near future. There are subways which are poorly drained due to the inadequacy of the existing sewers. The latter, however, is a general evil which is not confined to the areas in which railroad tracks are located. It has been brought about by—

First-The flat and low grade of the city itself.

Second-The phenomenally rapid growth of the city.

Third—The hand-to-mouth scheme on which the city finances have been run due to the low limit of bonded indebtedness. This means that the design of sewage and water systems could not sufficiently anticipate the future demand.

A number of subways have been depressed so far below the original elevation of the streets that the roadway grade is down dangerously close to the sewer tops. That this condition is undesirable is obvious. A number of subways on the West and North sides, having surface cars, were provided with only twelve feet six inches of headroom in the original ordinances. The large type of cars provided for in the "Traction Ordinances" requires thirteen feet and six inches of headroom. How to secure the additional twelve inches without further depressing the floors of the subways or without necessitating a further elevation of the railroad tracks has been a problem. The railroads had completed their track elevation, under their contract ordinances, and were subject to no further demands. On the south side fortunately the City Railway Company looked sufficiently far into the future and demanded thirteen feet and six inches from the beginning of track elevation.

At subways under construction where sufficient headroom was not provided in the ordinance, the track elevation department has successfully urged the railroads to provide the additional amount. This correction of the old ordinances is progressing in such manner that as the rehabilitation of the surface lines is effected, and the through routes are inaugurated, no obstruction is met in carrying out the programme on account of insufficient headroom in subways.

The policy of the present administration has been, and is, to provide thirteen feet and six inches of headroom at all streets where surface lines exist, or are probable, and twelve feet at all others. A smaller amount of depression of the streets is being allowed the railroads. Subways are to be provided at least eight for each mile of elevation. A more careful consideration of all the many factors is being made than heretofore.

PATENTS.

The following is a list of Canadian patents recently issued through the agency of Messrs. Ridout & Maybee, 103 Bay St., Toronto: Pollock Manufacturing Co., tone arm for talking mahines; R. H. Trumpour, clocks; Wm. S. Simpson, uniting, joining or welding of metals by fusion; Wm. S. Simpson, uniting or welding of metals; Pearce & Billington, typographical composing machines; Bevan & Morley, Nutlocks; J. C. Barker, automobile tires; F. W. Leever, stop and through way valves.

At Boat Harbour, Vancouver Island, between Nanaimo and Ladysmith, some thirty miles from Vancouver, the Pacific Coast Coal Mines, Limited, has recently opened up a new coaling port, capable of accommodating large oceangoing vessels. The bunkers are large, and the loading equipment has a capacity of 750 tons per hour. The collieries are distant seven miles from the harbor, and railway connection and modern rolling stock are already provided. The Company owns 200 acres, and has rights over 5,000 acres in addition. A large amount of tunnelling has been done and production has commenced. The seam at present worked is reported to be from 5 feet to 20 feet in thickness. Other underlying seams have been encountered in diamond drilling.

THE PHENOMENA OF RESONANCE IN ELECTRIC LINES.*

By J. Dalemont, E. E., M. Sc.

The phenomena of resonance may produce in electric circuits, as it is well known, some very serious accidents, such as the breaking of the cable insulation, sudden rise of tension or intensity, etc.

For example, the accident which happened in the underground light and power circuits of Berlin (Germany).

In this instance, the voltage of the busbars suddenly reached a value higher than the normal, the intensity of the current doubled, and the frequency was three times the normal; all this, without any higher admission of steam in the steam engines working the alternators.

This has often been attributed to the effect of resonance. We know that in a given circuit, the resonance proper depends on the self induction of the lines, on the machines, and also on the capacity of the lines.

But these values vary with the load of the circuit. In the present case, when the conditions for the resonance of the third harmonic were fulfilled, the amplitude of this harmonic increased rapidly.

To reduce the busbar tension to its normal value, the engineer of the power-house diminished the excitation current and thus, the amplitude of the third harmonic assumed a marked influence, and took the place of the fundamental wave.



Fig. 1.—Fictive Circuit replacing the actual distributing . Circuit.

In Berlin a recurrence of the accident was avoided by placing resistance coils in the circuits of the alternators. The impedance of these coils was sufficient to eliminate the currents of higher frequency. The foregoing shows the disadvantage arising from alternators having a low tension drop obtained through a low self-induction.

The tendency however, to-day, is to reduce the total reaction of the machines leaving a high value to the selfinduction proper of the armature circuits. The self-induction of working alternators comes into the formula expres-

- $O E_0$: elm. force at no load
- V = tension at the terminals. E₀ e' = opposite reaction.
- e' e'' = cross reaction.
- e'' e''' = elm. force of self-induction.
- e''' V = ohmic drop.

sing the frequency proper of the circuits.

Let us consider an alternator A which supplies a circuit having self-induction and capacity. Let E be the constant e. m. f. at no load of the alternator;

V, the tension at the busbars;

l, the self-induction of the alternator;

C, the capacity of the receiving and cable circuit;

*In a technological and scientific dictionary, edited by G. F. Goodchild, B.Sc. (London) and C. F. Tweney, the following definition is given of the word Resonance: "If any body be acted upon by a succession of impulses or vibrations, which recur at intervals corresponding to its own natural period of vibration, it will itself be caused to vibrate. The phenomenon is very easily observed in the case of sound, e. g., a stretched string is readily set in vibration if a note of the same pitch (frequency) as its own fundamental tone be sounded in the vicinity."

Webster says: "By extension, the increase of vibration of any kind, as in electricity, by an intermittent force of the same period. In electricity, the principle is valuable in detecting and investigating electro-magnetic waves."