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RINGING SYSTEM

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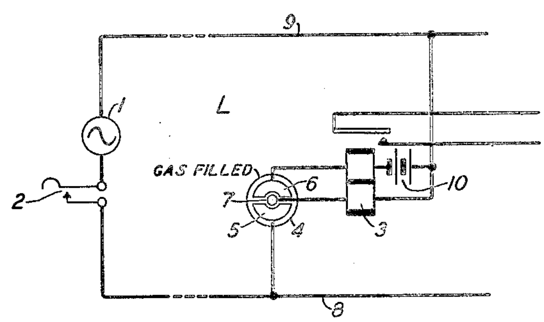

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RINGING SYSTEM

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This invention relates to ringing systems and more particularly to an arrangement employing a gas-filled discharge device to enable a direct current relay to respond and hold operated on alternating (ringing) current.

In systems at present in use the usual practice is to connect a relay, especially constructed for operating on alternating current, across the line in series with a condenser (whose principal function is to prevent direct current, normally present in such circuits, from passing through the relay). These alternating current relays are usually quite sensitive and consequently are subject to false operation on interfering currents frequently present on the line and usually referred to as surges. Relays of this type due to their construction are only capable of exerting light contact pressures and usually only close a single pair of light contacts. Because of such light contact pressure open circuit troubles due to dirt on the contacts are a frequent occurrence. Due to the limitation of the number of contact springs that can be operated by such relays, if more contacts are to be closed, an auxiliary relay with local current supply is required.

An object of the present invention is to provide a ringing responsive arrangement which will obviate the difficulties above enumerated.

A feature of the invention resides in employing a double wound direct current relay, instead of one designed for alternating current operation, and connecting one winding of this relay between the anode of a gas-filled discharge tube and one side of the line, connecting the other side of the line to the cathode and connecting the control electrode to the first side of the line in series with the other winding of the relay and the direct current source, so poling the source that when the direction of the alternating current in the line is such as to produce an anode-cathode discharge, the direct current source will oppose a discharge between the control electrode and the cathode. By choosing a suitable value for the direct current potential, and connecting the two windings in predetermined directions, a steady flux will be maintained in the relay and it will remain operated during ringing. The invention will be understood from the following description when read in connection with the accompanying drawing.

1 is a source of alternating ringing current, which may have a frequency of the order of 20 cycles, adapted to be connected to a line L by means of a switch 2. Other frequencies, however, may be used as the invention is not restricted in this regard. 3 is a double wound direct current type relay to be steadily operated by the alternating current while the switch 2 is closed and 4 is a cold-cathode gas-filled discharge device having two closely spaced electrodes 5 and 6, the electrode 5 representing the cathode of the device and electrode 6 the so-called control electrode. In addition to these two electrodes the tube is provided with an anode 7. 10 is a biasing battery whose function will later appear. The connections of the relay, battery and discharge device with respect to each other and the line are indicated on the drawing and explained hereinafter. A description of the operation of the arrangement follows:

When key 2 is closed, alternating current is applied to the line L. Now let us assume that the instantaneous direction of the current at the moment of connection is in a direction from left to right over conductor 8 of the line to the cathode 5 of device 4 and from right to left over conductor 9. Under this condition and assuming the voltage necessary to break down the control gap of device 4, i. e., the control electrode-cathode gap, is not greater than the difference between the voltage of source 1 and battery 10 then, when potential is applied to the line in the direction described, if the battery 10 is connected as shown on the drawing with its positive terminal connected to the line conductors 9 and its negative terminal to the upper winding of relay 3, the potential applied to the control gap will be equal to the sum of the potentials of the two sources and the gap will break down and, due to the excess potential over and above the required minimum, sufficient current will flow across the gap and through the relay winding to cause its operation.

Due to the fact that the anode-cathode gap is substantially unilaterally conducting, especially at the potentials here considered, no current will flow in the lower winding of the relay.

When the ringing current reverses its direction, i. e., on the next half cycle, it will be in the direction of an anode-cathode discharge and in an opposing direction to battery 10 in the control gap path. However, we have assumed that the difference between the voltage of the two sources is not less than the breakdown voltages of the control gap and therefore the control gap will reionize but the current flow will be very small and insufficient to affect the relay.

Now, however, if we assume that the voltage necessary to cause a discharge across the anode-cathode gap, when the device is ionized, is not greater than the voltage of the source 1, it will be seen that a discharge across this gap will take place and sufficient current will flow in the lower winding of relay 3 to hold it operated assuming that the lower winding is so connected that it creates the same flux direction as that of the upper winding. Therefore it will be noted that in one direction of the ringing current, current flows in the upper relay winding across the control gap sufficient to operate the relay and in the opposite direction the potential across the control gap is sufficient to cause ionization, although insufficient to cause any effective current flow, and due to the fact that the tube is ionized and the potential across the main gap is of the right polarity and of a sufficiently high value to cause a breakdown and maintain a discharge thereacross current will flow in the lower winding across the main gap sufficient to hold the relay operated.

It may be noted that if the voltage of source 1 is sufficiently higher than the required minimum some current will flow in the normally non-conducting winding of the relay but if the two windings have an equal number of turns, the flux created in the relay will never be less than that produced when current flows in only one winding.

What is claimed is:

1. In a ringing system, a line, a source of alternating current connected across said line at one end thereof, a double wound relay, a three-element cold-cathode gas-filled discharge tube and a source of direct current at the other end of the line, a connection between one side of the line and the anode of said tube including a first winding of said relay, another connection between said one side of the line and one of the remaining electrodes of said tube serially including said source of direct current and the second winding of said relay, and a connection between the third electrode of said tube and the other side of the line, said alternating current source being of such voltage with respect to the voltage characteristics of said tube, said direct current source of such a value and so poled in the circuit, and the windings of said relays being so connected that said tube will ionize and sufficient current will flow in said windings during each half cycle of said alternating current to operate and hold the relay operated.

2. In a ringing system, a line, a source of alternating current connected across said line at one end thereof, a double wound relay, a three-element cold-cathode gas-filled discharge tube and a source of direct current at the other end of the line, a connection between one side of the line and the anode of said tube including a first winding of said relay, another connection between said one side of the line and one of the remaining electrodes of said tubes serially including said source of direct current and the second winding of said relay, and a connection between the third electrode of said tube and the other side of the line, said alternating current source being of such voltage with respect to the voltage characteristics of said tube, said direct current source being of such a value and so poled in the circuit and the windings of said relays being so connected that the said tube is ionized and a sufficient flux will be generated in said relay during each half cycle of said alternating current to operate the relay.

3. In a ringing system, a line over which alternating ringing current is transmitted and an arrangement responsive to said ringing current comprising a three-element gas-filled discharge device having main and control discharge gaps, a double wound relay and a source of direct current, so connected to the line and arranged that one winding of the relay is connected across the line in series with said battery and the control gap of said discharge device and the other winding is also connected across the line in series with the main gap of said device to the exclusion of said battery, said windings and direct current source having such values and being so connected that, upon ionization of the device, a substantially uniform flux is maintained in said relay for either direction of said ringing current.

4. In a ringing system, a line over which alternating ringing current is transmitted and an arrangement responsive to said ringing current comprising a three-element gas-filled discharge device, a double wound relay and a source of direct current, the anode of said device being connected to one side of the line through a first winding of the relay, one of the remaining electrodes being connected to the same side of the line through the second relay winding and the direct current source in series, and the third electrode being connected to the other side of the line, the voltage values of said sources being so chosen with respect to the voltage characteristics of the device, said direct current source being so poled with respect to the device and said windings being so connected that when the alternating current flows in one direction in the line, it flows from one side of the line through one winding of the relay to the anode and thence to the other side of the line to operate the relay, and when it is in the opposite direction it flows between the other two electrodes of the device, through the other winding of the relay, and the direct current source, to maintain substantially the same flux in the relay and in the same direction during a complete cycle of said alternating current.

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