GROUNDED TRANSMISSION MEDIUMS.—II.

By J. Stanley Richmond, Consulting Engineer, Toronto, Ont.

Earth Voltage and Potential Measurements.

It is necessary for convenience to sometimes use in the consideration of electrical phenomena, besides absolute and arbitrary zeros, two others designated self-zero and medial zero; self-zero being that of the voltage of the point having the lowest voltage and medial zero, that of the voltage of the middle point electrically in a generating and transmission medium.

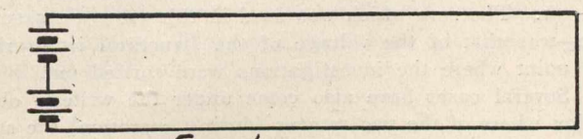

Fig. 1.

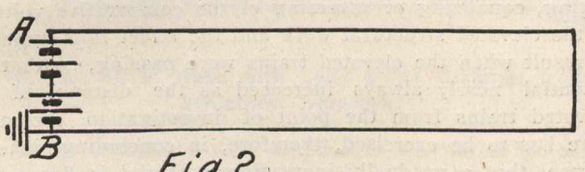

Fig. 2.

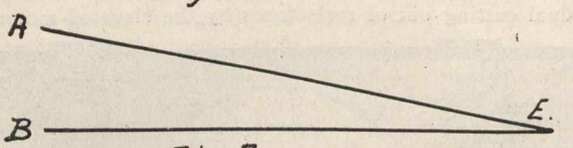

Fig. 3.

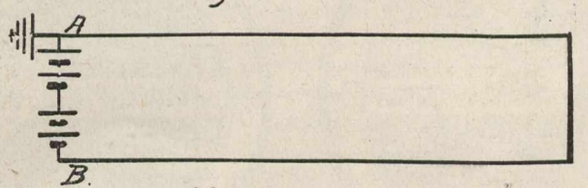

Fig. 4.

Fig. 1 is a diagrammatic representation of a so-called insulated transmission medium. In practice, however, such insulation is not obtainable; for, at some point or other of the circuit a lesser or greater ground exists. And it is due to the fact that such ground with direct-current transmission is one day at one point and another day at another point that the expression arose that "one day our system is positive and another day it is negative." It must be understood, of course, whether the system is running "negative" or "positive," that the direction of transmission remains the same.

Fig. 2 similarly represents a generating and transmission medium, but with the low voltage side of the generating medium grounded. As a result, the voltage conditions can be illustrated as shown in Fig. 3, in which BE being the zero line, E is the voltage of the pole B, A is the voltage of the pole A, and AE is the varying voltage of the transmission medium. The arbitrary zero and the self-zero of this circuit will be that of the voltage of the pole B.

Fig. 4 illustrates, diagrammatically, similar apparatus; A being grounded instead, of B, when the voltage conditions will have to be represented as in Fig. 5; in which AE being the zero line, E is the voltage of the pole A, B is the voltage of the pole B, and BE the varying voltage of the transmission medium. The arbitrary zero of this circuit will be that of the voltage of A; while the self-zero will be that of the voltage of B.

Fig. 6 also diagrammatically illustrates similar apparatus, but with C (the medial point electrically between the two poles) earthed, when the voltage conditions will have to be represented as in Fig. 7; in which CE being the zero line, A is the voltage of the pole A; B is the voltage of the pole B; AE is the varying voltage of one-half of the transmission medium and BE the varying voltage of the other half of it. The arbitrary zero and the medial zero, in this case, will be that of the voltage of C; while the self-zero will be that of the voltage of B.

The writer has defined electrical conditions as the abnormal position of the molecules of which matter is composed. Voltage, therefore, may be described as the degree of such abnormal position, and must not be confused with potential, which is the ability to do work due to the difference between two voltages. Potential and not voltage, therefore, is the "cause" producing any "effect" designated an electrical phenomenon.

Incidentally, it may be stated that a so-called voltmeter is incorrectly termed. Correctly speaking, it should be termed a potential meter. For it does not measure voltage in respect to a standard zero, but only the difference in voltage between (or potential of) two points, the one on one body and the other on another body, or between two different points of one body.

To illustrate, in a minor way, the practical application of the zero question, take the case of special potential meters designed by the writer for the measurement of earth potentials.

Fig. 8 is a sketch showing the arrangement of the scale for a single centre-zero potential meter having two ranges of five and fifty volts, respectively. As will be noticed, the words "Above" and "Below" are used instead of the usual signs + and —, and that the centre of the scale is marked "Zero." The binding-post, usually marked + on a centre-zero instrument, is, in this case, marked "Zero." To take, with such meters, the potentials between the rails of a surface street railway and the hydrants with a view to tabulating the voltages of the hydrants, the modus operandi is as follows:—

Each instrument, with two insulated cords, one long and the other short, is accompanied by two boys, the elder of which handles the meter and hydrant connection, while the younger one takes charge of the rail connection. The elder one is also provided with printed forms, a facsimile of which is marked Fig. 9, and is instructed to be very careful to keep his end of the longer cord always attached to the "Zero" post of the meter throughout the whole set of readings, while the younger boy holds the other end of it on to the near-by rail, which he has previously cleaned.

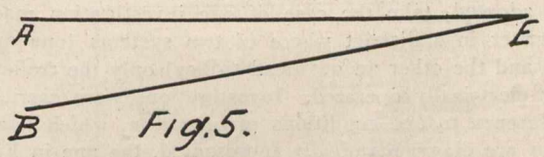

Fig. 5.

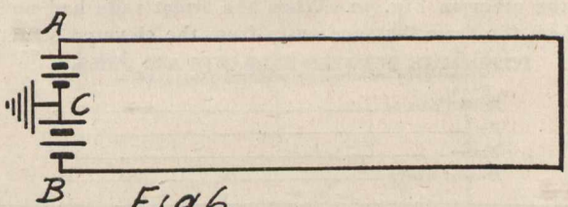

Fig. 6.

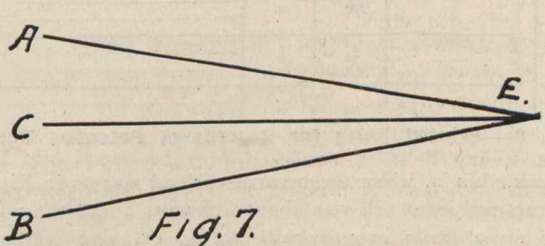

Fig. 7.

The shorter cord, which is attached to one of the two other binding-posts (according to which of the two ranges is being used), is connected to the hydrant by the elder boy, who is instructed to read the deflections just the same as he would the variations of temperature indicated by a thermometer; that is, if the deflection of the needle is above the zero the