

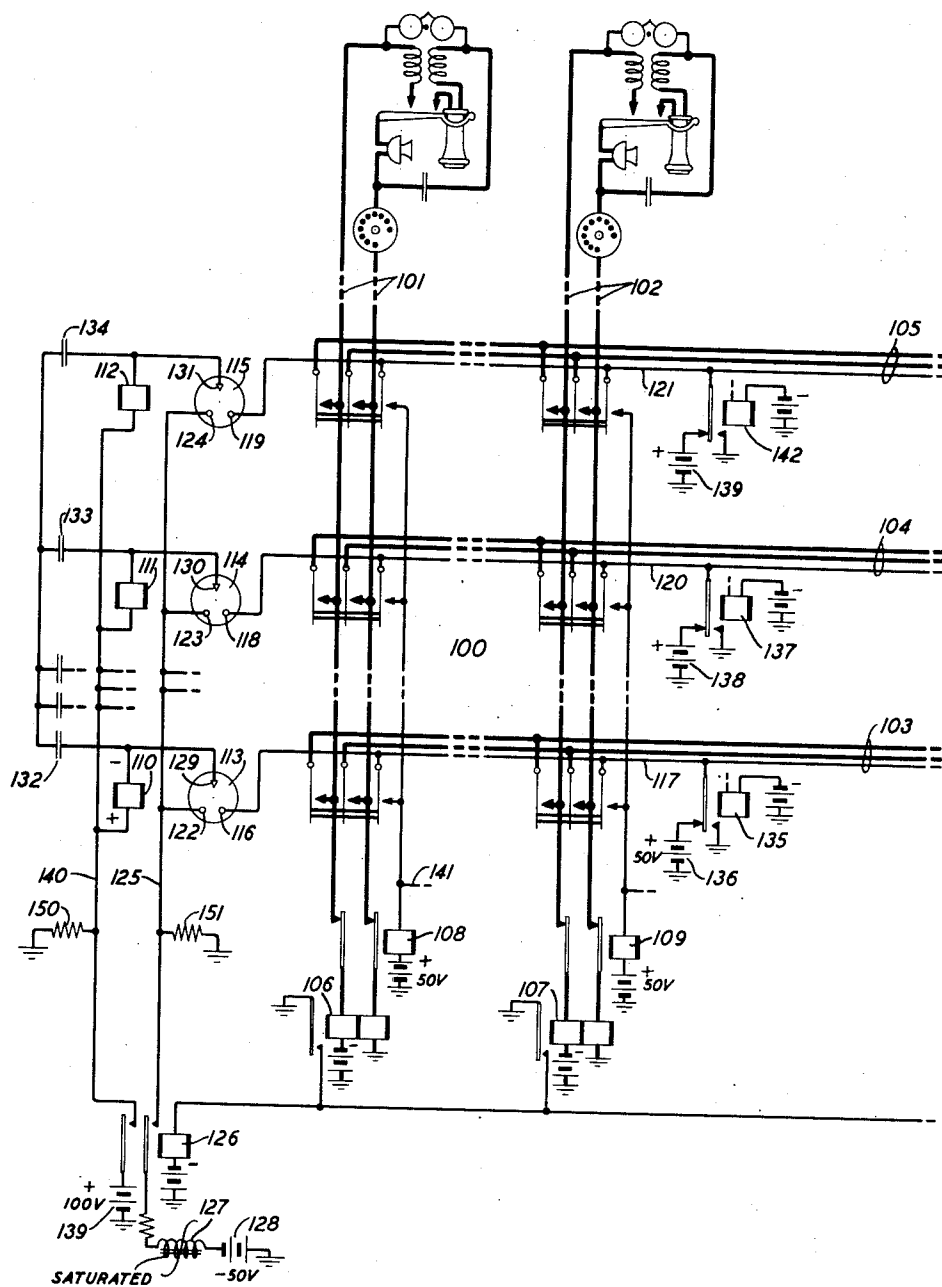
**Aug. 14, 1951**

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**2,564,125**

## SELECTING SYSTEM

Filed July 9, 1948



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## UNITED STATES PATENT OFFICE

2,564,125

## SELECTING SYSTEM

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Application July 9, 1948, Serial No. 37,858

4 Claims. (Cl. 179-18)

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This invention relates to improvements of selecting systems and more specifically to improvements in selecting systems wherein a saturable inductance is used to increase the speed with which a circuit is selected.

One of the primary objects of the invention is to increase the speed with which a circuit is selected for use from a plurality of lines, trunks, or other selectable circuits, while at the same time rendering all the other circuits of said lines, trunks or other selectable circuits unselectable.

A second object of the invention is to utilize an inductance as a common impedance to a plurality of space discharge tubes, representing selectable circuits in such a manner that the inductance becomes saturated immediately after a tube ionizes, thus removing the inductive impedance of the saturated inductance and allowing the current in the space discharge tube to increase rapidly.

Another object of the invention is to utilize a saturating inductance so as to increase the speed of operation of the selecting system.

A further object is to use a saturating inductance in combination with a plurality of space discharge tubes such that when one tube begins to ionize, the saturating reactance quickly acts to preclude any other tube from ionizing; each space discharge tube being individual to one of a plurality of selectable circuits.

Another object of the invention is to improve the operation of selecting systems generally.

An additional object is to make use of both the inductance and the resistance of the common inductive impedance to prevent other than one space discharge tube from ionizing.

The invention consists of a selecting system of circuits, each individual circuit having a gas tube and a saturable inductance impedance common to all the gas tubes. A voltage is applied commonly to all the tubes causing one of them to ionize. The mathematical odds are extremely high that only one will ionize. When one tube ionizes, the rising current will produce a drop in voltage across the common impedance and thus lower the voltage across the discharge gaps of the remaining tubes, effectively preventing them from ionizing. The current flowing through the tube that has ionized can be made to operate relays in the circuit individual to the said ionized gas tube.

There are in the prior art one or more devices whereby a common resistance or a common inductance has been used in series with a number of gas tubes connected in parallel with respect

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to each other. The function of these devices has been to preclude more than one tube from ionizing.

In the instance of the common resistance, however, there was a chance that more than one tube would ionize. To correct this deficiency a common inductance with resistance was used. The probability of more than one tube ionizing is considerably less than in the case where a resistance alone is used. But the use of the inductance presents a problem, e. g. that the current was prevented, due to inductance in the common impedance, from rising rapidly to a sufficient value to operate relays after the tube had ionized.

The objects of this invention are accomplished by causing the saturable inductance to become saturated immediately after the tube is ionized, thus allowing the current to increase to its full operating value much more quickly. Consequently, in applicant's invention there is less time lag between the ionizing of the gas tube and the operation of the relay than can be effected by use of a resistance or an ordinary inductance. The ionization of one tube, the transfer of its discharge, and the operation of the associated magnet such as 110, 111, or 112 may therefore be made to occur more quickly. Although the time saved may not, at first glance, seem consequential, it may amount to several tens of milliseconds, a time saving which may be of considerable consequence in the telephone switching art wherein substantial expenditures may be justified in order to save small amounts of time, it being noted in the present instance that the time saving is accomplished at substantially no increased cost, in fact, it may be accomplished at an actual decrease of cost. The saturated inductance will inherently have a resistance of some value. This resistance is so calculated as to provide for a voltage drop across said resistance after the tube has ionized and the effect of the inductance has become unimportant due to the leveling off of the current. Such a voltage drop will lower the applied voltage across the discharge gaps of the other gas tubes to a point sufficient to keep them from ionizing.

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

This invention is applicable generally to selecting and connecting systems but is disclosed in the drawing as used with a cross-bar type of telephone system. For further explanation of a

cross-bar system, reference is made to patent to Reynolds 2,021,329 of November 19, 1935.

Referring to the drawing the subscribers' lines 101, 102, etc., appear in the vertical rows and the outgoing lines appear in the horizontal rows 103, 104, 105, etc. Individual line relays 106, 107, etc., and switch hold magnets 108, 109, etc., represent the subscribers' lines, and select magnets 110, 111, 112, etc., represent the outgoing circuits. Each outgoing circuit is also represented by a space discharge tube 113, 114, 115, etc. Although several known gases are suitable, it has been found that argon filled tubes give satisfactory results. Ionization in the tube first occurs across the two cathodes 122, 123 and then transfers to the anode 129. The anodes of all the tubes are electrically connected together through condensers 132, 133, 134, etc., which condensers are all connected to a common point. The left cathodes 122, 123, 124, etc., of the tubes are all electrically connected to negative battery 128 through armature of relay 126. The starting electrodes 116, 118, 119, etc., of the tubes are electrically connected through test conductors 117, 120, 121, etc., respectively, through armatures of relays 135, 137, 142, etc., respectively, to positive batteries 136, 138, 139, etc., respectively. Each of the anodes 129, 130, 131, etc., is connected to one of the select magnets 110, 111, 112, etc., respectively. The saturable inductance 127, which is a common impedance to all the tubes, is connected to negative battery 128. Resistances 150 and 151 are of a value of approximately one megohm. Their purpose is to guard against false operation of one or more of the tubes which could be caused by leakage currents across the contacts of relay 126 when relay 126 is open. The high resistances 150 and 151 provide a path for any such leakage currents to flow to ground without developing appreciable voltage at the tube terminals. Consequently, both the cathodes 122, 123, 124 and the anodes 129, 130, 131 of tubes 113, 114 and 115 are held at ground potential through high resistances 151 and 150 respectively, prior to the operation of relay 126.

The operation of the invention will now be described in detail. A subscriber of line 101 picks up his receiver. This closes the circuit through lines 101 and the winding of relay 106, energizes relay 106. A circuit is thus completed from ground through the armature of relay 106, the winding of relay 126, to negative battery, and thence to ground, energizing relay 126, and closing the contacts of relay 126. This places positive 100 volts on the anodes of the tubes through the left armature of relay 126 and the select magnets 110, 111, 112, etc. It also places negative 50 volts on the left cathodes of the tubes through the right-hand armature of relay 126. Thus there is a difference of potential of 150 volts between the anodes 129, 130, 131 and the cathodes 122, 123, 124 of the tubes, but this is insufficient to ionize the tubes. There is, however, a positive voltage of batteries 136, 138, 139, etc., applied to the starting electrodes 116, 118, 119 of the tubes through conductors 117, 120, 121, etc., respectively. This creates a difference of potential across the cathodes and the starting electrodes of the tubes of batteries 136, 138, 139, etc., and battery 128. This difference of potential is sufficient to ionize the gas between the said cathodes and the said starting electrodes. But only one of the tubes will ionize. The tubes have inherently different characteristics and one of them, tube 113 for exam-

ple, will begin to pass a little more space current than the others. As this initial space current is of an increasing nature, a counter-electromagnetic force is induced in saturable coil inductance 127. This counter-electromotive force reduces the applied voltage across the tubes and restrains the tubes, other than tube 113, from ionizing. As long as the current through tube 113 is increasing there will be a counter-electromagnetic force induced in saturable reactance 127 which, acting in cooperation with the resistance of said coil, will keep the other tubes from ionizing. The saturable core coil 127 is designed so that immediately after the tube 113 is drawing sufficient current so that the tube can be said to be ionized, said sufficient current has saturated the saturable core coil and the current in the tube can then rise to its full operating value unimpeded by an inductance in saturable core coil 127. It is to be noted that the saturable core coil 127 becomes saturated before the current in the tube has reached its full operating value. This feature allows a rapid rise of current in the tube after saturation of the saturable core coil 127 and a subsequent rapid operation of relay 110. Before relay 110 can operate, however, the ionization within the tube must transfer to anode 129. This transfer is effected between cathode 122 and anode 129 after ionization has been established between cathode 122 and starting electrode 116. After the transfer is made a completed circuit exists through positive battery 139, line 140, winding of select magnet 110, anode 129, across the space gap to cathode 122, line 125, through saturable core coil 127, to negative battery 128. Select magnet 110 is operated almost immediately since saturable core coil 127 is saturated and the inductance of said coil is ineffective to restrain the increase of current to operating value.

The operation of select magnet 110 prepares the horizontal row of cross-bar contacts, which appear in outgoing circuit 103, for further operation. Thereafter in any suitable manner a circuit is closed over conductor 141 for the operation of hold magnet 108. The operation of hold magnet 108 closes the said cross-bar contacts and establishes a circuit from the subscriber's telephone to the outgoing circuit 103. At this time, relay 135 which is under the control of the supervisory relay (not shown) operates to place ground potential upon the starting electrode 116 and provides a holding circuit to ground for hold magnet 108. Since the voltage of battery 128 is insufficient to sustain an arc across the gap 122-116, said arc is extinguished. Relay 135 will remain energized as long as the subscriber upon line 101 continues his call.

Referring again to hold magnet 108 which has just been energized over lead 141, it can be seen from the drawing that such energization of hold magnet 108 opens lines 101 to deenergize relay 106 which in turn causes relay 126 to deenergize. Deenergization of relay 126 opens the circuit from positive battery 139, armature of relay 126, line 140, select magnet 110, anode 129, space gap to cathode 122, line 125, armature of relay 126, saturable core coil 127, to negative battery 128, deenergizing select magnet 110 and extinguishing tube 113.

If the subscriber upon line 102 should attempt to place a call, tube 113 would not be affected. Relay 126 would be operated, in this case, from the ground on the armature of line relay 107 in the manner previously described in connection

with the line relay 106. However, relay 135 is operated so long as the subscriber in line 101 is still talking and therefore the potential on electrode 116 from line 117 is ground from the front contact of 135 and since the potential of cathode 122 is only negative 50 volts, there is insufficient voltage to ionize the 122-116 gap in tube 113. Since relays 137 and 142 are unoperated the potentials on electrodes 118 and 119 of tubes 114 and 115, respectively, is positive 50 volts. The full starting gap voltages on tubes 114 and 115 as described heretofore in connection with tube 113 is therefore 100 volts and one of these, 115 for example, operates eventually connecting line 102 to outgoing line 104 in the manner herein described before.

When the subscriber of line 101 hangs up his receiver the supervisory relay (not shown) operates to deenergize relay 135. Deenergization of relay 135 opens the holding circuit for relay 108 which then becomes deenergized since there is a positive 50 volts on either side of the winding of relay 108 and therefore no current can flow through said winding. In addition the deenergization of relay 135 places a negative battery 136 on start electrode 116 to make tube 113 again ready for another subscriber. The supervisory relay referred to above, its use in a complete system, and its mode of operation are well known to those skilled in the art; by way of one example out of many which might be cited, reference is made to patent to Clark 1,844,147, dated February 9, 1932, wherein the supervisory relay 202 controls a relay 204 which corresponds to and may be provided with contacts to perform the functions of any one of relays 135, 137, 142 of the present application.

In addition to the saturable core coil 127 acting to keep the tubes, other than tube 113, from ionizing, condensers 132, 133, 134, etc., also act to further decrease the voltage applied across anodes and cathodes of tubes other than tube 113. This is accomplished as follows: When tube 113 starts to ionize, current passes through select magnet 110, causing a difference of potential across said select magnet. A current will flow from the positive side of said select magnet, along line 140, through select magnet 111, and will charge condenser 133. This charging current will produce a voltage drop across select magnet 111 and further decrease the voltage applied to anode 130. Similar circuits and charging currents will lower the anode voltage of tube 115.

What is claimed is:

1. In an arrangement for interconnecting only one circuit of a first group of circuits to the same circuit of a second group, the combination comprising a plurality of gaseous discharge tubes each including a main space path and a control space path, a power source, an inductor including a winding magnetically coupled to a magnetizable core saturable by current flow through said winding, said control space paths being connected in a low impedance parallel connection with respect to one another and the combination thereof being connected in series with said power source and said saturable inductor when any one of said first group of circuits requests to be connected to one of said second group of circuits thereby applying an ionizing potential to said control space paths through said saturable inductor, a second power source, a plurality of actuating means individually connected to each of said main space paths through said second power source for interconnecting one of said

second group of circuits associated therewith to one of said first group of circuits requesting an interconnection when said actuating means is energized by ionization of its associated main space path, said saturable inductor preventing more than one of said control space paths from being ionized at the same time by developing a potential thereacross opposing the potential of said first power source incident to the ionization of one of said control space paths thereby preventing an ionization breakdown potential from being applied to more than one of said parallel connected control space paths, and said saturable inductor thereafter saturating so as to prevent a high value surge potential from being developed thereacross due to ionization of one of said main space paths thereby diminishing the time interval during which the actuating means associated with said ionized main space path is operated.

2. In an arrangement employing a plurality of gaseous discharge devices wherein only one of said devices is to be fully ionized within a short time interval to the exclusion of the other of said devices, each of said devices comprising a main space path and a control space path, a plurality of impedance elements individually connected in series with a different main space path in the power supply circuit therefor, said control space paths being connected into a low impedance parallel connection, an inductor including a winding magnetically coupled to a magnetizable core saturable by current flow through said winding and being connected in series with said parallel connected control space paths in the power supply circuit therefor, and said saturable inductor preventing more than one of said control space paths from being ionized at the same time by developing a potential thereacross opposing the potential applied to said parallel connected control space paths by the power supply circuit therefor incident to the ionization of one of said control space paths thereby preventing an ionization breakdown potential from being applied to more than one of said parallel connected control space paths, and said saturable inductor thereafter saturating so as to prevent a high value surge potential from being developed thereacross due to ionization transfer to one of said main space paths thereby diminishing the time interval during which the impedance element associated with said ionized main space path attains peak potential thereacross.

3. In an arrangement employing a plurality of gaseous discharge devices wherein only one of said devices is to be fully ionized within a short time interval and each of said devices includes an auxiliary space path and a control space path, said auxiliary space path having a low impedance element individually connected to the power supply circuit therefor, and said control space path being connected in a low impedance parallel connection, the improvement which comprises an inductor saturable by current flow therethrough being connected in series with a power supply circuit for said parallel connected control space paths thereby preventing more than one of said control space paths from being ionized at the same time by developing a potential thereacross opposing the potential applied to said parallel connected control space paths by the power supply circuit therefor incident to the ionization of one of said control space paths so as to prevent an ionization breakdown potential from being

applied to more than one of said parallel connected control space paths, and said saturable conductor thereafter saturating so as to prevent a high value surge potential from being developed thereacross due to ionization transfer to one of said auxiliary space paths thereby diminishing the time interval during which the impedance element associated with said ionized auxiliary space path attains a peak potential thereacross.

4. In combination, a plurality of gaseous space paths being connected into a low impedance parallel connection, an inductor saturable by current flow therethrough in series with said parallel connected gaseous paths, a power supply source being connected to said inductor-gaseous space path subcombination so that the ionizing potential for said space paths is applied through said saturable inductor whereby a potential opposing the potential of said power supply source

is developed across said saturable inductor incident to the ionization of one of said gaseous space paths thereby preventing more than one of said space paths from ionizing and said saturable inductor thereafter saturating due to the magnitude of current flow therethrough so as to attain peak current flow therethrough in a short time interval after lock-out.

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