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SIGNALING SYSTEM

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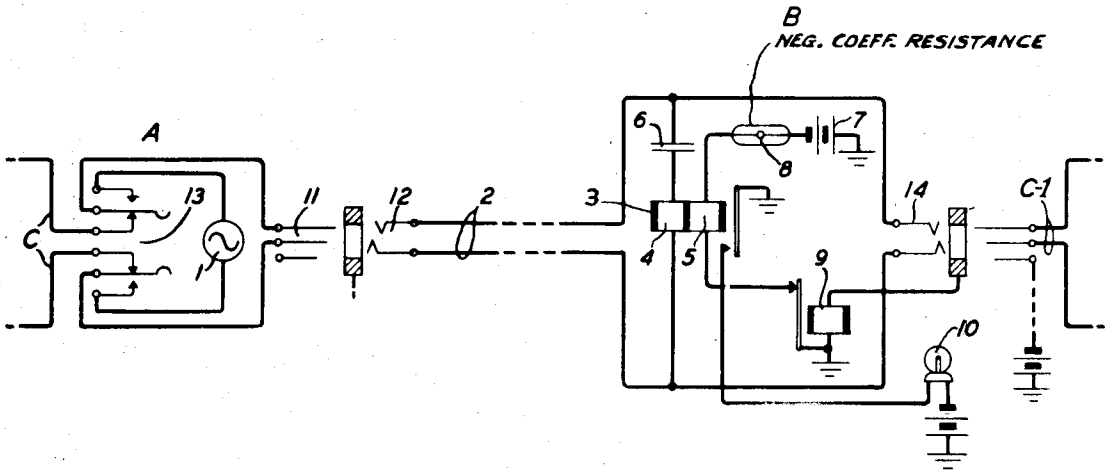

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SIGNALING SYSTEM

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4 Claims. (Cl. 175—320)

This invention relates to signaling systems, and its objects are to increase the responsiveness of signal operating devices, to enable positive signal indications to be obtained under varying conditions of signaling current, and in general to improve the usefulness of such systems.

It has been the common practice in the past to signal over communication circuits, such as telephone trunks and toll lines, by sending alternating signaling current over the circuit to operate a responsive relay at the distant end. The signal responsive relay in operating usually effects the operation of other relays which close the circuits for the operation of visual or audible signal devices. Since the signaling current is applied to the line for a limited time, it is necessary to provide some means for locking the responsive relays to insure the continuance of the signal indications after the signaling current has ceased to flow.

In accordance with the present invention improvements are secured over these prior art signaling arrangements by providing a signal responsive relay which responds to the alternating current signals incoming over the line and utilizes these currents to effect the energization of one of its windings from a local source to lock the relay in operated condition after the incoming signaling currents have ceased to flow. More specifically the signal responsive relay is provided with two windings, one of which is connected to the line for receiving the alternating signaling current incoming from a distant point, the other winding being normally closed in a local circuit including a source of current and a resistor having a normal resistance which is too high to permit the flow of sufficient current in the local circuit to energize and operate the signal relay. The two windings of the relay, however, are arranged in inductive relation, and the alternating signaling currents flowing in one winding induce currents in the other winding which flow through the resistor to raise its temperature. The resistor, having a large negative temperature coefficient, immediately lowers its resistance in response to these temporary induced currents, and in so doing allows an increased current to flow from the local source. This increased flow of current from the local source maintains the resistor at a low value and also supplies sufficient energy to the relay to hold it operated when the alternating signaling currents have subsided. The relay in operating operates a signal lamp or other indicating device to attract the attention of an operator.

The drawing accompanying the detailed specification herein discloses a communication line extending from one operator's position to another and equipped with a signaling circuit arrangement in accordance with the present invention.

Referring particularly to the drawing, an operator's position at the exchange A is provided with a connecting cord circuit C equipped with the usual relays, lamps, and other devices, not shown herein, and also provided with a source of ringing or signaling current 1. A communication circuit or line 2 appears in a connecting jack 12 at the operator's position in office A and extends to a distant exchange B where it appears in a terminal jack 14 at an operator's position, represented by a cord C—1. The incoming end of the line 2 in exchange B is equipped with a signal-responsive relay 3 having two windings 4 and 5. The winding 4 is connected across the tip and ring conductors of the line 1 and in series with a condenser 6. The winding 5 is connected in a local circuit including a direct current battery 7, a resistor 8 having a negative temperature coefficient of resistance and a normally-closed contact of control relay 9. Although the winding 5 is in a normally-closed circuit, the resistance of the element 8 is so high that no appreciable current flows through said winding. The resistor 8 may be made of any suitable material, such as boron or silver sulphide, which are known to have high negative temperature coefficients of resistance. The armature on the relay 3 controls a circuit for the calling lamp 10, which is individual to the jack 11 at the operator's position.

A description will now be given of the manner in which the system operates. Assume that the operator at exchange A desires to call the operator at exchange B over line 2 for the purpose of establishing a communication connection. The operator at exchange A inserts the plug 11 of her cord C in the jack 12 of line 2 and manipulates her ringing key 13 to connect the ringing source 1 to the line. Alternating current from the source 1 flows over the line 2 through the condenser 6 and the winding 4 of the relay 3 at the distant exchange. Relay 3 may or may not operate, depending on the duration and on the intensity of the applied ringing current. However, the signaling current flowing through the winding 4 induces a potential across the winding 5 by reason of the fact that the windings 4 and 5 are wound in close inductive relation to each other on the common core. The potential across the winding 5 is applied to the re-

sistor 8 and causes enough current to flow through the resistor to increase its temperature and consequently lower its resistance. The lowered resistance of the element 8 permits current to flow from the battery 7 through said resistance and through the winding 5 and in sufficient volume to operate and hold the relay 3 in operated condition. The operated relay 3 closes a circuit to light the lamp 10. Moreover, the flow of current from the battery 7 maintains the resistor 8 at its low resistance because of the well-known characteristics of these negative resistance materials. When, therefore, the signaling current is withdrawn from the line 2 by the release of the operator's key 13, the signal relay 3 remains operated because of the energization of its holding winding 5. The operator at C—1, observing the lamp 10, replies by inserting the plug of her cord circuit in the jack 14 of the incoming line. This operates relay 9, which opens the circuit of the winding 5 and the resistor 8, permitting the relay 3 to release and permitting the resistor 8 to cool immediately and raise its resistance to its normal, high value. The lamp 10 is extinguished, and the operators may now converse with each other.

It will be obvious to those skilled in the art that the relay 3 may vary as to the details of its construction and the manner in which the windings are assembled on the relay structure. The resistance values of these windings and the inductive relation between them may of course be designed to best meet the requirements for any particular use. For example, the relay 3 could be replaced by a transformer, having the battery 7, resistor 8, and a relay for closing the lamp circuit connected in series with the secondary winding. Moreover, it will be obvious that the present invention is applicable to a wide variety of signaling circuits and systems.

What is claimed is:

1. In combination, a relay having an operating winding and a holding winding, a circuit for said holding winding including a source of current, circuit means for delivering signal current to said operating winding to induce a potential across said holding winding, and a resistor having a normal high resistance included in circuit with said holding winding and responsive to the induced potential to lower its resistance and permit the flow of current from said source to hold the relay operated.

2. The combination in a signaling system of a relay having an operating winding and a holding winding, a circuit for said holding winding including a source of direct current, circuit means for delivering alternating signaling current to said operating winding to induce a potential across said holding winding, a variable-resistance element having a normally-high resistance for preventing the energization of said holding winding by said direct current source and responsive to current induced in said holding winding to lower its resistance and permit the flow of current from said source sufficient to hold the relay operated, and means controlled by said relay.

3. The combination in a signaling system of a source of direct current, a variable-resistance element having a normal resistance sufficiently high to prevent the flow of current therethrough from said source, a relay having a winding thereon, a circuit for said winding including said direct current source and said variable resistor, an operating winding on said relay arranged in inductive relation with said first-mentioned winding, and circuit means for supplying alternating current to said operating winding to induce in said first-mentioned winding and in the circuit thereof a current for heating said resistance element and causing its resistance to decrease to permit an increased flow of current from said direct current source through said first-mentioned winding.

4. The combination in a signaling system of a relay having a winding and a normally-closed circuit for said winding, a source of current included in said circuit, a variable-resistance element in said circuit and having a normal resistance sufficiently high to prevent the flow of energizing current in said circuit and through said winding, an operating winding for said relay wound in inductive relation with said first-mentioned winding, means for supplying said operating winding temporarily with operating current to induce current in said secondary winding and in the circuit thereof, the induced current flowing in said secondary winding serving to lower the resistance of said element, permitting current to flow from said source to hold the relay in operated condition and to maintain said resistor at a low-resistance value after current ceases to flow in said operating winding, and signaling means controlled by said relay.

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