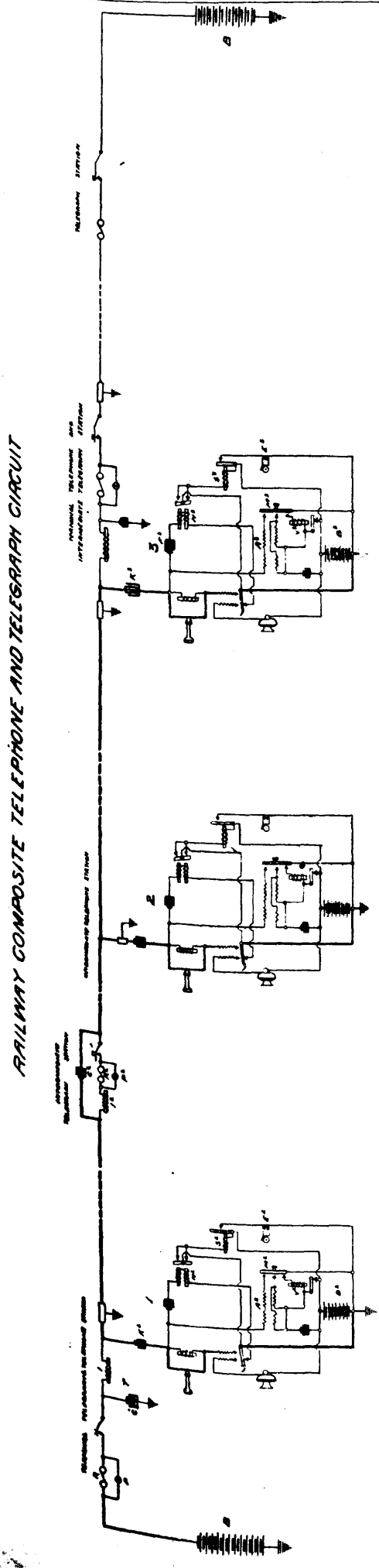

RAILWAY COMPOSITE TELEPHONE AND TELEGRAPH CIRCUIT

Composite Telegraph and Telephone System on the C.P.R.

The Bell Telephone Co.'s electrical engineering department has prepared the following description of the composite telegraph and telephone apparatus with which it has recently equipped one of the C.P.R.'s telegraph wires between Montreal and Ottawa, which allows telephone service to be added to grounded telegraph lines without interfering in any way with the telegraph service already carried on over such line. The system has been designed specially to meet the demands of railway companies for a service of this character applicable to terminal or way stations of lines of the above character. The length of the telegraph line and the number of way stations with which this system can be successfully employed depend largely on the character of the telegraph lines. The size and the material of the line wire and the amount of wire in cable are the most important factors limiting the range of the system. In general, it may be stated that it is usually possible to operate successfully over an ordinary telegraph line, 100 miles long having five intermediate stations.

The general arrangement of the system is shown in the accompanying drawing. At each terminal of that portion of the line over which telephone messages are to be transmitted is placed a terminal differentiator, consisting of an impedance coil in series with the line wire and a condenser from the line wire to earth. As the telegraph battery is placed outside this piece of apparatus the latter serves to graduate the rise and fall of the telegraph currents so that Morse signals will not interfere with the telephone service and so that inductive or other disturbances will not be transmitted to the telephones from portions of the line beyond the coils. Each telegraph way-station is provided with an intermediate differentiator, consisting of a condenser and impedance coil. The impedance coil is placed in series with the telegraph relay, and relay coil and key are shunted by the condenser. This apparatus affords a by-pass through the condenser for the telephone talking and signalling currents. Were it not for this apparatus the talking currents would be seriously reduced by the impedance of the relays and the telephone signalling currents would cause the relays to "chatter" or give false signals. In addition to the above precautions the relays are directly bridged by polarization cells. The latter offer such opposition to the passage of the direct telegraph currents that their presence does not in the least interfere with telegraphic signalling. At the same time, they serve as a shunt for any telephone signalling current that, passing through the impedance coil of the intermediate differentiator, would otherwise affect the relay. Each telephone set is connected to the line through a condenser, thus avoiding interference with the telegraphic service. The set, in addition to the transmitter, receiver and induction coil, contains for calling a special vibrator operated by a push-button, and for receiving calls, a direct current bell controlled by a slow-acting relay, which, in turn, is controlled by a biased, polarized relay. For signalling and talking, a battery of 5 or 7 Edison-Lalonde cells as found necessary is provided at each station. The station set is arranged to be mounted on the wall and is similar in general appearance to the standard magneto sub-station set. A special transmitter marked C. R. C. (Composite Railway Circuit) is employed with these sets. The receiver is of the standard type, but is permanently shunted by a special impedance coil which is designed to divert from the receiver the traces of the telegraphic or other currents which otherwise would cause disturbing noises to be heard. This impedance coil has a movable iron core which can be inserted into the coil, or removed from it, to a greater or less degree, thus widely varying the impedance and regulating the proportion of the current that is shunted around the receiver. The value of this impedance should be as high as is consistent with the necessary freedom from disturbing noise.

The circuits used in the railway composite system are shown in the accompanying drawing. At the left is a terminal telephone and telegraph station, next toward the right an intermediate telegraph station, next a telephone station which may or may not be associated with the preceding telegraph station, next a terminal and telegraph station, and beyond an isolated telegraph station. All telephone stations are connected between the line and earth. At the extreme left hand terminal of the line is shown one of the telegraph batteries B, the telegraph relay R of the combined telegraph and telephone terminal station, the polarization cell P shunting and relay R, and the terminal differentiator T, consisting of impedance coil I and condenser C I. The telephone set at this combined station is connected to the line through condenser K_2. At this station B_2 represents the local battery of 5 or 7 Edison-Lalonde cells. The transmitter, hook-switch, induction coil, receiver, and its shunting impedance are represented conventionally. At V_2 is a vibrator, operating through a coil, with condenser placed around the vibrator contact, and the operation of the vibrator controlled by a key M_2. This portion of the equipment provides the high frequency signalling current. At N_2 is a biased polarized relay, and at S_2 a slow-acting relay, controlled by the former, and having connected to its own back-contact the direct current bell E_2. This portion of the apparatus is for receiving incoming signals. At the next station (an intermediate telegraph station) is shown an intermediate differentiator consisting of impedance coil I_2 and condenser C_2. The relay R_2 is also shunted by the polarization of cell P_2. The remaining stations so closely resemble those referred to above as to require no further description.

To call a distant station, as, for example, station 3 from station 1, the operator at station 1 depresses key M_2, which causes the circuit of battery B_2 to be closed through the vibrator V_2, the operation of which produces an interrupted current in the split primary winding of coil A_2, and consequently a similar induced current being transmitted through the condenser K_2, along the line, through the condenser C_2, of the intermediate differentiator to station 3, and beyond. At station 3 this signalling current flows through condenser K_3 and F_3, and the polarized relay N_3 to earth. This current causes the armature of relay N_3 to vibrate, thus opening the circuit which previously existed from the battery B_3 through the slow-acting S_3 to earth. The armature of relay S_3 falling back, closes the circuit of the direct current bell E_3 which gives the signal. The talking circuit is of the simplest character and requires no explanation.