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O. BLYHOLDER

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TELEGRAPH SWITCHING SYSTEM

Original Filed Aug. 14, 1944

2 Sheets-Sheet 1

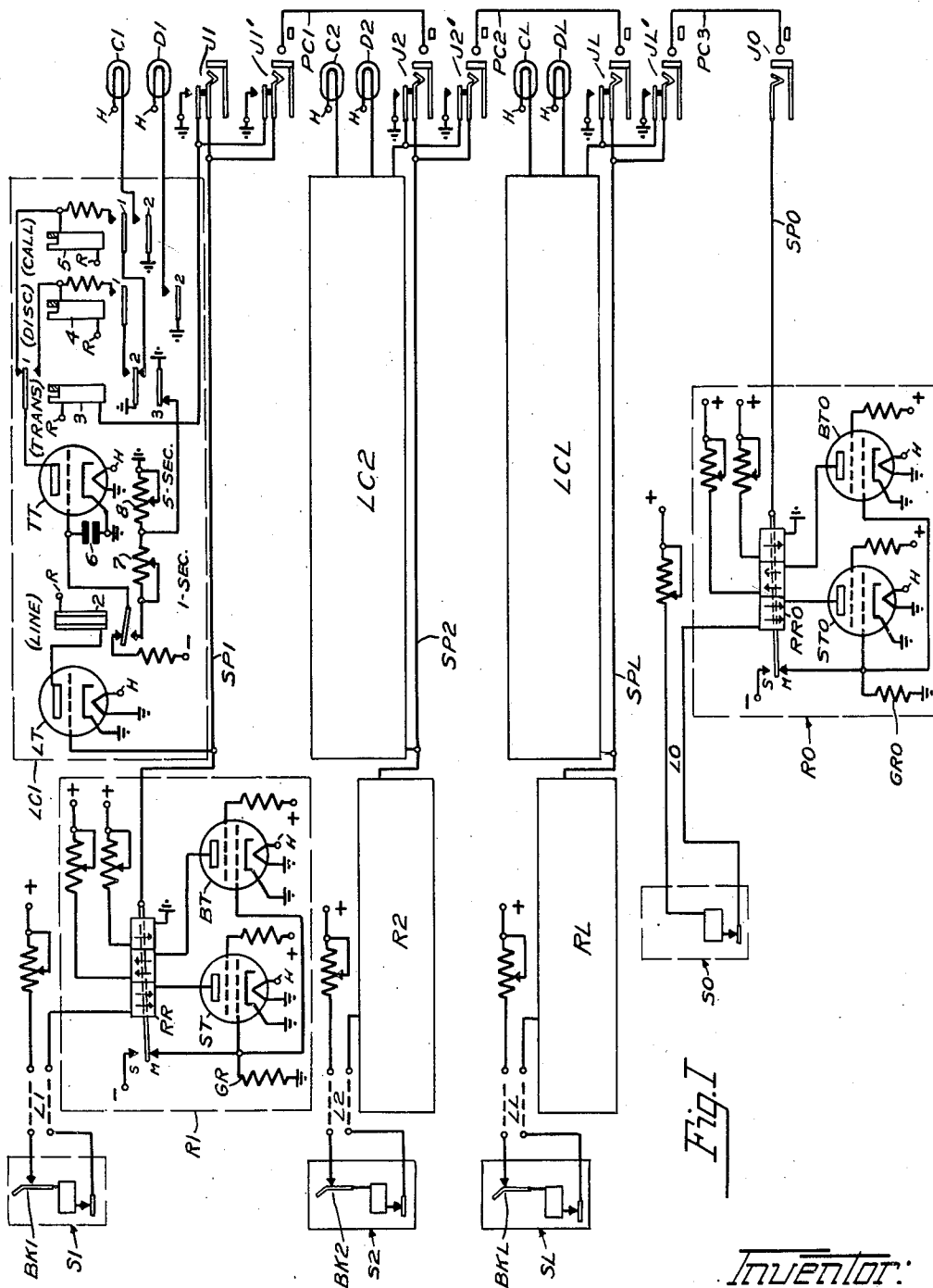


Fig. 1

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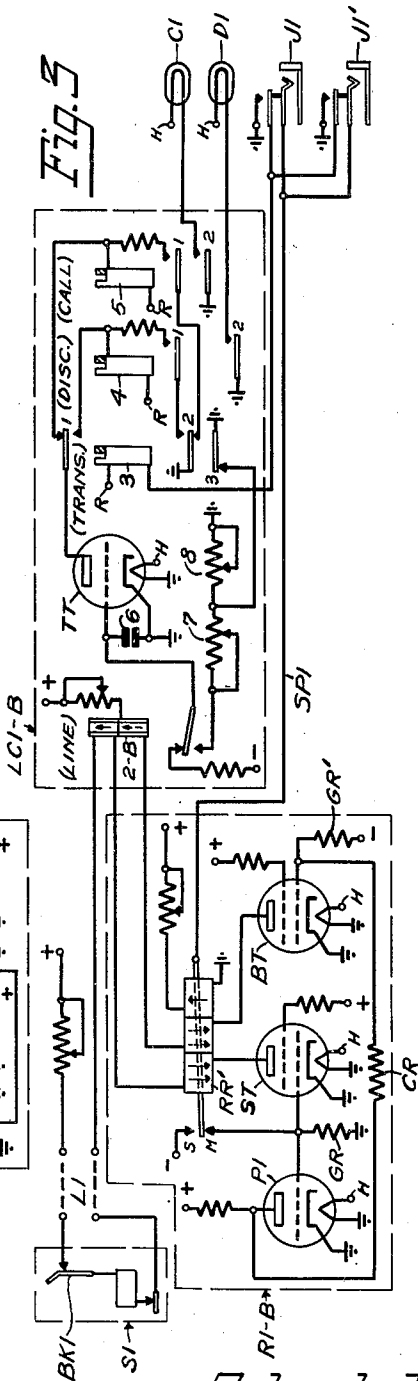
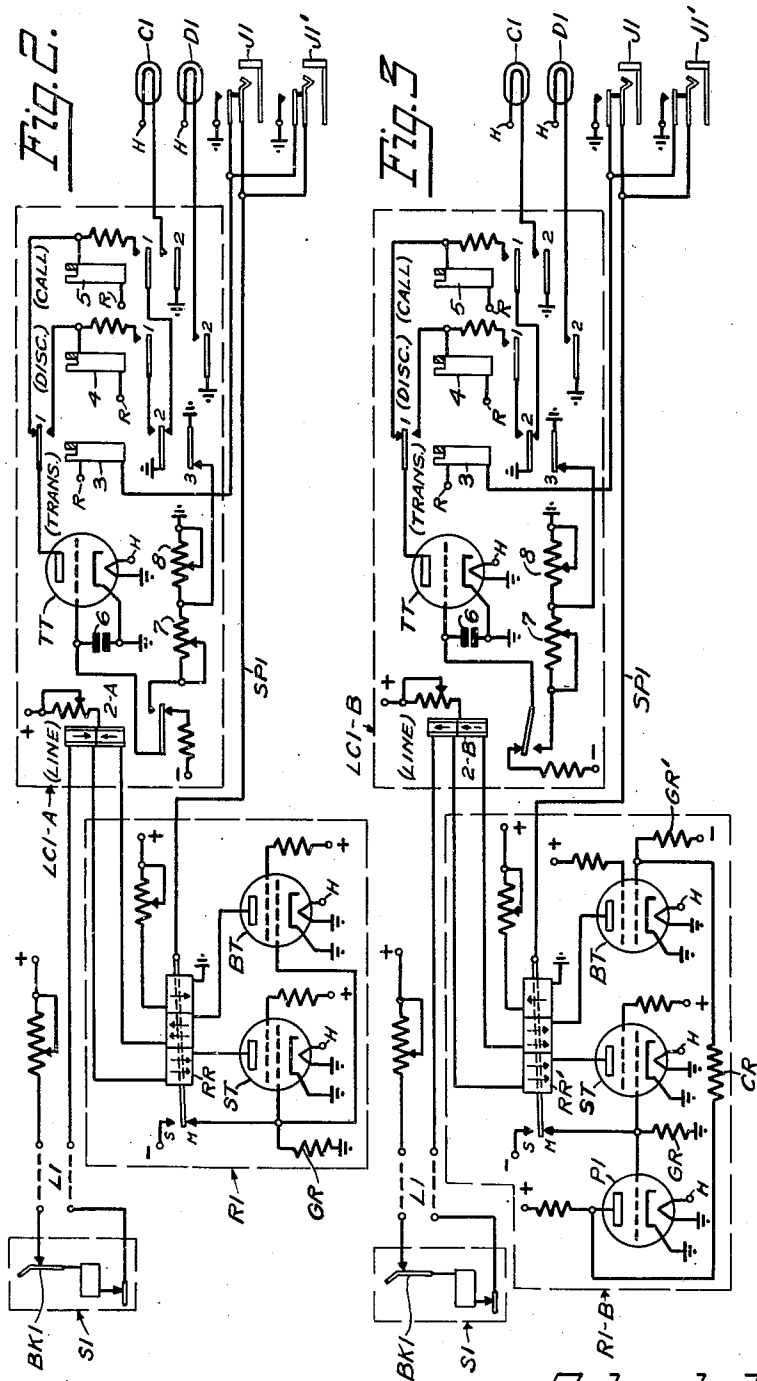
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TELEGRAPH SWITCHING SYSTEM

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,490,666

TELEGRAPH SWITCHING SYSTEM

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Original application August 14, 1944, Serial No.
549,339, now Patent No. 2,464,371, dated March
15, 1949. Divided and this application August
24, 1945, Serial No. 612,499

3 Claims. (Cl. 178—2)

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This invention relates to telegraph switching systems. Its general object is to provide a telegraph switching system affording improved features of operation.

This application is a division of applicant's previous application for Telegraph switching systems, Serial No. 549,339, filed August 14, 1944, now Patent 2,464,371, issued March 15, 1949.

GENERAL DESCRIPTION

The invention is illustrated as embodied in a telegraph switching system employing the so-called hub repeating arrangement wherein two or more lines may be interconnected through a common "hub" conductor having individual "spoke" conductors for the respective interconnected lines, and in which a two-way telegraph repeater is interposed between each individual line and its associated spoke conductor.

A specific object is to provide a telegraph switching system in which the lines have ordinary appearances at the switchboard and in which reliable provisions are made for signaling the switchboard operator over any line when connection or disconnection is desired.

Other objects and features of the invention, more or less incidental to the foregoing, will appear hereinafter.

THE DRAWING

The accompanying drawings, comprising Figs. 1 to 3, show sufficient of the apparatus incorporated in a system embodying the invention to enable the invention to be understood.

Fig. 1 shows one embodiment of the invention; Fig. 2 shows a modification of the equipment associated with line L1 of Fig. 1; and

Fig. 3 shows a second modification of such equipment.

Figure 1

Fig. 1 shows three subscriber lines of a system including any desired number of such lines; first and second lines L1 and L2, and the last line LL. These lines serve stations S1, S2, and SL respectively, shown diagrammatically as typewriter stations. The illustrated lines are provided with similar two-way repeaters R1, R2, and RL respectively, repeater R1 being shown in full. Spoke conductors SP1, SP2, and SPL connect the illustrated repeaters respectively with their switchboard jacks, J1, J2, and JL, with which the jacks J1', J2', and JL', are respectively multiplied, enabling patching cords such as PC1, PC2, and PC3 to be used to interconnect the spoke

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conductors in any desired arrangement of pairs and hubs.

Each repeater contains a receiving relay, such as RR of repeater R1. The receiving relay RR may be of any desired form of polarized relay, being illustrated as of the type in which the polarized armature passes axially through the winding space. Such a relay may be adjusted to assume a neutral position with no current flowing through any of its three windings. The armature of relay RR is normally held in marking position (against contact M) by the right-hand or marking winding, energized in a circuit including the positive pole of the current supply and the associated regulating resistor. The right-hand or marking winding may be eliminated if relay RR is biased to marking position, such as magnetically or by spring action. The circuit of line L1 includes the two conductors thereof in series with the equipment at station S1. It may be considered as originating at the positive pole of the current-supply source, and the normal current-flow thereover is controlled by the associated adjustable resistor. The return path for line current is through the left-hand or line winding of receiving relay RR, and the plate of sending tube ST, to ground through the grounded cathode element thereof. Assuming that the three windings of relay RR are equivalent, the line current is preferably regulated to be about double the current in the right-hand or marking winding, and is in such a direction through the line winding as to assist the marking winding in holding the armature of the relay in marking condition, as is indicated by the fact that the vertical arrows on the windings in question are directed downwardly.

The magnetic effect of the current through the left-hand or line winding of receiving relay RR is neutralized by the opposed current flow of substantially equal strength through middle or balance winding of the relay. The balance winding is included in what may be termed an artificial-line circuit, which includes the associated adjustable resistor connected between such winding and the positive pole of the supply source. The return path for the artificial line is through the plate of the balance tube BT, to ground through the grounded cathode element thereof.

Each of the tubes ST and BT is indicated as a tetrode, having its control and screen grids in the usual relative positions. Each screen grid is supplied with positive potential from the supply source through the associated individual resistor. The control grids of tubes ST and BT

are both connected to the marking contact M of receiving relay RR, and are normally supplied with ground potential through the associated grid resistor GR, permitting a normal flow of current through both. A tube such as the commercially available 6L6 beam-power tube is satisfactory at ST and BT, using a positive supply potential of 250 volts, for example.

Lines L1 to LL are provided with line circuits LCI to LCL respectively, of which the line circuit LCI is shown in full. Line circuit LCI is controlled over the associated spoke conductor SPI through the grid of line tube LT. Tube LT, as well as the other triodes shown herein, may be of the commercially available 605 type, using the same positive supply potential as the sending and balance tubes.

The purpose of line circuit LCI, is to light call lamp C1 at the switchboard responsive to a prolonged opening of line L1 (as by break BK1) in excess of one second, for example, and to light the disconnect lamp D1 responsive to a break in the associated line in excess of five seconds, for example, at a time when a connection with the line exists through the switchboard. Line circuit LCI includes line relay 2, normally operated through the plate-cathode circuit of line tube LT by half-wave-rectified current from relay terminal R, supplied with alternating current of commercial frequency and suitable voltage. Relay 2 is arranged to control the potential of the grid of timing tube TT by normally maintaining a cutoff bias on such grid, across condenser 6, and by discharging this biasing potential through resistor 7 for a one-second delay, and through resistors 7 and 8 for a five-second delay. As will hereinafter appear, timing tube TT controls one or another of the call and disconnect relays 5 and 4, according to the operated or restored condition of transfer relay 3, controlled from either of the associated jacks J1 and J1'. Relays 3 to 5 are supplied with current from the associated relay terminals R. Each such relay is preferably a shaded-pole relay which remains operated steadily when energized by alternating, pulsating, or direct current.

The switchboard operator is supplied with a telegraph station S0, also illustrated as a teletypewriter station, controlled over the operator's line L0. This line terminates in the operator's repeater R0, exactly similar to repeater R1. Repeater R0 is connected with the operator's switchboard jack J0 by the spoke conductor SP0.

Figure 2

In Figure 2, the equipment of line L1 of Fig. 1 is modified by replacing line tube LT and relay 2 of line circuit LCI by relay 2—A of line circuit LCI—A. Line circuit LCI—A is arranged to respond only to breaks occurring in the associated line and is independent of control over the common hub by way of the associated spoke conductor SPI, as will appear hereinafter. For this purpose, relay 2—A is a double-wound differential relay, having one winding in series with line L1 and the other winding in series with the artificial or balance line of the repeater R1. In the arrangement of Fig. 2, the transmission of a disconnect signal from a connected line causes the lighting of the disconnect lamp associated with that line only, whereas in Fig. 1 the disconnect lamps light at all interconnected lines responsive to a disconnect break at any one of them.

Figure 3

Fig. 3 shows a further modification of the equipment of line L1 (Fig. 1), illustrating what may be termed a uniform-current system. The arrangement in Fig. 3 is such that current flows alternately in the subscriber line and in the associated artificial or balance line, thereby simplifying the power-supply requirements, in addition to halving the simultaneous or demand current for the several natural and artificial lines, as will be explained more in detail hereinafter. Fig. 3 employs the additional tube PI, used as a phase-inverter triode effective to transmit a potential of the opposite sign to the control grid of balance tube BT when a potential of a given sign is impressed on the control grid of the sending tube ST.

DETAILED DESCRIPTION

The disclosure having been described generally, a detailed description of the operation of the system will now be given.

A. FIGURE 1

The system of Fig. 1 will be considered first.

A1. Calling the operator

Assuming that the subscriber at substation S1 (Fig. 1) desires a connection, he opens the associated line L1, as by break key BK1, for an interval somewhat in excess of one second, and then recloses the line. When the line is opened, the flow of line current ceases, deenergizing the left-hand or line winding of receiving relay RR. Thereupon, relay RR operates its armature from engagement with its marking contact M into engagement with its spacing contact S, by virtue of the fact that the more powerful current in the middle or balance winding then overcomes the current in the right-hand or marking winding. Spacing current from the negative biasing terminal is thereby impressed on the associated spoke conductor SPI.

Since spoke conductor SPI is normally disconnected at the jacks J1 and J1', the placing of the negative spacing potential thereon has no effect except in the line circuit LCI, where it blocks current flow through line tube LT. The normally operated line relay 2 thereupon restores, disconnecting the grid of timer tube TT (and the upper terminal of timing condenser 6) from the source of biasing potential and connects it through the adjustable one-second resistor 7, and contacts 3 of transfer relay 3, to ground. At the end of about one second, the normal negative charge of grid condenser 6 is sufficiently dissipated through resistor 7 to render the control grid of timing tube TT sufficiently positive to enable plate current of relay-operating value to flow there-through. Call relay 5 thereupon operates in a circuit from ground, through the cathode and plate of tube TT, armature 1 of transfer relay 3 and its back contact, and thence through the winding of call relay 5 to relay terminal R, supplied with alternating potential. The current which flows through relay 5 at this time is pulsating because of the half-wave rectifying action of tube TT. Upon operating, relay 5 closes a local self-locking circuit at its contacts 1, to ground through the back contact of armature 2 of transfer relay 3. This self-locking circuit may include the illustrated current-limiting resistor. At its contacts 2, relay 5 closes a lighting circuit for call lamp C1.

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When the circuit of line L1 is reclosed, the resumption of current flow through the line winding of receiving relay RR again neutralizes the effect of current flow through the balance winding of the relay, permitting the right-hand or bias winding of the relay to return the armature from spacing position to marking position. When this occurs, positive (ground) potential, obtained through grid resistor GR in the repeater R1 is again applied to the grid of line tube LT in line circuit LC1, whereupon current flow is resumed through tube LT and line relay 2. Relay 2 thereupon reoperates and disconnects the grid of timing tube TT from ground (cathode) potential by way of resistor 7 and transfers it to negative biasing potential. When this occurs, condenser 6 again charges to a negative value and the grid of tube TT becomes negative, terminating the flow of plate current therethrough. The resistor included in the lead extending to the front contact of relay 2 is to prevent momentary lowering of the biasing potential on the common supply lead by a sudden inrush of charging current to condenser 6. The cessation of the flow of plate current through tube TT does not cause call relay 5 to restore because of the above-noted self-locking circuit of relay 5 through its contacts 1. Only alternating current now flows through the winding of relay 5, but this relay is able to remain operated steadily when supplied only with alternating current, as previously noted.

A2. Answering

Upon noting the lighted condition of call lamp C1, the operator may insert one plug of an idle patching cord, such as PC3, into the jack J1 (or the jack J1') and insert the other plug of such patching cord into the operator's jack J0. By this operation, spoke conductor SP1 is connected electrically with spoke conductor SP0, the concerned single-conductor patching cord serving as the common hub between the two spokes. With the repeaters R1 and R0 both in marking condition, both spokes are at ground potential, wherefore there is no immediate interchange of current over the interconnection.

As a result of the insertion of a connecting plug into either of the jacks J1 or J1', the upper contacts of such jack connect ground to the lower terminal of transfer relay 3, operating relay 3 in an obvious circuit. Armature 1 of relay 3 disconnects the plate of tube TT from call relay 5 and transfers it to relay 4. Armature 2 of relay 3 disconnects ground from the self-locking circuit of call relay 5 and prepares a self-locking circuit for disconnect relay 4. Call relay 5 now restores, thereby extinguishing call lamp C1. Contacts 3 of transfer relay 3 remove the shunt normally existing around resistor 8 so as to increase the effective discharge time of grid condenser 6 from about one second to about five seconds, thereby insuring that no likely combination of telegraph signals nor a "break-in" signal will result in a premature operation of disconnect relay 4.

Having thus interconnected operator line L0 with the calling subscriber line L1, the operator may now type out the usual challenge at the operator station S0 to inform the subscriber at station S1 that he is in connection with the operator, the word "operator," for example. By this operation, line L0 is opened and closed, as required. Each time the line is opened, the cessation of current in the line winding of repeating relay RR0 causes the armature of such relay to move from its illustrated marking position into

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engagement with its spacing contact, thereby impressing negative potential on spoke conductor SP0. Each time line current is resumed in the line L0, the armature of relay RR0 is reoperated from spacing position to marking position, thereby disconnecting the negative spacing potential and reconnecting conductor SP0 to the grids of tubes ST0 and BT0. At the end of the instant sending operation, relay RR0 comes to rest in its illustrated marking position, in readiness for the receipt of instruction from the calling subscriber.

Each time negative spacing potential is placed on conductor SP0 as above noted, such potential is transmitted through jack J0 and the patching cord in use (PC3), to spoke conductor SP1, by way of jack J1 or J1'. With the armature of relay RR in marking condition, each application of spacing current to conductor SP1 results in the application of a negative biasing potential to the grids of tubes ST and BT, causing a cessation of current through both tubes and consequently through the associated subscriber line and the artificial line. When this occurs, the armature of relay RR is unaffected because it is still held in marking position by current flow through its right-hand or biasing winding. The resulting cessation of current flow over the subscriber line causes the usual response at the calling station S1, whereat the operator's challenge message is typed.

A3. Interconnecting

The subscriber at substation S1 may now type out the desired instructions to the operator. It may be assumed that the calling subscriber desires that his line be interconnected with lines L2 and LL. In this event, the operator may telegraphically interconnect line L2 with line L1 through jacks J1' and J2, and a cord such as PC1, and may then employ a patching cord such as PC2 to interconnect line L2 with line LL through jacks J2' and JL. The concerned patching cords now comprise the hub of the interconnected system, the spokes being SP1, SP2, SPL, and SP0. It will be understood of course that as many, or as few, lines as desired may be interconnected with the calling line by using the above procedure.

Having made the interconnection, the operator may signal the subscriber at substation S1 to proceed, as by typing a word, such as "start," at station S0, resulting in the transmission of the corresponding combination of spacing and marking signals over spoke conductor SP0, and thence by way of patching cord PC3, to spoke conductor SP1. At this time spoke conductors SP2 and SPL are obviously energized by the spacing signals, giving the same response at all interconnected subscriber lines. The response at repeater R1 is as described hereinbefore, the current flow being stopped in each of the tubes ST and BT for the duration of each negative spacing signal.

Having transmitted the proceed signal, the operator may withdraw from the interconnection by removing the plugs of patching cord PC3 from jacks J1 and J0.

A4. Intercommunication

The interconnected stations S1, S2, and SL may now intercommunicate as desired. On transmission from station S1, receiving relay RR operates to spacing position on each interruption of line L1 and returns to marking position on each reclosure of the line, thereby transmitting negative spacing signals over spoke conductor SP1 and thence over

the interconnecting hub (including the patching cords) to the interconnected spoke conductors SP2 and SPL. It will be apparent that a very large number of lines may be thus interconnected for effective intercommunication without overloading the spacing contact of any of the relays such as RR, because the only load imposed on such spacing contact is that represented by the current flow through the grid resistors of the repeaters such as R2 and RL, corresponding to grid resistor GR of the repeater R1. In practice, this grid resistor may be on the order of 100,000 ohms, or higher, up to a substantial fraction of a megohm, as it needs only to pass sufficient current to insure the quick resumption of positive potential on the control grids of the associated tubes such as ST and BT upon disconnection of negative spacing potential from the interconnected spoke and hub conductors.

During message transmission, line tube LT in each line circuit responds by terminating the current flow through the associated line relay 2 for each spacing signal, and by reestablishing current flow therethrough for each marking signal. For the most part, the spacing signals are too short for a slow-restoring relay of the nature of relay 2 to respond.

During transmission, the subscriber at any station may "break in" on the transmitting station by opening the break key thereat, such as BK1, for about one or two seconds. It may be assumed that station S1 is the transmitting station and that station S2 is the break-in station. Opening of line L2 causes the repeater R2 to transmit spacing potential over SP2 to the repeaters interconnected therewith. This transmission is begun immediately if the break occurs during marking condition. If the break occurs during spacing condition, the receiving relay in repeater R2 does not respond until the existing spacing condition is terminated.

In the repeater R1, no current can flow through either the subscriber line or the artificial line during the time the negative spacing potential resulting from the break-in operation is impressed on the control grids of tubes ST and BT, wherefore the apparatus at the transmitting station S1 temporarily ceases to function, thereby informing the subscriber of the break. He is expected to cease transmission to permit his line L1 to remain closed for the receipt of a message from the break-in station.

When the break key BK2 at the break-in station S2 is subsequently reclosed, the consequent resumption of current flow over line L2 causes the repeater R2 to remove spacing potential from the interconnected hub system, enabling transmission to proceed thereafter from any station.

During transmission of the break-in spacing signal over the hub system, line relays 2 may be restored in all line circuits, and start the timing operation of each of the associated timer tubes TT, but this does not cause disconnect signaling of the operator, for in the connected condition of any line, the associated transfer relay 3 is in operated condition to increase the length of the timing operation to about five seconds by including the associated resistor 8 in circuit with timing resistor 7, as previously noted.

A5. Disconnect signaling

The subscriber at any interconnected station can signal the operator at any time to request that the entire connection be taken down or that his line be disconnected from the other line, or

lines, of the interconnected group. Disconnect signaling is accomplished by opening the break key such as BK1 at station S1 for an interval exceeding the disconnect timing interval, assumed herein to be five seconds. Opening of the line causes spacing potential to be placed on the associated spoke conductor, whence it passes through the hub system to the other spoke conductors, causing a response at the line circuit of all connected lines. In the line circuit LC1, the disconnect spacing potential on conductor SP1 causes line tube LT to restore line relay 2. Relay 2 disconnects the upper terminal of timing condenser 6 and the grid of timing tube TT from negative charging potential and transfers them to ground through resistors 7 and 8 in series (contacts 2 of transfer relay 3 are open at this time because relay 3 is operated through the upper contacts of J1 or J1'). At the end of about five seconds, condenser 6 is discharged sufficiently to permit an operative flow of current through timing tube TT, whereupon relay 4 operates in a circuit from the associated alternating current terminal R, the winding of relay 4, front contact of armature 1 of relay 3 and the said armature, plate of tube TT, and thence to ground through the grounded cathode of such tube. At its contacts 2, relay 4 closes a lighting circuit for disconnect lamp D1, while at its contacts 1 it closes a self-locking circuit to ground through the front contact of armature 2 of transfer relay 3. Accordingly, relay 4 remains operated following reclosure of the break key at the signaling station and the consequent reoperation of line relay 2 and cessation of current flow through timing tube TT.

Since the same line-circuit operation occurs at each interconnected line (each of the concerned disconnect lamps such as D1, D2, and DL becomes lighted at about the same time), it may be necessary for the operator to inquire which station requires disconnection, or whether all stations require disconnection. This may be accomplished by interconnecting the operator's equipment with the interconnected hub system, as by way of patching cord PC3 and jacks J1' and J6. Upon learning what is required, the operator may temporarily take down the entire interconnection to restore the line circuits, and then reestablish such portion of it as may be desired.

Upon removal of the plug from jack J1', transfer relay 3 restores, disconnecting and restoring, disconnect relay 4 to extinguish lamp D1. Similar results occur at the other line circuits.

B. FIGURE 2

As previously noted, Fig. 2 shows a modification of the equipment associated with line L1 of Fig. 1, in that differential line relay 2—A replaces line tube LT and line relay 2. One winding of relay 2—A is in series with the associated subscriber line L1, and one winding is in series with the artificial line. Normally, relay 2—A is not operated because the opposed windings are of substantially equal strength, but it is operated (by current flow through its lower winding alone) when current flows in the artificial line at a time when no current is flowing in the associated subscriber line. This condition obtains only when the associated station S1 is transmitting. It does not obtain when station S1 is receiving, for at that time tubes ST and BT are both locked, to prevent current flow through both lines, subscriber and artificial. It may be noted that, since

line relay 2—A is normally restored instead of normally operated, the negative biasing potential is connected to the back contact of the relay armature, and the connection to timing resistors 7 and 8 is brought to the front contact of such armature. In the arrangement of Fig. 2, when one station of an interconnected pair or group transmits a disconnect signal (a prolonged line break) such signal operates on no line circuit LC1—A except the associated one, and consequently results in the lighting of the disconnect lamp, such as DI, only at the station transmitting the disconnect signal. Except as noted, the line circuit LC1—A is exactly similar to the line circuit LC1 (Fig. 1), and operation and restoration of relay 2—A produces results as hereinbefore described for restoration and operation of line relay 2. When a disconnect signal is received, it suffices for the operator to disconnect the line over which it was received, it being unnecessary to disturb the connections to the remaining lines.

C. FIGURE 3

As previously noted, Fig. 3 shows a further modification of the equipment of line 1 (Fig. 1). Line circuit LC1—B is exactly similar to line circuit LC1—A, except that the two windings of line relay 2—B are connected in aiding relationship rather than in opposed relationship, because operating current flows through only one line (subscriber or artificial) at a time in Fig. 3.

Repeater R1—B is generally similar to repeater R1 of Figs. 1 and 2, except that phase-inverter tube PI has been added, and the grid circuit of balance tube BT is controlled from the plate circuit of tube PI instead of in parallel with the control grid of sending tube ST. More in particular, the control grid of tube ST is connected to marking contact M of receiving relay RR', and is supplied with ground potential through grid resistor GR, as in Figs. 1 and 2. The position occupied in Figs. 1 and 2 by the control grid of balance tube BT is occupied in Fig. 3 by the grid of phase-inverter PI. Accordingly, current is normally flowing in the plate-cathode circuit of tube ST and in the plate-cathode circuit of tube PI. Balance tube BT in Fig. 3 has its control grid normally supplied with negative biasing potential through grid resistor GR', wherefore current flow is normally blocked through the plate-cathode circuit of balance tube BT to provide a condition of no current in the associated artificial line (including the middle winding of relay RR', the lower winding of line relay 2—B, and the associated adjustable resistor). It will be noted that the connecting resistor CR is interconnected between the plate of phase inverter PI and the control grid of balance tube BT. Accordingly, current flows continuously from the positive plate of tube PI to the negative control grid of balance tube BT. With no signal being received over conductor SPI at the repeater R1—B, however, the flow of current through resistor CR is very small because the positive voltage maintained on the right-hand terminal of resistor CR is very low with tube PI in its normal conducting condition. Under this condition, the grid resistor GR' is of such value that it accepts all of the current passing through control resistor CR and still maintains the potential of the control grid of tube BT sufficiently negative to substantially block the flow of current through tube BT and associated artificial line.

When transmission occurs from station S1 (either to signal the switchboard operator or to transmit signals to one or more interconnected stations), the opening of line L1 terminates the flow of current therein and through the left-hand winding of relay RR'. Since current is normally not flowing in the artificial line, the only current flow remaining through the winding of relay RR' is the normal current flow through the right-hand or bias winding thereof. The current flow through this winding is in such a direction as to cause the armature of relay RR' to move from marking position to spacing position. At this time, the current flow through tube PI is not affected, wherefore tube BT remains unaffected.

When the associated line L1 is reclosed, the resultant resumption of current flow thereover and through the left-hand winding of receiving relay RR' causes the armature of such relay to return from its spacing contact to its marking contact, thereby terminating the transmission of spacing potential over the associated spoke conductor SPI.

With receiving relay RR' in its illustrated marking position, receipt of spacing potential over conductor SPI from another station causes the control grid of tube ST and the grid of phase-inverter triode PI to become negative, thereby terminating the flow of plate current in both tubes. Tube ST directly terminates the current flow in the associated line L1, as a spacing signal to station S1. As a result of cessation of current flow through the plate-cathode circuit of phase-inverter PI, the plate element thereof tends to assume the full positive potential of the supply source, thereby increasing the flow of current from this positive source through control resistor CR to the grid of balance tube BT. As a result, the potential drop across grid resistor GR' is increased sufficiently that the grid terminal thereof assumes a relatively positive (or cathode) potential, rendering the plate-cathode circuit of balance tube BT conducting, whereupon current flows through the artificial line including the middle winding of relay RR' and the lower winding of line relay 2—B. The cessation of current flow in the plate circuit of tube ST and the starting of the flow of current through the plate circuit of tube BT occur substantially simultaneously, wherefore there is no open interval, when current is flowing through neither. Since the current normally flowing through the left-hand winding of relay RR' is replaced by a substantially equal current flow through the middle winding thereof, and in the same effective direction, the armature of relay RR' remains in engagement with its marking contact throughout the received marking signal.

When the negative spacing signal on the associated spoke conductor SPI is terminated, current flow through tubes PI and ST is resumed. Current flow through the plate-cathode circuit of tube BT is terminated as a result of the lowering of the positive plate potential at tube PI and the consequent lessening of current flow (in a positive sense) through the resistor CR to the control grid of tube BT. Upon the above-noted resumption of normal marking conditions in the repeater R1—B, the armature of relay RR' is held in marking position by current flow through the left-hand winding thereof instead of by current through the middle winding thereof.

In the line circuit LC1—B, line relay 2—B is normally held in operated condition by current

flow through the upper winding thereof, in series with line L1. The front contact of the armature of relay 2—B maintains a negative potential on the grid of the associated tube TT and maintains timing condenser 6 in charged condition. During the reception of a spacing signal at the repeater R1—B, the cessation of current flow in the upper winding of line relay 2—B is accompanied by the establishment of the current flow through the lower winding thereof, in circuit with tube BT and the middle winding of relay RR'. Consequently, line relay 2—B remains operated during the reception of spacing signals at the repeater R1—B and their transmission over line L1 to station S1. On the other hand, with the repeater R1—B in its normal marking condition, the opening of line L1 at station S1 pursuant to signal transmission causes a cessation of current flow through the upper winding of relay 2—B with no compensating current flow in the lower winding thereof, under which condition relay 2—B is currentless for the duration of the transmitted spacing signal. Being of the same type of slow-restoring relay as noted for relays 2 and 2—A (Figs. 1 and 2), relay 2—B may not respond to normal transmission. It does however respond to the comparatively prolonged line breaks at break key BK1 of station S1, as when the associated line is opened for a period somewhat in excess of one second to signal the operator by a lighting of the associated call lamp C1, or is opened for an interval slightly in excess of five seconds to signal the operator by a lighting of the disconnect lamp D1 at a time when a plug is in either of the jacks J1 and J1'.

I claim:

1. In a telegraph system wherein a switchboard is provided for interconnecting and disconnecting two-way telegraph lines terminating thereat, line circuits individual respectively to said lines, means, effective when two lines are interconnected at said switchboard for mutual two-way transmission, for controlling either concerned line circuit from its individual line to transmit a signal to the switchboard indicative of such individual line, and means for preventing the other line circuit from responsively transmitting a signal to the switchboard, thereby preventing the

control exercised over one line from causing a signal to be transmitted to the switchboard indicative of the other line.

2. In a telegraph system wherein a switchboard is provided for interconnecting and disconnecting two-way telegraph lines terminating thereat for mutual two-way transmission of signals between interconnected lines, line circuits individual respectively to said lines, means, effective when two lines are interconnected at said switchboard, for controlling either concerned line circuit from its individual line to transmit a supervisory signal to the switchboard responsive to a telegraph signal from its individual line and subject to such signal being of prolonged duration, and means for preventing the other line circuit from transmitting a similar supervisory signal responsive to the prolonged signal consequently transmitted over the other line.

3. In a telegraph system wherein a switchboard is provided for interconnecting and disconnecting more than two two-way telegraph lines for mutual two-way transmission of signals between any line and each of two or more lines so interconnected therewith, line circuits individual respectively to said lines, means, effective when lines are interconnected at said switchboard, for controlling any concerned line circuit from its individual line to transmit a supervisory signal to the switchboard responsive to a telegraph signal from its individual line and subject to such signal being of prolonged duration, and means for preventing any other line circuit from transmitting a similar supervisory signal responsive to the prolonged signal consequently transmitted over its individual line.

ORLANDO BLYHOLDER.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,206,663	Cramer et al.	July 2, 1940
2,252,629	Hanley	Aug. 12, 1941
2,362,194	Dodd	Nov. 7, 1944
2,369,578	Kinhead	Feb. 13, 1945
2,387,246	Demonet	Oct. 23, 1945