

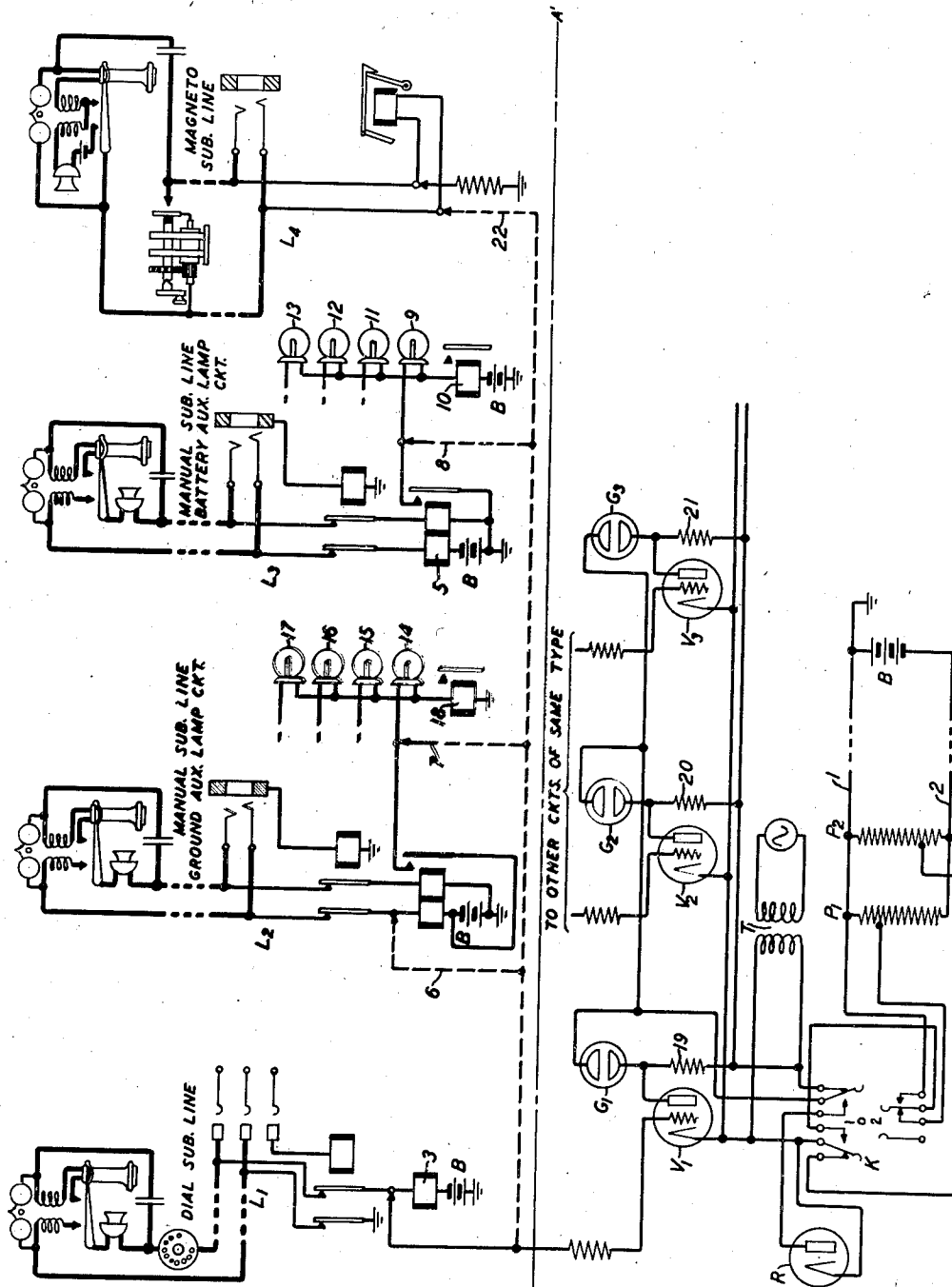
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SERVICE OBSERVING SET

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SERVICE OBSERVING SET

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This invention relates to telephone service observing systems and more particularly to systems for visually indicating to an observer when a call is initiated on a line under observation.

Central office line circuits may be roughly classified as dial line circuits, which lines have a line relay arranged to control automatic switching equipment, manual common battery line circuits having a line relay controlling a local circuit including a line lamp, and magneto line circuits over which alternating current, generated at a subscriber's station, is transmitted to actuate a drop or other alternating current electromagnetic device at the central office.

With regard to the local line lamp circuits of manual common battery lines, one terminal of each lamp of a plurality of lines is usually connected in multiple to either battery or ground through a common series relay, sometimes referred to as an "auxiliary" relay, which auxiliary relay controls a pilot lamp located before the operator which lights whenever any one of a group of line lamps is lighted. The other terminal of each individual line lamp is normally open at contacts of the respective line relay and when any line relay operates, the respective line lamp circuit is completed to either ground or battery depending on whether the common connection, including the auxiliary relay, is connected to battery or ground. Line lamp circuits in which the auxiliary relay is connected to battery are referred to as "battery auxiliary" circuits and those connected to ground as "ground auxiliary" circuits.

An object of the invention is to provide observing equipment which can be associated with any one of the foregoing three types of line circuit, including either ground or battery auxiliary lamp circuits, and caused to give an observer a visual signal when a call is initiated over a line with which the equipment is connected, without appreciably affecting the normal functioning of the line, and line equipment, in question.

A feature of the invention resides in the provision of a glow discharge lamp which is controlled, responsive to the initiation of a call, by means of a thermionic vacuum tube whose grid circuit is so associated with the line circuit, or lamp circuit, that a potential change caused by the initiation of a call causes the output circuit of the vacuum tube, which includes the glow lamp, to alter its impedance and cause the lamp to glow.

When observing on dial lines, the grid of the vacuum tube is connected to one terminal of the line relay, and the cathode to a point in a potentiometer connected across the central office battery, in such a manner that the cathode will, normally, be positive with respect to the grid by such an amount that the anode-cathode path

of the tube will present a high impedance to the passage of plate current. The glow lamp is connected in series with a source of alternating current between the anode and cathode of the vacuum tube to complete the output circuit of the tube. When the line relay is energized, the potential drop across its winding causes a change in the potential relation of the grid with respect to the cathode in a positive direction thereby decreasing the impedance of the anode-cathode path and permitting sufficient current to flow to cause the observer's lamp to glow.

In the case of manual common battery lines, this same arrangement, as previously described, can be used by connecting the vacuum tube input circuit in the same manner to the line relays of the lines on which it is desired to observe. Further, in the case of "battery auxiliary" line lamp circuits, a similar connection to a terminal of the line lamp, instead of the line relay, will cause the observer's lamp to glow when the line lamp is lighted.

In the case of "ground auxiliary" line lamp circuits, if for some reason it is desired or necessary to connect the observing circuit to the line lamp instead of the line relay, a somewhat different arrangement of the glow lamp in the output circuit of the tube is necessary.

In this arrangement, i. e., connection to "ground auxiliary" line lamp circuits, the grid of the vacuum tube will be connected to the circuit of the line lamp at a point between the lamp and the contacts of the line relay and the cathode to a point in a potentiometer connected across the central office battery such that when the line relay is non-operated, the potential of the cathode with respect to the grid will not be positive, which can be the case if current flows in the before-mentioned auxiliary relay due to other line lamps of the same group being lighted. Under this condition, i. e., the grid not negative to the cathode, the plate circuit impedance of the vacuum tube will be relatively low. When the line lamp is lighted by closure of the line relay contacts, the drop in potential across the lamp will drive the grid negative with respect to the cathode thereby increasing the impedance of the plate circuit.

In order that the observer's lamp shall glow, as before, when a call is initiated, the anode and cathode are connected to opposite terminals of the alternating current source, and the glow lamp, in series with the rectifier, is connected in shunt thereto. When the line under observation is idle, the impedance of the plate circuit is relatively low and passes current from the source, thereby shunting the glow lamp and rectifier which, therefore, does not receive sufficient voltage to glow. When a call is initiated the line lamp is lighted and a change of potential on the

grid of the vacuum tube occurs in a negative direction with respect to the cathode, thereby increasing the impedance of the plate circuit and causing the glow lamp to discharge.

The rectifier in series with the glow lamp is necessary in this case in order to prevent the lamp from glowing on alternate negative half waves when the vacuum tube does not conduct and, therefore, does not shunt the glow lamp.

When observing on magneto lines which, under normal conditions, are free of battery and ground, the grid of the vacuum tube is connected to the ring conductor of the line, the cathode is grounded, and the tip of the line is connected to ground through a high resistance which, in effect, results in connecting the grid and cathode to opposite sides of the line. In the absence of ringing, the grid and cathode are both of the same (zero) potential and hence the anode-cathode gap will be of low impedance and will shunt the glow lamp in the same manner as previously described. Alternate half waves of ringing current will drive the grid negative with respect to the cathode thereby increasing the plate impedance and permitting the glow lamp to fire as before.

A further feature of the invention resides in a switching arrangement whereby the circuits of the observing equipment can be conditioned for connection to any one of the foregoing types of circuit to function in the manner above described.

The invention will be understood from the following description and accompanying drawing which shows a service observing set and four different types of circuits including a dial subscriber's line circuit, a magneto subscriber's line circuit and two manual common battery line circuits, one of which manual circuits has its line lamp connected through an auxiliary pilot relay to ground and known as a "ground auxiliary" circuit and the other shows the line lamp connected through the auxiliary pilot relay to battery and known as a "battery auxiliary" circuit, the subscriber's line circuits being shown above the horizontal broken line A-A' and the circuits of the observing set below.

Further, the set is shown conditioned to observe on dial subscribers' lines or battery auxiliary line lamp circuits and a connection to a dial line L_1 is shown by the solid line extending from the grid of the first vacuum tube V_1 to a point in the circuit of line relay 3. Connections for observing on other types of lines and at different points therein are shown by dotted lines 6, 7, 3 and 22.

A description of the operation of the service observing set in connection with dial subscribers' lines will first be given.

Dial lines

The observing set as shown, provides facilities for observing on three lines, although in practice facilities for observing on thirty lines are usually provided. The individual facilities for each line consists of a thermionic vacuum tube V_1 , V_2 , etc. and a corresponding glow discharge lamp G_1 , G_2 , etc. Common to all the individual line facilities is a key K, a rectifier R, potentiometers P_1 and P_2 and a source of alternating current represented by transformer T. It will be understood that the batteries indicated as B, throughout the drawing, are one and the same and represent the usual central office source of direct current supply.

We will assume that key K is in its upper (No. 1) operated position, that the conductors 1 and 2 are connected to the positive and negative termi-

nals, respectively, of the central office battery B, that a source of alternating current is connected to the right-hand winding of transformer T, and that the grids of tubes V_1 , V_2 , etc are connected to the line relay circuit of a chosen group of dial subscribers' lines such as L_1 .

It will be observed that in the common circuit of the set, the cathode of each of the tubes is connected over the outer left upper contact of key K to an intermediate point in potentiometer P_2 , connected across the central office battery B, and that the left-hand winding of transformer T is in a series circuit including the anode of the tubes in parallel, glow lamp G_1 , upper outer right contact of key K, left winding of transformer T and the cathode of tubes in parallel.

Due to the fact that the grid of V_1 is connected to the negative terminal of battery B through line relay 3, and the cathode is effectively connected to a point in battery B which is at a higher potential, i. e., positive, with respect to the grid, the plate circuit of tube V_1 will be non-conducting as is well-known in the art. However, when the subscriber on line L_1 calls by lifting the receiver from the hook, line relay 3 is energized in the usual manner and the potential drop across its winding is sufficient to reduce the potential difference between the grid and cathode to zero or to a point where the grid is slightly positive with respect to the cathode whereupon the impedance of the plate circuit of the tube is decreased to a point where sufficient current from the alternating source will flow from the anode to the cathode of the tube to cause glow lamp G_1 to discharge, which will indicate to the observer that a call has been initiated on a line L_1 . She, therefore, connects her listening equipment (not shown), consisting of an amplifier and a head receiver, to the line, corresponding to glow lamp G_1 , by means of suitable key equipment, in order to observe the quality of the service. As this is an old and well-understood function, no further reference will be made thereto in the description which follows:

Obviously, as manual common battery lines such as L_2 and L_3 are equipped with line relays such as 4 and 5, the observation set can also be connected to either of these circuits, as indicated by the dotted connection 6 to line L_2 , the condition encountered being the same as that previously described for dial line L_1 . The position of key K will be the same as before and the vacuum tube and glow lamp will function in the same manner.

Further, if for some reason it is desired to connect the observing set to the line lamp circuit instead of the line relay circuit, the same condition as before will exist if a connection 8 is established from the grid of tube V_1 to the local circuit of line lamp 9 of line L_3 . When line relay 5 is not operated the circuit of lamp 9 is open and the grid is connected to the negative terminal of battery B, through lamp 9 and auxiliary pilot relay 10. Key K being still in position 1 the cathode is effectively connected to a point in the battery which is more positive than the grid, this value being so chosen that if line lamps 11, 12, etc. of other calling lines, are lighted, which lamps are connected in multiple to battery in series with auxiliary relay 10, the drop in potential across this relay will not raise the potential of the grid, with respect to the cathode, sufficiently to cause the plate circuit of the tube to pass current and discharge the glow lamp. It, therefore, will be observed that with the key K in its upper, or No. 1 operated, position the observing set is conditioned for connection to either dial or manual

common battery line circuits or to a so-called "battery auxiliary" line lamp circuit whereby when a call is initiated on a line, the plate circuit of a connected vacuum tube passes current to discharge a glow lamp included therein.

Ground auxiliary line lamp circuits

It may be that in the exchange where service is to be observed, the manual line lamp circuits are of the so-called "ground auxiliary" type, i. e., the line lamps of a group of lines are connected through a common auxiliary pilot relay to ground, as shown in connection with line L₂, instead of the so-called "battery auxiliary" arrangement previously considered as shown in line L₃.

In case it is desired to connect the observing set to a line lamp circuit of this type (i. e., ground auxiliary), a rearrangement of the observing set circuit is necessary in order that the same glow lamp indication is obtained when a call is initiated on such lines.

As before, a connection 7 is established between the line lamp circuit and the grid of a tube, V₁ for example, and key K is restored to its normal or "0" position, thereby connecting the tube cathode to a point in potentiometer P₁ which is negative, by a predetermined value, with respect to the point in the line circuit to which the grid is connected, thereby creating a condition such that when the circuit of lamp 14 is open at contacts of relay 4, the grid will not be negative by any effective amount with respect to the cathode under the extreme condition when all the other line lamps 15, 16, 17, etc. of the group connected to ground in series with auxiliary relay 18, are lighted. It will, therefore, be noted that under normal conditions, the grid of tube V₁, being at the same potential as the cathode, or positive thereto, will have no blocking effect on the passage of plate current therein.

The other connection established by the restoration of key K to normal consists in connecting the rectifying device R in series with the alternating source and all the glow lamps in parallel, and in connecting the anode and cathode of each tube, in series with a suitable resistance, in shunt to its respective glow lamp and the common rectifier. Under the above condition each tube whose grid is not sufficiently negative with respect to the cathode to block the flow of plate current from the alternating source will discharge thereby shunting its respective glow lamp and diverting sufficient current therefrom to prevent a glow discharge. The common rectifier R is so connected in the circuit as to block current, in a direction opposite to the direction of the vacuum tube, from flowing through the glow lamp. The connections of the foregoing arrangement can be traced as follows: Upper terminal of the left-hand winding of transformer T, cathode of rectifier R, anode of rectifier R, inner upper right contacts of key K, glow lamps G₁, G₂, G₃, etc., and respective series resistances 19, 20 and 21, in parallel, to the lower terminal of transformer T thereby connecting the rectifier and alternating current source in series with all the glow lamps in parallel. Further, the cathodes of tubes V₁, V₂, V₃, etc. are connected in parallel to the upper terminal of the transformer and each anode in series with its respective resistances 19, 20, etc. is connected to the lower terminal of the transformer, thereby applying alternating current potential between the anodes and cathodes of each tube, and all tubes whose grids are not appreciably negative with respect to the cathode

will present a relatively low impedance to alternate half waves of said source to cause current to flow from the anode to the cathode of such tubes, thereby preventing sufficient current from flowing in the parallel circuits including the respective glow lamps to cause a glow discharge therein.

Whenever a line relay is operated on any line under observation, the corresponding line lamp, 14 for example, will be lighted thereby connecting the grid of the tube V₁ directly to negative battery and blocking the plate circuit of tube V₁ by increasing the impedance of the anode-cathode path, whereupon alternating half waves of the alternating currents are passed by the rectifier R to the glow lamp G₁ which discharges to indicate that a call has been initiated on line L₂.

Magneto lines

The observing set can also be conditioned for connection to magneto lines such as L₄, by operating key K to its lower or No. 2 position whereby the only change from the foregoing arrangement (for ground auxiliary lamp circuits) is that the cathode of the vacuum tubes V₁, V₂, etc. are connected to solid ground instead of to a point in potentiometer P₁.

In making connections to a magneto line, on which it is desired to observe, a connection 22 will be established between the grid of the tube V₁, for example, and the ring conductor of the line, and a high resistance connection (of the order of two megohms) to ground will be made from the tip of the line which in effect results in connecting the output of the tube across the line in series with a high resistance. In this case there being no central office battery involved, the grid and cathode are at zero potential with respect to each other, and, therefore, the tube will be in a normally conducting condition thereby shunting out the glow lamp G₁ as before described.

When the subscriber calls by operating the hand generator at the station, alternating ringing current is transmitted over the line, alternate half waves of which will drive the grid negative with respect to the cathode thereby permitting the glow lamp G₁ to fire on alternate half waves of the source associated with the output of the vacuum tube.

What is claimed is:

1. In a telephone exchange system, a normally open line, a central office battery and a line relay in series with said line, means for closing said line to energize said relay, a vacuum tube having an anode, a cathode and a grid electrode, a glow discharge lamp and a source of potential therefor in series with said anode and cathode, a connection between said grid and the negative pole of said battery including said relay, a potentiometer of predetermined resistance in shunt to said battery and a connection between said cathode and a point in said potentiometer so chosen that when the line is open, said cathode will be positive with respect to the grid by such a potential value as to prevent sufficient current from flowing in the anode-cathode circuit to cause a visual discharge of said glow lamp and when said line is closed said grid will be raised in potential with respect to the cathode to a value permitting sufficient anode-cathode current to flow to discharge said glow lamp with satisfactory brilliancy.

2. In a telephone exchange system, a line, a line lamp and a source of direct current therefor, means responsive to the initiation of a call over

said line to connect said lamp in circuit with said direct current source, a vacuum tube having an anode, a cathode and a grid electrode, a glow discharge lamp and a rectifier in shunt with said anode and cathode, a source of alternating current and a resistance, in series, connected in parallel with said glow lamp and rectifier, a connection between said grid and the positive pole of said direct current source serially including said line lamp, and a connection between the positive pole of said source and said cathode excluding said line lamp whereby when said line lamp is deenergized, the impedance of said anode-cathode circuit is sufficiently low to prevent an effective glow discharge of said glow lamp and when said line lamp is lighted the anode-cathode path is of sufficiently high impedance to cause said glow lamp to discharge in series with said alternating current source with visible brilliancy.

3. In a telephone service observing system, a line lamp, a source of direct current therefor, means for completing a circuit including said lamp and direct current source, a vacuum tube having an anode, a cathode and a grid electrode, an input circuit for said tube, including said grid cathode, and a portion of said direct current source, connected in parallel with said lamp and in such a manner that when said lamp is conducting said grid will be positive to said cathode, an output circuit for said vacuum tube including a resistance, a source of alternating current, and said anode and cathode, and a glow discharge lamp in series connected between said anode and cathode.

4. In a service observing system, a line over which alternating ringing current is transmitted to initiate a call, a vacuum tube having an anode, a cathode and a grid electrode, said grid being connected to one side of the line and said cathode being connected to the other side of the line, an output circuit for said vacuum tube including a resistance, a source of alternating current and said anode and cathode, and a glow discharge lamp and a rectifier in series connected between said anode and cathode.

5. In a telephone exchange system, a line, a central office battery, an electroresponsive device effectively energized, in series with said battery, in response to the initiation of a call over said line, an observer's position, a glow discharge lamp at said position, and means for causing said discharge lamp to glow responsive to energization of said device, said means comprising a vacuum tube having an anode, a cathode and a grid electrode, said cathode and grid, in series with a portion of a potentiometer connected across said battery, being connected to opposite terminals of said device and said anode and cathode being connected to an output circuit including said glow lamp.

6. In a signal observing system, a source of direct current, a plurality of individual electrical devices, each having one terminal connected to the positive pole of said source in series with a common impedance, switching means individual to each device for connecting the other terminal of the respective device to the negative pole of said source, a vacuum tube having an anode, a cathode, and a grid electrode, a series circuit including a glow discharge lamp, a rectifier and a source of alternating current, and connections between said anode and cathode to points in said series circuit so chosen that when the impedance

of said anode-cathode path is sufficiently low to permit unidirectional current from said alternating source to flow from the anode to the cathode, said glow lamp will not receive sufficient current to discharge and when the potential of said alternating source is reversed, the polarity of said rectifier will prevent said glow lamp from discharging, a connection between said grid and a point between one of said individual devices and its respective switching means, and a connection between said cathode and a point in a potentiometer connected across said direct current source, said point being so chosen that when the individual device with which the grid is associated is connected to the negative pole of the source, the drop in potential across the common series impedance, due to any number of the other individual device terminals being also connected to the negative pole, will not impress a positive potential on said cathode with respect to the grid.

7. In a telephone service observing system, an electrical device and circuit therefor including a source of direct current, means to open and close said circuit to control said device, and means to indicate the closure of said circuit comprising a thermionic vacuum tube having its input connected at two points in said circuit whose potentials with respect to each other are changed when said circuit is closed, a glow lamp and a source of alternating current in series in the output of the tube whereby if the grid is connected to a point in the circuit which is negative to the cathode by a predetermined amount when the circuit is open, and changed to a value not negative with respect to the cathode when the circuit is closed, said glow lamp will discharge in response to closure of said circuit, a rectifying device, and switching means for associating said rectifier, glow lamp and alternating source in the output of the tube in such a manner that if the grid is connected to a point in the circuit which is not negative to the cathode when the circuit is open and is made negative by a predetermined amount with respect to the cathode when the circuit is closed, said glow lamp will only receive sufficient current to cause a discharge therein when said circuit is closed.

8. In a telephone service observing system, an electrical device, a circuit therefor including a source of direct current, means for closing said circuit to cause the energization of said device, means for indicating closure of said circuit comprising a vacuum tube and a glow discharge lamp, an anode, a cathode and a grid electrode for said tube, a connection between said grid and cathode to different points in said circuit such that when the circuit is open, the grid is not negative with respect to the cathode and when the circuit is closed, said grid is made negative to the cathode by a predetermined amount, a source of alternating current, and a rectifying device, said alternating current having such a potential and so connected to the anode, cathode, glow lamp and rectifier that when the circuit is open, current from said source will flow between said anode and cathode to the exclusion of said glow lamp and when the circuit is closed, alternate half waves of said source will flow through said rectifier and glow lamp to cause said lamp to discharge.

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