A due to i and the return current through the rails is equal to

$$\frac{2i}{10\,(h-a)}-\frac{2i}{10\,(h+a)}=\frac{4ai}{10\,(h^2-a^2)}$$

If N is the total number of interlinkages between the tubes of induction due to i and the turns of the coil, the emf induced in the coil when the current changes is given by

$$E=-\frac{dN}{dt}\times 10^{-8}\text{ volts}$$

$$=-\frac{4\,naS}{h^2-a^2}\cdot\frac{di}{dt}\times 10^{-9}\text{ volts}$$

Now, the deflections obtained are of the order of 5 cm. and E is therefore of the order of 30 microvolts. Also, the side of coil is 125 cm., and the approximate values of h and a are 2000 cm. and 200 cm. respectively.

Substituting these values in the above equation, and solving for $\frac{di}{dt}$, we obtain,

$$\frac{di}{dt}=50\text{ amperes per second,}$$

approximately.

This is of the right order for the rate of change of current taken by an electric locomotive when starting or stopping.

A similar calculation can be made in the case of the street car disturbances mentioned above.

If $2a$ is as before the height of the trolley wire above the rails, and d the horizontal distance between the coil and the line, it is easily shown that the emf produced in the coil when set in a vertical plane parallel to the line is given by

$$E=-\frac{4\,naS}{d^2+a^2}\cdot\frac{di}{dt}\times 10^{-9}\text{ volts}$$

The distance from the nearest street car line was about 300 yards. Even if we assume for E a value as large as 50 amperes per second, the value of E obtained is only 0.14 microvolt. This would give a deflection of 0.2 mm. approximately.

It is easily seen that current variations in a circuit composed of the trolley wire and the rails of a street car line can induce no emf in a horizontal coil at their own level.

We must conclude therefore that the disturbances mentioned in the beginning of this paper cannot be caused directly by the