the same length of time. One pound of oil will evaporate about fifteen pounds of water. Assuming the evaporation to be 750,000 pounds of water an hour, the horse power generated would be 25,000.

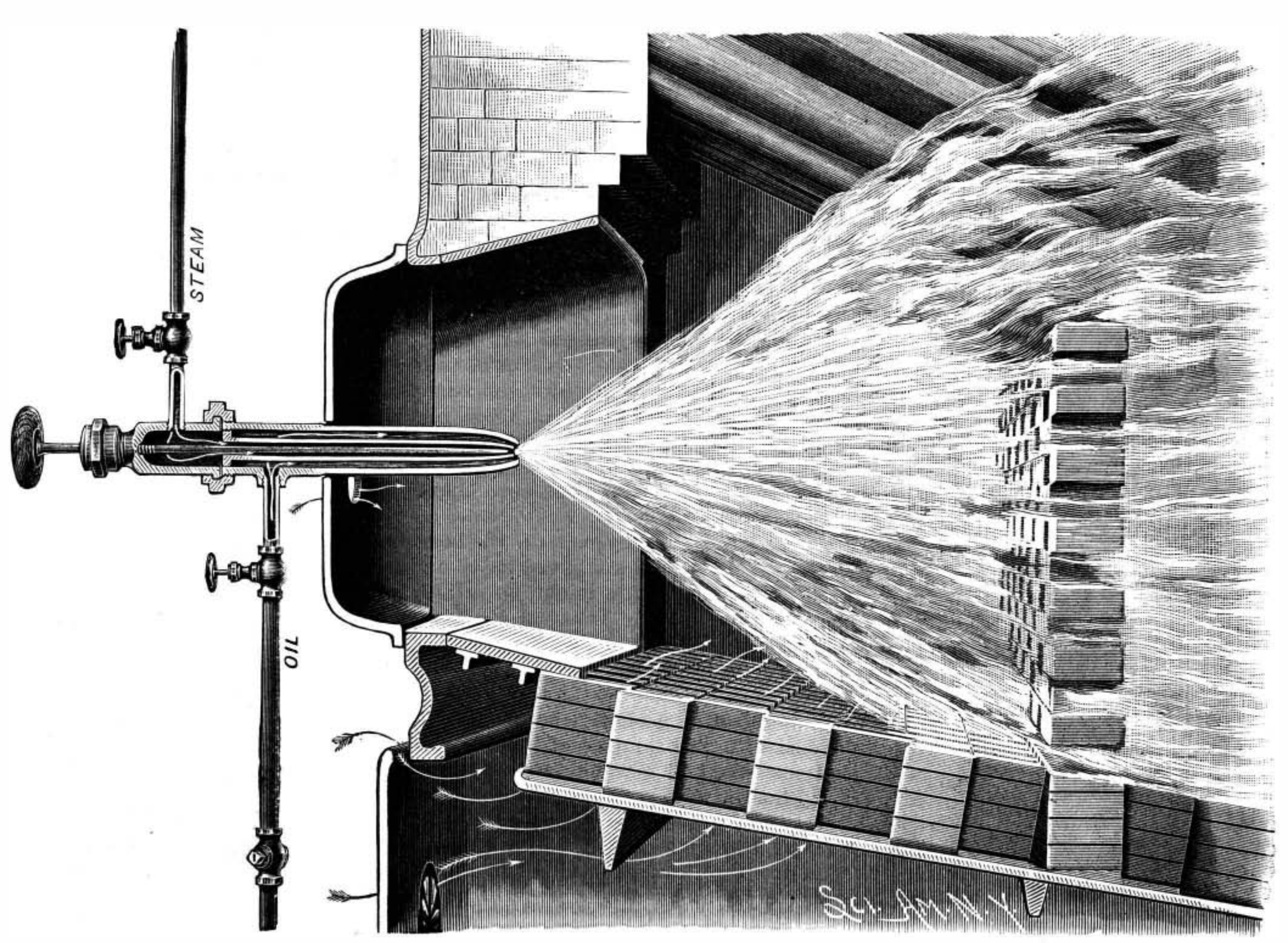
The permanent form which the water tube boiler has now assumed consists of a bank of tubes, usually 4 inches in diameter and from 12 to 18 feet in length, inclined upward at an angle from the rear, surmounted by a water and steam separating drum from 30 to 50 inches in diameter and about the same length as the tubes. The tubes are expanded into boxes or headers at each end, and these headers are connected with the drum above by circulating tubes or other connections. A clear idea of the details of construction and of the variations in different makes may be obtained by reference to the accompanying illustrations. When in use the tubes, headers, and connections are filled and the drum is half filled with water. The water level is carried about the middle of the drum, which, on account of its comparatively large diameter, offers an extensive disengaging surface. This is necessary for the production of dry steam. The furnace is placed under the bank of tubes. The flames circulate around the tubes, being guided up and down by suitable passages so as to cause them to give up as much heat as possible before escaping up the chimney. Connected with the rear end of the tubes and removed from the action of the flames is placed a mud drum for the collection of sediment. The sediment can be readily blown out at suitable intervals.

The boilers in the power house are furnished by eight exhibitors. Beginning at the east end of the boiler house the arrangement, number of boilers, and rated horse power are as follows: Abendroth & Root, four boilers, 1,500 horse power; Gill Water Tube Boiler Company, four boilers, 1,500 horse power; Heine company, eight boilers, 3,000 horse power; National, four boilers, 1,500 horse power; Campbell & Zell, nine boilers, 3,750 horse power; Babcock & Wilcox, ten boilers, 3,000 horse power; Stirling, four boilers, 1,800 horse power. In the annex are four Heine boilers of 1,500 horse power, three Climax of 3,000 horse power, and two Stirling of 900 horse power. These boilers, while separated from the main boiler room by the south entrance to Machinery Hall, are connected with the main system the same as any of the other batteries. They are not yet in use, however. All the boilers, as will be seen by the illustrations, are of much the same type, except the Climax, which is vertical, with U-shaped tubes opening into the central drum. The Jumbo of the boiler house is a Climax of 1,000 horse power.

The Abendroth & Root boilers have 126 tubes four inches in diameter by 18 feet in length, arranged in courses 14 wide by 9 high. They have 7 drums 14 inches in diameter by 20 feet in length, and one header 30 inches in diameter by 12 feet in length. The Gill boilers have 360 tubes 4 inches in diameter by 18 feet in length, 3 steam drums 42 inches in diameter by 21 feet long. The National boilers have 180 4-inch tubes 18 feet long and 8 steam drums 36 inches by 20 feet. The Campbell & Zell boilers have 236 4-inch tubes 18 feet in length, 3 30-inch water drums 19 feet in length, and one steam drum 52 inches in diameter by 12 feet in length. The Babcock & Wilcox boilers have 126 4-inch tubes 18 feet long, arranged in courses 14 wide and 9 high, a mud drum 12 inches in diameter and 8 feet 6 inches long, and 2 steam drums 36 inches by 18 feet. The Climax 500 horse power boilers have a main shell 42 inches in diameter by 29 feet high. The main shell is ¾ of an inch thick, with vertical seams welded. Each has 475 tubes 3 inches in diameter and 11 feet 6 inches long before bending.

The monster 1,000 horse power boiler Jumbo has a main shell seven-eighths of an inch thick. It is 56 inches in diameter and 35 feet 3 inches high. It has 864 3-inch tubes which were 12 feet 6 inches long before bending. It is capable, it is said, of developing 1,800 horse power.

(*Continued on page 22.*)



THE WORLD'S COLUMBIAN EXPOSITION—THE BOILER OIL BURNERS.

OIL FUEL AND BOILERS AT THE GREAT EXPOSITION.

(*Continued from first page.*)

These boilers, with the exception of one Campbell & Zell and the three Climax, are arranged in batteries of two. Each pair of boilers feeds steam into one common pipe which delivers into the 36-inch steam headers under the gallery floor. Of these headers there are seven; five in the main boiler plant and two in the annex, the longest being 150 feet in length. The headers are connected by pipes ten inches in diameter, except that between the main boiler plant and the annex, which is twelve inches in diameter. These connecting pipes are arranged with elbows and nipples to allow for expansion. The expansion in so large a system is considerable. If the header had been made in a single piece, the expansion in the 800 feet in length would have been about twenty inches. Such an amount would have been utterly unmanageable. By means of the connecting pipes the same effect is produced as though there were but a single header. The main headers are securely fastened in the center to large masonry foundations. They are further supported every few feet by rollers placed on foundations of masonry. These rollers permit the headers to expand freely in each direction.

A four-inch drain pipe runs the whole length of the boiler plant and discharges into a large tank outside. The headers are connected with three two-inch drain pipes, so that in case of emergency, if a battery of boilers should get to foaming, for instance, they can be quickly emptied. The water of condensation is carried back into the boilers by Westinghouse loops. The Westinghouse loop is simply a pipe carried from the bottom of the header up some distance above the top of the boiler, thence across to the rear of the boiler house, down below the water line, and then into the boiler through an ordinary check valve. The height of the vertical pipe is so calculated that the weight of the column of water in it added to the pressure in the header, which, of course, is somewhat less than the boiler pressure, shall be sufficient to overcome the excess of pressure in the boiler, and so carry the water of condensation and entrained water through the check valve and into the boiler. Water glasses are placed on the headers, so that if water should accumulate by any chance, it can be readily discovered.

The boilers are fed by pumps and injectors of various makes, all being listed as exhibits. The Abendroth & Root boilers are fed by means of six Watson injectors and two Deane pumps, 7½x4½x10 inches. The Gill boilers are fed by two Korting injectors and two Barr pumps, one 10x6x12 inches, the other 10x6x10. The pumps supplying these boilers are regulated by a Thomas automatic feed water regulator, which keeps the water at a constant level without the intervention of an attendant. The Heine boilers are supplied by eight Penberthy injectors, two Knowles pumps, 10x5x12, and two Blake pumps, 8x5x12. Four Hayden & Derby injectors and two Davidson compound pumps 12 and 20x10½x20 are required to supply the National boilers. The Zell boilers are supplied by six Nathan injectors, one Cameron pump, one Laidlaw & Dunn 7½x4½x10, one Wilson Snyder 14x8x18, one Canton, one Worthington and one Boyts Porter pump. The Babcock & Wilcox boilers are supplied by Hancock inspirators and three by Snow pumps. One is compound 8 and 12x7x12, the others are 10x5x10 and 8x5x10, respectively. Two Buffalo pumps 10x6x10 and 7½x5x8 and one Gould pump run by an Ideal engine and Schaefer & Budenberg injectors are used to feed the Stirling exhibit. In the annex two Marsh pumps supply the Heine boilers. The Climax boilers are fed by one Blakeslee and one Smedley, and the Stirling boilers are supplied by one Hall and one McGowan pump. Thus intending purchasers or any one interested in power plants may see most of the leading injectors, inspirators and pumps in practical operation and judge of their relative merits for himself.

On every make of boilers is a feed header into which the pumps of those boilers deliver. From this header separate pipes are run into each boiler.

Oil is the fuel used. The oil is atomized by a steam jet as it is discharged from the burner into the furnace. The various makes of oil burners are shown in operation. Any one interested in comparing the various makes will find twelve Reid burners under the Abendroth & Root boilers, sixteen under the National, and forty-six under the Campbell & Zell; thirty Larkin burners under the Babcock & Wilcox and twenty-eight under the Climax; sixteen Arms burners under the Gill boilers. The Heine boilers use seventeen Graves, sixteen Burton, eight Wright, and twelve Reid burners; the Stirlings use eight Burton and eight locomotive burners. The oil is fed from an oil vault half a mile from the boiler house. Two mains run from this vault into a five-inch header which runs the entire length of the boiler house. This header is tapped frequently, and every make of boilers is supplied through a separate pipe. The pressure, as allowed by the underwriters, is six pounds. Running along the tops of the boilers from one end of the boiler house to the other is a two and one-half inch steam pipe, with valves between each make of boilers. A two-inch steam pipe feeds into this from each boiler. From this two and one-half inch pipe, steam is carried into the oil burners for atomizing the oil. As steam is necessary to burn the oil, the pipe obviates the necessity of using wood to start up any battery of boilers after it has been allowed to cool down, so long as any other battery has steam up. The Gill and the Campbell & Zell boilers have independent steam connections with the burners in addition.

The safety valves, which are the ordinary pop valves, are set at 125 pounds.

The entire room is in charge of George Ross Green, who is known as the superintendent of the boiler house. His rank is that of second assistant engineer. Each exhibitor furnishes firemen and water tenders to care for its boilers. They work in watches of eight hours each, one or two men being required, according to the number of boilers in the exhibit. In addition, the Exposition furnishes a gang of thirty men under three foremen, who look after cleaning, oil, and oiling, repairs, alteratious, and so on. One man's duties consist in watching for smoke and promptly reporting any offense in this particular. He sits in a little house back of the boiler room, where he has a clear view of all the chimneys. Electric communication with every furnace is provided, so that as soon as a chimney begins to smoke the fireman is warned by a bell to look after the matter. Another man looks after the valves, of which there are 108 on the headers alone, and a grand total of 1,200 in round numbers in the boiler house.

Mr. Green has devised an ingenious yet simple scheme for keeping a record of the condition of the boilers and engine. On the north wall of the boiler house, near the east end of the gallery, hang two huge blue prints. On one is a diagram of the boiler house and machinery hall showing the location of every boiler and engine, each being numbered. The key to these numbers is given on the bottom of the blue print. A brass peg is screwed into each spot occupied by a boiler or engine. At one corner are stacks of red, white, and black tags about half an inch wide and two inches long. A white tag hung on a peg indicates that that particular engine or boiler is working; a red tag shows that the boiler or engine is hot and ready to be put in operation at a moment's notice; black shows that the engine or boiler is not in use for some reason. Whenever an engine or boiler is started or stopped, the foreman on duty goes to the diagram and hangs a suitably colored tag on the peg which stands for that engine or boiler. Thus the record is constantly kept up to date. On the second blue print is a diagram of the headers and header valves with similar pegs and tags. Whenever a request is made for steam for an engine the foreman in charge sends the valve man to open the valve and hangs a white tag on the proper peg to show that it is open. In changing watches the foreman coming on duty can see at a glance just how things stand. This saves a vast amount of labor in making out lengthy reports at the end of each watch.

An elaborate record is kept in the boiler room showing when each boiler is started up, when shut down, when valves are opened and when closed, the steam pressure, furnaces that smoke, repairs made, and so on.

Failure of the East End of the Great Austin Dam.

A serious break has occurred in the great dam at Austin, Texas, which was recently completed. The massive masonry inclosing the penstocks gradually went down at the east end, making a great crack in the wall where it leaves the top of the dam. The granite wall inclosing the wheel pits was swept away. Several of the pits were utterly destroyed, and the machinery in them tossed about and carried off by the force of the roaring torrent sweeping through the cavern under the penstock level. Water is working its way through nearly all the masonry surrounding the penstocks, and it will be a total loss. Some of the large penstocks and machinery have been injured, and a conservative estimate places the loss to the city at $200,000. It appears now that the plans of Engineer Frizell, who had charge of the work from its inception, but who was relieved before its completion, were not carried out, and the masonry failed to be extended into the east bank some fifty feet to a point designated by him.—*N. O. Times-Democrat.*

The Campania.

The average speed of the new Cunard steamer Campania on her last trip from Liverpool to New York was as follows:

	Miles.
June 19	509
" 20	548
" 21	521
" 22	494
" 23	532
" 24	260
	2,864

Correspondence.

Remedy for Ivy Poison.

To the Editor of the Scientific American:

In your issue of June 17 some one signing himself H. M. suggests a cure for *Rhus tox.* or poison ivy. He describes its effects, as myself and others can testify, who have been so unfortunate as to come in contact with it. He prescribes pills and promises relief after taking a few doses, or after a few days. Bean leaves bruised and applied will afford instant relief and arrest any further progress of the affliction. I have found a decoction of dried bean leaves quite as satisfactory; so that the prudent may always have the remedy, summer or winter. J. A. PALMER.

Plymouth, Ind., June 22, 1893.

Bright Gold Patented in France.

To the Editor of the Scientific American:

The facility with which a patent can be obtained in France has often been commented upon. A most striking example of recent occurrence has just come under my notice. The long known liquid bright gold has just been patented in France to a Mr. Pertsch, whose process consists in the treatment of balsam of sulphur with the chloride of a precious metal, thus obtaining a resinous compound of the precious metal suitable for china gilding, etc.

The very same process was used as far back as 1830 by the chemist Kuehne, at Meissen, Saxony. It is described in Dingler's *Polytechnisches Journal*, of 1861, and a French patent was issued for it, in 1851, to Dutertre Brothers, of Paris (*vide Bulletin de la Societe d'Encouragement*, March, 1861). Nevertheless, a new French patent has just been granted for the same process to another party. Your own "Scientific American Cyclopedia of Receipts" gives, on page 231, under "Gold Luster for China Painting," the principles of this "new" patented process. P. M.

[In France patents are granted to every applicant whose papers are in proper form, without official examinations as to the novelty of the invention, and the patent holds good if the invention is new, but not otherwise. Applicants make their own examinations. —ED. S. A.]

Electroplating Ships' Bottoms.

To the Editor of the Scientific American:

In an article on "The Maintenance of the Speed of War Ships," in June 3 SCIENTIFIC AMERICAN, you conclude: "But invention has not yet reached the point of adequately protecting a ship's bottom from barnacles and seaweed."

What is the matter with electroplating them with copper? The first expense, of course, would be great; but the actual cost of plating a large ship after the first expense for solutions, dynamos, and a suitable drydock would not be excessive.

At first glance there are other objections that appear. The difficulty of keeping a large surface of iron clean until the first coat of copper could be deposited is one. This can be overcome by a plan I used to keep the surfaces of the iron columns for the Philadelphia Public Buildings clean. They had each a surface of about 300 square feet, but after being pickled and freed from rust and scale, there was no trouble in keeping the exposed iron surface clean and free from oxide until such time as they could be got into the plating tank, and as they weighed about six tons, this took some time.

Another objection is that copper deposited from a solution of sulphate of copper always contains pin holes, which, of course, would admit the sea water and set up galvanic action between the copper and the iron of the hull. Also that the surface of the deposited copper would be rough, and thus interfere with the sailing qualities of the ship. These objections I have overcome by the use of a new plating solution that deposits copper in a much finer and more dense state than that deposited from the ordinary sulphate solution. Copper deposited from this new solution is entirely free from pin holes, and the surface, no matter how thick the coat, is perfectly smooth. It also adheres much better than ordinary plating, which is of great advantage, as there will be less danger of its being torn off by the accidental grounding of the ship in a sand bar.

In fact, there would be little danger of the copper being torn off anyway, as copper, when properly deposited on a clean iron surface, adheres very firmly, and nothing short of striking a rock or other equally hard obstruction would injure it. J. D. DARLING.

Philadelphia, Pa.

A Submarine War Boat.

The board of ordnance experts who have been considering the proposals and plans for the submarine boat, find only two of the plans suitable. It is thought one of these will be accepted by the Navy Department. All the bids came well within the appropriation of $200,000, and it is believed that one of the offers of $135,000 will be accepted and the boat built.