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SELECTING SYSTEM

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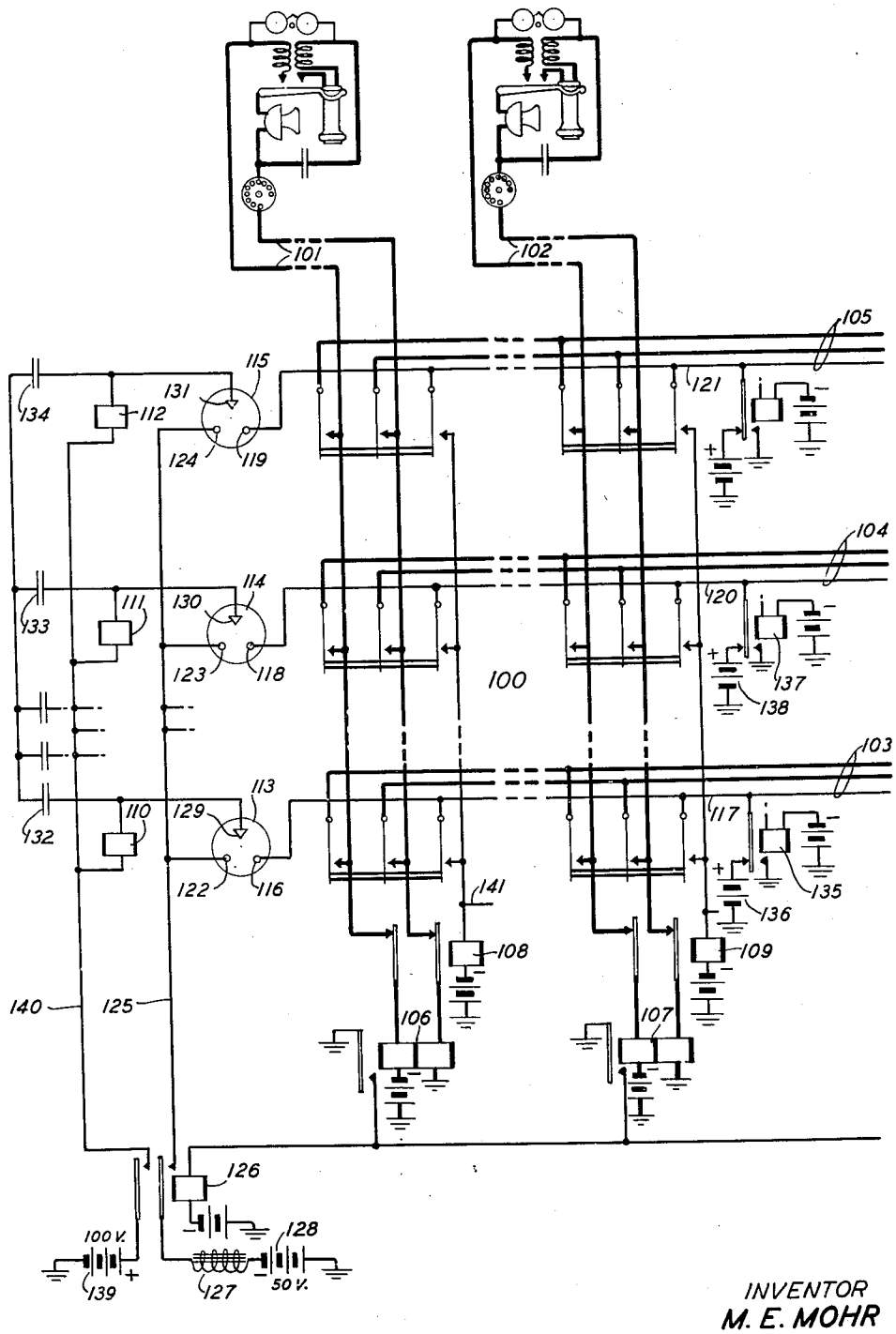

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SELECTING SYSTEM

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This invention relates to selecting systems and particularly to systems in which selections are made automatically in a group of lines, trunks or other electrical circuits.

An object of the invention is to increase the speed and certainty with which the lines, trunks, circuits or other devices of a group are rendered unselectable in response to the selection of one of them for use.

Another object is to utilize the inductive effect of a common impedance to render all circuits of a group unselectable in response to the flow of current resulting from the selection of one of them.

Another object is to cause the selection of one of a group of equivalent circuits by operating a discharge tube individual thereto and to utilize the inductance of a common impedance element to render the tubes of all other circuits ineffective.

Another object is to utilize both the inductance and resistance of the common element for preventing the selection of other circuits.

Other objects of the invention are to simplify, to increase the speed of operation, and otherwise to improve selecting systems.

These objects are realized by means of a selecting system in which a group of equivalent circuits, or other devices, from which selection is to be made is provided with a plurality of discharge tubes, one for each of the several circuits, together with means for causing the discharge of the tube individual to an idle circuit; and in which an inductive element common to all of the tubes responds to the flow of current, when any one of said tubes discharges, to produce a voltage change on the electrodes of all other tubes to prevent another one from discharging and selecting a second one of said circuits. More specifically this selecting system is so arranged that any one of the circuits may be chosen for use providing it is idle at the time selection is required. To this end potential is applied to the tubes of all idle circuits. Since, however, the individual characteristics of each tube differ somewhat from from those of the remaining tubes in the group, some one of the tubes representing idle circuits will be the first to discharge. The instant discharge current flows, the common inductance element produces a high voltage drop which is applied to the electrodes of all tubes and which serves to disable any other tube that may be about to discharge. After the current flow reaches a steady state the resistance drop across the inductive element disables the tubes and prevents a second one from discharging. Thus it is possible to select one from a number of equivalent idle circuits and to insure against the undesirable selection of a second circuit.

A feature of the invention is a selecting system of the kind above mentioned in which the anodes of the selecting tubes are connected to each other through a plurality of condensers. Whenever current flows in the discharge gap of one of these tubes, the voltage drop produced by the work relay in the anode circuit causes charging current to flow in the condensers to reduce the voltage on the anodes of all other tubes. Thus the voltage difference across the discharge gaps of all other tubes is reduced by the instantaneous voltage drop produced in the common inductance element and by the voltage drop produced by the charging of the condensers connected to the anodes of said other tubes.

These and other features of the invention will be described more fully in the following detailed specification.

The drawing accompanying the specification discloses the invention when applied to a switching system for connecting incoming circuits to any one of a group of equivalent outgoing circuits.

Although the invention is applicable to selecting and connecting systems in general and without regard to the specific purposes for which these systems are used, it is disclosed in the drawing in connection with the switches of a telephone system. One of these line switches 100, which may be of the well-known cross-bar type, serves to extend the calling subscribers' lines 101, 102, etc., to idle links or trunks 103, 104, 105, etc. Usually a plurality of these switches are assembled on a frame, and common controlling equipment is provided for selecting and operating the horizontal and vertical magnets to determine the orderly extension of the calling lines to respective idle outgoing circuits. For a better understanding of the structure and operation of the cross-bar switch reference is made to the patent to Reynolds 2,021,329 of November 19, 1935. As to the manner in which line switches of this type are controlled, reference is made to the patent to Busch et al. 2,224,251 of December 10, 1940.

Referring again to the drawing, the subscribers' lines 101, 102, etc., appear respectively in the vertical rows of contacts in the switch 100, and the outgoing circuits 103, 104, 105, etc., appear respectively in the horizontal rows of contacts

in the switch. The subscribers' lines are represented, respectively by individual line relays 106, 107, etc., and also by the switch hold magnets 108, 109, etc. The outgoing circuits are represented respectively by the select magnets 110, 111, 112, etc. The operation of any desired set of cross-point contacts in the switch is effected by energizing first the select magnet associated with the horizontal row containing the desired set of contacts and then the hold magnet pertaining to the appropriate vertical row of contacts.

In addition to the usual select magnets of the switch a plurality of space dicharge tubes are provided, there being one of these tubes for each horizontal row of contacts, or one tube for each outgoing circuit. For example, the tube 113 is associated with the outgoing circuit 103 and with the select magnet 110 individual to this circuit, and the tubes 114 and 115 are individual respectively to the outgoing circuits 104 and 105. And the same is true of the remaining tubes of the group not shown in the drawing. While these tubes may be of any suitable type, such as those filled with different gases, it has been found that much better results are obtained in the system disclosed herein when tubes filled with argon are employed. Tubes of this type having initial ionizing gaps and main discharge gaps are well known in the art. A starting voltage applied to the ionizing gap causes the initial ionization, which then transfers to the main discharge gap if an operating voltage of sufficient value is applied to the main gap. As soon as the main gap discharges, the voltage necessary to sustain this discharge drops to a value substantially lower than the initial operating voltage. These are well-known characteristics of gas-filled tubes.

The control or starting electrodes of the discharge tubes are connected respectively to the sleeve or test conductors of the associated circuits, the cathodes of all tubes are connected to a common conductor, and the anodes are connected respectively to the corresponding select magnets. For instance, the start electrode 116 of the tube 113 is connected to the test conductor 117 of the circuit 103. Likewise the start electrodes 118 and 119 are connected respectively to the test conductors 120 and 121 of outgoing circuits 104 and 105. The cathodes 122, 123 and 124 of all tubes in the group are connected by way of the common conductor 125 through the contacts of a control relay 126 through a common inductor and resistor 127 to the negative pole of battery 128. The anodes 129, 130, 131, etc. are connected to the corresponding select magnets 110, 111, 112, etc. Each of the tube anodes is also connected to one terminal of a condenser, there being one of these condensers for each tube. The other terminals of all condensers are joined together by a common conductor. For example, the anodes of tubes 113, 114 and 115 are connected to the associated condensers 132, 133 and 134, respectively. The purpose of the common element 127 connected to the cathodes and the individual condensers connected to the respective anodes of the tubes is, as will be explained more fully hereinafter, to prevent the simultaneous operation of two or more tubes and the false connections that would result therefrom

The operation of the selecting system will now be described in detail. For this purpose it may be assumed that line 101 initiates a call and that circuits 103 and 104 are idle at the time, whereas circuit 105 is busy. When the subscriber of line 101 removes his receiver to make the call, an obvious circuit is closed for energization of the line relay 106. Relay 106 closes an energizing circuit for the group relay 126. Relay 126 closes at its inner left contacts a circuit for applying the full negative potential of battery 128 to the cathodes 122, 123, 124, etc., of all tubes. Since the circuit 103 is idle at this time, relay 135 is deenergized, and the positive potential of battery 136 is applied to the start electrode 116 of the tube 113. Thus the voltage applied across the starting gap 116—122 is the sum of the voltages of batteries 128 and 136, which is sufficient to ionize said starting gap. Similarly, the relay 137 is deenergized, the circuit 104 being idle, and the positive potential of battery 138 is applied to the start electrode 118 of the tube 114. Hence the voltage applied to the gap 118—123 is the sum of potentials of batteries 128 and 138, which likewise is sufficient to ionize said starting gap. Similarly ionizing voltage is applied to the starting gaps of all other tubes representing idle outgoing circuits. However, each busy circuit, such as the circuit 105, has ground potential applied to its test conductor, and the resulting voltage across the starting gap 119—124 is insufficient to produce ionization.

Since the several tubes of the group are inherently different in their characteristics, the ionizing current in the control gap of some one of the tubes will reach the transfer value ahead of the remaining tubes. Assume, for example, that the ionizing current in the tube 113 reaches the transfer value ahead of the remaining tubes, including tube 114. As soon as the transfer value is reached discharge to the main anode takes place, and current flows in a circuit which may be traced from the positive pole of battery 139, contact of relay 126, conductor 140, through the winding of select magnet 110, anode 129, cathode 122, conductor 125, contacts of relay 126, element 127 to the negative pole of battery 128. It should be noted at this point that the inductive reactance of the impedance element 127 is preferably made high in comparison with its ohmic resistance. The high inductance of the element serves to produce a relatively high voltage when the initially small discharge currents first flow; while the low ohmic resistance of the element permits the subsequent flow of the relatively heavy discharge currents after the inductive effect of the element has subsided. Due therefore to the inductance of the element 127 the first flow of current in the discharge circuit above mentioned produces a relatively high voltage across the element 127. The polarity of this voltage is such that a positive potential is applied instantly to the cathodes of the remaining tubes in the group. This positive potential when applied to the cathode 123 opposes the flow of ionizing current in the starting gap 118—123 and also opposes the transfer of the discharge, which is about to occur, to the main anode 130. Thus the tube 114 is prevented from discharging and causing the selection of a second one of the outgoing circuits. Similarly the induced voltage created by the inductor 127 prevents any other tube associated with an idle outgoing circuit from discharging and causing the false selection of such circuit.

As the inductive effect of element 127 abates, the current in the discharge circuit above traced rises to its full operating value because of the relatively low ohmic resistance of element 127 and causes the energization of the select magnet 110 to prepare the horizontal row of contacts in

which the selected outgoing circuit 103 appears. Thereafter in any suitable manner a circuit is closed over conductor 141 for the operation of the hold magnet 108. The line 101 is now connected to the outgoing circuit 103, relay 106 releases, and relay 126 releases to disconnect the batteries 128 and 139 from the tubes. Magnet 110 is released, and the connection is now held by the hold magnet 108 over a circuit traceable from battery through the winding of the magnet, closed contacts of the switch to ground potential which has been applied to the holding or test conductor 117.

Returning to the point where the first tube, tube 113, transfers its ionization to the main anode, an explanation will now be given of the manner in which the condensers associated with the tubes serve with the inductor 127 to prevent the discharge of a second tube. At the instant transfer takes place to the main anode 129 in tube 113, the individual terminals of condensers 132, 133, 134, etc. are at the full positive potential of battery 139. As soon, however, as current begins to flow in the anode-cathode gap of the tube 113 and through the winding of magnet 110 the positive potential on the terminal of condenser 132 is lowered by the amount of the voltage drop across the magnet 110. Hence the potential of the individual terminal of condenser 132 differs from the potential of the corresponding terminals of each of the other condensers, and the resulting voltage drop causes charging current to flow over circuits including these condensers and the windings of the select magnets. One of these circuits may be traced through condensers 132 and 133 and through magnets 110 and 111 in series. The voltage drop produced by the flow of charging current in the winding of magnet 111 lowers the positive potential of the anode 130 by a corresponding amount, thus lowering still further the voltage applied across the anode-cathode gap 130—123. Therefore, the tube 114 is prevented from operating by the induced voltage produced by the inductor 127 at the instant the first tube 113 operates and by the lowering of the potential on the anode 130 resulting from the charging current flowing in condensers 132 and 133. In like manner charging current flows into each of the other condensers in series with the associated magnet, and the anode potential of the associated tube is lowered correspondingly.

After the current flow in the operated tube has reached the steady state the voltage drop across the common element 127 due to the resistance thereof maintains a potential on the cathodes of all other tubes such that no one of them can operate.

When it is desired to release the established connection through the switch 100, ground potential is removed from the sleeve conductor 117, and magnet 108 deenergizes to restore the cross-point contacts to their normal condition.

What is claimed is:

1. In combination, a plurality of selectable circuits, discharge devices individual respectively to said circuits, means for applying a potential to all of said devices to cause any one of them to discharge, means responsive to the current flowing in the discharged device for selecting the corresponding circuit for use, and inductive means responsive to the discharged device for changing the potential on the other discharge devices to prevent the discharge of a second one thereof.

2. In combination, a plurality of selectable circuits, discharge devices individual respectively to said circuits, means for applying an operating voltage to all of said devices, means responsive to the discharge current flowing in the first one of said devices to operate for selecting the corresponding circuit for use, and an inductive element responsive to the discharge current flowing in the operated device for producing an immediate reduction in the voltage on the remaining discharge devices to prevent a second one from operating.

3. The combination in a selecting system of a plurality of selectable lines, discharge tubes individual respectively to said lines, each tube having a plurality of electrodes, means for applying a voltage across the electrodes of all tubes sufficient to cause the operation of any one thereof, discharge circuits, one for each tube, means responsive to the flow of current in the discharge circuit of the first tube to operate for selecting the corresponding line for use, and an inductive element connected in common to an electrode of each of said tubes, said element responding to the current flowing in the discharge circuit of the operated tube to cause an instantaneous reduction below the operating value of the voltage applied to all other tubes.

4. The combination in a selecting system of a plurality of selectable lines, discharge tubes associated respectively with said lines, each tube having an anode and a cathode forming a discharge gap, means for applying operating voltages simultaneously across the discharge gaps of all of said tubes, means responsive to the discharge current flowing in the first tube to operate to select the corresponding line for use, and an inductor connected to all of said cathodes and responsive to the discharge current flowing in the operated tube for producing an instantaneous drop in the voltage across the gaps of all other tubes.

5. The combination in a selecting system of a plurality of selectable lines, discharge tubes associated respectively with said lines, each tube having an anode and a cathode forming a discharge gap, means for applying simultaneously operating voltages to the discharge gaps of the tubes corresponding to idle lines, means responsive to the discharge of the first tube to operate for selecting the corresponding line for use, and an inductor connected to all of said cathodes and responsive to the discharge of the operated tube for producing an instantaneous drop in the voltage across the gaps of the tubes associated with the remaining idle lines.

6. The combination in a selecting system of a plurality of lines, discharge tubes associated respectively with said lines, each tube having an anode and a cathode, an individual discharge circuit for each of said tubes, means for applying operating voltages simultaneously to said tubes, means responsive to the current flowing in the first tube to operate for selecting a corresponding line for use, an inductance element responsive to the current flowing in the operated tube for lowering the potential applied to the cathodes of the remaining tubes, and impedance elements connected respectively to said anodes and responsive to the current flowing in the operated tube for lowering the potential on the anodes of the remaining tubes, the lowered potentials of said cathodes and anodes serving to prevent the operation of a second tube.

7. The combination in a selecting system of a group of lines, a plurality of discharge tubes associated respectively with said lines, each of said

tubes having an anode and a cathode, relays connected respectively to the anodes of said tubes, means for applying simultaneously operating voltages across the gaps formed by the anodes and cathodes of said tubes, the discharge current flowing in the first tube to operate serving to energize the associated relay to select the corresponding line for use, an inductance element responsive to the discharge current flowing in the first tube to operate for lowering the potential applied to the cathodes of the remaining tubes, and a plurality of condensers connected respectively to the anodes of said tubes, said condensers being charged in response to the discharge current flowing in the first tube to operate to lower the potential applied to the anodes of the remaining tubes.

8. The combination in a selecting system of a cross-bar switch, a plurality of lines appearing in said switch, a plurality of discharge tubes individual respectively to said lines, a plurality of magnets for operating said switch to make connection with said lines, means for applying simultaneously operating voltages to said discharge tubes to cause the discharge on any one thereof, the current flowing in the first tube to discharge serving to operate one of said magnets to select the corresponding line for use, and inductive means connected to all of said tubes and responsive to the discharge current flowing in the first one to operate for lowering the voltage applied to all other tubes to prevent a second one from operating.

9. The combination in a selecting system of a plurality of selectable lines, discharge tubes associated respectively with said lines, each tube having an anode and a cathode forming a discharge gap and an envelope filled with argon gas, means for applying operating voltages simultaneously across the discharge gaps of all of said tubes, means responsive to the discharge current flowing in the first tube to operate to select the corresponding line for use, and an inductor connected to all of said cathodes and responsive to the discharge current flowing in the operated tube for producing an instantaneous drop in the voltage across the gaps of all other tubes.

10. The combination in a selecting system of a plurality of selectable lines, discharge tubes associated respectively with said lines, each tube having a main anode, a cathode and a starting anode, the cathode and starting anode forming an initial discharge gap, the cathode and main anode forming a main discharge gap, means for applying simultaneously operating voltages to the initial discharge gaps of a plurality of said tubes, means responsive to the discharge current flowing in the main discharge gap of the first tube to operate to select the corresponding line for use, and an inductor connected in common in the initial discharge gaps of all of said tubes and responsive to the discharge current flowing in the initial gap of the first tube to operate for producing an instantaneous drop in the voltage across the initial gaps of all other tubes to prevent the operation of a second one of the tubes.

11. The combination in a selecting system of a plurality of circuits, discharge tubes individual respectively to said circuits, each tube having a starting gap and a main discharge gap, a source of voltage, a common supply conductor for supplying ionizing voltage from said source to the starting gaps of said tubes and for supplying operating current from said source to the main discharge gaps of said tubes, means responsive to the flow of current in the main discharge gap of an operated tube for selecting the corresponding circuit for use, and an inductive element connected in said supply conductor and responsive to the flow of current for ionizing the starting gap of any one of said tubes to produce an instantaneous drop in the voltage applied to the starting gaps of all other tubes.

12. The combination in a selecting system of a plurality of circuits, discharge tubes individual respectively to said circuits, each tube having a starting gap and a main discharge gap, a source of voltage, a common supply conductor for supplying ionizing voltage from said source to the starting gaps of said tubes and for supplying operating current from said source to the main discharge gaps of said tubes, means responsive to the flow of current in the main discharge gap of an operated tube for selecting the corresponding circuit for use, and an impedance element included in said common supply conductor, said impedance element having a relatively high inductive reactance and responsive to the flow of current in said common supply conductor for producing an instantaneous voltage to prevent the remaining tubes from operating, said impedance element having a relatively low resistance to permit the flow of a relatively high current over said supply conductor and through the main discharge gap of the operated tube.

13. The combination in a selecting system of a plurality of selectable circuits, discharge tubes individual respectively to said circuits, each of said tubes having electrodes forming discharge gaps, each tube requiring a given voltage to cause ionization of its discharge gap and a substantially lower voltage to maintain the ionization, means for applying an operating voltage to all of said tubes, means responsive to the discharge current flowing in the first one of said tubes to operate for selecting the corresponding circuit for use, and an inductive element responsive to the discharge current flowing in the operated tube for reducing the voltage applied to all of said tubes to a value below the ionizing voltage and above the sustaining voltage of the discharge gaps of said tubes.

14. The combination in a selecting system of a plurality of selectable circuits, discharge tubes individual respectively to said circuits, each of said tubes having electrodes forming discharge gaps, each tube requiring a given voltage to cause ionization of its discharge gap, means for applying an operating voltage to all of said tubes, said tubes having inherently different time intervals for effecting discharge following the application of said operating voltage, means responsive to the discharge current flowing in the first one of said tubes to operate for selecting the corresponding circuit for use, and an inductive element responsive to the discharge current flowing in the operated tube for reducing the voltage applied to the remaining tubes before a second one of said tubes succeeds in operating.

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