They run both day and night and as they only pay a flat rate of $27 per year there is evidently a big loss of revenue here.

J. B. Booth & Company pay a flat rate of $1,636.86. We made a prolonged test of this plant and found that one of their services, if metered, would produce more revenue than this. This service had a steady flow of 93,500 gallons per 24 hours, which would produce, at the minimum meter rate of 6 cents per 1,000 gallons, a revenue of $2,047 per year.

**Conclusions.**—From the foregoing it will be clearly observed that immediate action must be taken to either increase the pumping capacity (and incidentally enlarge the distribution system) or pursue a vigorous policy of waste reduction. Undoubtedly the policy to pursue is that of waste reduction, and this is strengthened by the fact that, as the future supply for this city is likely to come from the Gatineau Hills the installing of additional pumps, which could only be of service for three years at the most, would be an unprofitable investment, and cost a great deal more than is necessary to spend on waste reduction. To be in a reasonably safe position before the warm weather comes in, it is quite apparent that immediate action must be taken.

**Recommendations.**—I cannot too strongly advise your committee to pursue a policy of waste prevention in preference to that of increasing the pumping capacity and enlarging the distribution mains. I submit the following recommendations for your consideration:—

1. That the city purchase two pitometer instruments and employ the necessary water survey force.

This recommendation is already in force in a large number of American cities, and also in Toronto and Montreal, where excellent work is being done. The city can be divided into districts, and by means of these instruments the flow can be ascertained from time to time, and any excessive flow can be readily observed and means taken to locate any defects which may cause same and have it repaired. These instruments can also be used to determine the pump slippage.

An appropriation amounting to $7,000 has been placed in this year's estimates for this work.

If it is decided to purchase two pitometers, then one of the pitometer survey people should be brought here for about a month to break in an assistant who will be kept on the staff for this purpose.

2. That all business premises be metered. This should include meters on all elevators, syphons, beer pumps, booster pumps, etc. That is, every service outside of an ordinary dwelling house should be metered.

3. That all public services be metered, including all buildings, parks, etc. Also, that a meter should be placed on all government services.

4. That an efficient force be maintained to carry out a thorough inspection of all pumping fixtures on all premises and dwelling houses.

5. That detailed plans be made of all the existing mains throughout the entire city.

## AMERICAN RAILWAY ENGINEERING ASSOCIATION.

The annual convention of the American Railway Engineering Association will be held at Chicago, March 18th to 21st. E. W. Fritch, 900 S. Michigan Avenue, Chicago, Ill.

## TEST OF WIRE ROPE FASTENINGS.*

**By C. W. Hubbell.**

A 5/8-in., six-strand plow-steel cable was bent around a thimble and the ends secured to the standing part by a standard 5/8-in. Crosby clip of the U-bolt type, with the nuts drawn as tightly as possible by a 12-in. wrench. The cable slipped under a load of 8,360 lb. In a second test with a new clip tightened with a 24-in. wrench, the cable slipped at a load of 10,020 lb., and after the nuts were again tightened, slipped at 12,380 lb. In a third test made with two new clips, the nuts were tightened under a load of 6,000 lb. with a 12-in. wrench, and the load was increased to 21,710 lb., which broke the cable where it was in contact with the lower U-bolt. As the rated ultimate strength of the cable was 36,000 lb., it was thought to have been weakened by the distortion under the U-bolt, which was set in contact with the standing part, while the head took bearing on the free end. It was assumed that in practice the head of the clip should always be placed on the standing part of the cable and the U-bolt on the free end.

A 95-lb. cast-iron clamp, 33½ in. long, made in two pieces, with grooves fluted to receive the cable, and connected by five 1-in. bolts having a theoretical holding power of 19,500 lb., was placed on a 2-in. seven-strand galvanized steel-wire cable. The bolts were drawn as tight as possible by one man with an 18-in. wrench, and the cable slipped under a load of 12,000 lb. The nuts were tightened by one man with a 30-in. wrench, and a slip occurred under a load of 12,500 lb. The nuts were again tightened, and the third slip occurred under a load of 16,500 lb. The clamp was removed and replaced on the cable in a new position, and the nuts tightened by two men with a 30-in. wrench. The cable slipped under a load of 17,800 lb., and in successive tests under 12,700 and 15,000 lb. When tightened with three men on the same wrench, turning each nut from one-eighth to three-eighths of a revolution, the cable slipped at a load of 19,300 lb. In the last test the groove in the clamps had a diameter of two inches, permitting the cable to rest on the bottom of the groove.

A lighter clamp of different design had a groove 1¾ in. in diameter, designed to develop a wedge action increasing the bolt pressure when the clamps were forced together and the cable distorted enough to bear on the bottom of the groove. The clamp was 12 in. long, weighed 47 lb., was provided with five ¾-in. bolts and had a theoretical ultimate strength of 22,650 lb. for each half. The bolts were fastened by one man with a 24-in. wrench and no slip was apparent under a 10,000-lb. load. The nuts were tightened and the load increased to 20,900 lb. without apparent slip. The clamp was removed and found practically uninjured.

It was concluded that, first, where more than one clamp is necessary they should be placed as close together as possible, in order that the necessary adjustment of cables to bring them all into action shall be as light as possible; second, the clamp bolts should be tightened from time to time as the load is applied; third, the safe holding power of a cable clamp may be taken at about 3,750 lb. per sq. in. or area of the bolts which secure the two halves of the clamp.

*Abstract of address presented to to Philippine Society of Civil Engineers.