

is intolerable to telephone working" (*vide* page 74, question 1067) There is other evidence to the same effect. We have also instances of the railway signals, which are worked on earth circuit, being interfered with by leakage from the tramway uninsulated return through the earth, the signal "line clear" being dropped by this means when a train is on the track, and some railway companies in England have been compelled to employ metallic circuits to obviate this.

With regard to the third objection, Mr Preece, in his notes on a trip to the United States, read before the Institution of Electrical Engineers, Vol. XXIII., No. 109, says—"The disturbances in telephone circuits created by the extension of electric railways have been severely felt in many parts of the United States. We have experienced the same in London, Liverpool, Leeds, and Blackpool. But, owing to the prompt action taken by the telephone and railway companies (especially in Boston), the area of disturbance has been much reduced, and the influence of electric railways on telephones has ceased to be a trouble. Of course, this result is very much favoured by the rapid introduction of metallic circuits into cities, but it has also been favoured by the prompt action of the railway companies themselves. They did all that they were asked to do, and that at once."

Experience has also shown that serious trouble and possible danger may be caused by the rapid destruction by electrolysis of water and gas pipes laid in the immediate vicinity of these electric tramways. This, however, can be obviated by connecting the negative pole of the dynamo to the pipe, and by properly screening such pipe from the action of the current, as provided for in the regulations appended to this report.

If the regulations now submitted are rigidly enforced, the Committee is of opinion that the objections raised and the disturbances complained of can be reduced to a minimum. Of course, the most effective means of overcoming these disturbances, due to induction and leakage, would be to place all the telephones in metallic circuit, using twisted wires. This, however, would involve a very serious expense, as it means doubling the whole of the telephone wires, and would soon render it necessary to place them in suitably-constructed subways or conduits.

The system occasionally used in the United States, known as the "Double-Trolley Overhead Conductors," forming a metallic circuit wholly insulated from earth, has some advantages.

Electrically it is satisfactory, both in the freedom it gives from disturbance to telephone and other wires and also on account of the satisfactory running of the cars, due to the completely insulated return. The great objection to it is the multiplication of overhead wires, and in this respect all the dangers of an ordinary single-wire trolley system are increased. This is specially noticeable at points where two or more lines cross each other, or where a junction occurs.

The chief obstacle to the adoption of the underground conductors with line and return wholly insulated from the earth is the great cost as compared with the overhead trolley system having uninsulated returns; and, while fully recognising the advantages of the former, the Committee is forced to agree with the decision arrived at by the Joint Committee of the House of Lords and the House of Commons:—

"That it is not, in the present state of electrical science, to the interest of the public to insist upon electrical tramways using an insulated return conductor, and that such insistence would retard the development of electric traction."

While there are many electric tramways and railways in operation worked on the overhead trolley system having uninsulated returns, there are very few with underground conductors wholly insulated from earth. A line of this description has, however, been in operation at Buda-Pesth for several years, and Mr H. D. Wilkinson, in an interesting paper recently read before the Institution of Electrical Engineers, London, and published in No. 113, Vol. XXIII., of the Institution's Transactions, describes two lines constructed on this principle during the last twelve months in America with underground conduits on Love's system, in which the conductors are in metallic circuit and wholly insulated from earth.

Such a system would wholly prevent any inductive action on telegraph and telephone wires, and electrolytic action upon water and gas mains; but at present there are several obstacles in the way, and it has as yet hardly emerged from the experimental stage.