much ahead of the old method of hand-raking. The coke is removed by pushing it out the rear end of the retort and falls into steel hoppers in the rear of the benches, where it is quenched with water and dropped into a small industrial car in the pit. This car is similar to coal car, with the exception that it is lined with asbestos. It is elevated to the level of the coke runway by means of a 2-ton platform sidewalk elevator which is motor-driven.

Coke is used in the benches for fuel. About three hundred pounds of coal is charged per retort and is carbonized from twelve to eighteen hours. The capacity of each bench is from 50,000 to 75,000 cu. ft. of gas per day according to the quality of coal used and heats run. The capacity can even be run above this by increasing the heat, but it is detrimental to the life of the retort.

When coal is roasted in an airtight retort at about 1,200 degrees Fahr., crude coal gas is given off mixed with tar and ammonia and other impurities, and if the heats are not proper, considerable naphthalene and carbon will also be formed. One ton (2,000 lbs.) of average coal will give 9,800 cu. ft. of 14 to 15 c.p. gas, 1,300 lbs. of coke, 12.5 gallons of tar, 27 gallons of 6 oz. ammonia liquor and 1 lb. of retort carbon. Naphthalene is a very troublesome substance in that it is normally a solid but is capable of being transported long distances in the form of vapor by coal gas. When, however, the temperature of the gas is reduced to such an extent that it becomes saturated with the vapor the naphthalene crystallizes out in the form of flakey white crystals which occupy a large volume and if deposited in large quantities will stop up mains and services. Carbon formed in the retorts is deposited in the stand-pipes, causing stoppages and other operating worries. After forming in the retort the gas is conveyed through the stand-pipes to the hydraulic main which acts as a seal to the retorts when they are open and prevents the return of the gas. It collects the heavier tars which should be drained off periodically and the water dissolves a portion of the ammonia but, being hot, the percentage is small.

Nearly all the ammonia present in crude coal gas is in the "free" state, i.e., it can be driven off by merely heating; only from 5 to 15% being fixed. Coal gas contains approximately 350 grains of ammonia per 100 cu. ft. At the outlet of the condensers, this is reduced to 250 grains and at the outlet of the washers and scrubbers this amount has been reduced to 1½ grains.

The gas leaves the hydraulic main varying in temperature from 140 degrees to 130 Fahr., and is conveyed by means of the 12″ foul main to the primary or air condenser, which is situated just outside the exhauster room. The gas should be approximately 110 degrees Fahr., in order to be able to extract the tar from it satisfactorily and it is the duty of the primary condenser to reduce the gas to this temperature before it reaches the tar extractor. The primary condenser is 6′ in diameter by 20′ high, made of ¼″ steel shell, has 61 tubes 3″ x 17′ and if fitted with a stack 24″ diameter. by 14′ high, which induces a natural draught through the apparatus, the draft being controlled by means of a stack damper. A portion of the tar and ammonia are deposited in the primary condenser and are drained by means of a suitable drain to the tar and ammonia separator and tar well.

The next piece of apparatus is the exhausters, which are two in number. They are of the P. H. & F. M. Roots type, known as a No. 4, and each have a capacity of 17,700 cu. ft. per hour per 100 revolutions. One exhauster is driven by a 5″ x 7″ vertical engine direct connected while the other is motor-driven, being belted to a 5-h.p. variable speed A.C. motor. The speed of the engine-driven unit is kept proportional to the amount of gas being made by means of an automatic governor. The speed of the motor-driven exhauster is hand-governed. The function of the exhauster is to take the gas from the hydraulic main on top of the benches and force it through the various purifying devices and into the holders against the holder pressure. The only pressure which the gas in the retorts is under is due to the amount of seal of the dip pipes which varies from 1″ to 2″ of water, preferably 1″. By the use of the exhauster the amount of carbon deposit in the retort is lessened; the loss due to leakage is very much less, and the amount of gas obtained from a given quantity of coal greater.

From the exhauster the gas is forced through the tar extractor, and in this case a 12″ P. & A. tar extractor was used. This piece of apparatus is most efficient and extracts practically all the tar from the gas. The principle of operation of a P. & A. tar extractor is as follows: The gas to be purified is forced through a series of small holes forming jets which impinge against a flat surface opposite. Tar is conveyed by the cool gas in the shape of small bubbles, and when the gas strikes the flat surface these bubbles attach themselves to it and drip down to a reservoir from which a pipe leads to the tar drain and then to tar well. The reason for locating the tar extractor in this order is due to the fact that the heavier tars have when cold, the property of absorbing the lighter hydrocarbons which are very efficient as light givers, thus destroying to some extent the value of the gas as an illuminant.

The next piece of apparatus is the secondary or water condenser, which consists of a steel shell 5″ diameter by 19′ high, made of ¼″ steel boiler plate and contains 61 tubes 3″ x 16′ long. The gas circulates around the tubes and the cooling water through them, the gas entering at a temperature of 90 to 100 degrees Fahr., and being cooled to a temperature of 60 to 70 degrees Fahr., at which temperature it is ready for the scrubber. When the gas reaches the secondary condenser it has been relieved of all but a small percentage of the tar it contained. It, however, still contains many other impurities, a considerable amount of water vapor, and ammonia compounds. The water vapor and some of the ammonia is condensed and collects in the bottom of the condenser, from which the solution is taken by means of a special syphon drain 3″ in diameter. The condensers in the North Yakima plant were installed in duplicate and the piping so arranged that either of the condensers could be used at a time or both in parallel. It should be noted that cooling the gas too quickly is very detrimental, as it reduces the candle-power by condensing some of the most effective light-giving hydrocarbons.

The gas next passes on to the scrubbers which, in the case of the plant described, consisted of two units arranged so as to be used singly or in parallel, each 6′ diameter by 19′ high with 10″ inlet and outlet nozzles and five 13″ x 18″ manholes. The inside of the shell is filled with wooden trays composed of small slats of wood, over which a small stream of water is kept flowing, just enough water being admitted to keep the slats wet. The gas is admitted at the bottom of the shell and in passing up between the slats is broken up into small streams coming into intimate contact with the water passing down. The cold water meeting the gas previously cooled in the secondary condenser readily absorbs the ammonia remain-