

Sept. 19, 1939.

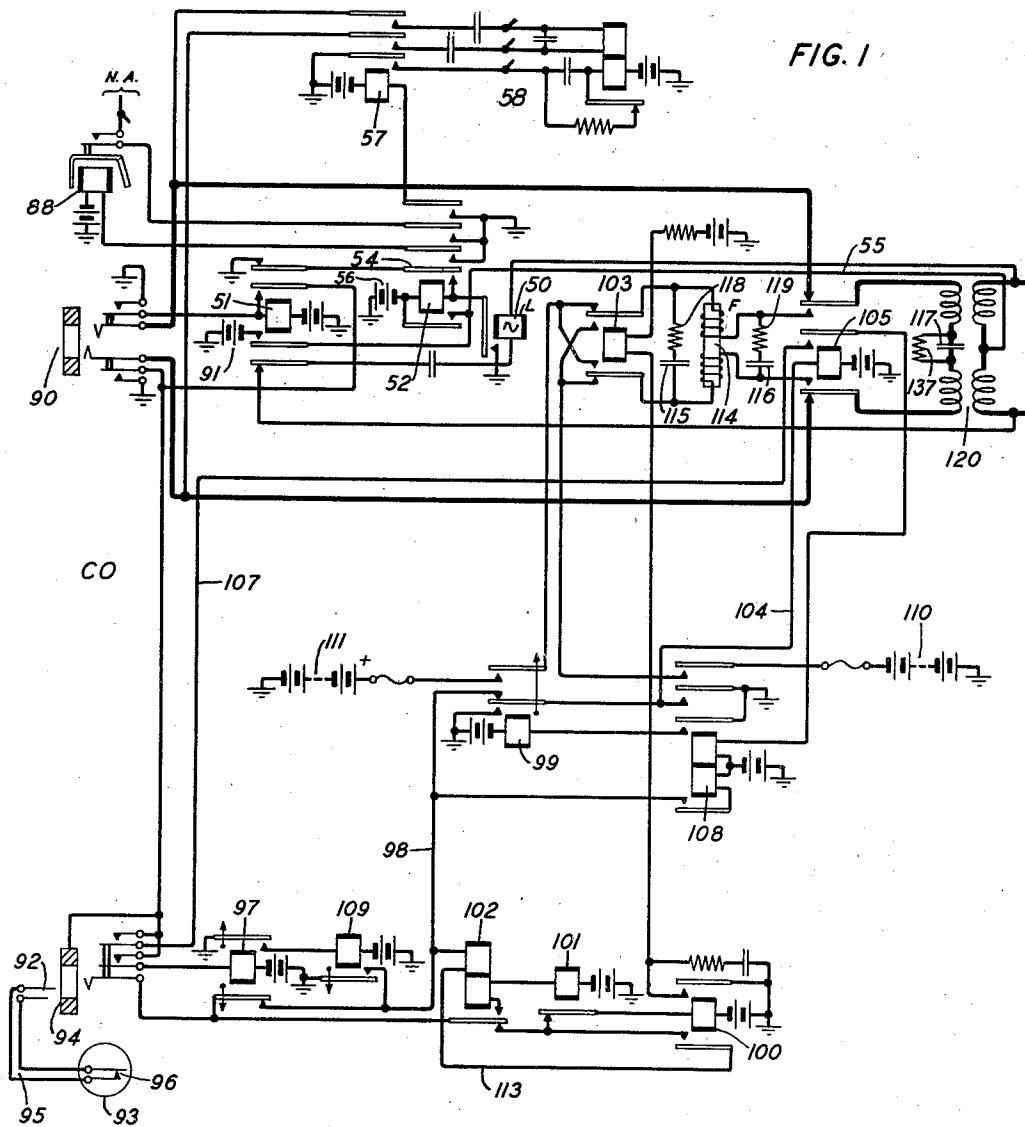
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2,173,675

TELEPHONE SYSTEM

Filed Oct. 2, 1937

3 Sheets-Sheet 1



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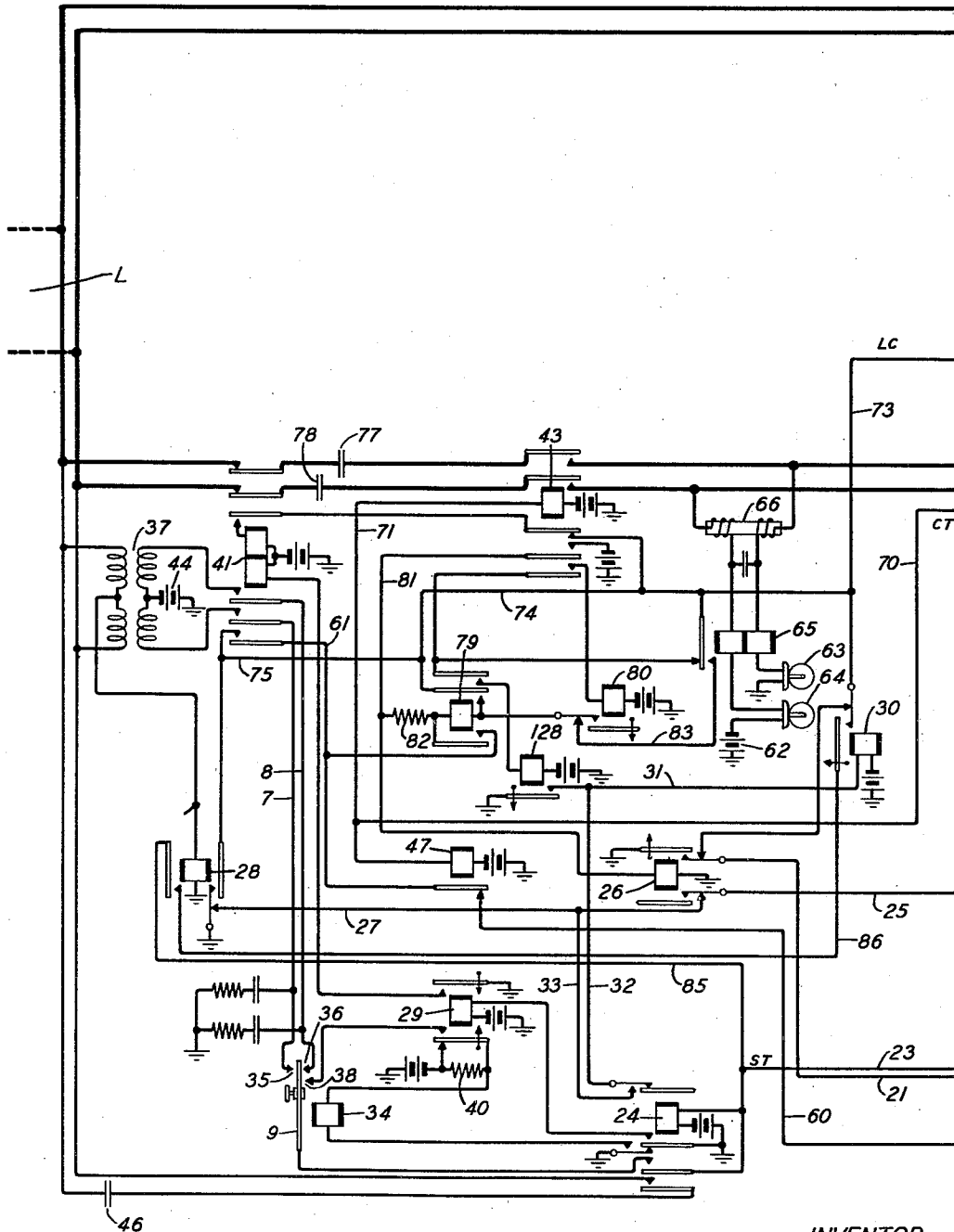
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FIG. 2



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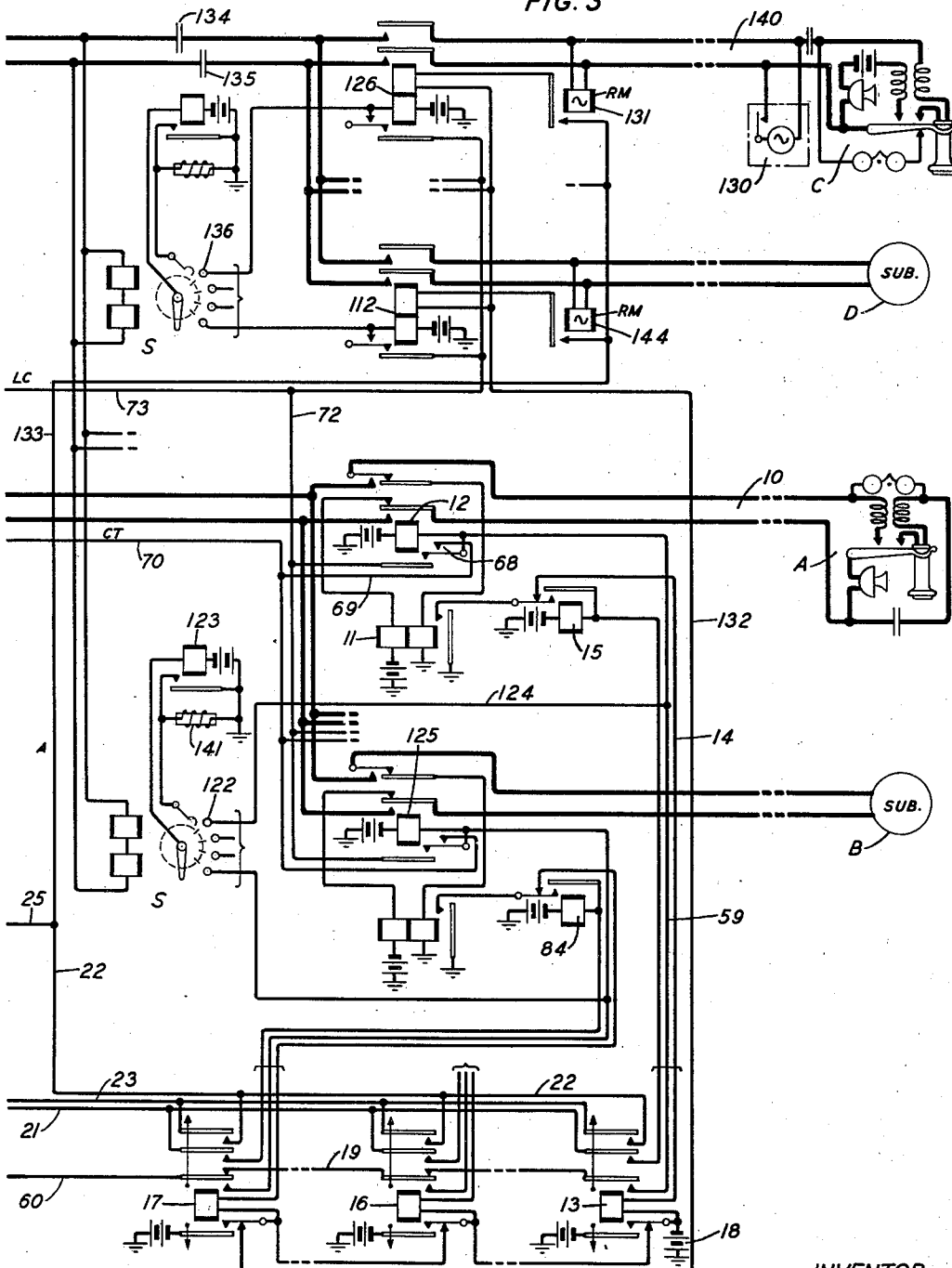
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TELEPHONE SYSTEM

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3 Sheets-Sheet 3

FIG. 3



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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to toll party line telephone systems.

It is the object of this invention to improve the telephone service accorded to small communities served by a single toll line from a toll center.

The invention is embodied in a toll party line circuit and associated subscriber's station connecting circuits which cooperate to effect a system of telephone communication between a large toll center and widely scattered outlying communities, as well as between subscribers of the same community and neighboring communities.

In accordance with the system of this invention, each of a plurality of outlying communities served by a toll line from a toll center is transformed into a switching center provided with automatically operating switching equipment in which a plurality of subscribers' lines, either magneto or common battery, terminate and which is controlled over the two conductors of the toll line by means of a telephone dial of the type commonly employed in establishing automatic and semi-automatic telephone connections.

Each subscriber's station, whether of the magneto or common battery type, on a party line is equipped with means for signaling an operator at a toll center by way of a toll line and for automatically rendering the toll line inaccessible to all other subscribers normally having access to the toll line. This lock-out feature is made possible by a relay, controlled over a circuit simplexed on the toll line, which operates as a consequence of the initiation of a call by a subscriber to remove ground potential from the line connecting relays at all other stations, thereby rendering them inoperative should a second subscriber attempt to use the toll line when in use by another subscriber.

In accordance with a feature of the invention, the lock-out control relay, subsequent to its operation as the consequence of the initiation of a call by a subscriber, is placed under the control of the toll operator in such a manner that the withdrawal of an answering plug from the toll line subsequent to its insertion therein in response to an incoming call, and the reinsertion thereof results in all subscribers' lines, including the calling line, being locked out from the toll line. This is a particularly desirable feature in that it furnishes a positive arrangement for number checking.

A further feature of the invention resides in the use of common signaling means at the toll office which functions automatically in response to the initiation of a call at either a magneto or

common battery station to transmit a tone signal over the toll line as an indication to the calling subscriber that the toll line is free for use.

These and other features of the invention not specifically identified, will be readily understood from the following detailed description made with reference to the accompanying drawings which combine to illustrate a complete toll party line system of telephone communication.

Fig. 1 is a circuit representation of the equipment located at a toll center;

Fig. 2 is a circuit representation of the equipment located at a line concentrating point and which is common to both magneto and common battery telephone lines; and

Fig. 3 illustrates a group of common battery stations and a group of magneto stations, all of which stations normally have access to the toll line terminating at the toll office shown in Fig. 1.

Outgoing call from common battery subscriber

In Fig. 3 there are illustrated two common battery stations A and B. For descriptive purposes it will be assumed that the subscriber at station A desires to communicate with the toll operator at the toll office indicated in Fig. 1 by the characters C. O. When the subscriber at station A removes the receiver from the switchhook, in accordance with usual common battery practice, the resulting bridge across the tip and ring conductors of the line 10 causes the line relay 11 to operate in a circuit extending over the back contacts and the two upper armatures of relay 12.

Relay 11, operated, causes relay 13 to operate in a circuit extending from grounded battery 18, winding of relay 13, conductor 14, normally closed back contacts of relay 15 to ground by way of the front contact and armature of relay 11. At its lower armature relay 13 disconnects battery 18 from the windings of preceding relays, such as relays 16 and 17, in the chain in order to prevent the operation of such relays at this time. Had relay 13 been any other than the last relay in the chain, such as relay 16 for example, it would lock up under control of a relay 11. At its upper innermost armature and back contact, relay 16 would open the chain circuit 19 to any succeeding relays in the chain to prevent, later on, the operation of other than the one connecting relay 12 associated with the first relay 13 of the chain operated. Relay 13 at its upper middle armature prepares an operating path from the lead 21 to the associated relay 15 which performs no function at this time. At its upper outermost armature and front contact, relay 13 connects the lead 22 to the

start lead 23 causing "start" relay 24 to operate in a circuit extending from grounded battery, winding of relay 24, conductor 23, upper outermost armature and front contact of relay 13, conductor 22, conductor 25, lower normal make-before-break contacts of relay 26, conductor 27 to ground at the right-hand normal make-before-break contacts of relay 28.

Relay 24, operated, establishes an obvious operating circuit for relay 29. At its upper armature, relay 24 causes relay 30 to operate in a circuit extending from grounded battery, winding of relay 30, conductors 31 and 32, operated upper contacts of relay 24, conductors 33 and 27 to ground at the normal right-hand contacts of relay 28. At its innermost lower armature and front contact, relay 24 establishes an obvious operating circuit for the interrupter relay 34 which relay operates. The interrupter 34 is a relay structure with a weighted reed 9 which is tuned to approximately 20 cycles. It has two contacts 35 and 36 used for connecting the battery 44 to repeating coil 37 and has a self-shunting contact 38. Relay 29 is slow to operate to give the interrupter 34 a chance to fully operate before resistance 40 is connected in series therewith. Relay 29 causes relay 41 to operate in an obvious circuit, removes the shunt from resistance 40 which is then connected in series with the winding of the interrupter relay 34 and connects the mid-point between resistance 40 and the winding of the interrupter relay 34 to the shunting contact 38 on the interrupter. This causes the winding of the interrupter relay to be deenergized and the reed 9 swings back past normal because of the weight and closes contact 35. The interrupter continues to vibrate shunting itself each time contact 38 is closed until the relay 24 releases. Relay 30 is slow to release to prevent false operation of relay 15.

When relay 29 operated, it closed a circuit to relay 41, as hereinbefore stated, which relay operates and locks under control of relay 43 and at its innermost and middle lower armatures and front contacts connects the interrupter contacts to the drop winding of repeating coil 37. Closure of interrupter contact 36 causes current to flow from battery 44 through the upper right-hand winding of repeating coil 37, front contact and innermost lower armature of relay 41, conductor 8, contact 36, reed 9, front contact and middle lower armature of relay 24, conductor 23, outermost upper armature and front contact of relay 13, conductors 22 and 25, normal lower contacts of relay 26, conductor 27, to ground on the normal right-hand contacts of relay 28, which sends one-half cycle of ringing current out on the line toward the central office by way of the left-hand winding of repeating coil 37 which is bridged across the conductors of the toll line L. Closure of the interrupter contact 35 causes current to flow through the lower right-hand winding of repeating coil 37, front contact and middle lower armature of relay 41, conductor 7, contact 35, reed 9 and thence over the circuit first traced to ground on the normal right-hand contacts of relay 28, causing one-half cycle of ringing current in the opposite direction to flow out on the line. The recurring alternate closures of contacts 36 and 35 of the interrupter thus continue to send ringing current toward the central office.

In addition to the starting of the ringing current circuit, relay 24 connects condenser 46 across the tip and ring conductors of the line to prevent excessive clicks from ringing current reaching any

other subscriber and operates relay 30 (as hereinbefore mentioned) which opens the path for conductor 21 to prevent the operation of relay 15 when relay 28 operates, as will appear from a later description.

Relay 41, at this time, disconnects the talking circuit of station A from the line L to prevent the subscriber hearing the ringing current later when relays 12 and 43 operate. Relay 41 prepares the operating circuit for relay 12 associated with the operated relays 11 and 13 through the back contact of relay 47, conductors 60 and 19 and the operated innermost upper contacts of the calling relay 13.

Signal received at central office

Ringling current from the interrupter relay 34 which is transmitted to the central office by way of the repeating coil 37 causes relay 50, which is connected across the tip and ring of the line L by way of lower outer armature and back contact of relay 51, to operate. Operated, relay 50 causes relay 52 to operate in an obvious circuit and establish an obvious circuit for the drop signal 88 which operates to appraise the operator of the incoming call. At its armature 54 and associated front contact, relay 52 locks up under control of relay 51. At its lower armature and front contact relay 52 connects 24 volt battery 56 to the simplex leg 55 of the toll line L which causes relay 28 and all such relays at other concentrating points to operate. At its outermost upper armature, relay 52 establishes an obvious circuit for relay 57 which connects the tone circuit, generally indicated by the numeral 58, to the line. This tone is heard by the calling subscriber as an indication that the toll line L is free for use as will appear presently.

The operation of relay 28, at the concentrating point at which a call is being originated causes relay 12 to operate in a circuit extending from grounded battery, winding of relay 12, conductor 59, front contact and innermost upper armature of relay 13, back contacts and innermost upper armatures of chain relays 16 and 17, conductor 60, back contact and armature of relay 47, conductor 61, outermost lower armature and front contact of relay 41 to ground at the right-hand armature and front contact of relay 28.

The function of other relays 28 at concentrating points other than the one at which a call is originated will be described later.

Relay 12 operated, connects the calling subscriber's station A to the talking battery supply 62 through the tip and ring resistance lamps 63 and 64, windings of relay 65 and retard coil 66 and disconnects the station from the battery through the windings of relay 11. Relay 12 locks up in circuit extending from grounded battery, winding of relay 12, front contact and lower armature of relay 12, conductors 72, 73, 74, 75 to ground at the right-hand armature and front contact of relay 28. Relays 43 and 47 now operate to ground by way of conductor 70, contacts 68 and lower armature of relay 12 and thence by way of the locking circuit for relay 12 just traced.

Relay 47 operates fast and opens ground from conductor 60 preventing the operation of any relay 12 which may be connected to conductor 21 through the operation of an operated relay such as 16 or 17 when relay 13 of the calling line releases and closes the lead 60, should the relay 13 be any but the last relay in the chain.

Relay 12 operated, releases relay 11 which in turn causes the release of relay 13. The re-

lease of relay 13 opens the circuit to the start relay 24 in order to stop the outgoing ring toward the central office. Relay 43 operated from the contacts 68 of relay 12, closes the talking circuit from the subscriber at station A to the tip and ring condensers 77 and 78 of the line concentrating circuit. At its innermost lower armature, relay 43 opens the locking circuit for relay 41 which relay, however, is held operated by way of its operating circuit under control of relay 29. At its middle and outermost lower armatures and front contacts, relay 43 prepares operating circuits for relays 79 and 80, respectively. If relay 65 had already operated, relay 79 will operate in a circuit extending from grounded battery, front contact and middle lower armature of relay 43, conductor 81, resistance 82, winding of relay 79, closed contacts of relay 80, conductor 83, front contact and armature of relay 65, conductors 74 and 75 to ground at the right-hand armature and front contact of relay 28. At its upper inner armature and front contact relay 79 locks to ground under control of relay 28. At its lower armature and front contact relay 79 prepares its own releasing path which includes the outermost lower armature and front contact of relay 41 and resistance 82. Relay 79 may buzz until relay 41 releases. At its middle lower armature and front contact relay 43 establishes an obvious energizing circuit for relay 26 which relay operates and at its upper armature and front contact connects ground to lead 21 to cause the operation of any relay, such as relays 15 and 84 which may be connected to lead 21 at this time. At its lower armature relay 26 prevents the continued operation of relay 30 which otherwise might occur due to the existence of a circuit extending from grounded battery, winding of relay 30, conductors 31 and 32, upper alternate contacts of relay 24, conductor 33, lower normal contacts of relay 26, conductor 25, conductor 22, the outermost upper front contact and armature of any operated chain relay such as 13, 16 or 17, conductor 23, conductor 85, left-hand armature and front contact of relay 23, conductor 86, armature and front contact of relay 30, conductors 74 and 75 to ground at the right-hand armature and front contact of relay 28. This locking circuit for relay 30 is therefore broken at the lower contacts of relay 26.

Relay 30 in releasing, opens the circuit for relay 24 which was established by the operation of relay 28 and also removes ground from the contact of relay 34 which stops the ringing current from going out on the line.

Relay 24 released, disconnects ground from the windings of relays 34 and 29, opens the circuit to the vibrating contact or reed 9 of relay 34, opens the operating path under this condition for relay 30 and disconnects condenser 46 from across the line. Relay 29 in releasing, restores the starting circuit for vibrating relay 24, opens the circuit to relay 41 which releases, disconnecting the repeating coil 37 from the vibrating circuit, opens the path to cause relay 79 to buzz, connects the tip and ring of the line to the subscriber's talking circuit and opens its own locking circuit.

If the central office line is not busy, tone from the tone circuit 53 will be heard by calling subscriber on the release of relay 41.

Operator answers

In response to the actuation of the drop signal 88 at the central office, the operator thereat inserts the plug of a cord circuit (not shown) into

the "talk" jack 90 associated with the signal. Ground from the contact on the jack operates relay 51 in an obvious circuit. At its inner lower armature, relay 51 connects the 24 volt battery 91 to the simplex lead 55 in multiple with the battery 56 from relay 52. At its outer upper armature, relay 51 opens the locking circuit for relay 52 which relay releases, deenergizing the drop signal 88 and releasing relay 57 which in turn, disconnects the tone circuit 58 from the toll line. At its outer lower armature it disconnects the winding of relay 50 from across the line to prevent its operation when the operator rings.

Relay 51 operates only when the tip spring contact closes and at its inner upper armature locks up to the ring spring contact of the jack 90 thereby preventing the possibility of a false release of the calling party when the operator answers. The operator is now in connection with the station A and may complete the call in the usual manner or by the "number checking" method.

Number checking

If the call is to be completed to a point which requires that the operator "number check" the calling party, she requests the calling subscriber to wait and removes the plug from the jack 90. This permits relay 51 to release, to disconnect the 24 volt battery 91 from the simplex lead 55 which releases all the simplex relays, such as 28, at all the station connecting circuits and releases the connected subscribers cut-through relays 43 and 12. Relay 26, which was held operated by the operation of relay 43, is slow to release so that when relay 43 releases, ground is momentarily maintained on the lead 21 for a purpose to be presently described.

When relay 12 released as a consequence of the release of relay 28, the subscriber's line relay 11 is reconnected to the subscriber's line and operates over the closed subscriber's line loop. In operating, relay 11 causes the operation of relay 13 which, at its middle upper armature and front contact connects the winding of relay 15 to the conductor 21 which, as mentioned in the preceding paragraph is still grounded at the upper armature and front contact of relay 26. Relay 15 therefore, operates and locks to ground at the armature and front contact of relay 11. In operating, relay 15 also opens the circuit to relay 13 which releases its armatures, opening the grounded lead 21. The release of relay 26 now is without effect, as the relay 15 is operated and locked to the line relay 11. The subscriber therefore would be disconnected from the toll line when the operator reinserts the plug in jack 90 at the central office.

The operator now dials the calling party code and if the correct number has been given, she

Dialing

In order to determine whether or not the correct number has been given, the operator dials the code given to her by the calling subscriber, using the dial 93, jack 94 and the plug 92 of dial cord 95. The selectors S used at the station connecting circuits or concentrating points are of the polarized type and have an armature which is movable into three positions, that is, when the selector is normal and there is no current on the line the armature is in a neutral position. With a positive line current, the armature is attracted toward one pole-piece and with a negative line current, it is attracted toward the other pole-piece. Movements of the armature toward either

pole-piece advance a contact wheel by means of a ratchet wheel under the control of the armature and a slow moving pawl. Alternate movements of the armature first toward one pole face and then toward the other pole face advance the selector wheel step by step following the dial at the central office. At selected points on the wheel, corresponding to its code, holding pins are located which engage with a holding spring before the retaining pawl releases the ratchet wheel associated with the contact wheel. The selector or selectors which has a pin at the periphery of the contact wheel in line with the holding spring remains in its operated position and selectors which do not have a holding pin at this point restore to normal. On the second and third digits the selectors advance in accordance with the code and the selector which has pins in accordance with the code sent from the dial closes the selected contact. The selectors just described do not, in themselves, form any part of the present invention and are well known in the art of train dispatching.

The current reversals for moving the selectors are generated by means of relays in the sending circuit which reverse the sending battery to the repeating coil at the central office once for each pulse of the dial. The combination of relays 100, 101, 102 and 103 convert the open period of each pulse into one-half cycle of line current, thus with digit "2" a complete cycle is sent out on the line, moving the selectors two steps; with the code "5", two and one-half cycles of line current would be sent which causes the selector wheels to move five steps.

When the operator inserts the dial plug 92 into the dial jack 94, ground on the sleeve of the jack 90 through the sleeve contacts of jack 94 and plug 92, dial pulsing contact 96 and the tip of the cord plug 92, lower armature and back contact of relay 97, conductor 98, back contact and inner armature of relay 99, conductor 104, winding of relay 105 to grounded battery causes relay 105 to operate and transfer the toll line L from the talk jack 90 to the sending circuit. Relay 100 also operates at this time in an obvious circuit direct from the dial. The function of relay 100 is described later.

Relay 105, at its inner upper armature connects ground from the jack contacts by way of conductor 107 to the upper winding of relay 108 to cause this relay to operate. At its innermost upper armature and front contact relay 108 establishes an obvious circuit for relay 99. Relay 108, at its middle upper armature and front contact, holds relay 105 operated while relay 99 transfers the operating path of relay 105 from jack ground to a lock ground on its inner armature and front contact. At its lower armature and front contact relay 108 also prepares a locking path to the contact of relay 109 and, at its outermost upper armature and front contact, connects negative sending battery 110 to the filter circuit F. Relay 99 operated, connects positive sending battery 111 to the filter F and at its inner armature connects ground to hold relay 105 operated. The purpose of this sequence of operation of relays 105, 108 and 99 is to prevent the transmission of a click to a station which may be connected to the line during the plugging in of the dial plug 92.

The remaining contact on the dial jack 94, when closed, causes relay 97 to operate in an obvious circuit, which in turn causes the operation of relay 109. Relay 109 in operating com-

pletes a locking circuit for relay 108 by way of conductor 98 and the lower winding of relay 108 and closes the operating circuit for relay 102 which circuit extends from grounded battery, winding of relay 100, armature and back contact of relay 101, front contact and lower armature of relay 100, conductor 113, upper winding of relay 102 to ground at the front contact and armature of relay 109. Relay 102, being shunted by the dial contacts does not operate at this time. The circuit is now in condition for the dial to operate the sending circuit.

The sending circuit consists of relay 103, retardation coil 114, condensers 115, 116 and 117, resistances 118 and 119 and retardation coil 120 which function to convert the reversals of current from relay 103 into a line current which is practically a sine wave so that, if a station is connected to the line during the signaling period, there will be no objectionable clicks.

On the first opening of the dial pulsing contact, relay 100 remains operated and relay 102, due to the removal of the shunt, operates and connects the pulsing contact circuit through its lower winding to relay 101. On the closure of the pulsing contact after the first open pulse, relay 102 remains operated on its lower winding and relay 101 operates opening the circuit to relay 100, which relay releases. Relay 100 released, opens the circuit to relay 103 which releases and reverses the line connections to sending batteries 110 and 111, thereby reversing the current on the line corresponding to one-half cycle, which causes all selectors S associated with the line to advance one step.

On the second opening of the dial contacts 96, relays 101 and 102 release, closing the pulsing circuit to relay 100. At the closure, at the end of the second open interval, relay 100 operates, closing the circuit to relay 103 which again operates and reverses the line current, completing the second half of the first cycle and advancing the selectors S to the second step. Further opens and closures of the dial operate relays 102 and 101, release relays 101 and 102 and reoperate relay 100 as follows: On the odd opens, relay 102 operates in series with relay 100 holding it operated. On the closure following an odd open, relay 101 operates in series with relay 102 holding relay 102 operated and releasing relay 100. On the even opens, relays 101 and 102 release and all pulsing relays are normal. At the end of a digit, relay 100 may be operated, or relays 101 and 102 may be operated according to whether it was an odd or even pulse that had been last sent.

Assuming that the subscriber at station A gave the correct code to the operator and the operator in turn actuated the dial 93 in accordance with this code, the current reversals sent out by the pulsing circuit just described would cause the selectors S to advance and the selector having a contact, such as 122 corresponding to the calling line would remain in its operated position and all other selectors would restore to normal.

In the system disclosed, all the stations are normally disconnected from the line and are selectively connected to the line by means of a selector S which has four contacts any one of which may be closed without affecting the relays connected to the other contacts. Any number of such selectors may be connected to the line and any one of the four contacts on one selector can be selected and closed without closing a contact on any other selector on the same line. The code wheels of these selectors are set so that

the same total number of steps is necessary to advance the code wheel to the first selected contact on all selectors that are to be used on the same line. In the system disclosed, the selectors will be set preferably for a total of 17 steps to the first code contact. The second, third and fourth code contacts require 19, 21 and 23 steps, respectively. In order to prevent the various selectors on the same line all stepping up to the first contact the 17 pulses are sent. These impulses are broken into three sets of pulses totalling 17 in number. For example, in a selector having a selector number 7-6-4, the code to be dialed to select a station on the first contact would be 764; for a station on the second contact the code would be 766; for a station on the third contact the code would be 768 and for the fourth contact the code would be 760. In like manner a second selector on the line having a number 7-7-3 would cause the four station contacts to be selected when the codes 773, 775, 777 and 779, respectively, are dialed.

In the case chosen for descriptive purposes, we may assume the selector individual to the group of common battery lines is numbered 7-6-4. With contact 122 as the first contact, the station A associated therewith would have assigned thereto the code 764, whereas the fourth contact, associated with subscriber's station B would be reached by dialing 760.

When the code is comprised of a set of impulses totalling 19, 21 or 23, the selector contact passes over the intermediate contacts and causes current to flow for a short time through the connecting relay, such as 12, connected to that contact point. This relay is prevented from operating by means of the selector relay 123 and retardation coil 141. The relay 123 is connected to the code wheel and the retardation coil 141 is connected to the holding spring. During the pass-by time, relays 123 and the connecting relay, such as 12, are in multiple and the combination is in series with retardation coil 141. The connecting relay, such as 12, cannot operate under this condition as it does not receive sufficient current and relay 123 will not operate fast enough to short-circuit the retardation coil 141. When the wheel comes to rest on a called terminal, relay 123 operates and short-circuits the retardation coil 141 and allows the associated relay, such as 12 associated with the engaged contact to operate.

From the foregoing it will be apparent that when the operator dials 764, the contact 122 will be selected and relay 12 operated from grounded battery, winding of relay 12, conductor 124, contact 122 and selector brush to ground at the front contact and armature of selector relay 123. The operation of relay 12 connects the subscriber's line 10 to the toll line and releases relay 11 which in turn causes the release of relay 15. The operator removes the dial plug to verbally check the given number.

If the correct code had not been given, some other relay such as relay 125, 112 or 126, for example, would have been operated and the operator finding no party on the line would know that an incorrect code had been given.

At the end of a normal code the operator removes the dial plug from the dial jack 94 allowing relays 97, 109, 108, 99 and 105 to release in the order named. The normal code combinations are such as to leave relay 100 normal when the plug is removed from the jack. Relay 97 releases slowly, in turn, releasing relay 109. The

releasing time of relay 97 is sufficient to allow the selector armatures to restore to their neutral position. When relay 97 restores to normal it connects the pulsing circuit, that is, the winding of relay 100 to the operated contact of relay 109 causing relay 100 to operate, in turn, operating relay 103 which sends a surge of current out on the line to move any operated selector from its holding position so that it will restore to normal. Relay 109 is slow to release in order to hold relays 108, 99 and 105 operated while this surge of current is sent out on the line. When relay 109 releases it opens the locking circuit for relay 103 which relay releases fast and disconnects the negative sending battery 110 from the sending circuit and opens the circuit for relay 99. Relay 99 releases slowly to allow condenser 117 to discharge through resistance 126 and for the energy in the windings of repeating coil 120 to dissipate before the line is cut back to the "talk" jack 90. Relay 99 released, releases relay 105 which disconnects the sending circuit and reconnects the line to the talk jack circuit.

Disconnection

At the end of the call the subscriber at station A replaces the receiver on the switchhook whereupon relay 65, (Fig. 2) which is operated over the line loop releases and connects ground from the right-hand armature and front contact of relay 28 through the operated contact of relay 79 to the winding of relay 128 causing relay 128 to operate. Relay 80 also operates, opening the operating path for relay 79.

Relay 128 operated, establishes an obvious operating circuit for relay 30 which relay operates causing relay 24 to operate in a circuit extending from grounded battery, winding of relay 24, conductor 85, left-hand armature and front contact of relay 28, conductor 86, armature and front contact of relay 30, conductors 74 and 75 to ground at the right-hand armature and front contact of relay 28. Relay 24 operated, causes relay 29 to operate in an obvious circuit and connects ground to the interrupter relay 34 causing the operation of the interrupter.

Relay 29 causes the operation of relay 41 over an obvious circuit, removes the shunt from resistance 40 which is then in series with interrupter winding 34 and connects the mid-point between resistance 40 and the interrupter to the shunting contact 38 thereof. This sets the interrupter into operation. When relay 29 operated it caused relay 41 to operate as previously stated. Relay 41 connects the contacts 35 and 36 of the interrupter to the repeating coil 37. Relay 41 also disconnects the subscriber's line and the bridged impedance talking supply circuit from the toll line to prevent ringing the subscriber's bell. Relay 41 also releases relay 79 by shunting the winding through resistance 82. Relay 79 released, opens the circuit to relay 128 which is slow in releasing and which, in turn, opens the circuit to relay 30. Relay 30 is also slow in releasing and disconnects ground from the interrupter and relay 24, the latter releasing and causing the release of relays 29 and 41. Relay 41 releases to disconnect the ringing current from the line. The period that the ringing current is connected to the line during the operation and release of the above-mentioned relays is approximately one-half second which is sufficient to operate ringing relays in the operator's cord (not shown) associated with the talking jack 90, which relays cause the operation of a cord signal. Upon

noting the signal the operator may challenge to make certain that the signal is for disconnect purposes and then remove the cord plug from the jack 90. This act causes relay 51 to release and disconnects battery 91 from the simplex leg 55 whereupon all simplex relays, such as 28, release which, in turn, causes the release of relay 12 and restores the circuit to normal.

Outgoing call from magneto station

In Fig. 3 there are shown two magneto stations C and D. For purpose of description it will be assumed that the subscriber at station C desires to establish a connection with the central office C. O. by way of the toll line L. In order to make such a call the subscriber operates the hand generator 130 in the usual manner for approximately one-half second. This causes the operation of relay 131 in an obvious circuit. If the toll line is not busy, relay 28 will be normal and providing no relay, such as relays 13, 16 or 17, on a common battery subscriber's line is operated, due to a common battery subscriber originating a call, relay 126 will operate in a circuit extending from grounded battery 18, normal make-before-break contacts of chain relays 13, 16 and 17, conductor 132, upper winding of relay 126, armature and front contact of relay 131, conductors 133 and 25, lower normal make-before-break contacts of relay 26 to ground at the normal make-before-break contacts of relay 28. Relay 126, at its two upper armatures bridges the subscriber's line 140 across the toll line through condensers 134 and 135 and the ringing current from the hand generator 130 is thus connected from the subscriber's line over the toll line L to the central office. This current causes relay 50 to operate in the same manner as hereinbefore described in connection with a call to the central office originating at the common battery station A. The drop signal 88 is accordingly operated, tone connected to the toll line and 24 volt battery 56 connected to the simplex leg 55 in the same manner as previously described.

The connection of 24 volt battery 56 to the simplex leg 55 as in the previous case, causes relay 28 at the calling point, and all similar relays at other points to operate to perform the functions hereinbefore described. Relay 126 in operating establishes a locking circuit for itself extending from grounded battery, lower winding of relay 126, lower front contact and armature of relay 126, conductors 73, 74 and 75 to ground on the right-hand armature and front contact of relay 28.

Relay 28 operated, opens up lead 27 to prevent any common battery line circuit operating the interrupter circuit and to prevent any relay, such as 144 in any other magneto subscriber line circuit at this point from operating its associated relay 112. The simplex relays, such as 28, at other concentrating points operate to open up the operating paths for other connecting relays such as 126 and 12, preventing stations at those points from connecting to the line in case they should try to originate a call. The call is answered in the manner already described.

Number checking

The removal of the plug from jack 90 at the central office would release relay 28 in the same manner previously described. Relay 126 would therefore restore its armature to disconnect the line 140 from the toll line. The operator then inserts the dialing plug into jack 94 and dials the

given code. The apparatus functions in the same manner as already described in connection with number checking or a common battery line except that the selector S associated with the group of lines to which line 140 belongs would select contact 135 to cause the operation of relay 126 in an obvious circuit to connect the line to the toll line L.

Disconnect

After the conversation is completed in the case of a magneto subscriber, the subscriber rings off in the usual manner. This causes the supervisory lamp or signal associated with the operator's cord (not shown) to be actuated.

Revertive calls

A calling subscriber, on either a common battery line or a magneto line calls the central office in the manner previously described and informs the operator that a connection with a second party is desired. When the operator learns that the called party is on the same line as the calling party, she instructs the calling subscriber to wait and removes the answering cord from the toll line jack to effect the release of all simplex relays such as 28 as well as the operated connecting relay, such as 12 or 126. The operator then reinserts the plug, dials the code of the called party and rings in the usual manner. When the called party answers, the operator informs the called party that she has a call, asks the called party to wait and dials the calling party. When the connecting relay, such as 12 or 126 of the calling party operates as hereinbefore described, the operator instructs the two parties to talk. No interruption to dialing will occur while the called subscriber's receiver is off the hook in the case of the common battery station because of the blocking condensers 77 and 78 which prevent the shunt of the common battery supply circuits and the station subscriber's set from interfering with the line circuits and because of the condensers 134 and 135 in the case of the magneto subscriber's line circuit which prevent the shunt of relay 131 and the subscriber's set from interfering with the line signals.

Lockout features

Relay 28, one of which is connected to the simplex leg 55 at each concentrating point, prevents any station from connecting to the toll line as long as it is operated. All such relays operate when central office 24 volt battery is connected to the simplex leg as already described. When relay 28 operates, connecting relay 12, relay 43 and lockout-control relay 26 operate, the last placing ground on the lead 21 which, as will be noted, is included in the operating circuits for all relays such as 15 and 84 which circuit is completed when a corresponding relay, such as 16 or 17 operate in response to the initiation of a call by a subscriber at any station such as station A or B.

Any common battery station such as stations A and B which attempts to originate a call when the toll line is busy causes its associated line relay, such as relay 11 to operate which, in turn, operates the corresponding relay 13 to complete the circuit for relay 15 to ground on lead 21 at the upper armature and front contact of relay 26. The operation of relay 15, or relay 24 as the case may be, opens the operating circuit to relay 13, or 17, so that the energizing circuit to the connecting relay 12, or 125 cannot be completed.

The calling subscriber is accordingly locked out when attempting to seize the toll line when busy.

Magneto subscribers are prevented from connecting to the line due to the fact that the lockout-control relay 26, which is operated, opens the lead 25 which controls the operation of the connecting relay 126, or 112, when their corresponding relay 131, or 144 is actuated in response to the initiation of a call at the station C, or D.

During the period after a common battery subscriber has initiated a call and before the central office circuit connects battery to the simplex lead, all other stations are prevented from connecting to the line at the same concentrating point by the two chain circuits through contacts of relays 13, 16 and 17. If the second call is originated by a line preceding the calling line, the relay, such as 16 or 17, in the preceding circuit is prevented from operating because battery is opened at the calling line relay, such as 13. If the second line is a succeeding line in the chain, lead 60 is opened at the preceding relay such as 16 or 17, thus preventing the connecting relay, such as 125 or 12 in the second calling line from operating when relay 28 operates.

On number checking, as hereinbefore described, the operator removes her plug from the jack 90 causing the release of all simplex relays 28 which release the connecting relay 12, 125, 126 or 112 as the case may be, thus disconnecting the calling party from the toll line. Relays 12 and 43, in the case of a common battery station, would release the latter opening the circuit to slow-to-release lockout-control relay 26. However, this relay holds ground on lead 21 long enough to effect the operation of relay 15 when relay 13 operates in response to the reconnection of relay 11 to the subscriber's station when relay 12 is released. Relay 15 would accordingly operate and lock to the armature of relay 11 and open the circuit to relay 13 which relay releases, opening the operating circuit to connecting relay 12. This relay accordingly cannot operate and the calling subscriber is disconnected from the toll line.

If the calling party were a magneto subscriber, the removal of the plug from jack 90 releases the relay 28 and the operated relay, such as relay 125 would release.

Call originating at central office

It is believed unnecessary to describe the circuit operations incident to the extension of a call originating at the central office and intended for any of the subscribers' stations A, B, C or D, since such operations have been covered in detail under the headings of "number checking", "dialing" and "revertive calls".

Recall

A subscriber may recall the central office operator after the operator has removed the dial plug from the jack after dialing. The magneto station subscriber can recall by operating the hand generator in the usual manner and the common battery station subscriber may recall by holding down the switchhook for approximately two seconds and then releasing it. This signal is passed to the operator by means of ringing current in the same manner as the disconnect signal, the only difference being that when the operator answers the recall signal, the subscriber is on the line when the operator challenges.

What is claimed is:

1. In a telephone system, a central office, a

toll line extending therefrom to a switching center and having a simplex leg, a station at the switching center normally having access to said toll line and connected thereto as the result of the initiation of a call at the station, and means controlled from said central office by way of the simplex leg of said toll line for disconnecting said station from said toll line and rendering the toll line inaccessible to the station.

2. In a telephone system, a central office, a toll line extending therefrom to a switching center, and having a simplex leg, a plurality of stations at the switching center normally having access to said toll line and one of said stations being connected to said toll line as the result of the initiation of a call thereat, and means controlled from said central office by way of the simplex leg of the said toll line for disconnecting the connected station from the toll line and rendering the toll line inaccessible to all of said stations.

3. In a telephone system, a central office, a toll line extending therefrom to a switching center, a plurality of stations at said switching center normally having access to said toll line, a lockout relay individual to each of said stations, a connecting relay for each of said stations, a relay individual to said toll line, and means including said last-mentioned relay responsive to the initiation of a call at one of said stations for actuating the connecting relay individual to the calling station to connect the calling station to the toll line, said means also being controlled from said central office to release the operated connecting relay, operate the lockout relay associated with the calling station and prepare an operating circuit for all other lockout relays whereby the calling station is disconnected from said toll line and said toll line is rendered inaccessible to all stations including the calling station.

4. In a telephone system, a central office, a toll line extending therefrom to a switching center and having a simplex leg, a plurality of stations at the switching center normally having access to said toll line, a lockout relay for each of said stations, a connecting relay for each of said stations, and means including a relay connected in the simplex leg of said toll line responsive to the initiation of a call at one of said stations for actuating the connecting relay of the calling station to connect the calling station to said toll line, said means also being controlled from said central office to release the operated connecting relay, operate the lockout relay of the calling line and prepare an operating circuit for all other lockout relays whereby the calling station is disconnected from said toll line and said toll line is rendered inaccessible to all said stations including the calling station.

5. In a telephone system, a central office, a toll line extending therefrom to a switching center and having a simplex leg, a plurality of stations at the switching center normally having access to said toll line, a lockout relay for each of said stations, a connecting relay for each of said stations, a relay controlled over the simplex leg of said toll line, a source of current at said central office, means responsive to the initiation of a call at one of said stations for connecting said central office source of current to the simplex leg of said toll line to effect the operation of the relay controlled thereover, and means responsive to the operation of said simplex relay for actuating the connecting relay of the

calling station to connect the calling station to said toll line, said simplex relay also being controlled from said central office to release the operated connecting relay, operate the lockout relay of the calling line and to prepare an operating circuit for all other lockout relays whereby all stations including the calling station are rendered inoperative to initiate a call over said toll line.

6. In a telephone system, a central office, a toll line extending therefrom to a switching center and having a simplex leg, a subscriber's line normally having access to said toll line, means including a relay controlled over the simplex leg of said toll line, responsive to the initiation of a call on said subscriber's line for connecting said subscriber's line to said toll line, means at said central office for controlling said relay over the simplex leg of said toll line to cause the release of said relay whereby said subscriber's line is disconnected from said toll line, and means operating in response to the disconnection of said subscriber's line from said toll line for rendering the toll line inaccessible to said subscriber's line.

7. In a telephone system, a central office, a toll line, extending therefrom to a switching center, a subscriber's line normally having access to said toll line, means responsive to the initiation of a call on said subscriber's line for connecting said subscriber's line to said toll line, and means effective, subsequent to the connection of said subscriber's line to said toll line and controlled from said central office for disconnecting said subscriber's line from said toll line and rendering said toll line inaccessible to said subscriber's line.

8. In a telephone system, a central office, a toll line extending therefrom to a switching center and having a simplex leg, a source of current at said central office, a relay in the simplex leg of said toll line, means responsive to the initiation of a call at said station for connecting said central office source of current to said simplex leg to cause the operation of the relay therein, a connecting relay for said station operating in response to the operation of said simplex relay for connecting said station to said toll line, and means responsive to the seizure of the toll line at the central office in response to an incoming call from said station for disconnecting said central office source of current from the simplex leg and substituting therefor another source of current whereupon said simplex relay remains operated, said means functioning upon the release of said toll line at said central office to release said connecting relay whereupon said station is disconnected from said toll line.

9. In a telephone system, a central office, a toll line extending therefrom to a switching center and having a simplex leg, a source of current at said central office, a relay in the simplex leg of said toll line, means responsive to the initiation of a call at said station for connecting said central office source of current to said simplex leg to cause the operation of the relay therein, a connecting relay for said station operating in response to the operation of said simplex relay for connecting said station to said toll line, and means controlled by the operator at said central office for effecting the release of said connecting relay whereupon said station is disconnected from said toll line.

10. In a telephone system, a central office, a toll line extending therefrom to a switching center and having a simplex leg, a plurality of stations including a calling station at the switching center

normally having access to said toll line, a connecting relay for each station for connecting its respective station to said toll line, a second relay for each station which operates in response to the initiation of a call at its respective station for preparing an operating circuit for its respective connecting relay, means controlled over the simplex leg of said toll line and operating in response to the initiation of a call at the calling station for completing the circuit to the connecting relay individual to the calling station, and means controlled by the operated second relay for rendering the second relays of all other stations unresponsive to the initiation of a call at its respective station whereby said toll line is rendered inaccessible to all other stations.

11. In a telephone system, a central office, a toll line extending therefrom to a switching center and having a simplex leg, a plurality of stations at said switching center normally having access to said toll line, a source of current at said central office, a relay controlled over the simplex leg of said toll line, a first relay for each of said stations, a connecting relay for each of said stations jointly controlled by its respective first relay and the relay controlled over the simplex leg, means responsive to the initiation of a call at one of said stations, for operating its respective first relay and connecting said source of current to said simplex leg to effect the operation of the relay controlled thereover whereupon the connecting relay of the calling station operates to connect its respective station to the toll line, and means including armature contacts of the operated first relay for rendering the first relays of all other stations inoperative should an attempt to originate a call at any thereof be made.

12. In a telephone system, a central office, a toll line extending from said central office to a switching center, a plurality of stations at said switching center, a source of tone at said central office normally disconnected from said toll line, means responsive to the initiation of a call at any of said stations for transmitting signaling current over said toll line to said central office, and means at said central office responsive to the signaling current incoming over said line for connecting said source of tone to said toll line to produce an audible signal in the receiver at the calling station as an indication of the receipt of the call at the central office.

13. In a telephone system, a central office, a toll line extending therefrom to a switching center, a source of tone at said central office normally disconnected from said toll line, connecting means at said central office for connecting said source of tone to said toll line, magneto and common battery stations at the switching center having access to said toll line, and means responsive to the initiation of a call at any of said stations for effecting the transmission of signaling current over said toll line to cause the operation of said connecting means whereby said tone source is connected to said toll line to advise the subscriber at the calling station of the idle condition of said toll line and that the call has been received at the central office.

14. In a telephone system, a central office, a toll line extending therefrom to a switching center, a source of tone at said central office normally disconnected from said toll line, connecting means at said central office for connecting said tone source to said toll line, a common battery station at the switching center having access to said toll line, a source of signaling current at

the switching center, and means responsive to the removal of the receiver at said station in initiating a call over said toll line for connecting said source of signaling current to the toll line to effect the operation of said connecting means whereby said tone source is connected to said toll line to advise the subscriber at said station of the idle condition of said toll line.

15. In a telephone system, a central office, a toll line extending therefrom to a switching center, a source of tone at said central office normally disconnected from said toll line, connecting means at said central office for connecting said tone source to said toll line, a magneto station at said switching center having access to said toll line and having a hand-operated generator, and means responsive to the operation of the hand-operated generator at said magneto station in initiating a call over said toll line for actuating said connecting means whereby said tone source is connected to said toll line to advise the subscriber at said station of the idle condition of said toll line.

16. In a telephone system, a central office, a toll line extending therefrom to a switching center, a source of tone at said central office normally disconnected from said toll line, connecting means at said central office for connecting said tone source to said toll line, a common battery station having access to said toll line, a source of signaling current controlled from said common battery station, a magneto station having access to said toll line, a source of signaling current controlled from said magneto station, and means responsive to the transmission of current from either of said sources of signaling current in response to the initiation of a call at either of said stations for actuating said connecting means

whereby said tone source is connected to said toll line to advise the subscriber at the calling station of the idle condition of the toll line.

17. In a telephone system, a central office, a toll line extending therefrom to a switching center, a signal at said central office individual to said toll line, a source of tone at said central office normally disconnected from said toll line, a relay controlling the operation of said signal and the connection of said tone source to said toll line, magneto and common battery stations at the switching center having access to said toll line, means at each of said stations effective in causing the transmission of signaling current over said toll line in response to the initiation of a call thereover, and means at said central office responsive to the transmission of signaling current over said toll line from either of said stations for operating said relay whereby said signal at said central office is displayed and said tone source connected to said toll line.

18. In a telephone system, a central office, a toll line extending therefrom to a switching center and having a simplex leg, a plurality of common battery and magneto stations at the switching center normally having access to said toll line, a relay in the simplex leg of said toll line, means including said relay responsive to the initiation of a call at any of said stations for connecting the calling station to the toll line and rendering the toll line inaccessible to all other of said stations, and means also including said relay and responsive to the seizure release and immediate reseizure of said toll line at said central office for rendering said toll line inaccessible to all of said stations including the calling station.

LANGFORD J. BOWNE.