The Water Works of the City of Minneapolis Minnesota

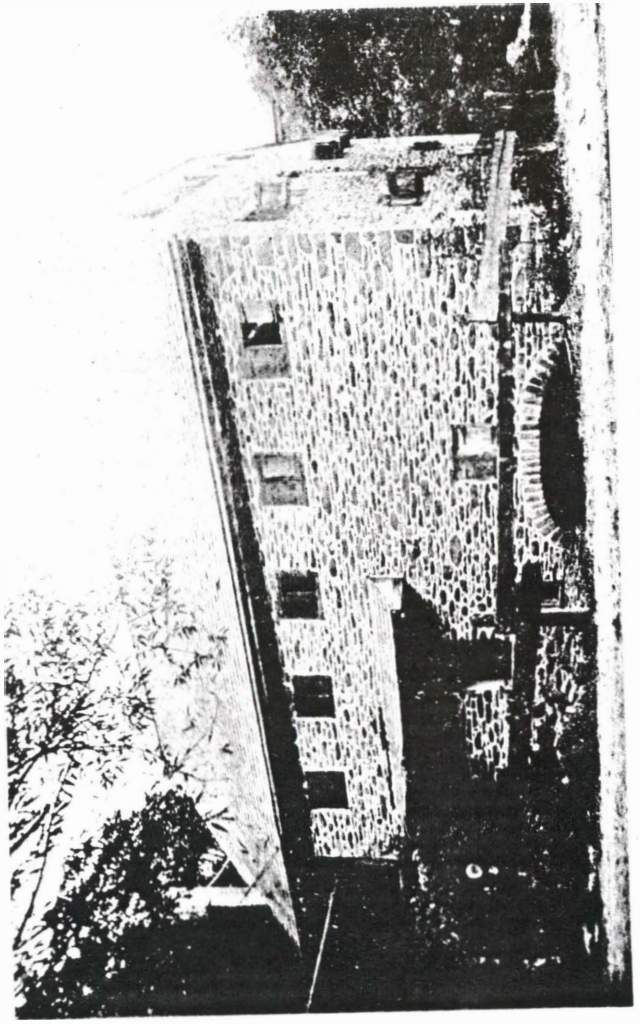
A Brief Historical Sketch and a Description of the Present Water Works

January First
1919

The Water Works of the City of Minneapolis

HISTORICAL.

The Water Works of the City of Minneapolis was authorized by the City Council in 1867, primarily as an auxiliary to the Fire Department. A small rotary pump was installed in the Holly Saw Mill and a supply of water was maintained for fire protection and other purposes to a limited extent. The first regular installation was made in 1872 at Station No. 1, located at the foot of Fifth Avenue South and the Mississippi River, above the falls. The unit was a vertical double acting piston pump driven by water power from St. Anthony Falls. It had a capacity of 2,500,000 gallons daily and was in service for twenty-seven years. By 1884 five additional pumps were installed at this Station, making a total pumping capacity of 33,000,000 gallons per day. Two of these pumps were five plunger, horizontal, single acting, water turbine driven units, each having a capacity of 10,000,000 gallons daily. They were known as "Jumbo Pumps" and were designed by James Waters, Chief Engineer, and were made in Minneapolis. Some of the features employed in their design are incorporated in the highest types of pumping engines of today.



PUMPING STATION NO. 2

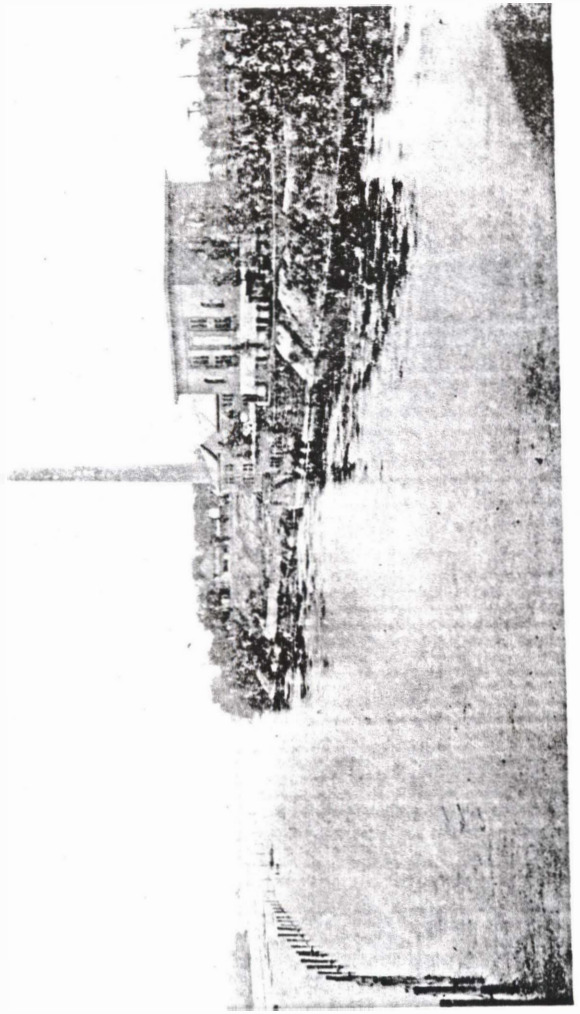
In 1885 Station No. 2 was put into service on Hennepin Island opposite Station No. 1 and supplied the East Side. The installation consisted of one Jumbo pump having a capacity of 10,000,000 gallons per day and was driven by water power.

In 1888 Station No. 3 at Camden, three miles north of the business center, was put into service. The equipment consisted of two Worthington, steam driven, duplex compound, double acting plunger pumps, each having a capacity of 15,000,000 gallons per day.

All pumping was made direct to the distribution system until 1897 when two reservoir basins at Columbia Heights were completed. These basins had a total capacity of 94,000,000 gallons and from them a distribution main delivered to the city by gravity the water pumped from Station No. 3.

The capacities of these pumps had each been reduced to 12,500,000 gallons per day for the altered requirements.

In 1904 Station No. 4 was completed and put into service. It is located at Thirty-seventh Avenue Northeast and the river. The installation comprised two Holly vertical triple expansion engines, each having a capacity of 15,000,000 gallons daily. These pumps were designed to deliver water to the reservoir basins.



PUMPING STATION NO. 4

THE WATER WORKS AT THE PRESENT TIME.

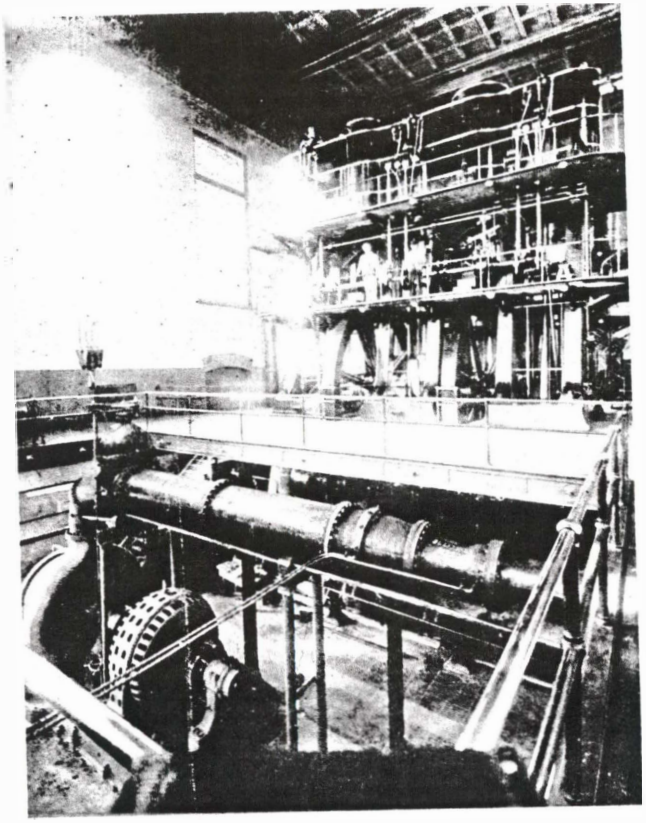
During 1904 Stations No. 1 and No. 2 were closed down permanently owing to the contaminated condition of the water taken from the river at their intakes. Since that time the total supply has been delivered to the distribution system by gravity from the reservoirs.

The pumping capacity was reduced by abandoning these stations, but it was augmented in 1911 by the installation of two Worthington electrically driven two-stage centrifugal pumps, each having a capacity of 20,000,000 gallons per day. One of these pumps was located at Station No. 3 and the other at Station No. 4. In 1916 the two Worthington steam pumps at Station No. 3 were dismantled and sold. In 1918 a DeLaval electrically driven centrifugal pumping unit, consisting of two single stage pumps in series, was put into operation at Station No. 4. This pump has a capacity of 30,000,000 gallons per day.

The total nominal pumping capacity available at the present time is 100,000,000 gallons per day.

The water supply has always been obtained from the Mississippi River. The present intakes are located at the foot of Thirty-seventh Avenue Northeast and the river in the east channel.

The city inaugurated the first steps toward the improvement of the water supply by treatment of the water with calcium hypochlorite at the



HOLLY TRIPLE EXPANSION STEAM PUMPING ENGINE. WORTHINGTON CENTRIFUGAL PUMP (Below).

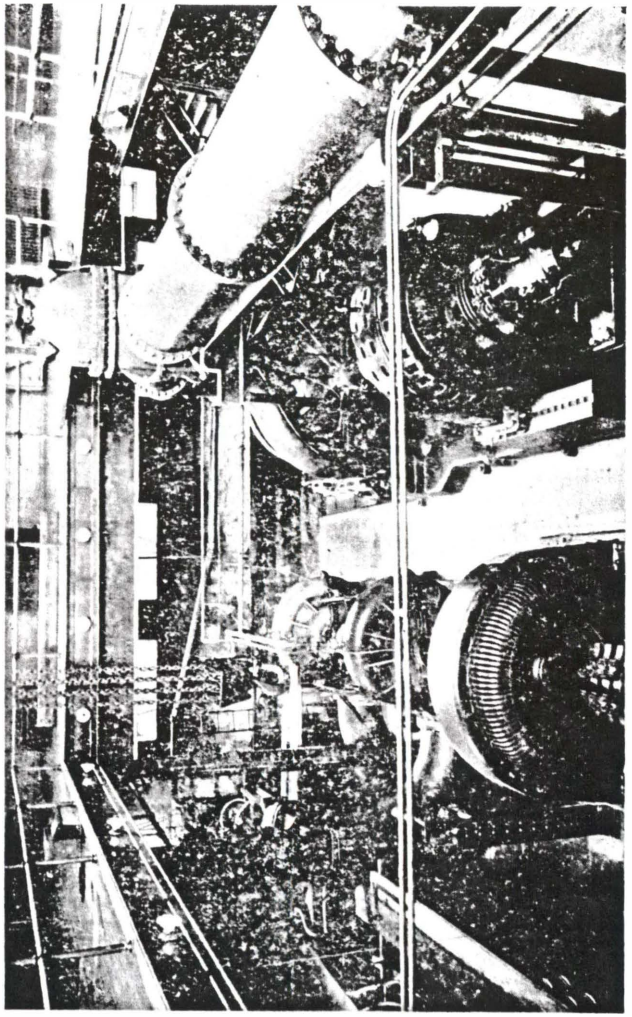
pumping stations in 1910. About the middle of the same year work was begun on the filtration plant, which was completed in 1913. Since January of that year the water supply has been purified by sedimentation, coagulation and filtration followed by chlorine sterilization.

The original distribution system consisted of lines of small pipe, several of which were of wood construction and bored logs. These were eventually replaced by cast iron pipe. At the present time the distribution system consists of 625 miles of cast iron and steel mains, varying in size from 6 inches to 54 inches in diameter, and supplies approximately 415,000 persons with purified water for industrial, civic and domestic purposes.

Practically all pumping is done by electric power, the steam pumps being held in reserve.

The cost of the steam plant was $6,600 per million gallons capacity for the pumps alone, while the last electrically driven centrifugal pump was $1,300 per million gallons capacity.

The basic rate for pumping with electric power is $4.00 per million gallons raised 240 feet with a pumping unit efficiency of 72 per cent. The actual total head is about 252 feet and the average efficiency of the DeLaval-General Electric unit is about 82 per cent, which affects the basic rate accordingly. The cost for power per million gallons raised to the reservoir by this unit in 1918 was $3.72. Total pumping expense for 1918 including labor, supplies and power averaged



DE LAVAL AND WOIRTHINGTON CENTRIFUGAL PUMPS

$6.75 per million gallons. This represents a unit cost of $.0264 per million gallons per foot of head. The equivalent cost per K. W. H. is 0.38 of one cent.

During 1918 the average daily pumpage was 31,941,000 gallons, which is equivalent to 77 gallons per day for each person. The highest pumpage for a single day shown on recent records was on July 28, 1916, when 58,929,000 gallons were raised to the reservoir.

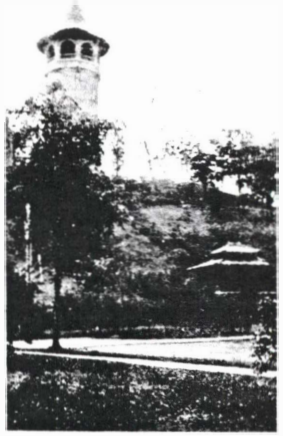
The Pumping Stations are operated under the direction of a Chief Engineer, three engineers and assistants. The pumps are operated so as to give a continuous supply at varying rates corresponding to the demand for water.

DISTRIBUTION SYSTEM.

The filtered water is delivered to the city by gravity. The distance from the clear water basin to the heart of the city is about 6.25 miles. The average maximum pressure in the downtown district is about 75 pounds per square inch.

During the hot weather in dry summer months, at maximum rates of consumption, the pressure falls off from 20 to 25 pounds. In three elevated districts, namely, Kenwood, Prospect Park and Washburn Park, the ordinary pressure thereby becomes less than that necessary for satisfactory service. These districts are now provided with water towers and auxiliary pumps which are operated automatically by electric power. The water is repumped into these special service dis-

KENWOOD WATER TOWER



PROSPECT PARK TOWER

WASHBURN PARK TOWER

tricts from nearby supply mains. The pumps operate only in extreme hot and dry weather.

The city supplies about 60,000 services which are practically all metered. The rate is uniform at 8 cents per 1,000 gallons. A minimum charge of $4.00 per year is in effect to insure sufficient revenue to cover overhead expense of accounts.

SERVICE DEPARTMENT.

A Service Department is maintained under the direction of a General Foreman and a corps of men for that purpose. The Service Department makes taps for new services, maintains and repairs mains, hydrants and valves and supervises all matters that concern service to consumers. The department has an electric machine for thawing frozen service pipes. A charge of $5.00 is made for each service to cover the expense of transporting and operating the machine.

FUTURE DEVELOPMENT.

The next development contemplated by the city, is a plant for softening of the water during periods of maximum hardness. This will involve the construction of a complete plant comprising softening, filtration, and semi-direct pumping of pure water. This will give the city a further improved water and insure a service that will practically be free from interruption from any ordinary cause.

The necessary land, about forty acres, has already been acquired for this purpose. The land is situated above the Northeast Pumping Station.

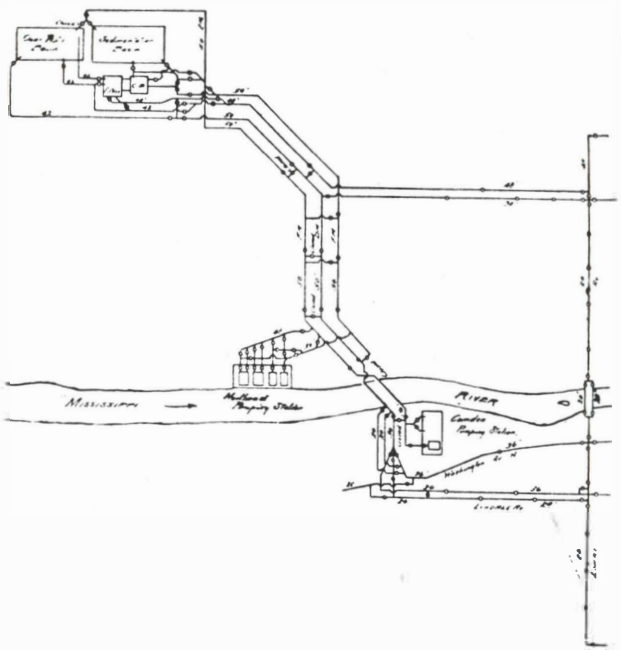


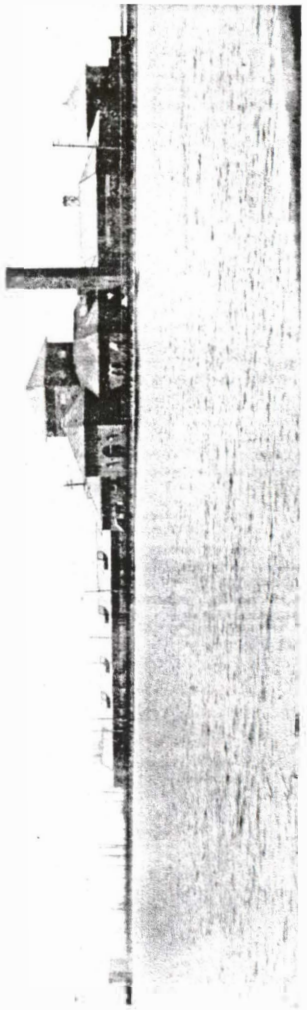
DIAGRAM OF WATER MAINS BETWEEN PUMPING STATIONS AND FILTRATION PLANT

WATER PURIFICATION PLANT.

The water purification plant is located in Columbia Heights on an elevated site adjacent to the two reservoirs which were built in 1896 and were remodeled for the use of the purification plant.

The original plant was completed and put in service on January 10, 1913. It consisted of a 75,000,000-gallon sedimentation basin, head house, mixing chamber, two coagulation basins, twelve filter units having a total capacity of 39,000,000 gallons per day, two auxiliary clear water basins, a covered 45,000,000-gallon clear water reservoir and an elevated wash water tank. In 1914 four additional filters and two more coagulation basins were added, thus giving a total capacity for the plant of 52,000,000 gallons per day. Eight additional filters just completed and two coagulation basins now under construction will give a total capacity of approximately 80,000,000 gallons per day when operating at the normal rate of 3,250,000 gallons per day for each filter. The filters can be operated at the rate of 4,000,000 gallons per day for short periods. This capacity should be sufficient until 1930 when the proposed softening plant and filters mentioned above will have been installed.

The water pumped from the Mississippi River enters the large sedimentation basin from which it passes through a 60-inch Venturi meter into the controlling chamber. Sulphate of aluminum is added by means of automatic chemical feed controllers to the water as it goes from the controlling

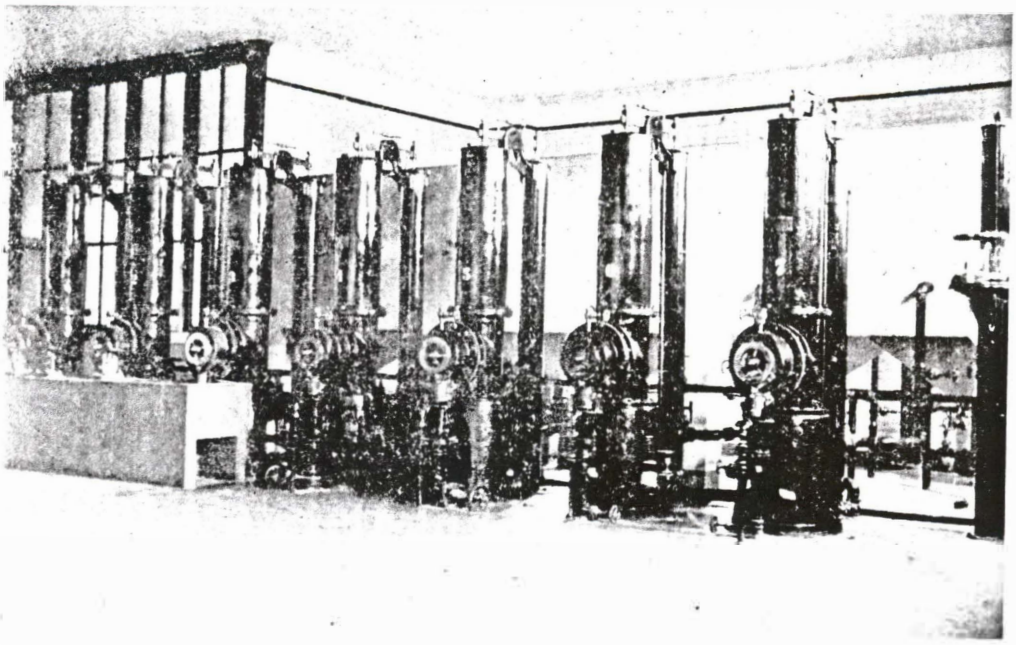


FILTRATION PLANT, LOOKING ACROSS SEDIMENTATION BASIN

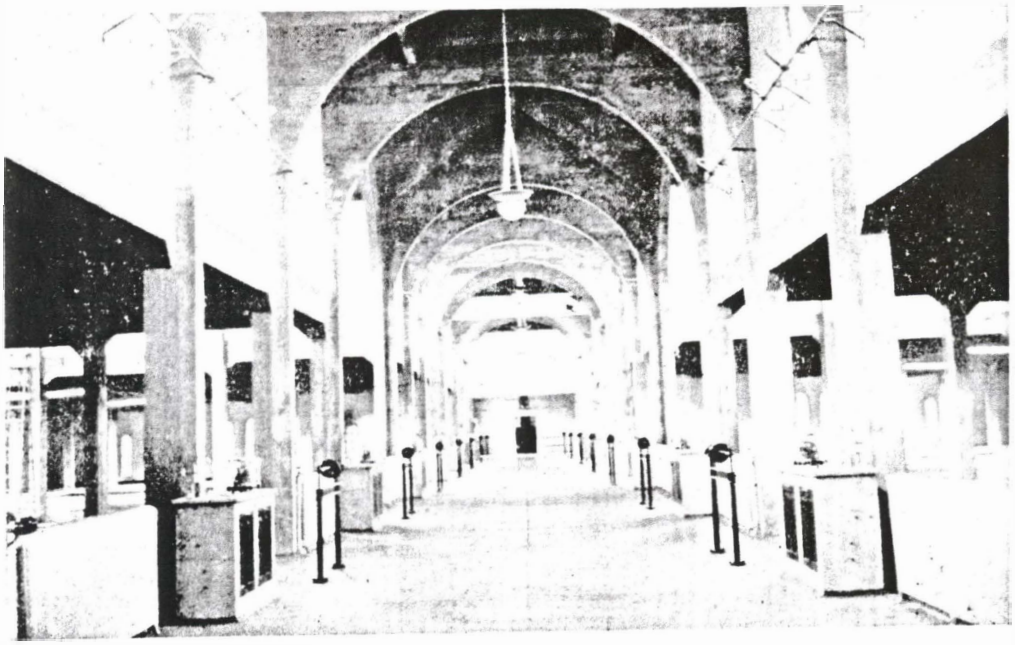
chamber to the mixing chamber where thorough agitation and mixing is accomplished by passing the water at a high rate around baffles. The water then goes to the coagulation basins where the greater part of the aluminum hydroxide (called "floc") which has formed in the water is allowed to settle. The period of reaction in the mixing chamber varies with the amount of water used. It would be approximately twenty minutes at a 40,000,000-gallon per day rate. The period of retention in the coagulation basins is approximately two hours when operating at the same rate as above.

The clearer supernatant water is carried over weirs in the coagulation basins to a concrete conduit which leads to the 60-inch influent pipe connected with the filters. The "floc" remaining in the water as it is applied to the filters forms a gelatinous film on top of the sand bed and this film accomplishes what the sand bed alone could not do, namely, it removes from the water the minute bacteria which have not been carried down by the "floc" in the coagulation basins.

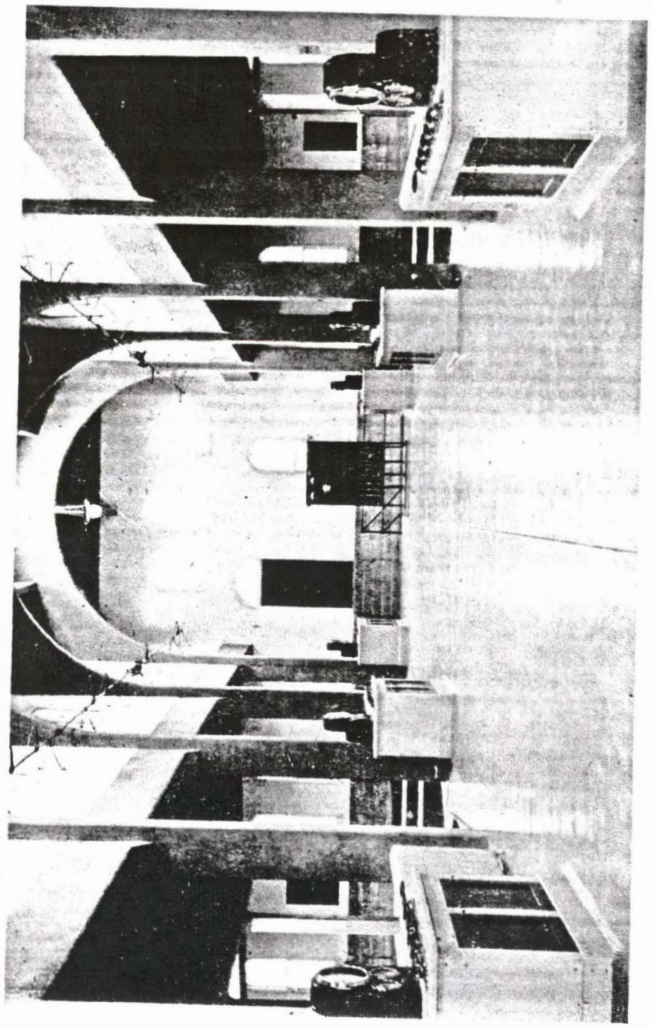
The filters consist of concrete tanks each containing a bed of sand 1,173 square feet in area, 30 inches in depth, supported by a bed of gravel 14 inches in depth and graded in size from two inches in diameter at the bottom of the bed to a size slightly larger than the sand grains which rest upon the small gravel. Beneath the gravel bed and supporting the same are strainer plates of Tobin bronze in sixteen of the filters and monel metal in eight new filters. The strainer



CHEMICAL FEED CONTROLLERS



FILTER GALLERY (Original Plant)



FILTER GALLERY (Annex)

plates are supported between concrete ridge blocks and each plate is drilled with three-sixteenth inch holes, the total area of the holes in all the plates of each filter amounting to three-tenths of one-per cent of the total sand area of the filter.

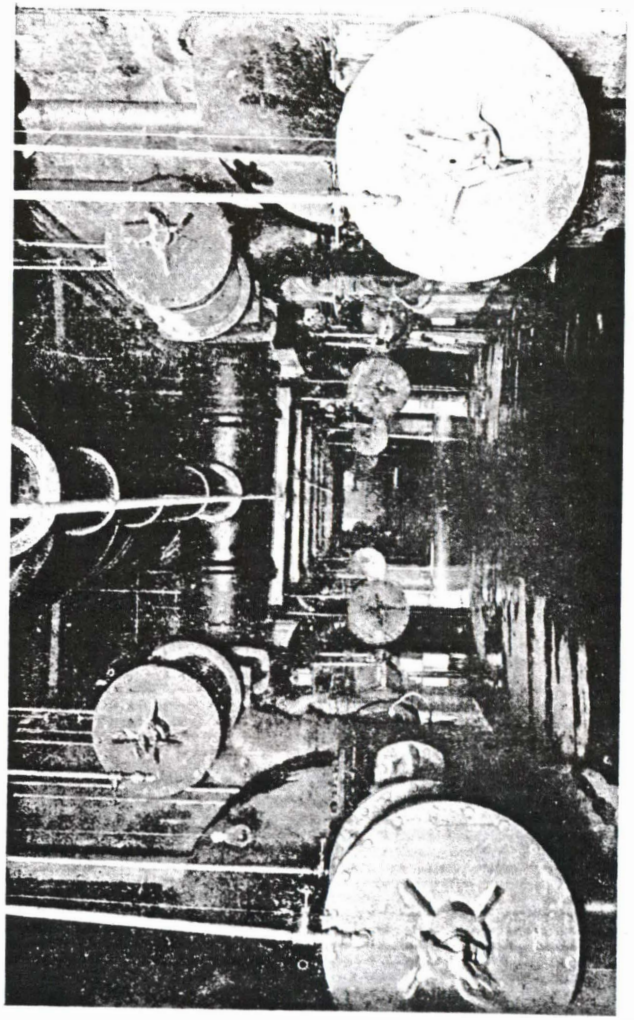
When a sand bed becomes clogged by accumulated "floc" it is washed by a reverse flow of filtered water under pressure. The dirty wash water overflows into a drain and is carried to the river below the intakes of the pumping stations. The sand beds are cleaned on an average of once every two days and approximately 2½ per cent of all the water filtered is used for washing the filters.

The water passing the filters goes through controllers which keep the rate of filtration constant for the rate set. It then goes into the auxiliary clear water basins underneath the twelve original filters and from there into a conduit which takes the water to the covered clear water reservoir or directly to the city mains as desired.

The final step in the purification process consists of sterilizing the filtered water with chlorine gas as the water leaves the auxiliary clear water basins. An infinitesimal amount of chlorine is required to sterilize the water, two and one-half pounds being sufficient for 1,000,000 gallons of water. No residual chlorine remains in the water as it is delivered to the consumers.

The water supplied from the purification plant to the people of Minneapolis is pure, wholesome, free from bacteria, objectionable coloring matter, and suspended matter, and contains no "alum." No attempt is made to soften the city water at the present time.

Careful supervision of the entire water purification process is carried on by means of numerous daily chemical and bacteriological examinations made in a well equipped laboratory at the plant.



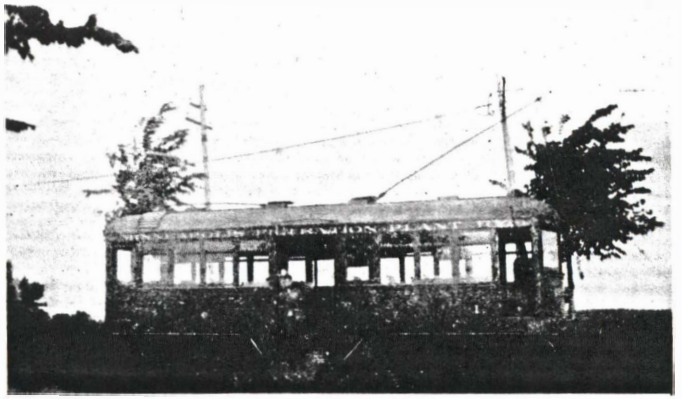
PIPE GALLERY, SHOWING HYDRAULIC VALVES AND RATE CONTROLLERS

The typhoid fever death rate in Minneapolis has been reduced from an average of 35 per 100,000 inhabitants during the period 1900-1912, inclusive, to 4 per 100,000 at the present time. The residual typhoid fever deaths are due to causes other than city water, which it is to be hoped may eventually be eliminated. Dr. H. A. Guilford, City Health Commissioner, has stated that there has been no case of typhoid fever traceable to city water since the water purification plant was put in operation.

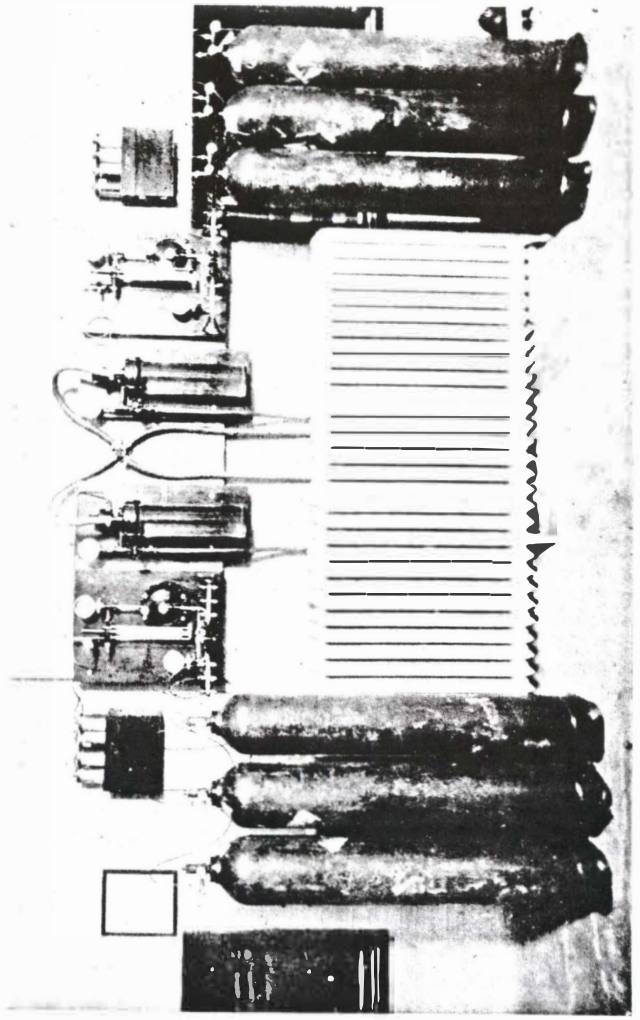
A force of twenty-four employes working in three shifts keep the plant in operation day and night.

The cost of purifying water during 1918 was $7.80 per million gallons. This cost does not include interest charges or depreciation charges other than maintenance and repairs.

An electric railway has been built from Central Avenue and Thirty-seventh Avenue Northeast to the filtration plant. Connection is made with the Soo Railway at Thirty-sixth Avenue and Central. An electric car carries the employes to and from the street railway line on Central Avenue and also hauls cars of freight to the plant.



FILTRATION PLANT RAILWAY CAR



CHLORINE CONTROL APPARATUS

SOME STATISTICS OF MINNEAPOLIS WATER WORKS.

First works constructed in 1867.

Water works always owned by City.

Source of supply, Mississippi River.

All water filtered and sterilized with chlorine gas.

Population supplied 1919, 415,000.

Consumption:

Average per day, 32,000,000 gallons.
Maximum daily, 59,000,000 gallons.
Per capita daily, 77 gallons.

Total pumping capacity, 100,000,000 gallons.

Total purification capacity, 80,000,000 to 90,000,000 gallons.

Miles of mains, 625.

Number of services, 64,000.

Number of services in use, 60,000.

Number of services metered, 59,500.

Per cent of services metered, 99.2.

Cost of water works, $11,477,160.99.
Bonded debt, $2,100,000.00.

Cost of pumping water, $6.75 per million gallons.

Cost of purifying water, $7.80 per million gallons.

Chemicals used 1918:

Sulphate of aluminum, 204 pounds per million gallons.

Liquid chlorine, 2.6 pounds per million gallons.