Jan. 6, 1942. H. F. PAGE ET AL 2,269,346

TELETYPEWRITER SWITCHBOARD SERVICE OBSERVING CIRCUIT

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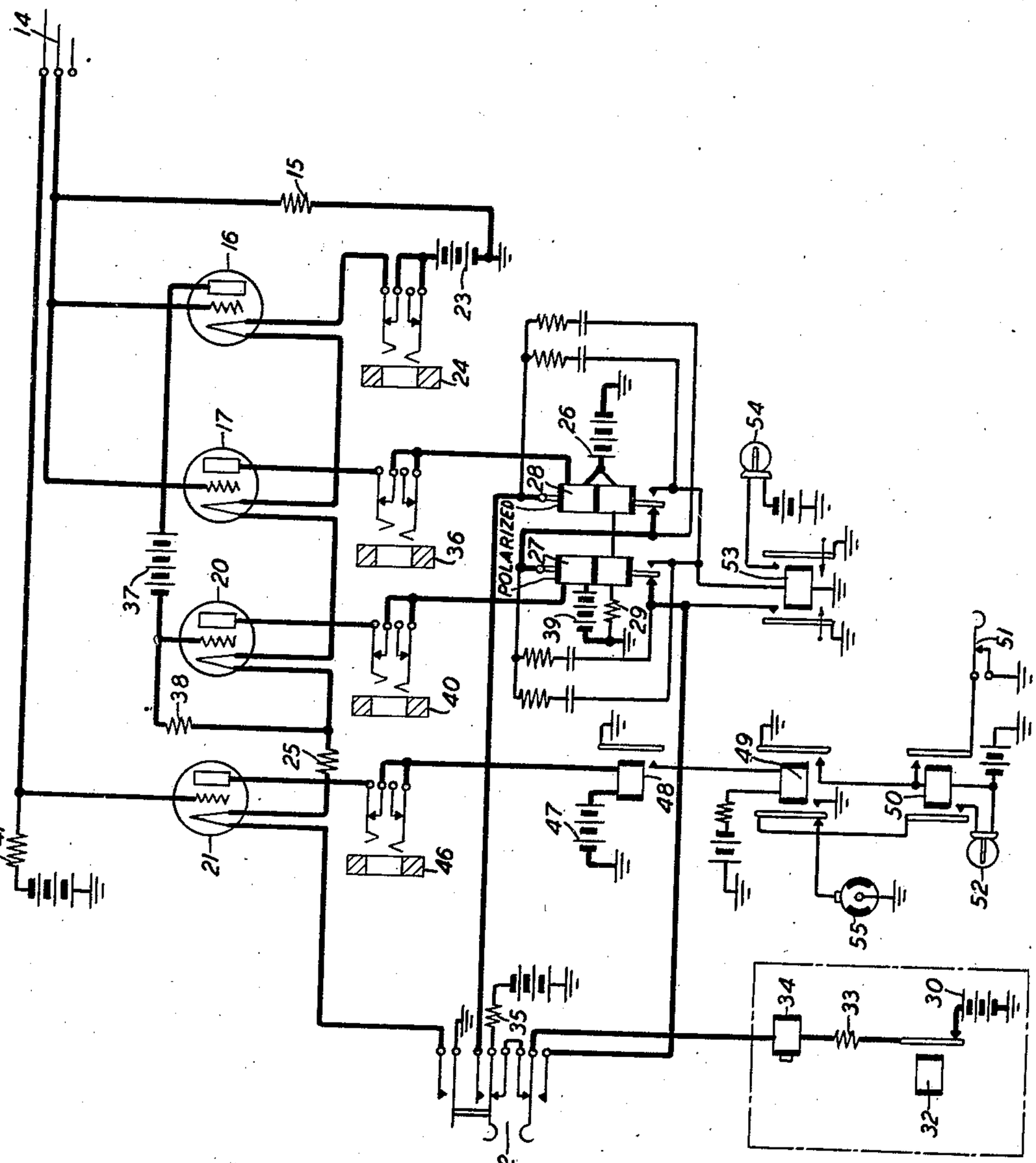

FIG. 1

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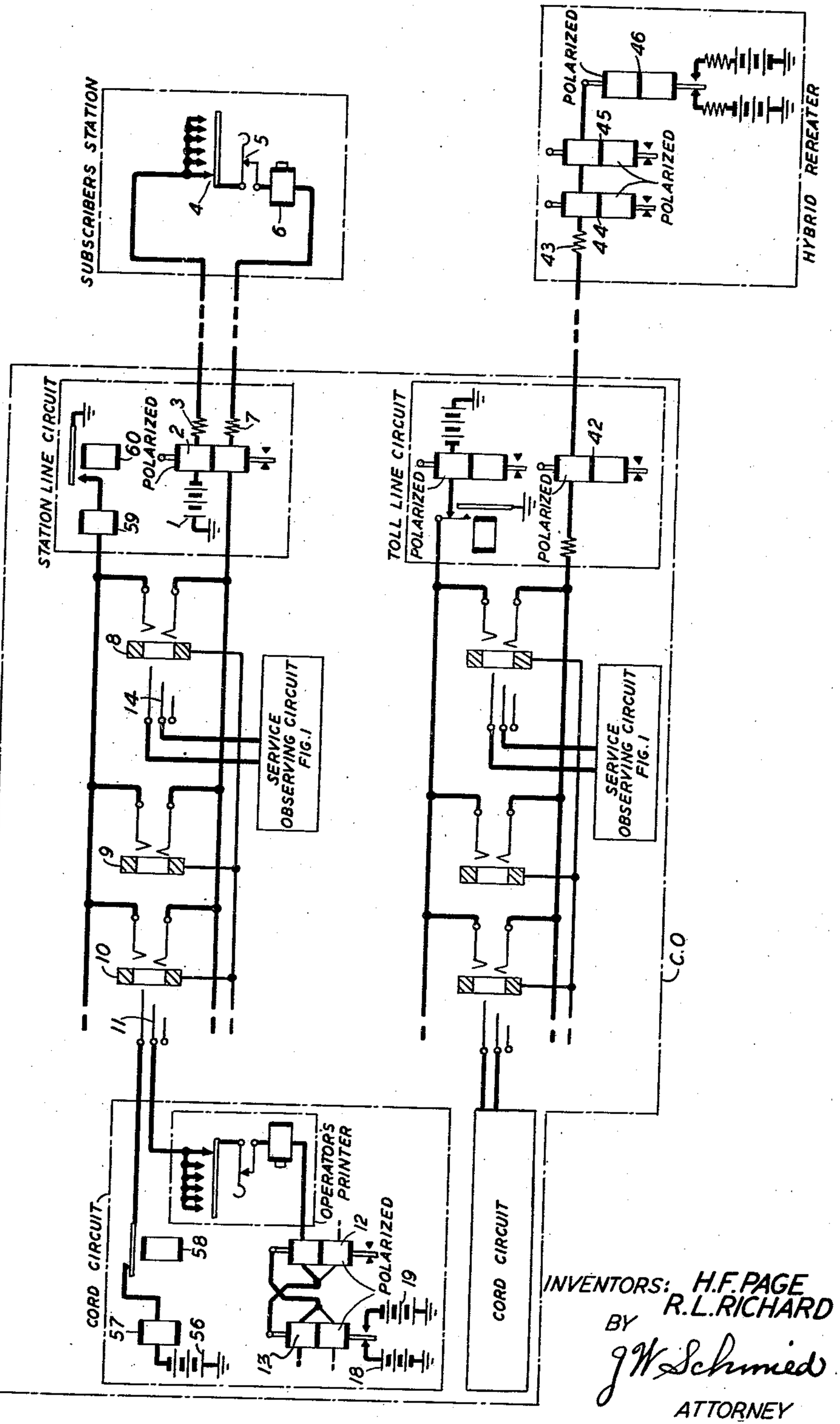

FIG. 2

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TELETYPEWRITER SWITCHBOARD SERVICE OBSERVING CIRCUIT

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8 Claims. (Cl. 178—2)

This invention relates to teletypewriter switching circuits and more particularly to a service observing circuit for use in a teletypewriter switching system for observing service at a teletypewriter switchboard in connections involving teletypewriter cord circuits connected to teletypewriter subscribers' line circuits or telegraph toll line circuits.

An object of this invention is to improve service observing circuits for use in teletypewriter switchboard service.

A further object of this invention is to improve service observing circuits for use in observing service involving manual cord circuits at a teletypewriter switchboard by providing a circuit which may be flexibly connected into a multiple jack of a subscriber's line circuit or a multiple jack of a telegraph toll line circuit to reproduce telegraph communication signals and the supervisory signals appearing in a cord circuit connected to either the subscriber's line circuit or the telegraph toll line circuit.

There are a number of different types of service observing circuits available for use in connection with teletypewriter switchboard circuits for observing service on manual connections through a teletypewriter switchboard. In certain of the circuits, telegraph communication signals alone are reproduced. In others for use in connections involving a cord circuit with a subscriber's line circuit, it is possible to reproduce the cord circuit supervisory signals in the observing circuit. Subscribers' cord circuits are used in interconnecting subscribers' line circuits directly and also in connecting subscribers' line circuits to telegraph toll line circuits. So far as applicants are aware, no service observing circuit is as yet available which may be flexibly interconnected to a multiple appearance of a subscriber's line circuit or a multiple appearance of a telegraph toll line circuit and which reproduces both communication and cord circuit supervisory signals.

The manner in which the circuit of the invention herein operates to reproduce telegraph communication signals and to reproduce cord circuit supervisory signals in the service observing circuit will be understood from the following description when read with reference to the associated drawings:

Figure 1 shows the service observing circuit of the invention herein; and

Fig. 2 shows the relationship of the observing circuit per Fig. 1 with the circuits with which it cooperates.

The upper portion of Fig. 2 shows the observing circuit per Fig. 1 cooperating with a station line circuit to which a cord circuit has been connected at a teletypewriter switchboard. The lower portion of Fig. 2 shows the observing circuit per Fig. 1 cooperating with a telegraph toll line circuit to which a cord circuit has been connected in a teletypewriter switchboard.

Refer now to the upper portion of Fig. 2. It shows a subscriber's station circuit at the right connected through a subscriber's loop circuit, indicated by the dotted lines, to a portion of a well-known station line circuit at a teletypewriter central station. The station line circuit extends the subscriber's station circuit and the associated loop to a jack circuit in the teletypewriter switchboard. The jack circuit is indicated as being a multiple jack circuit so that the station line circuit has a number of jacks in multiple appearing at different operators' positions in the teletypewriter switchboard. A portion of a well-known cord circuit by means of which the station line circuit may be extended towards the called station is shown at the left of the upper portion of Fig. 2. A service observing circuit which, it is to be understood, is that of Fig. 1, is shown in position to engage with one of the multiple jack appearances of the station line circuit. The cord circuit and the service observing circuit are shown disengaged from their associated jacks. When a station line circuit is under observation, the service observing circuit per Fig. 1 and the cord circuit will be connected to the indicated jacks. When the circuits are so connected, a path may be traced from negative battery 1 through the top winding of relay 2, through resistance 3, over the top loop conductor through sending contacts 4, which are normally closed when the subscriber's station circuit is conditioned for communication, through break key 5, through the winding of the receiving magnet 6, through the bottom loop conductor, through resistance 7, through the bottom winding of relay 2, to the rings of the jacks, 8, 9 and 10 in multiple. When the plug of the cord circuit is inserted into one of the jacks associated with the line circuit, let us assume jack 10, the ring of the station line circuit is extended through the ring of the cord circuit plug 11, through the top winding of relay 12, and the armature and left-hand or marking contact of relay 13 to positive battery. The plug 14 of the observing circuit is connected in parallel with the cord circuit to one of the multiple jack appearances of the station line circuit, let us assume jack 8.

Refer now to Fig. 1. The ring of plug 14 extends through the high resistance 15 to ground and also to the grids of tubes 16 and 17 which are connected in parallel. Battery 1 (Fig. 2) is 48 volts negative. Battery 18 (Fig. 2) is 48 volts positive. Battery 19 (Fig. 2) is 48 volts negative. The resistance 15 is 500,000 ohms, which is very high with relation to the total resistance of the various components of the station line circuit and the cord circuit.

When the sending contacts of the subscriber's station are closed and the path connecting the subscriber's line station with the cord circuit, which has just been traced, is completed through the armature and marking contact of relay 13, with the observing circuit connected to jack 8, a potential of approximately 42 volts negative is impressed between the ring of plug 14 and ground. When the sending contacts 4 at the subscriber's station are opened for the transmission of a spacing signal, negative battery 1 is disconnected from the circuit. Positive battery 18 is impressed, through a relatively low resistance, on the ring of jack 10 and since resistance 15 (Fig. 1) is inordinately high, a potential of approximately 47½ volts positive is impressed between the ring of plug 14 and ground. When a signal is incoming from the distant end of the connected circuit through the cord circuit, the armature of relay 13 (Fig. 2) is operated so as to engage its right-hand or spacing contact and negative 48-volt battery 19 is connected to both ends of the transmitting conductor connecting the cord and station circuit. For this condition, negative 48-volt battery is impressed between the ring of plug 14 and ground.

When key 22 in Fig. 1 is operated, a circuit may be traced from battery 23 through the break contact and tip of jack 24, through the filaments of tubes 16, 17 and 20, through resistance 25, the filament of tube 21, and through the top make contact and armature of key 22 to ground, lighting the filaments of the four tubes in series.

Battery 23 is a 48-volt battery. As indicated, its positive terminal is connected to the right-hand terminal of vacuum tube 16. The resistance of the various elements in the filament circuit just traced are such that the negative side of the filaments of the various tubes are at the following potential: Tube 16 is at positive 46 volts; tube 17 is at positive 42 volts; tube 20 is at positive 38 volts; and tube 21 is at ground potential. A circuit may be traced from battery 26 through the bottom windings of relays 28 and 27, through resistance 29 to ground. The effect of this current is to tend to operate the armatures of relays 27 and 28 so as to engage their right-hand contacts. When the subscriber's station circuit is closed and a cord circuit and a service observing circuit are connected to the multiple jacks so that approximately 42 volts positive potential is impressed between the ring of plug 14 and ground, no current will be passed through the plate circuit of tube 16, as the grid of this tube is 4 volts negative with respect to the negative side of the associated filament. Since the grid of tube 17 is of the same potential as the negative side of the associated filament, the plate circuit of tube 17 will pass current. Under these circumstances, a circuit may be traced from positive battery 26 through the top winding of relay 28, through the contacts of jack 36, to the plate of tube 17, across the gap to the filament of tube 17 and to ground, through the top make contact and armature of key 22. The effect of this current preponderates over the effect of the current flowing through the bottom winding of relay 28, and the armature of relay 28 is held in engagement with its left-hand or spacing contact. A 130-volt battery is inserted in the plate circuit of tube 16 with its positive terminal connected to a plate and its negative terminal connected to resistance 38 which is of relatively high value, 15,000 ohms. The opposite terminal of resistance 38 is connected to the negative terminal of the filament of tube 20. Since no current flows in the output circuit of tube 16, the grid of tube 20 is at approximately the same potential as the negative terminal of its associated filament. Under these circumstances, a current will flow in the plate circuit of tube 20. This circuit may be traced from positive battery 39 through the top winding of relay 27, the contacts of jack 40, to the plate of tube 20, through the gap from the plate to the filament of tube 20, to ground on the top armature of key 22. The effect of this current preponderates over the effect of the current in the bottom winding of relay 27, and the armature of relay 27 is held in engagement with its left-hand contact.

When the armatures of relays 27 and 28 are held in engagement with their respective left-hand contacts, a circuit may be traced from positive battery 30, in the operator's position equipment in Fig. 1, through the back contact and armature of relay 32, through resistance 33, through the winding of the receiving magnet 34, through the bottom armature and front contact of key 22, which key is operated, through the left-hand contact and armature of relay 27, through the left-hand contact and armature of relay 28, through the top inner make contact and armature of key 22 and through resistance 35 to negative battery. Receiving magnet 34 in the operator's position equipment of Fig. 1 will therefore be energized when the subscriber's station circuit is closed.

When the loop of the subscriber's station circuit is opened, the potential of the grids of tubes 16 and 17 is raised, as has been shown, to positive 47.5 volts. The grid of tube 16 is now 1.5 volts positive with respect to the negative side of its associated filament. The grid of tube 17 is 5.5 volts positive with respect to the negative side of its associated filament. A current will therefore flow in the plate circuit of each of these tubes. As a result of the current flowing in the plate circuit of tube 16, the grid of tube 20, due to the large drop in resistance 38, is made exceedingly negative with respect to the negative terminal of the filament of tube 20 so that no current flows in the plate circuit of tube 20. Under these circumstances, the top winding of relay 27 will be deenergized and the armature of relay 27 will be actuated under the influence of current flow through its bottom winding to engage with its right-hand contact. The position of the armature of relay 28 will remain unchanged. The transfer of the armature of relay 27 from its left-hand to its right-hand contact will break the path heretofore traced through the winding of the receiving magnet in the operator's position equipment in Fig. 1. The magnet will therefore be deenergized.

From the above, it should be apparent that when a marking signal is transmitted from the subscriber's station a marking signal is received in the operator's position equipment in Fig. 1.

When a spacing signal is transmitted from the subscriber's station circuit, a spacing signal is received in the operator's position equipment.

Attention is now directed to the manner in which communication signals transmitted from the distant station to which the cord circuit of Fig. 2 is connected, are reproduced in the operator's position equipment of Fig. 1.

When signals are transmitted from the distant station to which the cord circuit is connected, the armature of relay 13 follows the signals. For the marking condition, the armature of relay 13 is in engagement with its left-hand contact so that the potential between the ring of plug 14 and ground is the same as for a marking signal transmitted from the subscriber's station. For this condition, it has been shown that the armatures of relays 27 and 28 are in engagement with their left-hand contacts and the winding of receiving magnet 34 is energized. When a spacing signal is received by relay 13 in the cord circuit, the armature of relay 13 is actuated to engage with its right-hand or spacing contact. Negative battery 19 is connected to one end of the subscriber's loop and negative battery 1 is connected to the opposite end of the subscriber's loop. Negative 48 volts approximately is impressed between the ring of plug 14 and ground. The grids of tubes 16 and 17 are each approximately 48 volts negative with respect to ground. For this condition no current will flow in the plate circuits of tubes 16 and 17. When no current flows in the plate circuit of tube 16, it has been demonstrated that current flows in the plate circuit of tube 20. For this condition the armature of relay 28 will be actuated to engage with its right-hand contact. The armature of relay 27 will be maintained in engagement with its left-hand contact. The energizing circuit for magnet 34 will be broken and a spacing signal will be received in the operator's position equipment.

As is well understood by those having a knowledge of the teletypewriter switching art, a cord circuit such as that indicated in Fig. 2, is arranged so that an operator's position circuit may be inserted by means of a switching operation in series with the transmitting conductor of the cord circuit. The operator's printer circuit may be connected in series with the transmitting conductor in either the answering or the calling end of the cord circuit as may be required. The circuit of the invention herein is arranged to function when an operator's printer circuit is so connected in either end of the cord circuit.

If the operator's printer circuit is connected in the transmitting conductor of the cord circuit between the subscriber's station circuit and the polar relays in the cord circuit, when a marking signal is transmitted from the operator's printer, the transmitting conductor is closed. The conditions in Fig. 1 resulting from this are the same as obtained when a marking signal is transmitted from the subscriber's station and a marking signal is therefore reproduced in the operator's position equipment. When a spacing signal is transmitted from the operator's printer circuit, the transmitting conductor is opened in the operator's printer circuit. For this condition the batteries in the cord circuit are ineffective. Battery 1, however, is connected through the subscriber's loop on the rings of jacks 8, 9 and 10 and the circuit is extended through the ring of plug 14 through high resistance 15, which resistance is of the order of 500,000 ohms to ground. The drop between the ring of plug 14 and ground is impressed between the grids of tubes 16 and 17 and ground. For this condition the grids of tubes 16 and 17 are excessively negative with respect to the negative side of their respective filaments and tubes 16 and 17 are blocked. Tube 20, as has been shown, passes current through its plate circuit for this condition. As a result of the above, the armature of relay 28 will be actuated to engage its right-hand contact. The armature of relay 27 will remain in engagement with its left-hand contact. A spacing signal will be received by the magnet 34.

If the operator's printer circuit is connected in the transmitting conductor on the opposite side of the cord circuit, the transmission of signals from the operator's printer will result in the operation of relay 13. For the marking condition, the transmitting conductor through the top winding of relay 13 will be closed. The armature of relay 13 will be held in engagement with its left-hand contact. It has been shown that this will result in the reception of a marking signal by magnet 34. When a spacing signal is transmitted from the operator's printer, the path through the top winding of relay 13 will be opened and the armature of relay 13 will be actuated to engage with its right-hand or spacing contact, so that negative battery will be connected to each end of the subscriber's loop. It has been shown that for this condition a spacing signal is received by magnet 34.

The use of a high resistance 15 connected between the grids of the tubes 16 and 17 and ground results in a definite potential being impressed on the grids when the plug 14 is disconnected from the jack circuit. Under these circumstances, the circuit through the receiving magnet 34 is maintained open, resulting in a permanent spacing signal being received by the associated printer. As a result of this, the associated printer runs open which prevents the printing of random characters due to slight fluctuations in the grid potentials.

The circuit of Fig. 1 will function also when a cord circuit is connected to a toll line circuit, as indicated in the bottom portion of Fig. 1. The voltage conditions on the ring of plug 15 are practically identical with the voltage condition described for the condition when a subscriber's station and station line circuit are connected to a cord circuit. When a cord circuit is connected to a toll line circuit, positive battery is connected through the marking contact and armature of relay 13 in the cord circuit through the top winding of relay 12, through the ring of plug 11, through the ring of the associated toll line jack to which the cord circuit is connected, as shown in the lower portion of Fig. 2, through the winding of relay 42 in the toll line circuit, through resistance 43 and the windings of relays 44 and 45 in the hybrid repeater, and through the armature and left-hand or marking contact of relay 46 to negative battery. For this condition the relative values of the resistance units in the circuit are such that with plug 14 of Fig. 1 connected to one of the multiple jacks of the toll line circuit, the voltage impressed between the grids of tubes 16 and 17 and ground is approximately 42 volts positive. This is the same voltage as is impressed on the grids of tubes 16 and 17 for the marking condition when the service observing circuit per Fig. 1 is cooperating with a connection involving a cord circuit and a station line circuit and subscriber's station circuit. As a result of this, as has been shown, a marking signal

is received by magnet 34. When the armature of relay 46 in the hybrid repeater circuit is actuated so as to engage its right-hand or spacing contact, positive battery in the hybrid repeater is connected to one end of the transmitting conductor and positive battery in the cord circuit is connected to the opposite end of the transmitting conductor. The voltage of both of these batteries is the same, namely 48 volts. For this condition, positive 47.5 volts approximately is impressed between the grids of tubes 16 and 17 and ground. This is the same voltage as was impressed on the grids of these tubes for a spacing signal transmitted from the subscriber's station. It results in a spacing signal being received by magnet 34 in the manner which has already been described.

In the case of signals received from a distant station connected to the opposite end of the cord circuit, in a connection involving a toll line circuit, for the marking condition the armature of relay 13 will be held in engagement with its left-hand or marking contact and the voltage condition will again be the same as for a marking signal transmitted from the hybrid repeater. When a spacing signal is received from the distant end of the circuit connected to the cord circuit, the armature of relay 13 will be actuated to engage with its right-hand or spacing contact and negative battery 19 will be connected to one end of the transmitting conductor and negative battery will be connected to the marking contact of relay 46. For this condition, approximately 48 volts negative potential will be impressed between the grids of tubes 16 and 17 and ground. As a result of this condition, a spacing signal will be received in magnet 34.

The circuit herein is arranged to indicate that a particular subscriber's station line circuit to which it may be connected is in the open condition, which is the normal conditon when the loop through the subscriber's station is not in use. Under such circumstances, no cord circuit will be connected to any of the multiple jacks associated with the station line circuit. When the subscriber's loop through the subscriber's station is not in use, it is open and there will be no battery connected to the ring of any of the jacks. Consequently, as described above, there will be no current flowing in the output circuits of tubes 16 and 17. For this condition the circuit through the receiving magnet in the operator's position equipment will be opened which will cause the receiving teletypewriter to run open in a manner well known in the art. This will indicate that an idle line has been selected.

When a subscriber's station is in the idle condition before his loop is closed to establish a direct current path, as is well known in the art, the subscriber's loop is closed through a condenser not shown which shunts the contacts of the station switch to permit the station to be rung. When an open station line circuit is rung by machine ringing from the calling end of the cord circuit, the monitoring set runs open, thus giving an indication that the subscriber is being rung. When ringing is sent manually from the answering end of the cord, the monitoring set runs open during the ringing interval.

The manner in which the circuit of the invention herein functions to reproduce disconnect and flashing recall signals will now be described. A circuit may be traced from negative battery 56 in the cord circuit through the winding of relay 57 and the back contact and armature of relay 58 to the tip of plug 11. When plug 11 is inserted into one of the multiple jacks associated with a station line circuit, the circuit is extended through the tip of the jack, through the winding of relay 59 to the front contact of relay 60. The station line circuit shown in Fig. 2 is not shown in complete detail as it is well known in the art. When the subscriber's station circuit and its associated station line circuit is connected through a cord circuit and is conditioned for communication, relay 60 is unoperated so that the circuit last traced is open at the front contact and armature of relay 60. When a disconnect signal is sent from the subscriber's station circuit, relay 60 is operated in a manner well known in the art so as to connect ground through the armature of relay 60 to the circuit last traced. When the observing circuit per Fig. 1 is connected to one of the multiple jacks, such as jack 8, and a ground indicating a disconnect signal is impressed from the armature of relay 60 through the tip of jack 8 and the tip of plug 14, it is extended to the grid of tube 21. The negative side of the filament of tube 21 is at ground potential. A current will, therefore, flow in the circuit which may be traced from battery 47 through the winding of relay 48, the contacts of jack 46 to the plate of tube 21, across the gap between the plate and the filament of tube 21 to ground connected to the make contact and armature of key 22. This will operate relay 48. The operation of relay 48 will, in turn, operate relay 49 over an obvious circuit. The operation of relay 49 will, in turn, operate relay 50 over an obvious circuit. When relay 50 operates, it will lock up from ground through the contacts of key 51 and the right-hand armature and front contact of relay 50, through the winding of relay 50 to battery. The operation of relay 49 also closes the circuit from ground through the left-hand front contact and armature of relay 49 and the left-hand armature and front contact of relay 50, through the filament of lamp 52 to battery, lighting lamp 52. When lamp 52 is lighted steadily in response to a steady ground connected through the armature of relay 60, it indicates a disconnect signal.

For a flashing recall signal, relay 60 is momentarily operated and released in a well-known manner. In response to this, relay 48 is energized to light lamp 52 and thereafter relay 48 is released, in turn releasing relay 49. Relay 50 remains operated since it has been locked as described. The release of relay 49 connects ground through the interrupter 55 and the left-hand back contact and armature of relay 49, through the left-hand armature and front contact of relay 50 and the filament of lamp 52 to battery, causing lamp 52 to flash, as an indication that a flashing recall signal is being transmitted from the subscriber's station.

If the armature of relay 27 or 28 is actuated so as to engage with its respective right-hand contact and remains in engagement with its right-hand contact for a protracted interval, relay 53, which is a slow-to-operate relay, will be operated. The circuit which is established when the armature of relay 28 is actuated so as to engage with its right-hand contact may be traced from battery through resistance 35 and the top inner armature and front contact of key 22, through the armature and right-hand contact of relay 28 and the winding of relay 53 to ground. If the armature of relay 28 remains in engagement with its left-hand contact and the armature of relay 27 is actuated so as to engage with

its right-hand contact, the circuit for the operation of relay **53** may be traced from battery through resistance **35**, through the top inner armature and front contact of key **22**, through the armature and left-hand contact of relay **28**, through the armature and right-hand contact of relay **27** and through the winding of relay **53** to ground. When, after an interval, relay **53** operates, lamp **54** is lighted over an obvious circuit. At the same time a circuit is closed from battery **30** through the break contact and armature of relay **32**, through resistance **33**, through the winding of the receiving magnet in the operator's position equipment, through the bottom armature and front contact of key **22** and through the left-hand front contact and armature of relay **53** to ground. This energizes the receiving magnet **34** and prevents the teletypewriter machine in the operator's position equipment from running open.

The function of jack **24** is to permit the measurement of the filament current in tubes **16**, **17**, **20** and **21**. The function of jacks **36**, **40** and **46** is to permit the measurement of the plate current in each of the tubes with which each jack is associated.

What is claimed is:

1. In a teletypewriter switching system, a teletypewriter cord circuit, a teletypewriter subscriber's line and station circuit, means for interconnecting said circuits at a first time, a teletypewriter toll line circuit, means for interconnecting said cord circuit to said toll line circuit at a second time, a teletypewriter service observing circuit, means for interconnecting said service observing circuit at said first time to said connection comprising said cord circuit and said subscriber's line and station circuit, means for interconnecting said observing circuit at said second time to said connection comprising said cord circuit and said toll line circuit, and means in said circuits for reproducing communication signals and supervisory signals transmitted through said connected circuits in said observing circuit.

2. In a teletypewriter switching system, a teletypewriter cord circuit, a subscriber's teletypewriter line and station circuit, a telegraph toll line circuit, means for connecting said cord circuit at a first time to said subscriber's line and station circuit to form an operable telegraph path, means for connecting said cord circuit at a second time to said toll circuit to form a second operable telegraph path, means for transmitting communication signals and supervisory signals over each of said paths, a teletypewriter service observing circuit, means for connecting said service observing circuit to either of said paths, and means for reproducing said communication signals and said supervisory signals transmitted over either of said paths in said observing circuit when so connected.

3. In a teletypewriter switching system, a telegraph service observing circuit, means in said observing circuit for connecting said circuit to a telegraph path including a switching device at a manual teletypewriter switchboard, an electron discharge device in said observing circuit responsive to changes in potential in said path, due to supervisory signals, and means also in said observing circuit, responsive to said discharge device, for reproducing supervisory signals transmitted over said path.

4. In a teletypewriter switching system, a telegraph signal path, means for transmitting telegraph communication signals thereover, means for transmitting supervisory signals thereover, a telegraph service observing circuit, means in said circuits for flexibly interconnecting said circuits so that service over said path may be observed, means including a first electron discharge device in said observing circuit for reproducing communication signals transmitted over said path and means including a second electron discharge device in said observing circuit for reproducing supervisory signals transmitted over said path.

5. In a teletypewriter switching system, a telegraph service observing circuit, a first and a second polar relay in said circuit responsive to control means in a telegraph circuit to which said observing circuit is connectable, and a series circuit extending through the winding of a telegraph signal receiving device and through armatures and contacts on each of said relays.

6. In a teletypewriter switching system, a telegraph service observing circuit, three electron discharge devices, three relays each having a winding in series with the output of said devices and means responsive to said relays, for reproducing communication and supervisory signals in said observing circuit.

7. In a teletypewriter switching system, a service observing circuit, a conductor in said observing circuit connectable to an operable telegraph path including a switching device in a teletypewriter switchboard, a first and a second electron discharge device in said observing circuit, a grid in each of said devices connected in parallel to said conductor so as to impress substantially uniform potentials between said grids and ground, a common series circuit extending through a filament in each of said devices, and means for controlling said devices so that the output circuit of one of said devices conducts current while at the same time the output circuit of the other of said devices is substantially blocked.

8. In a teletypewriter switching system, a service observing circuit connectable to an operable telegraph path including a manual switching cord circuit, a first, second and third electron discharge device in said observing circuit, grid control means in said first and second devices to enable the output circuit of both of said devices to conduct current simultaneously or to block the output circuit of one of said devices while the output circuit of the other device conducts, and grid control means in said third device responsive to the output current of one of said devices.

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