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DUPLEX SIGNALING SYSTEM

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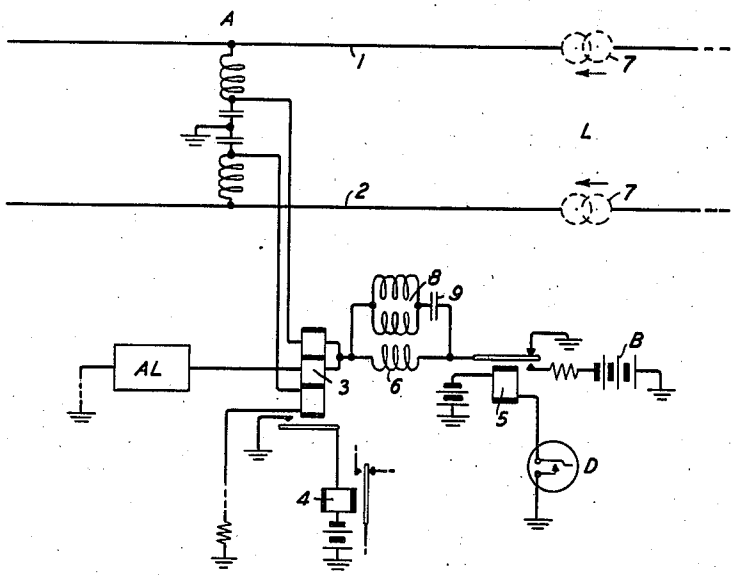

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DUPLEX SIGNALING SYSTEM

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3 Claims. (Cl. 179—3)

This invention relates to duplex signaling systems arranged to compensate for differences in ground potential at the two ends of the line and commonly used in telephone systems for direct current signaling over relatively long distance as for example systems of the character described in United States Patents 1,287,831 to H. M. Bascom and 2,138,832 to G. A. Pullis.

In such systems, although not shown in the above patents, an inductance of relatively low resistance called a "thump coil" or noise-killing inductance is connected in series between the junction of the signaling and artificial line windings of each multiwound differential relay and the contacts of the respective signaling relay for the purpose of reducing the sharp wave fronts of the signal impulses, for example, dial pulses. These noise-killer coils, however, offer a relatively high impedance to alternating current and therefore when such currents are impressed on the line, either induced from near-by power lines or due to an alternating potential difference between the terminal grounds the differential relays become unbalanced and may operate falsely.

An object of the invention is to prevent false operation of the differential relays in systems of the character described when the signaling and ground compensating line conductors are subjected to interfering longitudinal alternating current.

A feature of the invention whereby the foregoing object is obtained resides in effectively short-circuiting the noise-killing coils, at the frequency of the disturbing potential, by means of an individual series resonant circuit connected in shunt thereto.

The invention will be understood from the following description and accompanying drawing which show a single two-wire toll line between two terminals arranged to provide a two-way direct current signal transmission channel and a ground compensation channel therebetween. In practice a plurality of two-wire lines are usually employed thereby providing twice as many signaling channels, less one, as there are two-wire lines as shown for example in the patent to Pullis 2,133,832.

In the drawing the signals to be transmitted are impulses produced by a dial but it will be understood that any other type of signal employing direct current can be transmitted with equal facility.

A description of the invention follows: A two-wire line L extends from a telephone station A, having a dial D adapted to transmit impulses over conductor 1 of the line to a distant station, not shown, it being understood, however, that a duplicate arrangement of circuit as shown at station A is located at the distant station. The path for transmitting and receiving impulses controlled by the dials at the terminal stations comprises conductor 1 of line L and the upper winding of the multiwound relays such as 3 at the stations. Relay 3 and the corresponding relay at the other end of the line each has three windings, the upper winding being designated the line winding, the middle as the biasing winding and the lower as the compensating winding. Associated with each of the multiwound relays is an auxiliary pulse receiving relay such as 4, and a transmitting relay, such as 5, is also associated with each multiwound relay and controlled by the corresponding dial D. Under normal conditions relay 5 and the corresponding relay at the other end of the line are released thereby connecting ground through the upper or line winding of the corresponding multiwound relays, such as 3, to the line conductor 1, i. e., both ends of the line conductor 1, are normally grounded through the upper or line windings of the corresponding multiwound relays. If the ground potential is the same at both ends of the line, no current flows in the line windings of the multiwound relays and therefore these relays are not affected. Relay 5, and the corresponding relay at the other station, in their normal condition also connect ground to one end of the middle or biasing winding of the respective multiwound relays, such as 3, the other end of which is connected to ground through a corresponding artificial line such as AL. Closure of the dial contacts and the consequent operation of relay 5 connects battery B to the signaling channel whereupon current flows to ground at the other end of the line through the upper windings of the multiwound relays and current also flows to ground at station A through the middle or biasing winding of relay 3 in a flux direction opposite to that of the current flowing in the upper winding of the same relay, and hence this relay remains released whereas the relay at the other end of the line operates in a well-known manner.

If there is a ground potential difference between the grounds at the opposite ends of the line there would be a tendency for one of the multiwound relays to operate falsely if it were not for the ground compensation circuit which extends between the two distant ground connections over a circuit including line conductor 2

and the lower or compensating windings of the multiwound relays at each end of the line which relays are connected in such a manner as to neutralize the flux set up in the respective relays by current in the upper or line windings which otherwise might cause false operation.

Further, in order to prevent annoying thumps in the telephone receivers connected to the line during dialing, which "thumps" are occasioned by the sharp wave fronts of the direct current impulses an inductance **6** is frequently connected in series between the junction of the upper and middle windings of the multiwound relays and the armatures of the signaling relays such as **5**, which inductance has the effect of rounding off the sharp wave front of the dial impulses. This is a well-known arrangement frequently called a noise killer.

In the arrangement described, however, if line L is exposed to inductive interference from a power line, for example, or an alternating ground potential exists at one end of the line so-called longitudinal current flows in the same direction in both line conductors simultaneously as represented by the alternating current generators **7** in series with each line conductor, and, due to the presence of the noise-killing inductance **6** in the signaling channel, which obviously offers a considerable impedance to such interfering frequencies (60 cycles being the frequency most frequently encountered) the normal balance of the multiwound relays will be interfered with and may result in this false operation. For example, assuming that an interfering alternating potential of 60 cycles is impressed on the line L, in such a manner that longitudinal currents in both conductors result, then this current will tend to flow to ground at station A, through both the upper or line winding of relay **3** and the lower or compensating winding of the same relay. However, due to the presence of inductance coil **6** in series with the upper winding, a smaller value of current will flow through this winding than through the lower winding and further an appreciable potential will be built up across the ends of inductance **6** and due to the fact that the middle or biasing winding is connected in parallel with inductance **6**, this potential will cause current to flow in this winding in an aiding direction to that in the upper or line winding and in an opposite direction to the current flowing in the lower or compensating winding and consequently the combined flux effect of the biasing and line windings will overbalance the effect of the current in the lower or compensating winding and the relay will have a tendency to break its contact when dial pulses or other signal pulses are transmitted through that relay to the distant end.

To overcome the foregoing unbalanced effect the obvious remedy is to remove the inductance **6** from the circuit but as it is required for another purpose, before mentioned, the present invention is aimed at effectively eliminating its effect on such interfering frequencies by shunting it with a series resonant circuit consisting of two parallel inductances **8** in series with a condenser **9** tuned to the frequency of the interfering potential, whereby current of substantially equal value will flow in both the line and compensating windings of relay **3** and thereby maintaining the normal balance of the relay.

Other methods, heretofore proposed are ineffective to correct the foregoing trouble in systems of the character described in which ground potential compensation is effected by a third winding on each multiwound relay in series with a separate line conductor as herein described.

What is claimed is:

1. In a duplex composite signaling system comprising a plurality of line conductors subject to interfering longitudinal alternating current flowing therein, a multiwound relay having one winding in series with one line conductor, a second winding in series with an artificial line, and a third winding in series with a second line conductor, a noise-killing inductance common to both said first and second windings and in series therewith, characterized by means comprising a series resonant circuit in shunt to said inductance for preventing said interfering current from falsely operating said relay, said shunt circuit being resonant to the frequency of said interfering current.

2. In a duplex composite signaling system comprising two distant telephone stations each employing a multiwound differential relay and connected by a signaling conductor and a ground compensating conductor, said system being arranged to reduce the sharp wave fronts of direct current impulses transmitted between the stations by the series inclusion in the signaling circuit at each station of an impedance having a low direct current resistance and a relatively high inductance, characterized by means for preventing false operation of said relays due to interfering longitudinal alternating current flowing in both said conductors, said means comprising a series resonant circuit connected in shunt to each wave shaping impedance, said shunt circuit being constructed to resonate at the frequency of the interfering alternating current.

3. In a duplex composite signaling system for telephone lines arranged to compensate for differences in earth potential between two stations which system employs a multiwound relay at each station interconnected by a signaling conductor and a ground compensating conductor, and further arranged to reduce the sharp wave fronts of direct current signaling impulses transmitted between the stations by the series inclusion of a noise-killing inductance in the signaling circuit at each station characterized by means for preventing false operation of the station relays due to interfering alternating current superimposed on both the signaling and compensating conductors, said means comprising a circuit serially including a predetermined inductance and capacitance connected in shunt to each noise-killing inductance, the elements of said circuit being so adjusted that it presents a substantially zero impedance of the frequency of the interfering current.

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