

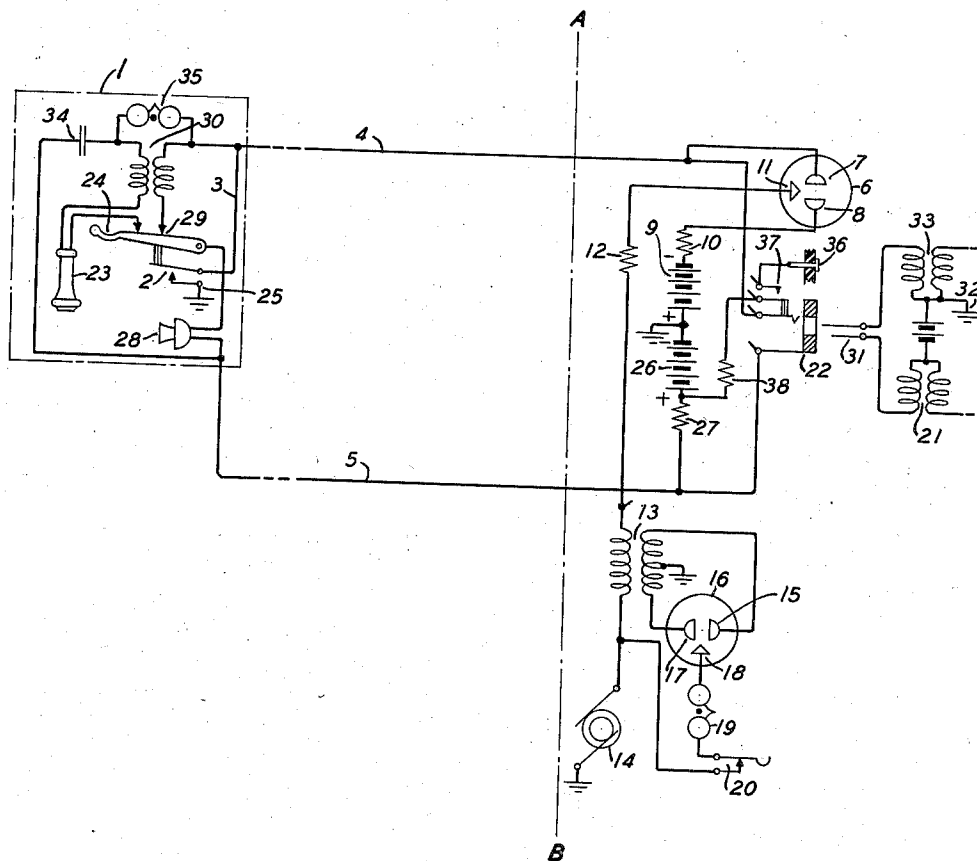
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and more particularly to common battery subscribers' lines which terminate at a manual switchboard and are so arranged that when a subscriber calls by removing his receiver from the hook a lamp is lighted before an operator as a calling signal.

In such systems it has been customary in the past to connect each line to a central battery through a double wound line relay which operates when a calling subscriber removes his receiver thereby closing a local circuit through a signal lamp usually located in the face of the switchboard. When the operator answers by inserting a cord circuit plug in the answering jack of the line a sleeve circuit is completed which operates what is known as a "cut-off" relay associated with the line which disconnects the line relay and battery from the line thereby darkening the line lamp. Such an arrangement requires three distinct devices for each line, namely, a line relay, a cut-off relay and a line lamp.

An object of the present invention is to decrease the number of such devices required for a line thereby reducing the cost of the line without lessening the efficient operation thereof.

A feature of the invention whereby the foregoing object is attained resides in the employment of what is known as a gas-filled or ionic device the function of which is to serve in the threefold capacity of a line relay, a line lamp and a cut-off relay.

The invention will be understood from the following description when read in connection with the accompanying drawing which represents a common battery subscriber's line arranged in accordance with the present invention and terminating at a common battery manual switchboard.

Referring to the drawing, the apparatus within the box bounded by the broken lines, with its circuit interconnections, illustrates a common battery subscriber's station 1, with receiver shown off the switchhook, of the usual type, except that a special contact 2 is provided to normally ground the tip side of the line over conductor 3, for a purpose that will be hereinafter described. Station 1 is connected by line conductors 4 and 5 with central office apparatus located to the right of the broken line AB.

The ionic gas-filled tube 6, located in the face of the switchboard adjacent to the answering jack 22, which is of the cold cathode, double gap type, is so constructed that the potential

necessary for ionization applied across anode element 11 and control element 7 or across anode element 11 and cathode element 8 is much greater than the ionizing potential required across control element 7 and cathode element 8. After the control gap across elements 7 and 8 has broken down, however, the anode gap also breaks down and ionization across the main gap is sustained, that is, across elements 11 and 8 at a potential only slightly greater than the breakdown potential required for the control gap. After the main or anode gap of the tube has once broken down, the control gap cannot regain control until ionization across the main gap ceases.

It has been found in practice that tube 6 can be constructed so that the control gap between elements 7 and 8 will break down and effect ionization of the tube when the potential connected to these elements is approximately 65 to 70 volts and that the sustaining potential across these same elements is then about 50 to 60 volts. Correspondingly, for a tube of this construction the breakdown potential between anode element 11 and cathode element 8 is much higher—about 150 to 180 volts. However, after the tube has ionized the sustaining potential across the main gap, that is, between elements 11 and 8 is much less—about 70–80 volts.

Tube 6 has a three-fold function as line relay, line lamp and cut-off relay. Control element 7 is connected to the tip conductor 4, and cathode element 8, to the grounded negative pole of battery 9 through the resistance 10. Anode element 11 is connected through resistance 12 and the left winding of a transformer 13 to a grounded alternating current ringing generator 14. Transformer 13 is constructed so that the left or primary winding is of low impedance, and the right or secondary winding of high impedance. The right winding of transformer 13 is grounded at its center point. Cathode element 15 of gas-filled tube 16, which is of the same general construction as that of tube 6, is connected to the upper terminal of aforesaid right winding and cathode element 17 to the lower terminal. Anode element 18 is connected to one terminal of a night alarm ringer 19, which is connected through a key 20 to the upper terminal of the generator 14. Incoming calls which cause tube 6 to glow, as hereinafter described, are answered with cord circuit 33, which is shown in abbreviated form and is of the usual common battery type, by plugging into jack 22, in which line conductors 4 and 5 terminate.

Let it be assumed that the subscriber of sta-

tion 1 initiates a call by removing receiver 23 from its associated switchhook 24, which then assumes the position shown in the drawing, thereby opening contacts 2 to disconnect ground 25 from line conductor 4. The normal grounding of conductor 4 is to avoid the possibility of causing an improper ionization of tube 6 by leakage across line conductors 4 and 5, which might raise the potential across elements 8 and 7 sufficiently to falsely ionize tube 6. A circuit can now be traced from ground through auxiliary battery 26, high resistance 27, over conductor 5, through transmitter 28, switchhook contacts 29, right winding of induction coil 30 over conductor 4, through control element 7, tube 6, cathode element 8, resistance 10 and central office battery 9 to ground. The sum of the potentials of batteries 9 and 26 which in practice can be conveniently fixed at approximately 96 volts, is accordingly impressed across elements 7 and 8 and causes tube 6 to break down and ionize. However, due to the high resistance 27, which may be of the order of 50,000 ohms, the tube discharge current will be of low value and there will be little illumination. As soon, however, as tube 6 breaks down across the control gap as just described, it immediately breaks down across the main gap, that is, from anode element 11 to cathode element 8, on the occurrence of the first positive half cycle of current from the generator 14, the voltage of which exceeds the main gap sustaining potential of 70-80 volts, hereinbefore mentioned. There will now be a flow of current in a circuit traced from ground through generator 14, left winding of transformer 13, resistance 12, anode element 11, through tube 6, cathode element 8 and resistance 10 to grounded negative battery 9. This current will cause tube 6 to glow and attract the attention of the operator before whose position the jack 22 is located. Due to the unidirectional character of the anode element 11 the current passed by ringing generator 14 through the left winding of transformer 13 will be pulsating, each negative half wave being suppressed. This current will be superimposed on the current through the control gap of the tube and cause thereby a corresponding variation of the line current, which will be heard at station 1 as a ringing signal. The aforesaid pulsating current will induce a potential in the right winding of transformer 13, which will cause tube 16 to break down and ionize. As in the case of tube 6 a unidirectional pulsating current will flow from ground through generator 14, key 20 (assuming that key 20 is normal as shown), ringer 19, anode element 18, tube 16, cathode element 15 or 17 to ground through the associated half section of the right winding of transformer 13. The current from anode element 18 will be directed to the cathode 15 or 17, which may be negative while anode 18 is positive. Ringer 19 now responds to the pulsating current aforesaid.

Answering the visual and audible signals before described, the operator inserts the plug 31 of cord circuit 33 into jack 22. When the tip conductor of plug 31 makes contact with the tip conductor of jack 22, ground 32 is connected through the left upper winding of repeating coil 21 to line conductor 4, which reduces the potential across the elements 8 and 7 to such a value that tube 6 deionizes on the first occurrence of zero current from generator 14. Consequently, current ceases to flow through the left winding of transformer 13, no current is induced in the right winding and

tube 16 also deionizes, silencing the ringer 19. The circuit is now ready for communication.

The description before given discussed the operation of the invention for a call originated by station 1. For calls originated at the switchboard the operator will insert plug 31 into jack 22, and with a ringing key, not shown, connect ground and a source of grounded ringing current, also not shown, to line conductors 4 and 5, respectively, thereby causing ringing current to flow over conductor 5, through condenser 34, ringer 35 over conductor 3 to ground 25 through closed switchhook contacts 2. The subscriber of station 1, in response to the actuation of ringer 35 now removes receiver 23 from switchhook 24. Tube 6, however, does not break down because of the ground on tip conductor 4, connected during the ringing interval and also after ringing ceases, through one of the upper windings of the repeating coil 21.

The description hereinbefore given, with the accompanying drawing covers only a single switchboard appearance of the subscriber's line. It is to be understood, however, that other appearances may be provided, by connecting one additional tube, similar to tube 6, for each additional appearance.

For a plurality of tubes, the control elements corresponding to element 7 of tube 6 should all be connected together. Each element corresponding to element 8 should be provided with an individual resistance corresponding to resistance 10 and connected to the common battery 9. Each anode element 11 should be provided with its individual resistance 12 and connected to the upper terminal of the left winding of transformer 13 and the tip and sleeve conductors of all jacks should be multiplied. When the receiver at station 1 is removed from its switchhook 24, all tubes will ionize and glow and the entire anode discharge current of all tubes will now pass through the left winding of common transformer 13. As soon as an operator responds by inserting the plug of a cord circuit into an associated jack all tubes will be deionized and cease to glow and the operators at other positions will know that the call has been answered. For calls outgoing to station 1, a busy test terminal 36 may be provided for each jack and so arranged that when a plug is inserted into a jack associated local contacts 37 will close and connect auxiliary battery 26 through common resistance 38 to the corresponding test terminal and all the other terminals which are connected in multiple with it. When the operator touches a test terminal with the tip of the cord circuit plug, current will flow from battery 26, through resistance 38, contacts 37 of jack 22, or corresponding contacts of another multiple jack, terminal 36 or some other corresponding multiplied terminal, through the tip conductor of the cord circuit and winding of repeating coil 21 to ground, thereby causing a click in the receiver of the operator's telephone circuit, not shown, and indicating that the line is busy.

What is claimed is:

1. In a common battery telephone system, a switchboard, a subscriber's line terminating thereat, a gas-filled discharge device having two discharge paths, a source of alternating current, a central office battery, an auxiliary source of direct current potential, a connection across said line serially including one of said discharge paths, said central office battery, said auxiliary source and a high resistance, and a circuit serially including said second discharge path, said alter-

nating current source and said central office battery, said auxiliary source of potential being connected in an aiding direction with respect to the central office battery across said first discharge path, the potential of said auxiliary source being of such a value as, when added to the potential of the central office battery, to cause said first discharge path to break down and effect ionization of said device, and said discharge device being so constructed and arranged that the anode electrode of the second path will be sufficiently illuminated by discharge thereacross to serve as a visual signal.

2. In a common battery telephone system, a switchboard, a subscriber's line terminating thereat in a jack, a cord circuit adapted to be connected to said line through the medium of said jack, a central office battery connected in bridge of said cord circuit, a gas-filled discharge device having two discharge paths, a source of alternating current, an auxiliary source of direct current potential, a connection across said line serially including one of said discharge paths, said auxiliary source, the central office battery and a high resistance, and a circuit for said second discharge path serially including said central office battery and said alternating current source, said auxiliary source of potential and said central office battery in said first discharge path being connected in series aiding with respect to each other and in a reverse polarity direction across

said line to the polarity of said central office battery when it is connected to the line by means of said cord circuit and jack.

3. In a common battery telephone system, a line, a central office battery, a link circuit adapted to be connected to said line to connect said central office battery thereacross in one polar direction, an auxiliary source of direct current, a source of alternating current, a three-element gas-filled discharge device comprising an anode, a cathode, and a control electrode, a first circuit in bridge of said line serially including said cathode, control electrode, central office battery, and auxiliary source, said battery and auxiliary source being connected in said first circuit in series aiding and in a polar direction opposed to the direction of connection of said battery to the line by said link circuit, and a second circuit including said anode, alternating current source, and that portion of the first circuit including the cathode and central office battery.

4. In a common battery telephone system, a line, an ionic glow discharge device associated therewith, and means, including a central office battery, an auxiliary source of direct current, and a source of alternating current, cooperating with said line and device for causing said device to serve the three-fold purpose of a line relay, line lamp, and cut-off relay.

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