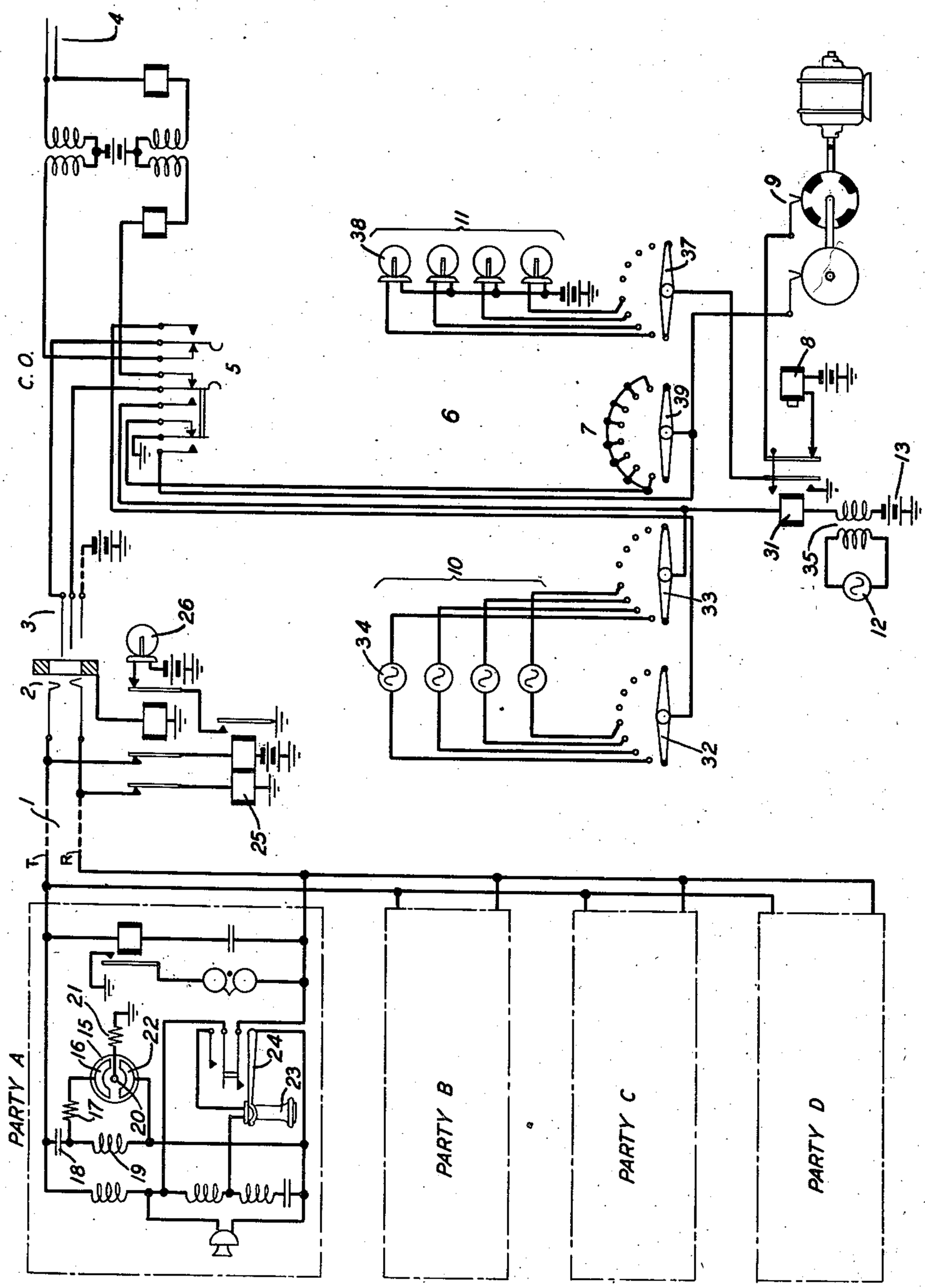
March 30, 1943. M. A. LOGAN 2,315,000

TELEPHONE SYSTEM

Filed Feb. 2, 1940



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Patented Mar. 30, 1943 2,315,000

UNITED STATES PATENT OFFICE

2,315,000

TELEPHONE SYSTEM

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Application February 2, 1940, Serial No. 316,902

9 Claims. (Cl. 179—8.5)

This invention relates to telephone systems and particularly to improvements in systems for identifying subscribers on party lines.

An object is to obtain greater effectiveness in the use of identification tests for determining the calling subscribers on party lines.

Heretofore arrangements of this kind have been used in which tests were performed by having a two-element space discharge device arranged in series with a relay at each substation connected so that when a party is calling a potential of proper direction applied at the central office will activate the tube and cause the associated relay to operate to connect one side or the other of the line to ground to test for the calling party. Another arrangement that has been proposed heretofore makes use of three-element tubes for identifying a calling party. In this case when a subscriber calls, a current of a particular polarity is applied to operate a tube and cause it to unbalance relay devices at the central office to identify the calling party.

It is a feature of the present invention to employ cold-cathode three-element tubes at the substations of party lines for identification tests arranged so that a control electrode of the tube at each station is connected through a specially tuned network to both conductors of the line, another electrode is connected to ground, and a third electrode is connected directly to one of the conductors of the line. At the central office an arrangement is provided whereby a series of different testing frequencies may be applied in succession across the line conductors and simultaneously current from a special source may be applied to the conductor connected directly to the third electrode. When the frequency to which the network at the calling station is tuned is applied, the associated tube is ionized over the control gap between the first and third electrodes. This permits current to flow from the special source over the associated conductor and the main gap between the second and third electrodes to ground. This current causes the operation of a relay at the central office to identify the calling line as determined by the particular testing frequency applied at the time.

The invention has been illustrated in the accompanying drawing in which a four-party line has been shown arranged in accordance with the invention. This line terminates at a central office in a jack where a plug and associated circuits at an operator's position are shown for applying the frequencies to perform the identification tests.

Referring now to the drawing, 1 is a line terminating in four-party line stations A, B, C and D. The equipment of party A has been shown in detail whereas the equipments of parties Nos. B, C and D are shown merely by boxes. Line 1 terminates in a jack 2 at the central office CO where an operator's equipment has been shown having a plug 3 for insertion in the jack 2. This operator's equipment may consist of the plug 3 and a cord circuit arrangement for extending a connection to a called subscriber through a plug 4, and an operator's key 5 which may be operated to perform identification tests to determine the calling subscriber. The equipment for this purpose has been shown at 6 and consists of a step-by-step switch 7 and an associated stepping magnet 8 therefore and a motor driven device 9 for actuating the stepping magnet to step the brushes of the switch from one position to another to apply the different frequencies in the series 10 to the line and to operate lamps in the series 11 to signal the operator that a particular party is calling. A special current source 12 and 13 has been shown for applying current therefrom to one conductor of the line for testing as will hereinafter be described.

It should be noted that in the subset for party A, a tube 15 is provided with a connection from the auxiliary or control electrode 16 through a resistance 17, a condenser 18 and an inductance 19 of a specially tuned network to the tip and ring conductors of the line. This network is connected in shunt of the subscriber's telephone circuit including the usual transmitter, receiver and induction coil. Networks comprising such elements as 17, 18 and 19 but differently tuned are provided for each party line station and the resonant frequency for each party corresponds to one of the frequencies in the series 10. Another connection is provided from the main anode 20 through a resistance 21 to ground, and still another connection is provided from the control cathode 22 directly to the ring conductor of the line.

If it is assumed that the party A desires to establish a connection, he removes his receiver 23 from the switchhook 24 and thereby closes a connection across the tip and ring conductors to operate the line relay 25 at the central office, this relay in turn closing a circuit for lamp 26 to notify the operator that the call is waiting on jack 2. The operator then inserts plug 3 into jack 2 and through suitable means (not shown) establishes a connection through the cord circuit over plug 4 to the desired subscriber's line as is well known in the art. If now the operator de-

sires to identify the calling party, she operates key 5 and thereby closes a circuit through the motor driven interrupter arrangement 9 for the stepping magnet 8 to cause this magnet to step the brushes of the switch 7 from one set of terminals to another. This circuit may be traced from battery, winding of magnet 8, contacts of relay 31, brushes of interrupter 9, contacts of key 5 to ground. On the first step, the brushes of banks 32 and 33 establish a connection over the tip and ring conductor from the first frequency 34 through contacts of the key 5, plug 3, jack 2, line 1 through the condenser 18 and inductance 19. This network is wired in shunt of the subscriber's telephone circuit and the inductance 19 may be wound with very fine wires and thus noise disturbances in the subscriber's telephone circuit and transmission losses may be reduced to a minimum. If now this network is tuned to respond to the frequency from source 34, an increased potential due to series resonance will be established between the control electrode 16 through resistance 17 and cathode 22 for ionizing the tube 15. This in turn permits current to flow from the special sources comprising the special frequency source 12 operative through the repeating coil 35, and the special direct current source 13 through the winding of relay 31, contacts of key 5, plug 3 and jack 2, the ring conductor, switchhook contacts 24, the cathode 22, the main gap and main anode 20, resistance 21 to ground. This current will operate relay 31. This relay is slow to operate to guard against false operation of the relay that may be due to a transient breakdown of the tube 15. The special alternating current source 12 is provided to allow the tube to extinguish if the control gap does not remain ionized. Relay 31 in operating opens the circuit for the stepping magnet 8 to stop the switch 7 after the first step on the first contacts of the various banks. It will be noted then that relay 31 also closes a circuit from battery through lamp 38, the first contact of bank 37 to ground at the contacts of relay 31 to light this lamp to indicate to the operator that the party A is the one making the call. If any of the other parties had called, the switch 7 would have operated to test the succeeding parties until the calling party's terminals were found when current would have flown from the corresponding frequency in the group 10 through the corresponding network at the calling station and thus cause the operation of the corresponding lamp in the group 11 to identify the calling party. The operator may now restore the key 5 to normal and disconnect the testing equipment 6 from the line. The release of key 5 opens a circuit for relay 31 which now releases and disconnects the alternating current sources from the line. Relay 31 in releasing closes again the operating circuit for stepping magnet 8 from battery through the winding of this magnet, contacts of relay 31, the interrupter 9, the brush of bank 39, through the first contact of this bank to ground at key 5. Thus the stepping magnet 8 will cause the switch to step back to normal position over circuits closed through contacts of bank 39.

What is claimed is:

1. In a telephone system, a two-conductor line having a plurality of subscribers' stations, a network tuned to a different frequency at each station, a cold cathode tube at each station, a plurality of sources of voltage, each of a frequency corresponding to one of said networks, means for applying in succession voltages from each of said sources across the conductors of said line for causing the tube at a calling station to ionize when the frequency to which the associated network is responsive is applied across the line conductors, and means operative in a circuit including one of the line conductors only in response to the ionization of the tube for identifying the calling station.

2. In a telephone system, a two-conductor line, a plurality of subscribers' stations on said line, a network tuned to a different frequency at each station, a three-element space discharge device at each station, a plurality of sources of voltage each of a frequency corresponding to one of said networks, means operative for applying in succession voltage from each of said sources across the conductors of said line for causing the space discharge device at the calling station to ionize the control gap between two of its electrodes in response to the frequency to which the associated network is responsive when applied across said conductors, and means operative in response to said ionization for causing current to flow across the main gap of said space discharge device between one of said electrodes and the anode electrode and over one conductor only of said line for identifying the calling station.

3. In a telephone system, a two-conductor line having a plurality of subscribers' stations, a network tuned to a different frequency at each station, a cold cathode tube at each station, a group of courses of voltage each of a frequency corresponding to one of said networks, a separate source of current, means for connecting the sources of voltages in said group in succession across the conductors of said line and for simultaneously connecting said separate source of current to one conductor only of said line, means effective when any one of said stations is calling for causing the associated tube to ionize in response to the frequency to which the associated network is responsive when applied to the line from the corresponding source, means responsive to the ionization of said tube for causing current to flow from said separate source over said one conductor only of the line through said tube to ground, and means operative in response to said flow of current over said one conductor only for identifying the calling station.

4. In a telephone system, a two-conductor line having a plurality of subscribers' stations, a tuned circuit responsive to a different frequency at each station, a cold cathode tube at each station having electrodes forming a control gap and a main gap, a group of sources of voltage, each of a frequency corresponding to one of said tuned circuits, a separate source of current, means for applying across the two conductors of said line voltage from each of the sources of voltages of said group in succession and for simultaneously applying current from said separate source to one of said line conductors only, circuit means for connecting the tuned circuit and the associated tube at a calling station so that when voltage of the frequency to which the said tuned circuit is responsive is applied to the line conductors said tube will ionize over the control gap and so that current from said separate source will then ionize the main gap and cause current to flow from said separate source over said one conductor only through said main gap to ground, and means responsive to said flow of current for identifying said calling station.

5. In a telephone system, two-conductor line having a plurality of subscribers' stations, a

tuned circuit responsive to a different frequency at each station, a cold cathode tube at each station having electrodes forming a control gap and a main gap, a group of sources of voltage, each of a frequency corresponding to one of said tuned circuits, a separate source of current, means for applying across the two conductors of said line voltage from each of the sources of voltages of said group in succession, and for simultaneously applying current from said separate source to one of said line conductors only, circuit means for connecting the tuned circuit and the associated tube at a calling station so that when voltage of the frequency to which the tuned circuit is responsive is applied to the line conductors, said tube will ionize over the control gap and so that current from said separate source will then ionize the main gap and cause current to flow from said separate source over said one conductor only through said main gap to ground, a relay having its winding connected in said one conductor operative in response to said flow of current, and means operative in response to the operation of said relay for identifying the calling line.

6. In a telephone system, a two-conductor line having a plurality of subscribers' stations, a three-element space discharge tube having an auxiliary electrode, a cathode and a main anode with the main anode connected to ground at each station, a network at each station connected to the auxiliary electrode and the cathode of the associated tube and to the line conductors, said network being tuned to different frequencies at each station, a central office at which said line terminates, a plurality of sources of voltages at said central office, each of a frequency corresponding to one of said networks, means for applying in succession voltage from each of said sources over the conductors of said line for causing the tube at a calling station to ionize when the frequency to which the associated network is responsive is applied across the conductors, a separate source of current at said central office, means operative on ionization of a tube for causing current to flow from said separate source in a circuit including one of the conductors only, over the cathode and the main anode of said ionized tube to ground, and means responsive to the flow of said current over said one conductor only for identifying the calling station.

7. In a telephone system, a two-conductor line, a plurality of subscribers' stations connected to said line, a telephone circuit at each station including inductance coil, transmitter, and receiver elements, a network tuned to a different frequency at each station connected in shunt of the associated telephone circuit, a space discharge tube connected to each network, a plurality of sources of voltage, each of a frequency corresponding to one of said networks, means for applying in succession voltages from each of said sources across the conductors of said line for causing the tube at a calling station to ionize when the frequency to which the associated network is responsive is applied across said conductors, means responsive to the ionization of said tube for causing current to flow through said tube in a circuit including one of said line conductors only, and means operative in response to said flow of current for identifying the calling station.

8. In a telephone system, a two-conductor line, a plurality of subscribers' stations connected to said line, a telephone circuit at each station including induction coil, transmitter and receiver elements connected across the two line conductors when the associated station is calling, a network circuit comprising a condenser and an inductance in series and tuned to a different frequency at each station, said network circuit being connected across the line conductors in shunt of the associated telephone circuit, a cold cathode tube having electrodes forming a control gap and a main gap, a circuit connecting the electrodes for the control gap across the said inductance, a plurality of sources of voltages each of a frequency corresponding to one of said networks, means for applying in succession voltages from each of said sources across the conductors of said line for causing the tube at the calling station to ionize across said control gap when the frequency to which the associated network is responsive is applied across said conductors, and means operative in a circuit including one of the line conductors only and said main gap of the tube in response to the ionization of the control gap for identifying the calling station.

9. In a telephone system, a two-conductor line, a plurality of subscribers' stations on said line, a telephone circuit at each station including induction coil, transmitter and receiver elements connected across said conductors when the associated station is calling, a network circuit tuned to a different frequency at each station and connected across the line conductors and in shunt of the associated telephone circuit when said station is calling, a space discharge device at each station connected in parallel with said network circuit, a plurality of sources of voltages, each of a frequency corresponding to one of said network circuits, means operative when a subscriber is calling for applying in succession voltages from each of said sources across said line conductors for causing the associated network circuit to respond to the frequency to which it is tuned and thereby cause the control gap between two of the electrodes of said space discharge device to ionize, and means operative in response to said ionization for causing current to flow across the main gap of said discharge device between one of said electrodes and the anode electrode and over a circuit including one of the line conductors only for identifying the calling station.

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