Nov. 12, 1935. W. HATTON ET AL 2,020,466

TELEPHONE SYSTEM

Filed Sept. 13, 1933 3 Sheets-Sheet 1

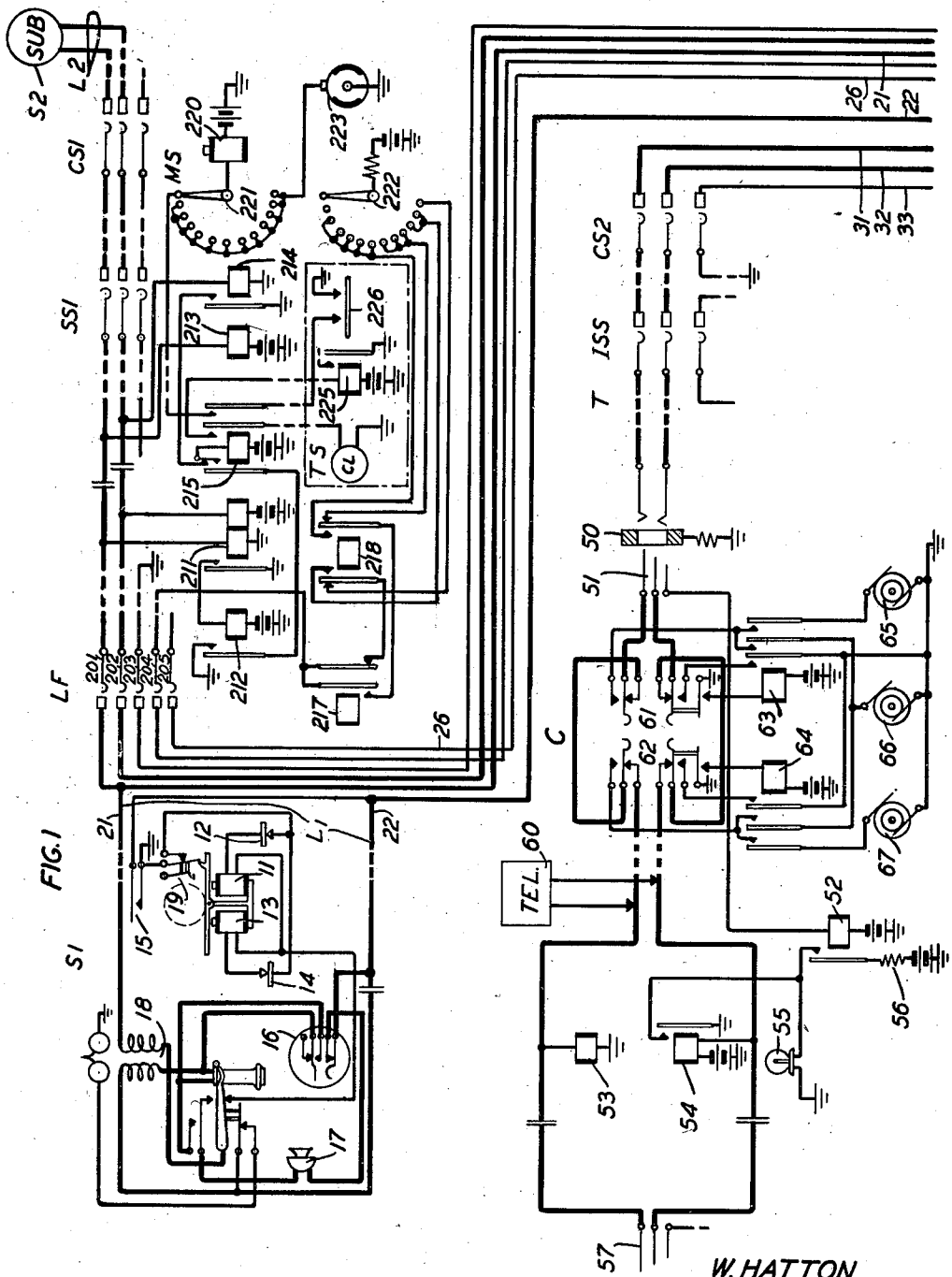


FIG. 1

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TELEPHONE SYSTEM

Filed Sept. 13, 1933 3 Sheets-Sheet 2

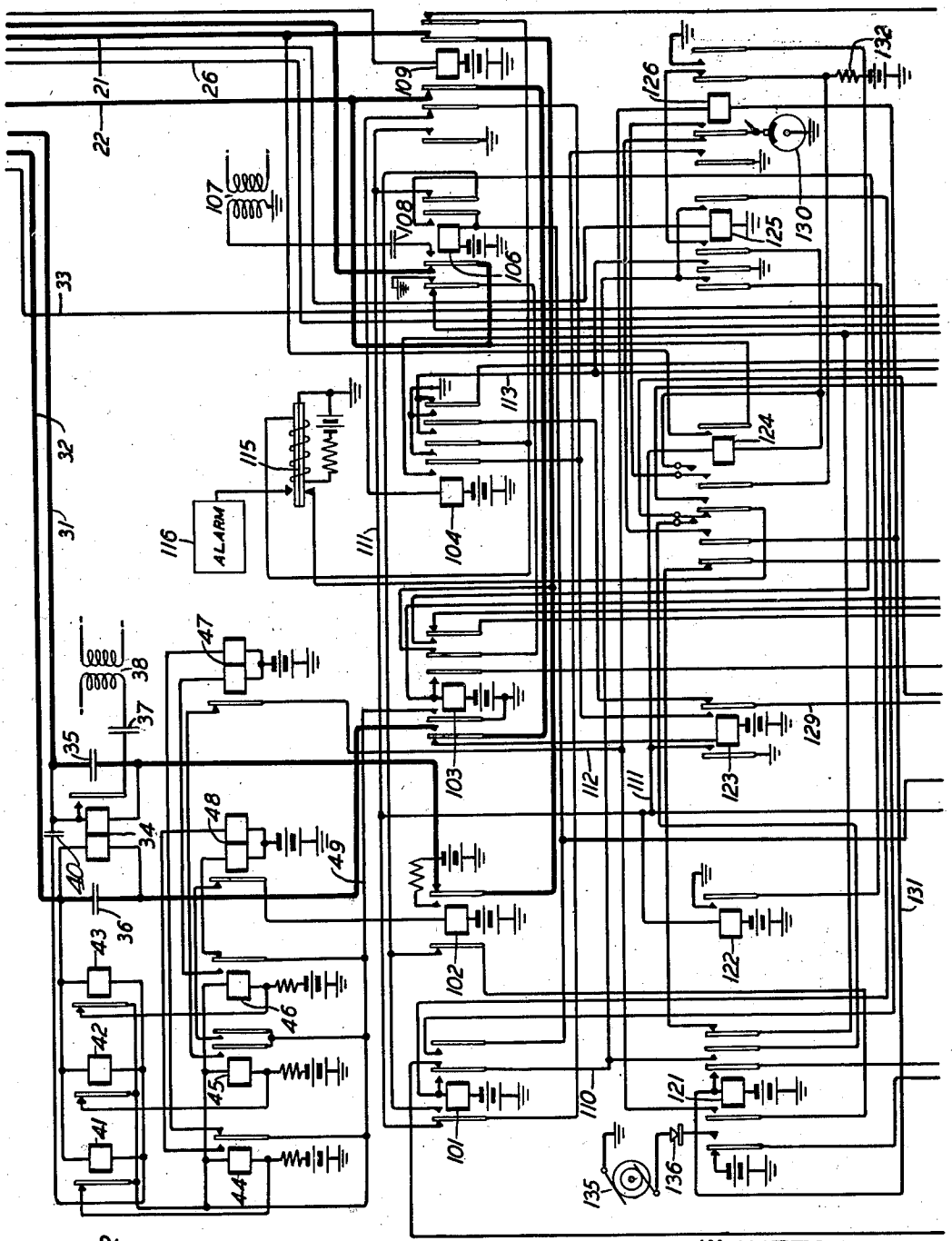


FIG.2

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TELEPHONE SYSTEM

Filed Sept. 13, 1933 3 Sheets-Sheet 3

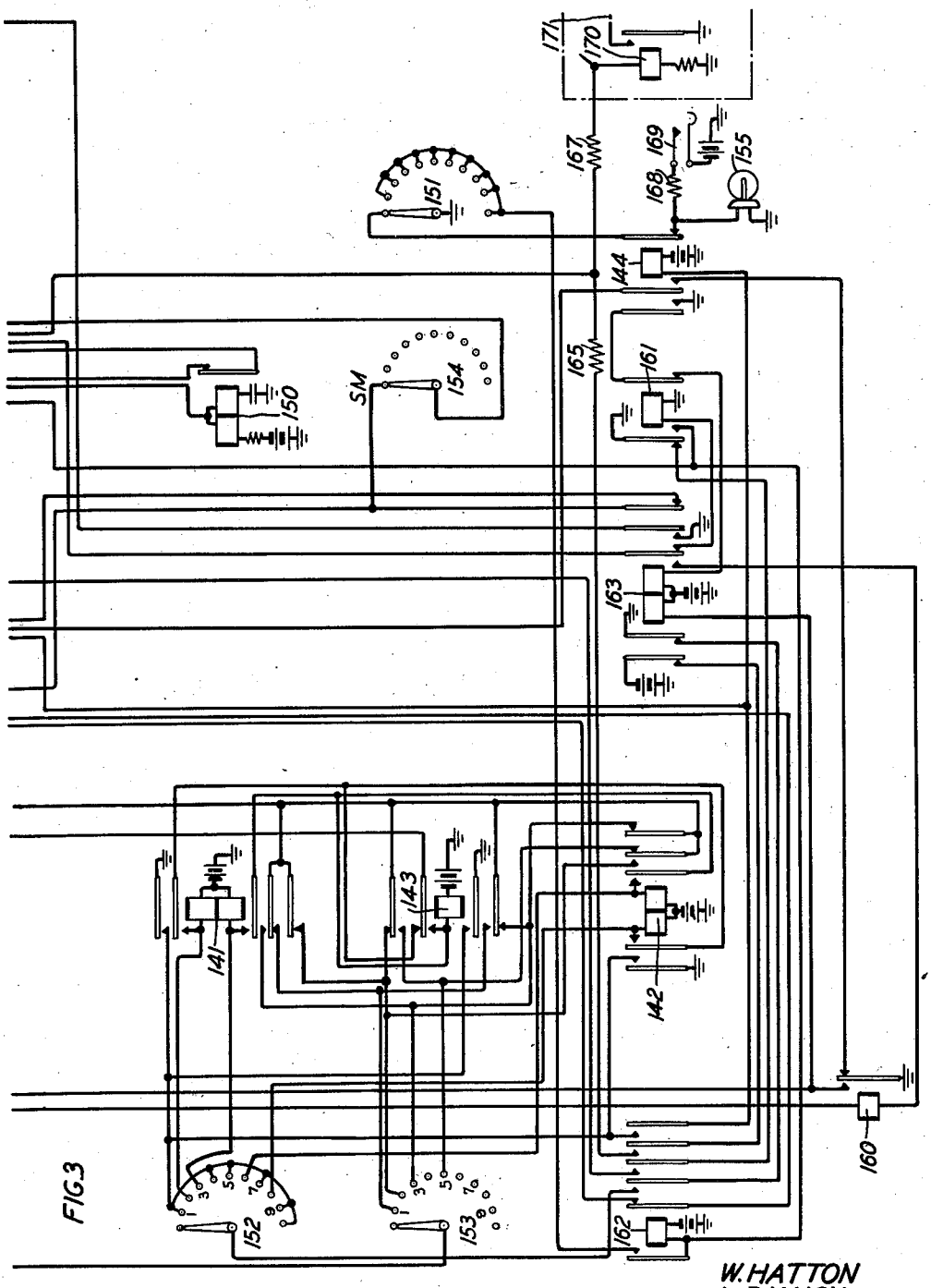


FIG 3

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Patented Nov. 12, 1935 2,020,466

UNITED STATES PATENT OFFICE

2,020,466

TELEPHONE SYSTEM

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Application September 13, 1933, Serial No. 689,192
In France September 29, 1932

15 Claims. (Cl. 179—6.31)

This invention relates to telephone systems and more particularly to automatic or semi-automatic systems comprising coin-box stations.

It is the object of this invention to provide improved means for allowing coin-box subscribers to establish automatically calls requiring different charges, to provide improved means for effecting the collection or refund of deposited coins, and to provide improved means for preventing fraud and for simplifying the coin collecting or refunding operation on calls completed through a toll operator's position.

According to one feature of the invention a record of the number or value of coins inserted at a coin box station is automatically set up at the central office and subsequently compared automatically with charge indicating signals in accordance with the value of a completed call, means being provided for breaking down the connection in case the deposited coins are insufficient to pay for the call.

According to a further feature the calling line is short-circuited during determination of the charge to be made.

According to another feature of the invention an operator is informed, on calls completed through a manual toll switchboard, of the value of inserted coins by signals which cannot be simulated by the operation of the receiver hook. According to this feature of the invention visual and audible indications are given to the toll operator, in accordance with the value of inserted coins.

According to another feature of the invention an operator's position is provided with means for transmitting voice frequency signals to selectively effect the automatic collection or refund of coins inserted at a calling station.

These and other features of the invention will be appreciated from the following description of one embodiment of the invention which is shown schematically in the drawings which form a part of this specification. The invention is, however, not limited in its application to the particular system which is disclosed in the drawings.

Referring to the drawings,

Fig. 1 represents in schematic form a coin-box subscriber's station S1 and line L1, a line-finder switch LF, a first selector switch SS1, a connector switch CS1, and another subscriber's station S2; Fig. 1 also shows in schematic form an operator's cord circuit C and telephone set TEL, a toll switching trunk T and associated incoming selector switch ISS, and a toll connector switch CS2.

Figs. 2 and 3 represent schematically the line circuit and apparatus individual to the line L1 including apparatus for use in determining the charge of a call as compared with the amount of money in coins deposited in the coin-box of station S1 and including apparatus for collecting or refunding the deposited coins as required in any given case.

The subscribers' station S1 and S2 are of the type generally employed in common battery telephone systems, a dial or other impulse sender being provided for use in controlling the operation of the selector and connector switches employed in establishing a desired connection. The station S1 includes coin-box apparatus comprising coin collect magnet 11, a coin return magnet 13, contact 15 which represents a system of contacts which are collectively actuated by a coin as it passes through the coin box a number of times characteristic of its value, and a contact 19 which is closed when a deposited coin comes to rest temporarily awaiting collection or return. The system of contacts actuated by the passage of a coin may be similar to that disclosed in the patent to Goodrum, No. 1,137,399, granted April 27, 1915. The box is arranged to take coins of 10, 20 and 50 centimes. The coin actuated contacts, represented by contact 15, are operated by the passage of a coin to ground the line conductor 22 once for a 10 centime coin, twice for a 20 centime coin, and five times for a 50 centime coin. The line circuit, to which the line L1 connects at the central office, includes line relays 123 and 161, cut-off relay 109, coin identifying relays 141, 142 and 143, a rotary step-by-step switch SM, metering relay 125, a toll call supervisory relay 34 and toll call control relays 41 to 48 inclusive. The circuit also includes a number of auxiliary control relays and a thermostatic relay 115.

The line-finder, selector and connector switches, which are each represented by a set of brushes and a single set of terminals, may be similar in operation to those shown and described in the patent to Hatton et al. No. 1,831,387 granted November 10, 1931. The line-finder LF and first selector SS1 form a link circuit which is represented by the supervisory relays 211, 213 and 214, the control relays 212 and 215, the zone relays 217 and 218, and a metering switch MS. The link circuit may be similar to that shown in Fig. 15 of the drawings, and described in the specification, of the aforementioned Patent No. 1,831,387.

The toll operator's cord C and position equip-

ment is arranged to collect or return the coin deposited at a calling subscriber's station. To this end the cord C includes a coin collect key 61, a coin return key 62 and auxiliary relays 63 and 64 which control the connection of three alternating current generators 65, 66, and 67 for variously operating voice frequency relays in the line circuit of a calling subscriber, the necessary control conditions for connecting a coin collect or coin refund potential to the calling line, upon termination of a connection, being established by these voice frequency relays. The sleeve relay 52 operates when plug 51 is inserted in the jack of a trunk thereby lighting the supervisory lamp 55. The supervisory relay 54 is connected to the ring conductor of the plug so as to respond to supervisory signals when the subscriber answers or deposits coins as instructed by the operator.

Assuming that the subscriber at station S1 desires to originate a call, coins equal in value to the charge for the desired connection are deposited, in the coin box, before removing the receiver. Each coin as it passes through the box to its preliminary resting place closes the contact 15 a number of times characteristic of its value to cause the operation of the line relay 123 of the associated line circuit a corresponding number of times. The circuit for operating relay 123 is traced from battery through its winding, left back contact of relay 103, inner left back contact of relay 109, conductor 22 of line L1 to ground at contact 15 of the coin-box at station S1. The operation of relay 123 closes an obvious circuit for operating relay 122 and a circuit from battery through the winding of relay 104, left outer back contact of relay 109, right front contact of relay 123, conductor 129, inner back contact of relay 162, inner left back contact of relay 124, to ground at thermostatic relay 115. Relay 104, operated by the current in this circuit, closes a holding circuit through its inner front contact and the back contact of the magnet 150 of switch SM to ground at its own outer front contact. When relay 123 releases due to the opening of contact 15 at the coin-box, the magnet 150 of switch SM is energized in a circuit from battery through the left winding of this magnet, next-to-the-outer front contact of relay 104, back contact of relay 123, conductor 129, thence to ground at relay 115 as hereinbefore traced. The operation of magnet 150 opens the holding circuit for relay 104, and the release of relay 104 opens the circuit through the winding of magnet 150. The switch SM is thus advanced by the cooperation of relay 104 and magnet 150 in response to each impulse received by relay 123, to a position corresponding to the value of the coin or coins deposited at the subscriber's station.

Having deposited the coins, the subscriber removes the receiver, thereby closing a circuit from battery through the winding of line relay 123, thence to conductor 22 of line L1 as hereinbefore described, through the lower contact springs of the dial 16 at station S1, transmitter 17, lower front contact of the receiver-hook switch, right winding of induction coil 18, back over conductor 21 of line L1, inner right back contacts of relays 109 and 103, outer left back contact of relay 106, inner right back contact of relay 163, through the winding of relay 161 to ground. Relays 123 and 161 are both operated by the current in this circuit. Relay 161 closes an obvious circuit for operating relay 162 and relay 123 again closes the circuit for operating relay 104. Relay 162 locks through its left front contact and the off-normal terminals and brush of bank 151 of switch SM and opens the operating circuit of relay 104. With relay 162 operated, relays 141, 142 and 143 are variously operated according to the position to which the switch SM is advanced as hereinbefore described. If the switch SM is in off-normal position 2, relay 141 is operated by a circuit from battery through its upper winding, off-normal terminal 2 and brush 152, right inner front contact of relay 162, to ground at the inner left back contact of relay 163; relay 141 locks through its inner upper front contact and the inner upper back contact of relay 143, over conductor 111 to ground at the left front contact of relay 123, neither of relays 142 or 143 being operated in this case. If switch SM is advanced to off-normal position 3, relay 141 is operated by a circuit from battery through its lower winding, off-normal terminal 3 and brush 152, thence to ground at the inner left back contact of relay 163. The operation of relay 141 with switch SM in position 3, closes a circuit for operating relay 143; this circuit is traced from battery through the winding of relay 143, inner lower front contact of relay 141, off-normal terminal 3 and brush 152, thence to ground at the inner left back contact of relay 163. Relay 143 locks through its inner upper front contact, over conductor 111 to ground at the left front contact of relay 123. If switch SM is advanced to off-normal position 8, relay 142 is operated due to the energization of its left winding in a circuit through off-normal terminal 8 and brush 152 to ground at the inner left back contact of relay 163; relay 142 locks through its inner left front contact, the inner upper back contact of relay 143, over conductor 111 to ground at the left front contact of relay 123, neither of relays 141 or 143 being operated. If switch SM is advanced to off-normal position 6, relay 142 is operated due to the energization of its right winding in a circuit through off-normal terminal 6 and brush 152 to ground at the inner left back contact of relay 163. The operation of relay 142 with switch SM in position 6 closes a circuit through the inner right front contact of this relay for operating relay 143; and relay 143 locks as hereinbefore described. The operation of either of relays 141 or 142 closes a circuit for operating relay 144, from battery through the winding of relay 144, the outer right front contact of relay 162 to ground at the upper front contact of relay 141 or to ground at the outer left front contact of relay 142. In the arrangement shown, there is no tariff corresponding to the first, fourth, fifth, seventh, ninth or tenth off-normal positions of switch SM, and if switch SM is advanced to any one of these off-normal positions relay 144 is operated due to the energization of its winding in a circuit through the outer right front contact of relay 162, the particular one of the off-normal terminals with which brush 152 is in contact, and through the inner right front contact of relay 162, to ground at the inner left back contact of relay 163. Relay 144 closes a locking circuit through the outer right back contact of relay 103, its own left inner front contact, to ground at the back contact of relay 160.

The aforementioned operation of relays 161 and 162 closes a circuit for operating the group relay 170, this circuit being traced from battery through the outer left back contact of relay 163, next-to-the-outer right front contact of relay 162, through resistances 165 and 167 and the winding of relay 170 to ground. Start relay 170

connects ground to the start lead 171 whereby one or more idle line-finders such as LF are set in operation. When a finder LF finds and seizes the terminals to which line L1 and the associated line circuit are connected, the cut-off relay 109 is operated due to the energization of its winding in a circuit through brush 203 of the line-finder switch. The operation of relay 109 disconnects relays 123 and 161 from the line L1, opens the holding circuit for relay 104 and connects a holding ground to its outer left front contact to conductor 111 in place of the ground at the left front contact of relay 123. The release of relay 161 closes an obvious circuit for energizing the right winding of relay 163. Relay 163 operates, disconnects the winding of relay 103 from the incoming test conductor 33, disconnects the hunting potential from test conductor 26 and releases group relay 170. The release of relays 161 and 104 closes a circuit for operating the magnet 150 of switch SM whereby this switch is advanced to normal; this circuit is traced from battery through the left winding of magnet 150, outer right back contact of relay 104, interrupter contacts of magnet 150, outer right back contact of relay 121, outer left back contact of relay 124, next-to-the-inner right front contact of relay 162, to ground at the left back contact of relay 161. Relays 141, 142 and 143, if operated, are held operated by the ground connected at the outer left front contact of relay 109 to conductor 111. Relay 162 releases as soon as switch SM reaches normal position.

When the line-finder LF finds the terminals to which line L1 is connected, the windings of relay 211 are connected through brushes 201 and 202 to conductors 21 and 22 thereby operating relay 211. The operation of relay 211 closes a circuit for operating relay 212. An idle register-controller (not shown) is thereupon associated with the link circuit, the subscriber receives a dial tone, the called number is dialed, the zone relays 217 and 218 of the link circuit are operated in accordance with the zone within which the called line is located with respect to the calling line as indicated by the office code registered in the register-controller, the connection is completed by the operation of switches SS1 and CS1, and the called station is signalled by ringing current all in the manner described in the aforementioned patent to Hatton et al. 1,831,387. When the call is answered by the removal of the receiver at the called station, the ringing circuit is opened and the supervisory relays 213 and 214 are connected to the called line. The operation of relay 214 closes an obvious circuit for operating relay 215. Relay 215 locks under control of relay 212 and closes a circuit for operating the stepping magnet 220 of the metering switch MS; this circuit is traced from battery through the winding of magnet 220, brush 221 and normal terminal, right outer front contact of relay 215, to ground at the springs of cam 226 of timing switch TS. The operation of magnet 220 advances the brushes 221 and 222 to the first off-normal position thereby placing the stepping magnet 220 under control of interrupter 223 so that the brushes continue to advance step-by-step until they again reach normal position. The aforementioned operation of relay 215 also closes an obvious circuit for operating the start relay 225 of the timing switch TS whereby the driving magnet (not shown) of the timing switch is placed under control of timed impulses from a clock CL. The timing switch is thus advanced at a constant rate as long as relays 215 and 225 remain operated. The springs of cam 226 of the timing switch are opened as soon as the timing switch begins to advance and are closed again at the end of three, six, nine and twelve minutes, each three minute period constituting a conversational unit for charging purposes in a zone metering system.

During the advance of switch MS an impulse circuit is closed from battery, through brush 222 and the various off-normal terminals, and contacts of zone relays 217 and 218, through brush 204 of line-finder LF to the winding of metering relay 125. Relay 125 is thus operated a number of times corresponding to the value of the established connection. The relation between the various charges and the metering impulses transmitted by the operation of switch MS is as follows:

Coin value in centimes	Metering signals
20	1
30	2
60	3
80	5

The operation of relay 125 in response to the first metering or charging impulse received closes an obvious circuit for operating magnet 150 of switch SM. Each operation of relay 125 is thus effective to operate magnet 150 and thereby advance the brushes to switch SM to a position corresponding to the required charge for the completed call. The first operation of relay 125 also closes a circuit from battery through resistance 132, right back contact of relay 126, inner left front contact of relay 125, winding of relay 124, over conductor 111 to ground at the front contact of relay 109. The operation of relay 124 closes a short circuit through its right front contacts across the conductors 21 and 22 of line L1 to prevent conversation until the switch SM has responded to the metering impulses and a comparison made between the coins deposited and the required charge. Relay 124 also closes an obvious circuit for reoperating relay 162, and opens at its outer left back contact the restoring circuit for switch SM. With relay 124 operated, a circuit is closed by interrupter 130 for operating relay 121; this circuit is traced from battery through the winding of relay 121, conductor 131, outer left front contact of relay 124, through the inner left back contact of relay 126, and through interrupter 130 to ground. Relay 121 closes a holding circuit for relay 163, from battery through the left winding of relay 163 and the inner right front contact of relay 121, over conductor 131 to the ground at interrupter 130. Relay 121 also closes a circuit from battery through its winding in series with the winding of relay 126, through the inner left front contact of relay 121, left back contact of relay 102, right back contact of relay 106, conductor 111, to ground at the front contact of relay 109. Relay 126 operates in series with relay 121 as soon as interrupter 130 opens the connection to ground. Relays 121 and 126 are now locked in series independent of the continued operation of relay 109 due to the connection of ground through the outer left front contact of relay 126 through the left back contact of relay 101 to conductor 111. After relay 126 operates, relay 124 remains operated due to a holding circuit which is traced from battery through resistance 132, inner left front

contacts and winding of relay 124, over conductor 111 to ground at the outer left front contact of relay 109 and, through the left back contact of relay 101, to ground at the outer left front contact of relay 126. After an interval of time sufficient for relay 125 to have received the maximum number of metering impulses, ground is again connected through interrupter 130, thence through the inner left front contact of relay 126 and the left inner front contacts of relay 124 to short circuit the winding of relay 124 and thus cause its release. The release of relay 124 opens the short circuit across line L1.

If the number of metering impulses, as indicated by the position to which the brushes of switch SM are advanced, does not correspond with the value of the coins deposited, as indicated by relays 141, 142 and 143, a circuit is closed through brush 153 for operating relay 106; but if the position of switch SM does correspond with the value of the deposited coins there is no circuit for operating relay 106. Assume first that the deposited coins do correspond in value with the required charge for the call so that relay 106 does not operate. If the conversation terminates at or before the end of a three minute interval after the first metering impulses were received, the release of relay 211 causes the release of relay 212. The release of relay 212 causes the release of relay 109 of the line circuit and the restoration of the line-finder and selector switches to normal as described in the aforementioned patent to Hatton et al. No. 1,831,387. The release of relay 109 closes a circuit for operating the coin-collect magnet 13 at station S1; this circuit is traced from the alternating current source 135 through the rectifier 136, the outer left front contact of relay 121, winding of relay 160, inner right front contact of relay 163, outer left back contact of relay 106, inner right back contact of relay 103, inner right back contact of relay 109, conductor 21 of line L1, right winding of induction coil 18, upper normally closed contacts of the receiver-hook switch through the winding of coin-collect magnet 13 and rectifier 14 to ground at coin contacts 19. The coin-return magnet 11 does not operate since its winding is connected in series with the rectifier 12 which is oppositely poled to the rectifier 14 with respect to line conductor 21. Relay 160 of the line circuit also operates thereby connecting ground through its front contact and the inner right front contact of relay 121 to hold relay 121 operated and to short circuit and thus cause the release of relay 126. With both relay 109 and relay 126 released, there is no holding ground connected to conductor 111 so that each of relays 141, 142 and 143 releases, if previously operated. With relays 141 and 142 normal and with relay 160 operated, relay 144 releases. When contacts 19 open the coin collect circuit due to the coins being collected, the magnet 13 and relay 160 release. The release of relay 160 causes the release of relays 121 and 163. The release of relay 121 closes the above described circuit for operating stepping magnet 150 to return switch SM to normal. When switch SM reaches normal, relay 162 releases and the line circuit is now normal awaiting another call.

To illustrate the circuit operations which result when the coins deposited do not correspond to the required charge for the call, assume that 20 centimes were deposited by the calling subscriber, relay 141 alone of relays 141, 142 and 143 having been thereby operated as hereinbefore described. If 30 centimes should have been deposited, as indicated by the receipt of two metering impulses by relay 125 and the consequent advance of switch SM to position 2, a circuit is closed from battery through the winding of relay 106, the uppermost back contact of relay 143, terminal 2 and brush 153 of switch SM, right back contact of relay 101, conductor 110, outer right front contact of relay 121, inner back contacts of relay 124, to ground at thermostatic relay 115. If 60 centimes should have been deposited, switch SM is in position 3 and the circuit for operating relay 106 passes through the outer lower front contact of relay 141 in parallel with the lowermost back contact of relay 143, and in parallel with the outer right back contact of relay 142. If 80 centimes should have been deposited, switch SM is in position 5, and the circuit for operating relay 106 passes through the inner right back contact of relay 142 and the outer upper front contact of relay 143 in parallel. Similar circuits are provided and may be easily identified for operating relay 106 for all other possible cases where the required charge, as indicated by the position to which the switch SM is advanced in consequence of the metering impulses received by relay 125, does not correspond to the value of the deposited coins. Relay 106 locks through its right front contact to ground at the front contact of relay 122 and causes the release of relays 121 and 126; and the release of relay 121 causes the switch SM to be advanced to normal as hereinbefore described. The operation of relay 106 also opens the talking connection by disconnecting line conductor 22 from the terminal with which brush 202 of line-finder LF is in contact. The operation of relay 106 also connects the tone source 107 through condenser 108 and the inner left front contact of relay 106 to line conductor 22, thereby transmitting a tone to the calling subscriber to indicate that he has failed to deposit the required value of coins.

The opening of the connection over line conductor 22 initiates the release of the line-finder and selector switches and their restoration to normal. Relay 109 releases thereby closing a circuit for reoperating line relay 123; this circuit is traced from battery through the winding of relay 123, left back contact of relay 103, inner left back contact of relay 109, conductor 22 over the line loop and back over conductor 21, through the inner right back contacts of relays 109 and 103 to ground at the outer left front contact of relay 106. Relay 122 is now held operated through the left front contact of relay 123 and relay 122 maintains the energization of relay 106. The aforementioned release of relay 109 also closes an energizing circuit for thermostatic relay 115; this circuit is traced from the winding of relay 115 through the outer right back contact of relay 109 to ground at the outer right front contact of relay 163. If the subscriber unduly delays hanging up the receiver, relay 115 operates, thereby connecting ground to operate the alarm 116. When the subscriber hangs up the receiver relay 123 releases causing the release of relays 122 and 106. Relay 144 is holding to ground at the back contact of relay 160 as hereinbefore described so that the release of relay 106 closes a circuit for operating the coin-return magnet 11 at station S1; this circuit is traced from battery through the left back contact of relay 121, winding of relay 160, inner right front contact of relay 163, outer left back contact of relay 106, inner right back contact of

relay 103, inner right back contact of relay 109, conductor 21, right winding of induction coil 18, upper normally closed contacts of the receiver-hook switch, through rectifier 12 and winding of the coin-return magnet 11 to ground at coin contacts 19. The operation of magnet 11 returns the coins to the subscriber and the operation of relay 160 causes the release of relay 144. Relay 163 is held by the energization of its left winding to ground at the front contact of relay 160 until contacts 19 at station S1 are opened due to the return of the coins.

In case the called subscriber is busy or the call is abandoned for any reason by the calling subscriber prior to the answer of the called subscriber, the return of the deposited coins is effected in the manner described. In case the calling subscriber wishes to regain deposited coins without making a call, it is necessary to remove the receiver and then hang it up. In this way relays 123, 161, 163 and 144 operate in the manner hereinbefore described to close the circuit for operating coin return magnet 11. When the receiver is replaced, the line circuit is restored to normal.

Since calls from coin-box stations are limited to a single conversation period, for instance, three minutes, the arrangement is such as to cause the breaking down of the connection at the end of this interval. When the metering switch MS starts its second cycle of operation at the end of three minutes, the reoperation of relay 125 upon receipt of the first of the metering impulses initiates the breaking down of the connection. The operation of relay 125 closes a circuit for operating relay 101; this circuit is traced from battery through the winding of relay 101, outer left front contact of relay 125, conductor 110, outer right front contact of relay 121, inner left back contacts of relay 124 to ground at thermostatic relay 115. Relay 101 locks through its inner right front contact independent of relay 125 and closes a circuit for operating relay 106; this circuit is from the winding of relay 106, through the outer right front contact of relay 101, right front contact of relay 125, conductor 110, outer right front contact of relay 121, inner back contacts of relay 124 to ground at relay 115. Relay 106 causes the release of the connection as hereinbefore described. When relay 109 releases, relay 123 reoperates; and when the calling subscriber hangs up, relays 123, 122 and 106 release successively. The collection of the coins and restoration of the line circuit to normal is completed as hereinbefore described.

In case the coin-collect or coin-return circuit is open so that relay 160 can not operate, relays 144 and 163 remain operated; and, relay 109 having been released, the thermostatic relay 115 operates to close the alarm circuit. If the operation of the coin-collect magnet 13 or coin-return magnet 11 fails to dispose of the coins and open contacts 19, relays 160 and 163 in the line circuit are held operated, and the alarm circuit is closed by relay 115.

On calls incoming to line L1, relay 103 operates when the line is seized by a final selector; the circuit for operating relay 103 is traced from battery through its winding, outer right back contact of relay 163, normal terminal and brush 154 of switch SM, over conductor 33 and through the brush of the final selector to ground. With relay 103 operated the incoming connection is extended over conductor 31 through the right winding of relay 34 and condenser 35 in parallel, right back contact of relay 102, and inner right back contact of relay 109 to line conductor 21 and extended over conductor 32 through the left winding of relay 34 and condenser 36 in parallel, outer left front contact of relay 103, and inner left back contact of relay 109 to line conductor 22.

If the subscriber at station S1 wishes to make a toll call, the receiver is removed and the toll number dialed without depositing any coins in the coin box. The connection is extended to a toll recording operator with whom the subscriber communicates and then hangs up. No operation of the switch SM results either from the initiation of the call or from its completion since metering impulses are not received by relay 125 on such a connection. When a toll operator has obtained connection with the wanted party, the connection is extended to the calling line by the operator. Such a connection is represented in Fig. 1 as established through the cord C, over the toll switching trunk T, through an incoming selector ISS and final selector CS2, to the conductors 31, 32 and 33 of the line circuit of line L1. Relay 103 operates as hereinbefore described, connecting ground to conductor 49, thereby causing the energization of the right winding of relay 47 and left winding of relay 48. Relays 47 and 48 both operate; but relays 44, 45 and 46 remain normal since their windings are short-circuited by the back contacts of relays 41, 42 and 43, respectively.

When the calling subscriber removes the receiver in response to the usual ringing signal, the toll operator instructs the subscriber to hang up, deposit the coins required for the call, and then again remove the receiver. When the coins are deposited the contacts 15 momentarily close a signaling circuit a number of times corresponding to the value of the coins; this circuit is traced from ground through contacts 15, over line conductor 22, through the inner left back contact of relay 109, outer left front contact of relay 103, left winding of the differentially wound relay 34, over conductor 32, through the middle brush and conductor of both final selector CS2 and incoming selector ISS, over the lower conductor of trunk T, ring conductor of jack 50 and plug 51, lower normally closed contacts of coin collect key 61 and coin-return key 63, and through the winding of supervisory relay 54 to battery. The differential relay 34 of the line circuit operates, since there is no current through its right winding as long as the receiver is on the hook at station S1. Relay 34 connects the left winding of the tone source 38 through condenser 37 and the right front contact of relay 34 to line conductor 31 thereby transmitting a tone to the toll operator each time contacts 15 at station S1 are closed by the coins which are deposited. The supervisory relay 54 of the toll operator's cord operates each time contacts 15 close thereby extinguishing the supervisory lamp 55. Thus, the toll operator receives both audible and visual signals to indicate the value of the coins deposited. When the subscriber at station S1 removes the receiver after depositing the coins, the toll operator completes the connection between the calling and called subscribers; if necessary the operator can re-ring the calling subscriber in the usual manner. The talking connection having been established, the toll operator operates the coin-collect key 61 thereby operating relay 63. Relay 63 connects the alternating current sources 65 and 66 through the front contacts of key 61, through the conductors of plug 51 and jack 50,

over the conductors of trunk T, through the incoming selector ISS and final selector CS2, over conductors 31 and 32, and through condenser 40 across the windings of voice frequency relays 41, 42 and 43 in the line circuit of the calling subscriber. The frequency of the two sources 65 and 66 is such as to cause the operation of relays 41 and 42 without operating relay 43. The operation of relays 41 and 42 opens the short circuit across the windings of relays 44 and 45 so that these relays both operate. The operation of relay 44 causes the release of relay 47. Relays 47 and 48 are slow in releasing and each of relays 44 and 46 are arranged to close holding circuits for relays 48 and 47, respectively. The release of relay 47 closes a circuit from ground at the inner left front contact of relay 103, over conductor 49, through the inner right front contact of relay 45, back contact of relay 47, conductor 112, and through the windings of relays 126 and 121 in series to battery. Relays 121 and 126 are thus operated and they lock as hereinbefore described to ground at the outer left front contact of relay 126. Relays 41 and 42 release as soon as the coin-collect key 61 is restored to normal, thereby causing the release of relays 44 and 45 and the reoperation of relay 47. Relay 126 closes a circuit for operating relay 144; this circuit is traced from battery through the winding of relay 144, outer right front contact of relay 103, to ground at the right front contact of relay 126. The operation of relay 144 causes the operation of relay 163.

No further operations occur until the conversation is completed at which time the operator is informed by the release of relay 54 and consequent lighting of the supervisory lamp 55 that the receiver has been hung up at station S1. The removal of the plug 51 from jack 50 causes the release and return to normal of the selectors ISS and CS2. The release of relay 103 causes the release of relays 47 and 48 and closes the circuit from the alternating current source 135 over conductor 21 to operate the coin-collect magnet 13 at station S1 as hereinbefore described.

Should the occasion arise, the operator may return the deposited coins by operating the coin-return key 62 instead of the coin-collect key; in which case relay 64 operates to connect the alternating current sources 66 and 67 to the line, the frequency of the current being such as to cause the operation of relays 42 and 43 of the calling subscriber's line circuit. The operation of relays 42 and 43 causes the operation of relays 45 and 46. The operation of relay 46 causes the release of relay 48, and a circuit is thereupon closed for operating relay 102. The circuit for operating relay 102 is from battery through its winding, back contact of relay 48, outer front contact of relay 45, over conductor 49, to ground at the front contact of relay 103. Relay 102 releases relays 121 and 126 if already operated since the holding circuit for these relays passes through the left back contact of relay 102. Relay 102 connects battery through its right front contact and inner right back contact of relay 109 over conductor 21 to effect immediate operation of the coin-return magnet 11. When the coin-return key is released, the release of relay 64 disconnects alternating current sources 66 and 67 to release relays 42 and 43 and 45 and 46. The release of relay 45 causes the reoperation of relay 48 and the release of relay 102. The call may be abandoned or the operator may then instruct the subscriber again as to the value of the coins which should be deposited.

If a permanent signal condition arises, no coins having been inserted, relays 123 and 161 operate in series. Relay 161 causes the operation of relays 162 and 170 so that a line-finder operates to seize the terminal to which line L1 is connected. In this case the call is automatically routed to an intercepting operator in well known manner. If a subscriber dials before the line has been found by a line-finder and relay 109 operated, relay 161 releases when the first dial impulse is received, thereby operating relay 163. Relay 163 causes the release of relay 170, disconnects the calling potential from test conductor 26, and closes a circuit for energizing the winding of thermostatic relay 115 so that an alarm is given as soon as relay 115 operates. If the calling subscriber dials a number after dial tone is received but without depositing any coins, the call is broken down as soon as metering impulses are received since none of relays 141, 142 and 143 will have been operated. Should line conductor 22 become grounded, the operation of relay 123 alone causes the operation of relay 104 and relay 104 closes a circuit for energizing the winding of thermostatic relay 115 so that the alarm circuit is closed after a predetermined interval.

What is claimed is:

1. In a telephone system, subscribers' lines, a subscriber's coin-box station permanently connected to one of said lines, means for transmitting a signal over said coin-box line in response to the deposit of a coin, said signal varying in character in accordance with the value of the coin, means responsive to said signal for registering the value of the coin, switching means for establishing a connection between the line of the coin-box station and another of said lines, means for automatically indicating the tariff for a completed call in accordance with the called number, and means for releasing the connection if the value of the inserted coin does not agree with the indicated tariff.

2. In a telephone system, subscribers' lines, a central office common to said lines, a subscriber's coin-box station individual to one of said lines, means at said station operatively responsive to the depositing of each coin for transmitting one or more signals over said line, the number of signals thus transmitted being indicative of the value of the coin, means at said central office responsive to said signal for registering the value of said coin, switching means for establishing a connection between said coin-box line and a called line, means for automatically indicating the value of the established connection, and means for releasing the connection if the total value of all coins deposited differs from the indicated value of the connection.

3. In a telephone system, subscribers' lines, a subscriber's coin-box station permanently connected to one of said lines, means effective upon the deposit of one or more coins for transmitting a signal over said coin-box line, said signal being indicative of the value of the coins inserted in the coin box, means responsive to said signal for registering the value of the coins inserted, means for establishing a connection between said coin-box line and a called line, means for automatically indicating the tariff for a completed call in accordance with the called number, means for short-circuiting the coin-box line for a period of time sufficient for the operation of said indicat-

ing means, and means for releasing the connection if the registered value of the inserted coins does not agree with the indicated tariff.

4. In a telephone system, a coin-box subscriber's station, line and line circuit, other subscribers' lines, signal means in the coin-box of said station for actuation by each coin deposited, means in said line circuit responsive to signals created by the deposit of a coin for registering the value of the coin, means including automatic switches for extending a connection from said coin-box line to a called line, means associated with one of said switches and operative in response to the answer of the called subscriber for transmitting signaling impulses to said line circuit, the number of said impulses being indicative of the value of the completed connection, and means in said line circuit for releasing the connection if the registered value of the deposited coins is not equal to the indicated value of the connection.

5. In a telephone system, a coin-box subscriber's station, line and line circuit, other subscribers' lines, signal means in the coin-box of said station for actuation by each coin deposited, means in said line circuit responsive to signals created by the deposit of a coin for registering the value of the coin, means including automatic switches for extending a connection from said coin-box line to a called line, means associated with one of said switches and operative in response to the answer of the called subscriber for transmitting metering-signal impulses to said line circuit, the number of said impulses being indicative of the value of the completed connection, means for short-circuiting the coin-box line for an interval of time sufficient for all metering-signal impulses to have been transmitted, and means for releasing the connection if the registered value of the deposited coins is not equal to the indicated value of the connection.

6. In a telephone system, a coin-box subscriber's station, line and line circuit, other subscribers' lines, signal means in the coin-box of said station for actuation by each coin deposited, means in said line circuit responsive to signals created by the deposit of a coin for registering the value of the coin, means including automatic switches for extending a connection from said coin-box line to a called line, means associated with one of said switches and operative in response to the answer of the called subscriber for transmitting signalling impulses to said line circuit, the number of said impulses being indicative of the value of the completed connection, and means for collecting the deposited coins, said means being rendered operatively effective only if the indicated value of the connection agrees with the registered value of the deposited coins.

7. In a telephone system, a coin-box subscriber's station, line and line circuit, other subscribers' lines, signal means in the coin-box of said station for actuation by each coin deposited, means in said line circuit responsive to signals created by the deposit of a coin for registering the value of the coin, means including automatic switches for extending a connection from said coin-box line to a called line, means associated with one of said switches and operative in response to the answer of the called subscriber for transmitting signaling impulses to said line circuit, the number of said impulses being indicative of the value of the completed connection, and means for returning the deposited coins, said means being rendered operatively effective only if the indicated value of the connection differs from the registered value of the deposited coins.

8. In a telephone system, a coin-box subscriber's station, line and line circuit, other subscribers' lines, signal means in the coin-box of said station for actuation by each coin deposited, means in said line circuit responsive to signals created by the deposit of a coin for registering the value of the coin, means including automatic switches for extending a connection from said coin-box line to a called line, means associated with one of said switches and operative in response to the answer of the called subscriber for transmitting signaling impulses to said line circuit, the number of said impulses being indicative of the value of the completed connection, means for collecting the deposited coins, means for returning the deposited coins, means for rendering said coin-collecting means operatively effective if the indicated value of the connection equals the value of the deposited coins, and means for rendering said coin-return means operatively effective if the indicated value of the connection differs from the value of the deposited coins.

9. In a telephone system, a coin-box subscriber's station, line and line circuit, other subscribers' lines, signal means in the coin-box of said station for actuation by each coin deposited, means in said line circuit responsive to signals created by the deposit of a coin for registering the value of the coin, means including automatic switches for extending a connection from said coin-box line to a called line, means associated with one of said switches and operative in response to the answer of the called subscriber for transmitting signaling impulses to said line circuit, the number of said impulses being indicative of the value of the completed connection, means for collecting the deposited coins, means for returning the deposited coins, means for rendering said coin-collecting means operatively effective if the indicated value of the connection equals the value of the deposited coins, and means for releasing the connection and for rendering said coin-return means operatively effective if the indicated value of the connection differs from the value of the deposited coins.

10. In a telephone system, a coin-box subscriber's station, line and line circuit, other subscribers' lines, signal means in the coin-box of said station for actuation by each coin deposited, means in said line circuit responsive to signals created by the deposit of a coin for registering the value of the coin, means including automatic switches for extending a connection from said coin-box line to a called line, means associated with one of said switches, and operative in response to the answer of the called subscriber for transmitting metering-signal impulses to said line circuit, the number of said impulses being indicative of the value of the completed connection, means for repeating said metering impulses upon expiration of a predetermined interval of time, means for collecting the deposited coins, said means being rendered operatively effective if the indicated value of the connection equals that of the coins deposited, and means responsive to the first of said metering impulses received by said line circuit at the end of said predetermined interval for automatically breaking down the connection.

11. In a telephone system, subscribers' lines, a central office common to said lines, a subscriber's coin-box station individual to one of said lines, means at said station operatively responsive to

the depositing of a coin for transmitting a signal over said line in accordance with the value of the coin, a line circuit at the central office end of said coin-box line, means in said line circuit responsive to said coin signal for registering the value of said coin, means including automatic switches for establishing a connection between said coin-box line and a called line, means associated with one of said switches and operative in response to the answer of the called subscriber for transmitting a signal to said line circuit to indicate the value of the completed connection, means in said line circuit operative upon release of the connection for collecting the deposited coins, means in said line circuit effective upon release of the connection for returning the deposited coins, and means for selectively rendering said coin collecting or coin returning means operatively effective dependent upon whether the indicated value of the connection corresponds or does not correspond with the value of the deposited coin.

12. In a telephone system according to claim 1, a toll operator's position, means for extending a connection from said position to said calling line, and means responsive to the coin signals over said line for transmitting tone signals to said operator and for operating visual signals to indicate to the operator the value of the inserted coins.

13. In a telephone system, a coin-box subscriber's station and line, a toll line, a toll operator's position, visual signaling means at said position, switching means comprising selector switches controlled by said operator for establishing a connection between said toll line and said coin-box line, means in the coin-box of said station for actuation by each coin deposited therein to transmit one or more signal impulses, the number of said impulses varying in accordance with the value of the coin, and circuit means individual to said line for transmitting to said toll operator a tone signal and for causing the operation of said visual signaling means in response to each of the impulses created by the deposit of a coin.

14. In a telephone system, a coin-box subscriber's station, line and line circuit, a toll line, a toll operator's position, switching means including an operator's link circuit for establishing a connection between said coin-box line and said toll line, means in the coin-box of said station for actuation by each coin deposited to transmit one or more signal impulses, the number of said impulses corresponding to the value of the coin, supervisory means in said line circuit and supervisory means in said link circuit both responsive to said coin signal impulses, a tone generator in said line circuit controlled by the associated supervisory means for transmitting to the operator tone signals corresponding to the value of a coin deposited at said station, and visual signaling means in said link circuit controlled by the associated supervisory means for indicating the value of the deposited coin.

15. In a telephone system according to claim 1, a toll operator's position, means for extending a connection from said position to said calling line, means responsive to the coin signals over said line for transmitting tone signals to said operator and for operating visual signals to indicate to the operator the value of the inserted coins, means for collecting coins deposited, means for returning coins deposited, voice frequency relays controlling said coin-collect means and said coin-return means, alternating current generators corresponding in frequency to that required for the operation of said relays, and means controlled by the operator for connecting said generators to operate said relays and thereby collect or return the deposited coins as desired.

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