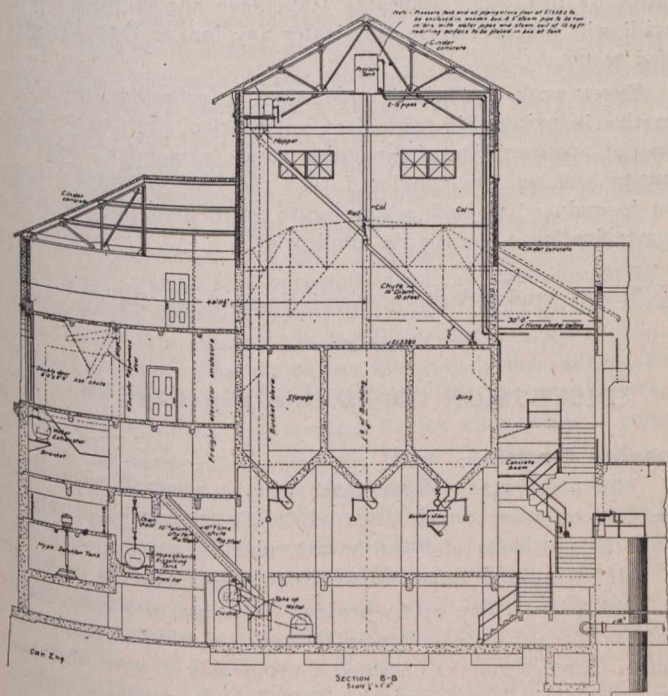


**Brickwork.**—The brickwork facing of concrete and solid walls above the grade fill to the head house, filter building, gate house and wash water tower is laid in cement mortar. The panels are laid with dark headers and light stretchers, which give the buildings an effective appearance. All interior walls are coated with  $\frac{3}{8}$  inch of plaster. The cost of the labor for the brickwork was \$4.00 per 1,000. All copings and window sills are of terra cotta of such a shade to blend with the brickwork.

**Carpentry.**—All interior doors and frames are of red oak, exterior door and frames of clear white pine; the floors to offices and rooms at grade 328 are  $\frac{3}{8}$ -in. by 3-in. tongued and grooved, close grained, long leaf, yellow pine fixed to bevelled strips embedded in the concrete floor. These bevelled strips stand above the concrete  $1\frac{1}{2}$  inches, the intervening space being filled with cinders. A  $\frac{3}{8}$ -in. by 7-in. moulded base goes around all the rooms that have lumber floors.

**Laboratory and Chemical Benches.**—These benches are of hard maple, made up of  $1\frac{1}{2}$ -in. by 3-in. strips, with the thin edge up, bolted together and secured with waterproof glue. A gas machine of 150 cubic-foot capacity per hour is installed to furnish gas for laboratory purposes. The water pipe lines stand up to a pressure of 150 lbs. per sq. inch. All other pipes 50 lbs. hydrostatic pressure.



Cross Section Through Head House.

**Steam Heating.**—Steam heating is furnished by two boilers situated at grade 300 with a heating capacity of 1,500 square feet, capable of supplying steam for 8,000 square feet of radiation surface with a steam pressure of 25 lbs. per square inch. The radiators are of the peerless two-column type.

**Vacuum Cleaner.**—The vacuum cleaning system is of the rotary pump type, having a displacement of 85 cubic feet per minute when operated at a speed of 220 revolutions per minute.

**Earth Fill and Embankments.**—A fill is placed around the head house, filters, wash water tower and coagulation basins, from grade 301 to 323, with a 12-foot crown and a 1 in 1 slope. This embankment is to keep the water in the coagulation, filters and tower from freezing. The roof to the clear water reservoir is covered with 3 feet of earth,

which will be planted and laid out in an artistic manner. The embankment to the raw water of settling reservoir has been carried up another ten feet to overcome the loss of head in the filtration plant, and to give the same pressure to the city's distribution system.

Total quantities:—35,000 cubic yards of concrete, 500,000 cubic yards of excavation, 260,000 cubic yards of fill and embankments, 900,000 pounds of reinforcement to concrete, 600,000 bricks.

Embankment and fill, watered and rolled, cost 85 cents per cubic yard. Excavations, 65 cents per cubic yard.

The accompanying illustrations show the work during construction, which was carried out under the supervision of Mr. A. W. Ellson Fawkes, C.E., chief assistant engineer on the works for the city of Minneapolis. Messrs. Hering and Fuller, consulting engineers, New York, designed the system.

## PURIFICATION BY OZONE.

By R. M. Leggett.

(Continued from last issue.)

If the pre-filter removes the gross matter, the ozone will remove the bacteria and the organic matter in solution, the effluent being clear, pure and free from odor, color or taste.

Ozonization is but another name for oxidation and it is by rapid and more or less complete oxidation that the desired results are accomplished.

Ozone is allotropic oxygen expressed by the symbol  $O_3$ , as distinguished from oxygen,  $O_2$ . It is an unstable form that tends to give up its extra atom.

Bacteria are composed of about 86 per cent. water and 18 per cent. of organic matter, 6 to 8 per cent. of which is carbon. The contact of these bacteria with ozone spells their instant destruction, as the carbon is reduced by oxidation to carbonic acid, the water is freed from the organic matter and we have as a result, water, carbonic acid and nitrous and nitric oxides.

In water highly contaminated with mineral salts, these gases may very slightly increase the nitrates and carbonates, but on such a minute scale as to be hardly detectable by analysis.

It has been estimated that one million bacteria represent one-sixteenth of a milligram total weight, of which, as stated, 80 to 86 per cent. is water and the rest carbon.

The average untreated natural water contains from 1,000 to 10,000 bacteria per cubic centimeter, which represents so small an amount of carbon as to make its products of oxidation negligible.

Various devices are in use for the production of ozone, but in all, the object is to bring a current of air in contact with the silent discharge of a high-tension current of electricity.

The ozonizers in use in the Ann Arbor plant are of the tubular type, and consist of 109 tubes. They are 35 inches long and 24 inches in diameter. There are three of these ozonizers, two of which are in operation all of the time, and one is kept ready in case of emergency. The ozonizers are simply steel shells, containing 2-inch aluminum tubes, about 30 inches long, rolled in, and have the appearance of small fire tube boilers. Inside these tubes are mica tubes for the dielectrics and inside the mica tubes are other aluminum tubes. The discharge takes place between the two aluminum