MANUFACTURE OF WATER-GAS AT THE FORTY-FOURTH STREET STATION, NEW YORK.—I.

The manufacture of coal gas was illustrated and described in our issue of October 6, 1900, the plant of the Consolidated Gas Company at Fourteenth Street being selected for illustration. The present article is devoted to a description of the manufacture of water-gas, as carried on by the same company in their plant at the foot of West Forty-fourth Street, in this city. Water-gas is a gaseous mixture which consists mainly of carbon monoxide and hydrogen. It is produced by forcing steam through a body of incandescent fuel. Although water-gas possesses great heating power, it is practically useless as an illuminant, and hence when it is manufactured, as in the present instance for lighting purposes, it has to be mixed with a certain proportion of illuminating gas before it is delivered to the city mains. Of our two front page engravings representing the Forty-fourth Street plant, the upper one shows the details of the plant for making pure water-gas, while the lower cut shows a complete plant for making illuminating water-gas; the last-named being known as the Lowe Apparatus.

ILLUMINATING WATER GAS.—A single element of the Lowe Apparatus, as shown in our illustration, consists of a generator a carbureter, a superheater, a condenser, and a scrubber, with the necessary boilers and blowers to supply, under pressure, the necessary steam and the air. The generator is a vertical shell 8 feet 6 inches in diameter and 16 feet high. It is lined with firebrick and at about a fourth of its height is a grate on which the fuel (coal and coke) is loaded to a depth of 7 feet. The cabureter is of the same dimensions as the generator and is also lined with firebrick, while the interior is filled with firebrick checkerwork. The superheater is 8 feet 6 inches in diameter by 20 feet in height, and like the carbureter it is lined with firebrick and filled with checkerwork. The generator and carbureter are provided with manholes at the top, while the superheater terminates in a stack valve as shown. Each of the three cylinders is provided with air inlets, with connection to a series of air mains, that are fed by a centrifugal blower. A series of pipes connecting the cylinders with one another facilitates the flow and control of the gases during the process. One air connection leads beneath the grate of the generator, another leads to the top of the carbureter above the checkerwork, and a third connection admits air below the checkerwork of the superheater. There is also a steam pipe which terminates in a jet below the grate of the generator; and by means of a pipe connecting with the oil supply, a spray of oil can be injected upon the top of the checkerwork in the carbureter.

In operation a supply of coal and coke fuel is loaded into the generator from a platform at the level of the top manhole, until it stands about 7 feet deep upon the grate. The stack valve of the superheater is opened, and the steam and oil supply are closed. Air is then blown through the fuel in the generator, the resulting products of combustion passing through the checkerwork in the carbureter and superheater, and finally escaping through the open stack valve in the last-named element. The air, in blowing up through the fuel, combines with the carbon of the fuel to form carbon monoxide, which is conveyed from the top of the fuel through piping to the top of the carbureter. Here it meets a fresh supply of air from the air mains, and taking up more oxygen, forms carbonic acid gas. This combustion takes place as the gases pass down through the checkerwork. From the bottom of the carbureter the gases are led to the bottom of the superheater where, if it is necessary, a fresh supply of air is added to produce complete combustion. The gases then travel up through the checkerwork in the superheater, and finally escape through the stack valve. By the proper regulation of the air supply the combustion is rendered so complete that the gases as they pass to the stack are completely colorless. During the blow, which lasts about four minutes, the checkerwork in the carbureter and superheater is raised to a cherry red heat.

The various air valves and the stack valve are now closed, and steam is turned on below the grate of the generator. In passing up through the incandescent fuel the steam is decomposed into hydrogen and carbon monoxide. The oxygen in the steam combining with the carbon in the fuel forms carbon monoxide, and sets free the hydrogen, the gases as they pass from the top of the generator consisting chiefly of carbon monoxide and hydrogen, with a small amount (about 3½ per cent) of carbon dioxide, whose presence is due to the fact that a small amount of steam has not been thoroughly decomposed. This water gas now passes to the top of the carbureter, where it is mixed with a spray of oil (naphtha or gas oil), which is forced in under a pressure of 70 pounds to the square inch. The mixture of water, gas and sprayed oil now travels through the checkerwork of the carbureter and the superheater, the heat of which transforms the mixture into a fixed gas whose average analysis, as shown by tests which are taken regularly at the works, is as follows:

Carbon dioxide	3.4
Illuminants	12.3
Oxygen	.5
Carbon monoxide	29.1
Hydrogen	30.3
Marsh-gas	21.3
Nitrogen	3.1

From the top of the superheater, the fixed gas now passes through the water of the seal-box, the object of the seal being to prevent any possible reversal of the flow of gas. From the sealed box the gas is led to the bottom of the scrubber, a vertical cylinder which is filled with a large number of superimposed wooden slats or gratings. A spray of water plays continually upon the top grating and trickles down through and over those beneath, thereby providing an exceedingly large wetted surface. As it passes up through the innumerable openings of the gratings the gas is cooled, and the heavy oils and pitch which it contains are condensed and deposited. The gas then passes between the tubes of a vertical condenser, consisting of a shell, containing a number of tubes through which cold water is constantly circulating, where it is cooled to the temperature of the atmosphere, the lowering of its temperature causing the condensation of any oils and pitch that may be left in the gas. The purified gas is now led to a relief holder, as shown in the illustrations.

The operation of blowing the air is known as the "blow," and that of blowing the steam as the "run." The run lasts about six minutes, at the end of which time the fuel and the checkerwork have been so far cooled that it is necessary to heat them again. To this end the steam and oil supply are shut off, the stack valve is opened, and the air blast is again turned on, as already described. The flow of steam, however, at the succeeding "run" is reversed by means of a reversing valve on the steam connections, the steam now being introduced at the top of the fuel and passing down through the same. The object of reversing is to keep the fuel at a more even temperature for if the "run" were all in one direction, say upwardly, the lower part of the bed of fuel would be comparatively cool and the top of the fuel excessively hot.

In the Lowe apparatus, as thus described, it is possible to vary the illuminating power of the gas by varying the amount of oil that is sprayed into the carbureter. The gas made at the Forty-fourth Street plant is of about twenty-eight candle power, and the capacity of the Lowe plant is 2,000,000 cubic feet per twenty-four hours.

STRAIGHT WATER-GAS PLANT.—In addition to the Lowe apparatus as above described, there is at the Forty-fourth Street station a complete plant for manufacturing non-illuminating water-gas. The product is conveyed direct to the relief holder, where it is mixed with the product of the Lowe apparatus, preparatory to being mixed with an oil gas that is prepared in a plant which will form the subject of an article in a later issue. The straight water-gas plant is a French system, which was introduced into this country in 1877, and was the first water-gas plant of any kind to be erected in this country. It consists of a generator, which is technically known as the "Gasogene," and a scrubber, as shown in the upper illustration on our front page. The gasogene consists of a rectangular shell, built up of wrought iron plates, which measures 6 feet by 12 feet by 14 feet high, and is lined throughout with firebrick. Two feet from the bottom is a grate for the coke and coal fuel, which is introduced through a charging door at the top of the furnace. Air is fed to the gasogene at two different levels, one set of pipes leading in below the grate, another at about the mid-height of the generator. There is also a steam connection at the bottom and one at the top. In the operation of blowing or heating up, the air supply at the bottom and at the center of the fuel is opened, the stack valve being left open, and the blow is continued for about five minutes, at the end of which time the fuel is heated to the proper temperature. The stack valve is then closed, the air supply shut off, and steam is turned on under the fuel bed, when the same reactions take place as were described in connection with the generator of the Lowe apparatus. The gases pass off from the top of the gasogene, through a seal-box, and down to the bottom of the scrubber, a large rectangular structure filled with a series of trays, at the top of which a spray of water is continually playing. As the gas passes up through the scrubber it is cooled and washed, the water serving to catch any dust or dirt which may have been carried over from the gasogene. The gas is here cooled down from about 180 degrees F. to 60 degrees F. From the top of the scrubber it is led to the relief holder, where it is mixed with the illuminating water-gas from the Lowe apparatus. The run lasts for about twenty minutes. After the steam has been blown up through the fuel for ten minutes, the valves are reversed and the steam is blown downward through the fuel for the next ten minutes, the object of the reversal being, as in the case of the Lowe apparatus, to maintain the fuel at an even temperature throughout its whole mass. The capacity of the gasogene plant is 8,000,000 cubic feet per twenty-four hours.

It will be seen that there is a radical point of difference between the gasogene and the Lowe apparatus, in the fact that, while the latter manufactures a finished illuminating gas, the former manufactures a simple water-gas without any illuminating qualities. The products of both plants being carried, as we have seen, to a common relief holder. From the relief holder the mixed gases are led to the condensers of an oil-gas plant, where they are mixed with the oil-gas, and the combined mixture is condensed, scrubbed, purified, and measured, and finally carried to a main holder of 2,000,000 cubic feet capacity, from which it is led to the city mains. This oil gas plant will form the subject of an illustrated article in a later issue.

Engineering Notes.

Two ice-breakers for Port Arthur are being constructed in a Finnish shipyard.

Shipments of pig iron from Alabama and Tennessee for the first eleven months of 1900 amounted to 1,200,000 tons.

One of the largest chimneys in New York State has just been completed for the power station of the Schenectady Locomotive Works. It is 200 feet high and 32 feet square at the base.

According to the Board of Trade returns for 1899, strikes in the commercial industries of Great Britain are appreciably decreasing. The aggregate duration of disputes for 1899 was 2,516,416 working days, compared with 15,289,478 working days in 1898. The latter heavy total, however, was due to the great strike in the engineering and marine industries. Compared with the average returns for other years, the figure for 1899 shows a decrease of 70 per cent, and is the lowest annual total yet recorded.

In view of the success that has attended the experiments with the ice-breaking steamer "Ermak" in forcing a navigable channel through the ice in the Baltic Sea, the Russian government have decided to construct several other similar vessels for the same purposes in other parts of the Russian Empire. It is stated that two of these vessels will be stationed in the East to keep the harbors of Russian Tartary open to navigation throughout the year, especially the harbor of Vladivostock, where it is proposed to lay down a number of new docks and to provide extensive wharf accommodation.

Experiments have been carried out on the Thames by the Thames Conservancy Board with the marine torch with conspicuous success. The tubes containing the calcium carbide ignited immediately the substance came into contact with the water, casting a brilliant light, which was visible for a considerable distance. There is every probability of this torch being requisitioned for the illumination of certain parts of the river by night for the guidance of vessels, etc. The existent illuminants are inadequate and very unsatisfactory, whereas the acetlyene gas sheds a glaring pure white light, covering a wide area.

The shipbuilding industry on the Clyde has received a decided stimulus during the past few months, and the output for November last year was the heaviest recorded during the past ten years. Twenty-three vessels were launched during the month, representing a tonnage of 67,693, as compared with 40,000 tons for the same month last year. For the first eleven months of last year 226 steamers were launched, aggregating 433,724 tons, as against 415,724 tons for the same period in 1899, an increase of 18,000 tons. Fresh orders are also being placed, including steamers for the Peninsular and Oriental, Union-Castle, and other steamship companies.

A meter for measuring the amount of steam which flows through a steam pipe has been introduced in Berlin by A. Friedeberg. It is described as follows: Inside a horizontal length of the main, a flap-plate, hung from a horizontal axis, actuates, through an internal sector and rack, a conical plug valve controlling an opening in the top of the main. When no steam is being used, the plate hangs vertically and keeps the valve closed; when steam is flowing through the main, it turns the plate more or less toward a horizontal position, thereby opening the valve correspondingly, and the steam escaping through the valve is condensed in a worm. The water from the worm is either collected in a measuring tank, provided with a gage-glass, or is delivered upon a bucket wheel, the revolutions of which are indicated upon a counter arranged to show the corresponding quantity of steam flowing along the main.

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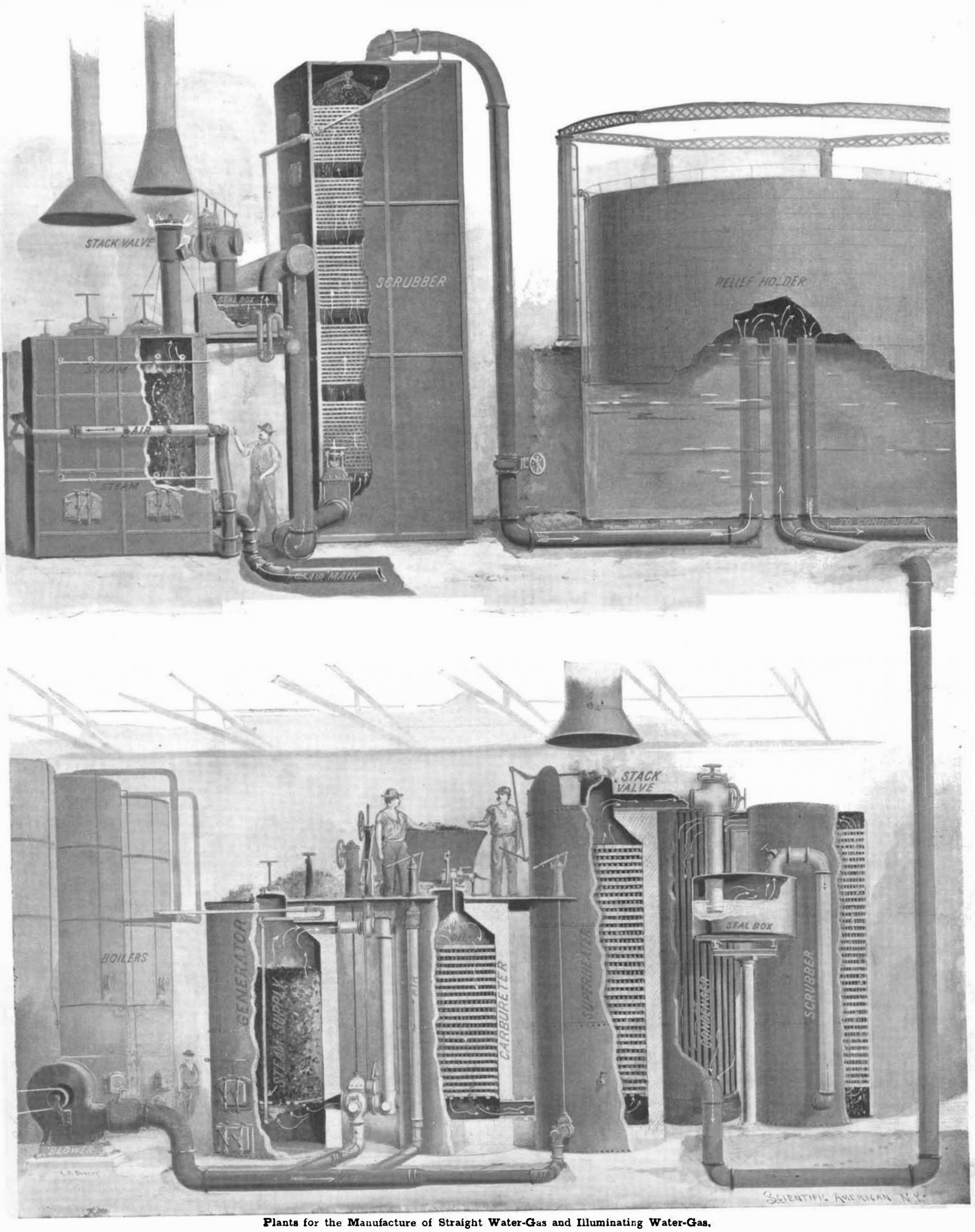

Plants for the Manufacture of Straight Water-Gas and Illuminating Water-Gas.

MANUFACTURE OF WATER-GAS. I.—[See page 39.]