ELECTROLYSIS OF WINNIPEG WATER MAINS.

Louis A. Herdt, Ma. E.E., Professor of Engineering, McGill.

Pursuant to the resolution of the Council of the City of Winnipeg, which appointed me under date of Jany. 5, 1909, 1909, to report upon the electrical conditions in the City of Winnipeg, particularly in connection with return current of the Winnipeg Electric Railway Company's system and their connection with the Government Telephone Cable System, to report upon the electrical conditions existing in the City of fire standpoint and to submit recommendations dealing with improvements of the present system so that any electrolysis or fire risk, if such exists, may be eliminated, I have the honor to present herewith the following report:

The Winnipeg Electric Railway Company, in operating their street railway system, use the rails as a return for the current operating the cars. In order to make the rails a continuous conductor and thus secure a good return path for the current, the rails are bonded at the rail joints with

copper bonds, besides this the rails are connected to the station negative bus bars by return copper feeders, bonded to the track at different points of the system.

This is the usual method of street railway return construction, but electric railway companies using this system, that is, using the rails as the return circuit for the returning currents, are a serious menace to piping and cable systems in proximity to the tracks, if the methods of constructing the above described rail returns are such that the railway companies are unable to control their own currents, but use the piping and lead-covered cables as part of their return circuit.

Cause of Electrolysis.

Currents from the railway system, if the track returns are in bad condition, having to find their way back to the power house, will flow from the rails which are in contact with the ground, through the ground and such metallic constructions in it as offer the least resistance to the flow, and after flowing through these (gas pipes, water mains, lead-covered cables, etc.) towards the station, will return through the ground, back to the rails to return conductors in the vicinity of the power house. These stray currents cause electrolytic action, that is, wherever current passes from a pipe or cable to ground, or to another pipe or cable, corrosion of the metal is set up; holes and pittings are produced, causing bursting and leaking of pipes, eating away of the lead-covering on telephone and other cables, rendering them useless. This corrosion may be very rapid and depends on the intensity of the stray currents passing through.

If the rails in a track system were continuous and the current density in the rails kept low, with rails well connected to the power house, the rails would offer such a good return path for the current that street piping, cables and other metallic structures would be practically immune from electrolytic damage due to stray currents. However, as the rails are not continuous but made up in lengths, they must be jointed by copper bonds possessing such mechanical and electrical properties as will secure permanent and efficient electrical continuity of the rails between sections. If such bonding does not exist, and if return feeders connecting the rails to the power house are inadequate for the purpose, the amount of leakage current must be great and electrolysis is bound to exist. The immunity of street piping and other metallic structure from electrolytic damage due to stray currents demands that electric railway companies adopt such method of construction for their track returns as will minimize the danger and the railway companies must maintain the efficiency of such construction through systematic inspection and repair.

In view of the above and in order to arrive at correct and definite conclusions regarding the conditions existing in the City of Winnipeg, a survey for electrolysis and examination of the track piping and cable systems was made.

Plans Prepared.

Drawings were made as follows:—

Plan No. 1 showing electric railway tracks, high pressure water mains, domestic mains, gas mains, telephone cables—City of Winnipeg. Only those close to or paralleling railway tracks are shown.

This plan also shows districts affected by electrolysis.

Plan No. 2 shows also present lay out of feeders and sections—electric railway tracks, weight of rails, return feeders, bonds, etc.

Plan No. 3 showing localities where damage to water pipes by electrolysis has taken place (from reports of F. A. Cambridge, Esq., city electrician).

Description of System.

The Winnipeg Street Railway Company have two plants in the City of Winnipeg—one, the old steam plant at the foot of Main Street, corner of Assiniboine Avenue; the other, the sub-station on Mill Street. The first plant is kept as a steam reserve; the second plant, which furnishes the whole of the electric current for the street railway system, receives its electrical energy from the hydro-electric plant at the Pinawa Channel of the Winnipeg River. The average current for the railway service fed out from this plant approximates 6,000 amperes, but reaches as high as 9,000 amperes at times of heavy load in the winter months.

The street railway tracks are bonded at the corner of Main Street and Portage Avenue to return feeders connected to the negative busbars at the station. Other return feeders connected at different points to the track are also used (see Drawing No. 2).

It was apprehended at once from a study of the geographical location of the power station, its distance from the street railway tracks, the large volume of current that required to be returned to it, the run of the underground piping system and the telephone cables (see Drawing No. 1) and the proximity of the river, that unless the track returns were of the very best, and unless there was a very generous amount of copper used for the negative feeders, the conditions were such as to point to great possibilities for stray currents.

Electrolysis Investigation and Survey.

The electrolysis survey which was carried out, involved not only mere readings of potential difference between the rails, the piping system and telephone cables, but it embraced an examination of the feeding circuits, the general