means practical at the present time to this end, but there is still very much to be desired. The following several means if taken together would seem to minimize the chances of a serious fire:

1. If a suitable material could be found a non-combustible outer covering could be placed over the insulation on the stator end connections. This would greatly delay the spread of fire and even if no other protective means were taken, would undoubtedly prevent much serious damage. Where fire extinguishers were used the covering would at least hold back the fire until they could be brought into play. At present no material suitable for such a covering appears to be available.

2. If a non-combustible outer covering should be put on, its advantages would be partially lost in time unless the cooling air were freed of the dirt and oily vapor liable to be in it. This could be done by filtering, as has already been advocated several times.

3. Means could be provided for cutting off the air supply in case of fire in generators by placing dampers in the inlet ducts designed so as to be normally held open by fusible links. The links could be placed so that they would be quickly fused by the heat and allow the dampers to close automatically. By reducing the oxygen supply to that entering by leakage the action of the fire would be slow.

4. Arrangements could be provided for the quick introduction of carbon dioxide gas into the machines. The carbon dioxide could be kept in liquid form and piped through valves, expansion tanks, etc., to the generators. The valves could be arranged to be opened by the closing of the air inlet dampers so that the gas would be automatically introduced into the generators. This gas would be very effective in extinguishing fires inside the machines after the air supply had been cut off.

The employment of some efficient method of reducing the fire hazard in generators of the turbo type either along the lines mentioned or in some other way is important. The value of these generators is great and the damage by fire may amount to a considerable proportion of the first cost. It is probable that the damage is more liable to occur towards the end of the life of thé generators, but even then the loss may be large, both directly and indirectly. The large central stations have reserve units so that the increased damage due to fire in one of their generators would probably not affect the continuity of service, but the increased time necessary for repairs may be long and during this time the reserve capacity will be weakened. In the case of industrial plants the longer time needed for repairs might be serious. Many manufacturing concerns who generate their own current depend on only one unit and, therefore, their whole production, or a large part of it, would be affected.

UTILITY AND ATTRACTIVENESS IN ECONOMIC RESERVOIR DESIGN*

DESCRIPTION AND DESIGN OF A CIRCULAR REINFORCED CONCRETE RESERVOIR, 200 FEET IN DIAMETER, 26 FEET DEEP, WITH SIDE WALL WHOLLY ABOVE GROUND.

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MUSKOGEE, Oklahoma, takes its water supply from the Grand River. The present intake is located in the channel of the river, about 1,800 feet above its confluence with the Arkansas River. Two 16-inch cast iron pipes, each 2,600 feet long, laid in the bed of the Grand and across the Arkansas, convey the water to the pumping station. Low-lift pumps raise the water to a three-million-gallon settling basin. The water is then pumped through a 24-inch main, 20,800 feet long, to the city. A standpipe located in the northern part of the city, equalizes the pressure in the town.

The improvements to the water system are the result of recommendations made by the writer, who, in the fall of 1910, was retained by the city to investigate the existing water and sewerage systems, and to devise methods and means to adapt the existing systems, then overtaxed, to the present and probable future needs of the city. The improvements consist of the replacing of the two 16-inch suction lines by a 4-ft. 6-in. intake constructed in rock tunnel, with an intake tower at the upper end; the installation of additional high and low-lift pumping units; the construction of a water purification plant, including a six-million-gallon settling basin; the construction of the six-million-gallon reservoir with which this article deals; together with the construction of a 24-inch supply main, 12,600 feet long, connecting the reservoir located on the other side of the city from the pumping station with the existing distribution system.

The Need of a Large Storage Reservoir.—The object in constructing the reservoir was twofold; namely, to increase the pressure throughout the town, and to have at all times a large quantity of water available at a sufficently high elevation to maintain the pressure in the town at times of heavy draft or in case of a serious breakdown of the pumping station or force line.

The pressure in the central portion of the city ranges from sixty to seventy pounds. At times of heavy draft, these pressures cannot be maintained. A stand-pipe, 25 feet in diameter and 120 feet high, was erected in 1903 to help maintain the pressure in the city. The effect of the stand-pipe in this direction, however, is very slight, because of the small quantity of water in the pipe at the height at which it is required.

Conditions Which Influenced Design of Reservoir.—A storage and distribution reservoir, to be effective, should always be located as close to the city as possible; otherwise, too great a fluctuation in pressure will exist in

* Before the Convention of the American Waterworks Association, Minneapolis, June 25, 1913.