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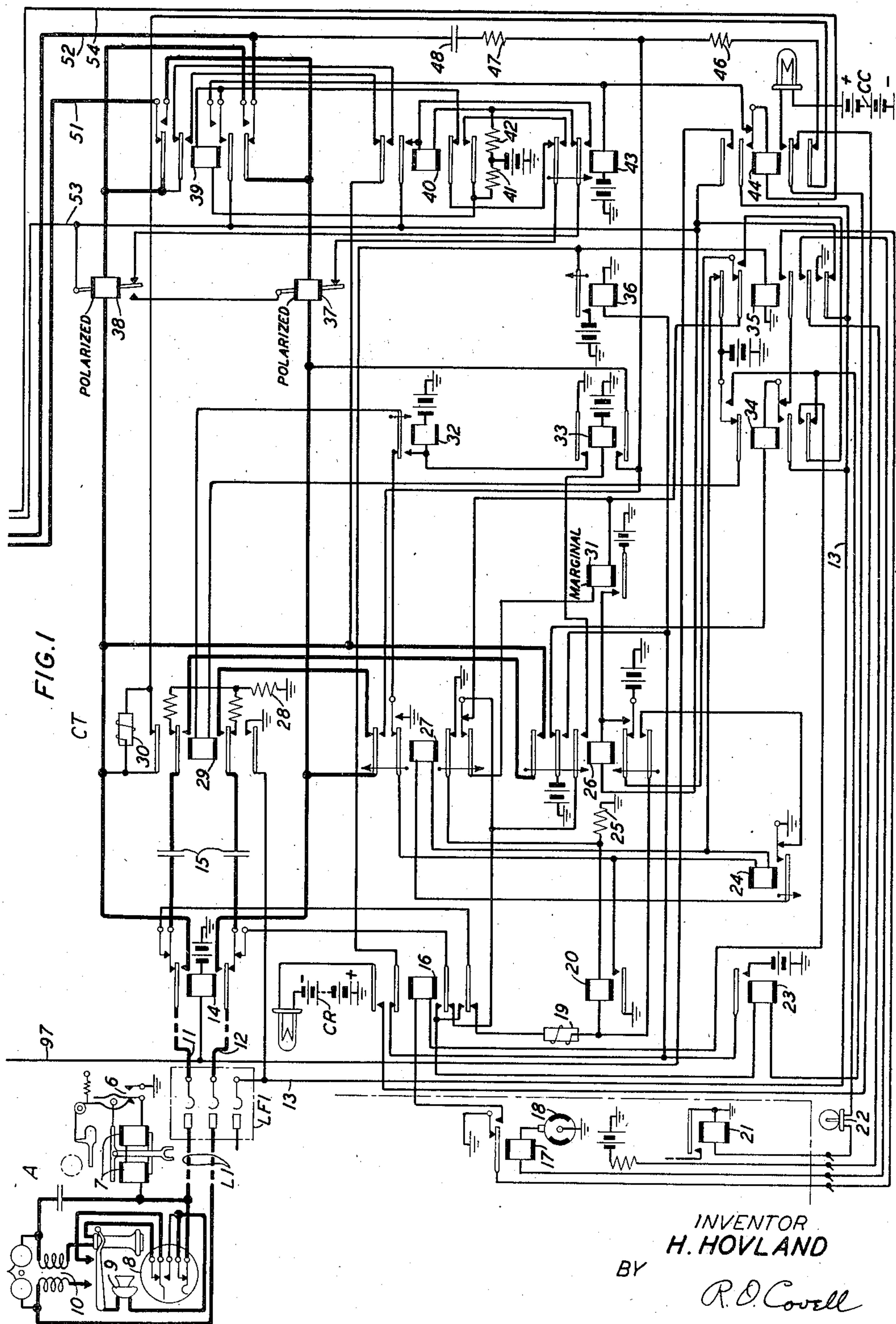
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2,427,000

COIN OPERATED TELEPHONE SYSTEM

Filed Aug. 28, 1942

6 Sheets-Sheet 1



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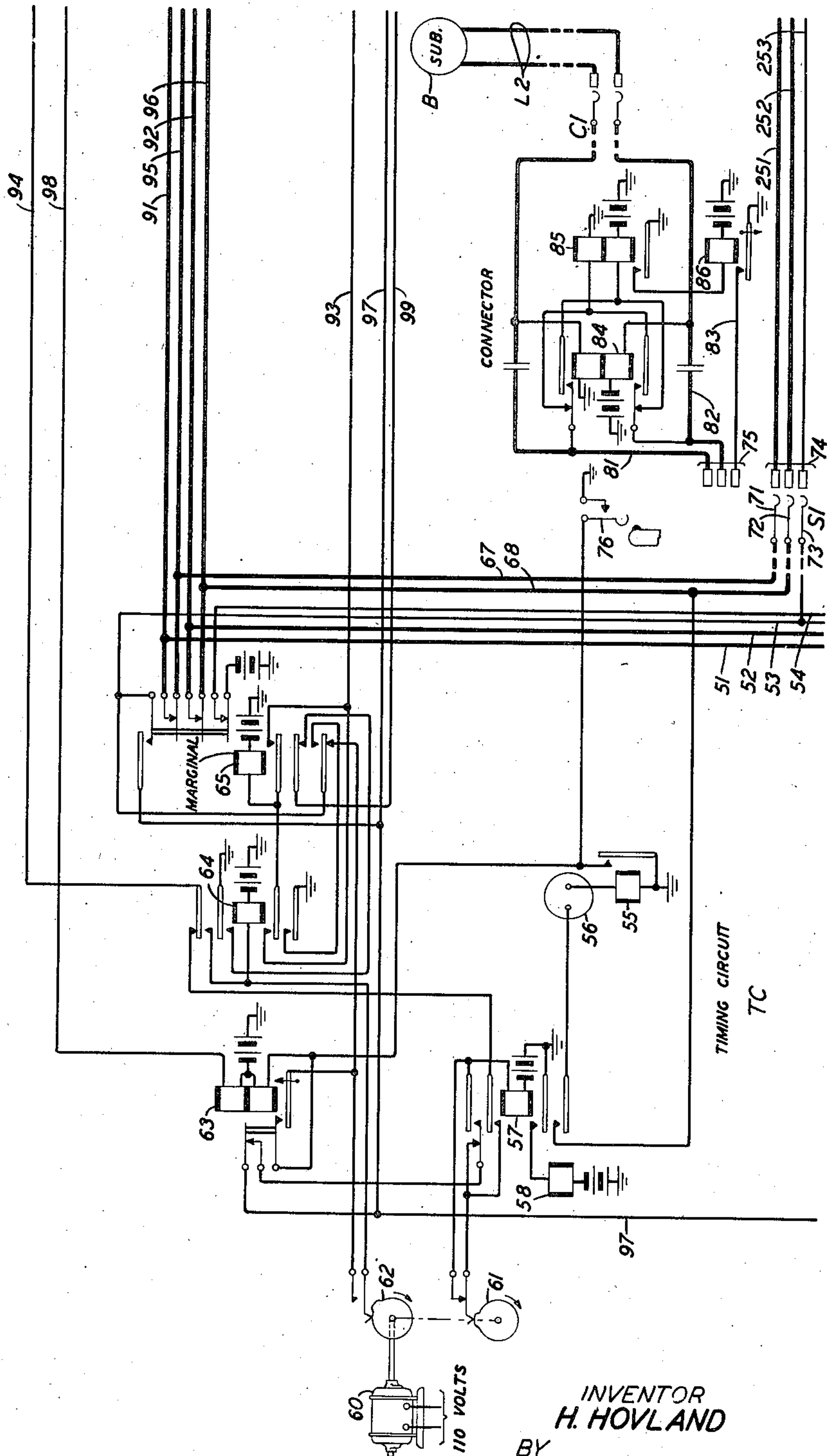
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FIG. 7

FIG. 2	FIG. 3	FIG. 4	FIG. 5
FIG. 1			FIG. 6

FIG. 2



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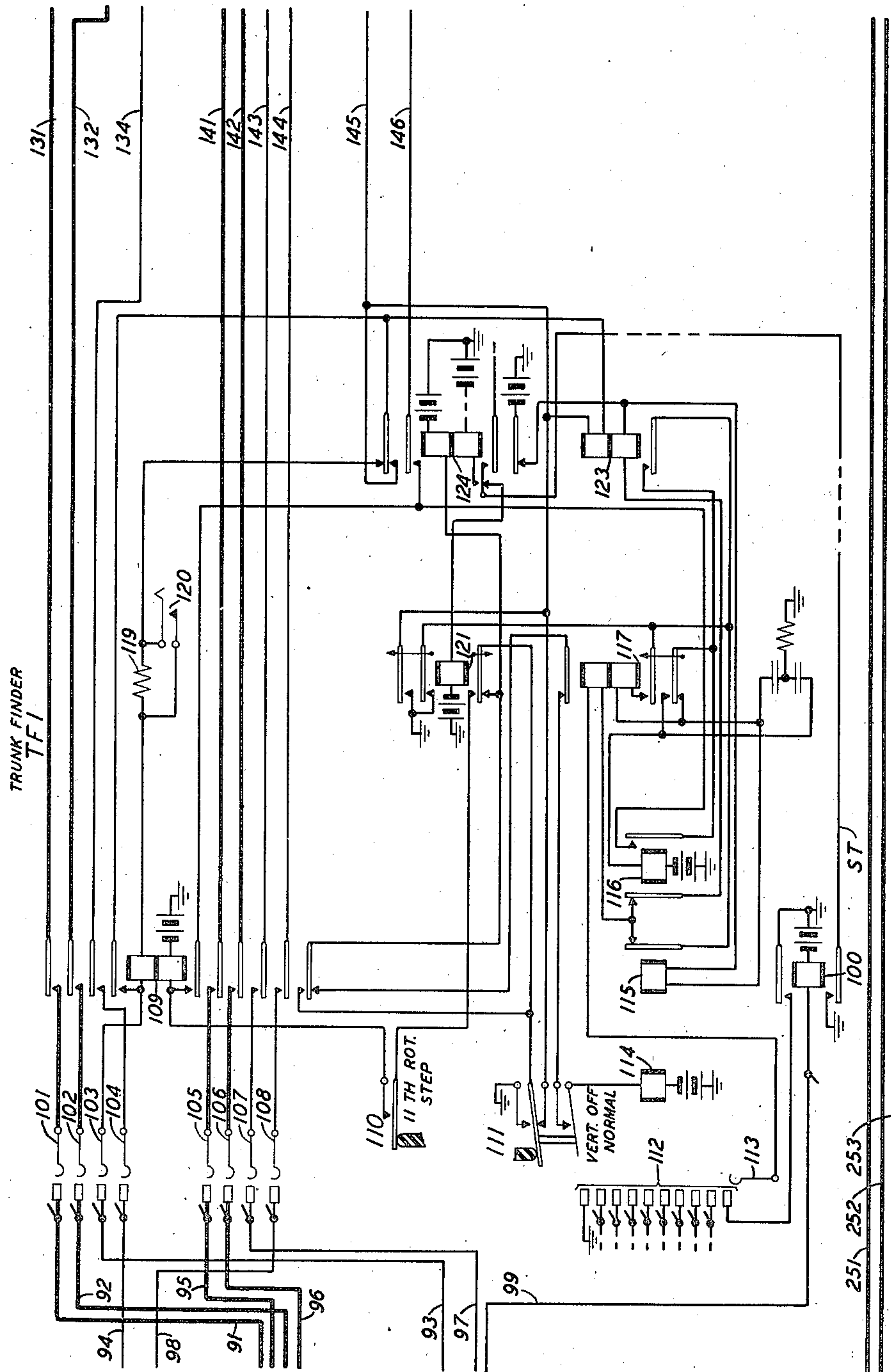
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FIG. 3



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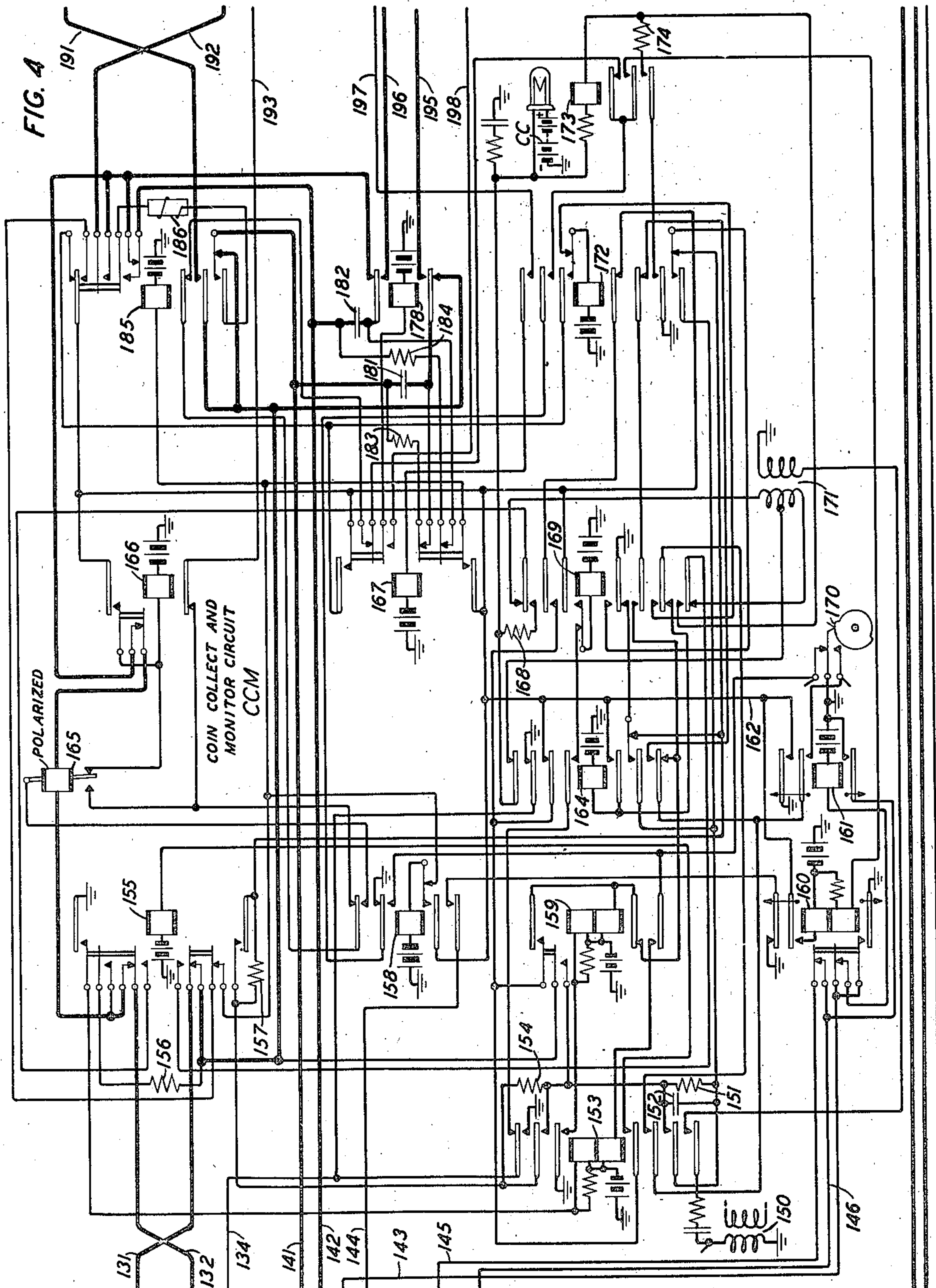
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6 Sheets-Sheet 4



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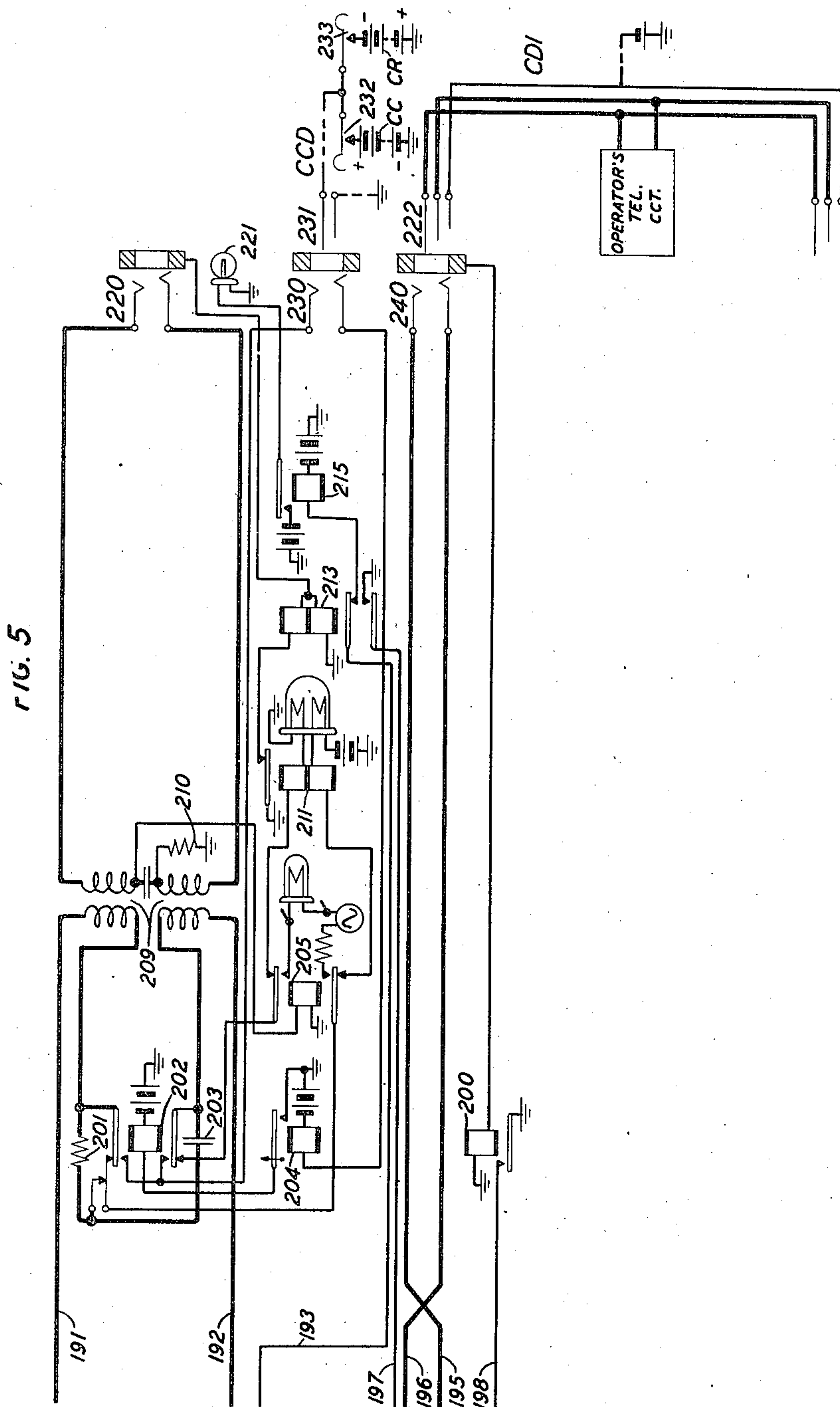
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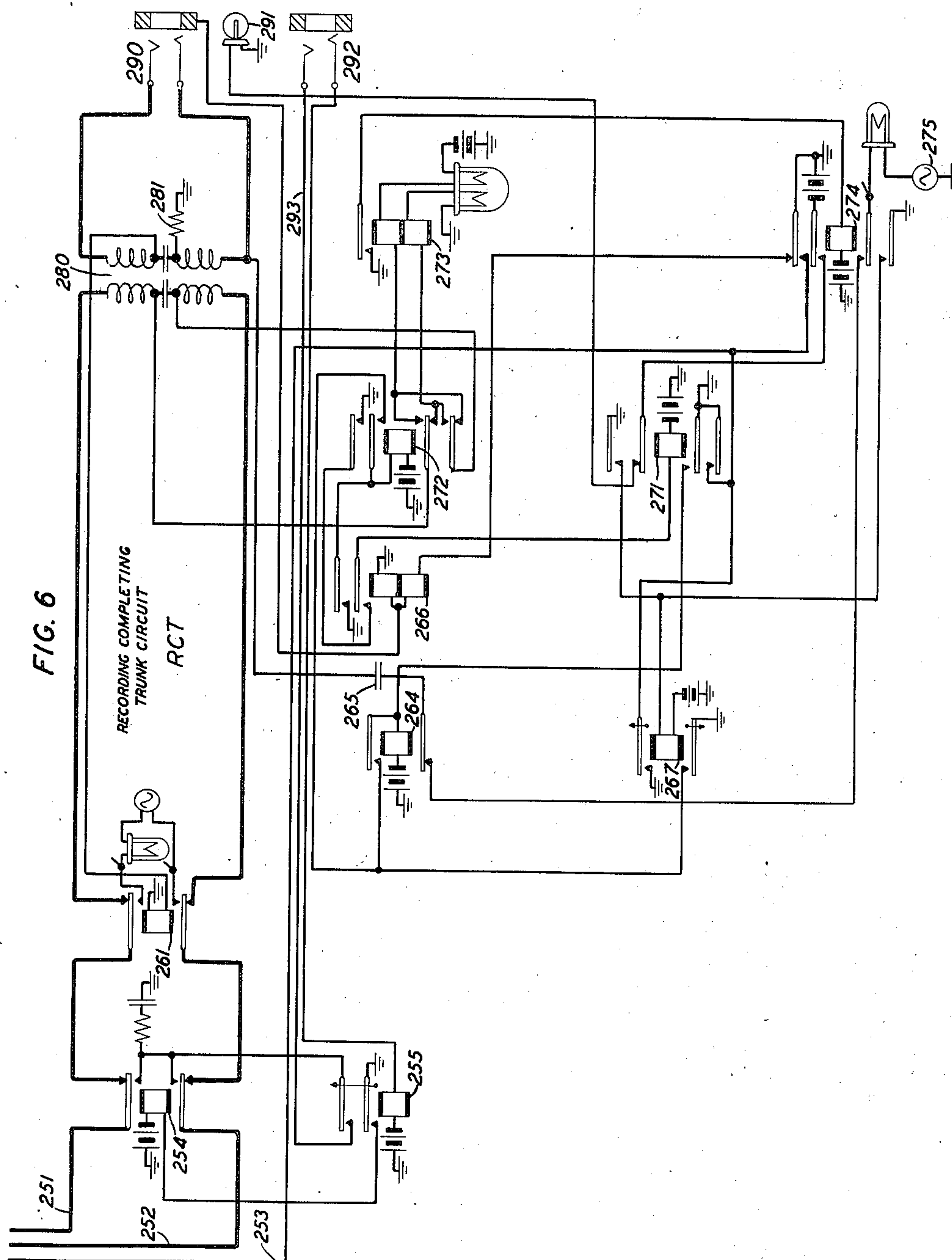
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6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,427,000

COIN-OPERATED TELEPHONE SYSTEM

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Application August 28, 1942, Serial No. 456,482

6 Claims. (Cl. 179—6.3)

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This invention relates to telephone systems and particularly to systems comprising coin stations and arranged for overtime charging:

Objects of the invention are the improvement of systems comprising coin stations and particularly the improvement of means for collecting and refunding coins and an increase in the efficiency of the timing means provided for overtime charging.

It is known in automatic telephone systems comprising stations of the prepay coin type to provide a coin control trunk circuit associated with a first selector for controlling the collection and refund of coins. It is also known to provide timing means for timing the interval for which coins have been deposited. According to this invention, the timing means associated with a coin control trunk circuit and first selector in an automatic telephone system comprising prepay coin stations is rendered inoperative in case the selector is operated to select a trunk to an operator.

The invention and its features will be better understood by considering a system in which the invention is embodied, one such system being shown in the drawing which forms a part of this specification. The invention is, however, not limited in its application to the specific system shown but is generally applicable to systems comprising coin stations arranged for overtime charging.

Referring to the drawing:

Fig. 1 shows a coin subscriber's station A and line L1, a line finder LF1 and a coin trunk circuit CT;

Fig. 2 shows a timing circuit TC individual to the trunk circuit CT of Fig. 1. Fig. 2 further shows a first selector S1 associated with the trunk circuit CT, a connector C1, a line L2 and a called subscriber's station B;

Fig. 3 shows a trunk finder TF1 having access to coin trunks including trunk CT, for connecting a coin trunk to a monitoring operator;

Figs. 4 and 5 show a coin collect and monitor circuit CCM terminating at an operator's position;

Fig. 6 shows a recording completing trunk circuit accessible to selectors including the selector S1; and

Fig. 7 shows the relative position in which Figs. 1 to 6 inclusive are to be placed to form an operative arrangement.

The invention is illustrated in an automatic telephone system in which switches of the step-by-step type are used for extending connections

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between calling and called subscribers' lines. Reference may be had to pages 53 to 65 of the second edition of "Automatic Telephony" by Smith and Campbell for a description of the structure and operation of step-by-step selector and connector switches; and reference may be had to the patent to R. L. Stokely No. 1,799,654 granted April 7, 1931, for a description of a line-finder switch of the step-by-step type.

The subscribers' stations A and B are of the type usually provided in automatic telephone systems, the station A being further provided with a coin control mechanism comprising the coin actuated contact 6 and the coin collect and refund magnet 7. Reference may be had to the patent to O. F. Forsberg No. 1,043,219 of November 5, 1912, for a description of a prepay coin box. The timing cams of timing circuit TC may be part of a timer mechanism such as is disclosed in the patent to E. D. Mead No. 2,112,375 granted March 29, 1938.

Further description of the system shown in the drawing will be facilitated by a description of the operations involved on calls initiated at station A. Assume first, a call from station A to station B. When the receiver at station A is removed from normal position, a line finder LF1 is operated, in the manner described in the aforementioned patent to R. L. Stokely, to connect the line L1 to a coin trunk CT. Upon connection of line L1 through the brushes of line-finder switch LF1 to coin trunk CT, relay 20 is operated in a circuit traced from ground at the inner lower back contact of relay 27, winding of relay 20, winding of retard coil 19, a back contact of relay 16, upper back contacts of relay 14, conductor 11, upper brush of line finder LF1, upper conductor of line L1, lower normally closed contacts of the dial 8 at station A, through transmitter 9, left-hand contact of the receiver-hook switch, left winding of induction coil 10, lower conductor of line L1, middle brush of line finder LF1, conductor 12, lower back contacts of relay 14, inner lower back contact of relay 16, outer lower back contact of relay 27, inner upper back contact of relay 35 to battery at the lower back contact of relay 26. The operation of relay 20 closes circuits for operating relays 24 and 29. The circuit for operating relay 24 is traced from ground at the front contact of relay 20, through the winding of relay 24 and outer upper back contact of relay 35. The circuit for operating relay 29 is traced from ground at the front contact of relay 20, through the inner upper back contact of relay 27, back contact of relay 32, winding of relay 29 and the

upper back contact of relay 34. The operation of relay 29 opens the short circuit across retard coil 30 and connects ground to conductor 13 to hold line finder LF1. The operation of relay 24 closes a circuit for operating relay 27, this circuit being traced from ground at the front contact of relay 24, through the winding of relay 27 and outer upper back contact of relay 35. The operation of relay 27 closes a holding circuit for relay 29, independent of relay 20; changes the circuit through the winding of relay 20 to include the resistor 25 and the winding of relay 31; and closes a bridge across conductors 51 and 52 to operate the line relay (not shown) of selector S1. Relay 20 is held operated in series with resistor 25; but relay 31 is marginal and does not operate until a coin is deposited at the calling station. The bridge across conductors 51 and 52 is traced from conductor 51 through the uppermost back contact of relay 39, winding of relay 38, retard coil 30, winding of retard coil 30, lowermost back contact of relay 44, resistance 46, uppermost front contact of relay 27, winding of relay 37, lowermost back contact of relay 39, to conductor 52. Relays 37 and 38 are polarized relays, the current through the operating windings of these relays being in the operating direction for relay 37 and in the non-operating direction for relay 38. The operation of the line relay of selector S1 effects the connection of ground to the holding conductor 53 in usual manner, this ground potential being further connected through the lowermost back contact of relay 35, to conductor 13 in parallel with the ground from the front contact of relay 29.

When the coin is deposited by the calling subscriber, the coin contacts 6 are actuated, connecting ground through the winding of coin magnet 7 to the upper conductor of line L1, thereby increasing the current through the winding of relay 31 to effect its operation. The operation of relay 31 closes a circuit through the winding of relay 26, lower back contact of relay 35 and conductor 13, to ground at the front contact of relay 29. Relay 26 operates; and it locks independent of relay 31, through the back contact of relay 35 to ground on sleeve conductor 13. Relay 26 also locks directly to ground on conductor 53 if the selector S1 has already connected holding ground potential to this conductor. The operation of relay 26 opens the circuit through the winding of relay 31 and connects the winding of relay 33 to the lower conductor of line L1, thereby causing the release of relay 31 and the operation of relay 33. Relay 33 closes a circuit for operating relay 32 and at its lower front contact closes the bridge across conductors 51 and 52 independent of the contacts of relay 27. At its middle upper front contact relay 26 closes circuits for operating relays 35 and 36, the circuit for operating relay 35 being traced through the upper back contact of relay 16. Relay 36 locks under the control of relay 16, but independent of relay 26; and closes a circuit for holding relay 35 operated. The operation of relay 35 causes the release of relays 24 and 27, disconnects sleeve-conductor 53 from sleeve conductor 13, and connects ground to sleeve conductor 13. The release of relay 27 short-circuits resistor 25; and the release of relay 24 short-circuits the winding of relay 20, thereby causing the release of relay 20. Since relays 24 and 27 are slow in releasing, relay 33 is fully operated before relay 27 releases, due either to the operation of relay 35 or due to the release of relay 20 in case this relay releases upon deposit of a coin, to maintain the bridge across conductors 51 and

52. The operation of relay 32 closes a circuit for holding relay 29 operated, independent of relay 27.

With relays 26 and 29 operated and relay 27 released, conductors 11 and 12 are connected through talking condensers 15 to conductors 51 and 52 of selector S1, so that dial tone is transmitted from selector S1 to the calling station. When the subscriber dials the first digit of the called subscriber's number, relay 33 is alternately released and reoperated, due to the opening of the subscriber's loop at the impulse contact of the dial 8, as many times as there are units in the digit dialed. The first release of relay 33 causes the release of relay 32; and, being slow in operating, relay 32 remains normal during the receipt of the remaining impulses of the digit. Each release of relay 33 opens the bridge across conductors 51 and 52 thereby repeating the impulses, corresponding to the first digit dialed, to the first selector S1. The release of relay 32 causes the release of relay 29 whereby the retard coil 30 is short-circuited to improve the transmission of impulses to the selector S1. The release of relay 29 also disconnects the talking condensers 15 from conductors 51 and 52. The selector S1 is operated in response to the dial impulses to select a level corresponding to the first digit dialed and to select the first set of terminals in that level which is connected to an idle trunk or succeeding switch. Assuming the selected set of terminals to be the terminals 75, the line relay 85 of connector C1 is operated. Relay 85 closes a circuit for operating relay 86; and relay 86 connects holding ground potential through conductor 83 and brush 73 to conductor 53. The next two digits dialed by the calling subscriber are repeated by relay 33 of coin trunk circuit CT to the line relay 85 of connector C1. The connector C1 is thereby operated in usual manner to select the terminals of the called line, to make a busy test of this line, and to connect a ringing current source to the line in case the line is idle.

If the call is answered by the called subscriber, a circuit is closed for operating relay 84; whereby the connections between the conductors 81 and 82 and the windings of relay 85 are interchanged so as to reverse the current through conductors 51 and 52 and thereby cause the operation of polarized relay 38 and the release of polarized relay 37. With relay 38 operated and relay 37 released, a circuit is closed for operating relay 39, this circuit being traced from battery through resistor 41, winding of relay 39, the inner lower back contact of relay 40, outer back contact of relay 43, back contact of relay 37, front contact of relay 38, to ground potential on conductor 53. Relay 39 locks to conductor 53 and closes a circuit for operating relays 43 and 44, this circuit being traced from battery at the inner upper back contact of relay 65 of timing circuit TC, through conductor 54, winding and continuity back contact of relay 44, all in parallel with the circuit path from battery through the winding of relay 43, thence through the inner lower front contacts of relay 39, to ground on conductor 53. The operation of relay 39 short-circuits the winding of relay 38 and interchanges the connections between conductors 51 and 52 and the windings of relays 37 and 38 thereby reversing the current through the winding of relay 37, causing the reoperation of relay 37 and the release of relay 38. When the slow-to-operate relay 43 operates, it closes a circuit including a back contact of relay 38 for operating relay 40. Relay 40 locks directly

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to the ground on conductor 53, independent of relay 38. The operation of relay 40 opens the short-circuit across the winding of relay 38; but relay 38 does not reoperate since the current through its winding is in the non-operating direction. The operation of relay 44 closes a locking circuit to ground at the outer lower front contact of relay 35, opens the impulse repeating bridge through resistor 46 across conductors 51 and 52, closes a circuit for operating relay 14, and connects ground to conductor 97 to start the operation of the timing circuit TC. Relay 14 connects the calling subscriber's line, through conductors 11 and 12 and the inner front contacts of relay 14, directly to the windings of relays 38 and 37 thereby holding relay 35 operated and completing the talking connection, through the talking condensers of connector C1, between the line L1 and the line L2.

When ground is connected to conductor 97 due to the operation of relay 44 upon answer of the called subscriber, the start relay 57 of the timing circuit TC is operated thereby closing a circuit for operating the rotary magnet 58 of the timer mechanism to start the timer cams 61 and 62 in operation. Relay 57 also closes a locking circuit independent of the normally closed contacts of timer cam 61, these contacts being opened as soon as the timing elements move out of normal position. At the end of an interval of four and a half minutes after the operation of cams 61 and 62 is initiated, cam 62 actuates its associated contacts, thereby closing a circuit including the outer lower back contact of relay 65 for operating relay 64. Relay 64 connects ground through its inner upper front contact and the inner lower back contact of relay 65 to conductor 99 to operate the group relay 100 associated with the group of coin trunk circuits which are connected to one level of the bank of the trunk finder TF1. Relay 100 connects ground to the associated commutator segment of each of the trunk finders having access to the trunk circuit CT and connects ground to start conductor ST to start an idle trunk finder, in well-known manner. Assuming the trunk TF1 to be the first idle finder in the group, the connection of ground to conductor ST causes the operation of relay 121. Relay 121 closes a circuit from battery at the outer lower back contact of relay 124, through the lower winding of stepping relay 123, back contact of rotary stepping magnet 116, and back contact of vertical stepping magnet 115, to ground at the inner upper front contact of relay 121. Relay 123 operates thereby closing a circuit for operating the vertical stepping magnet 115. This circuit is traced from battery at the outer lower back contact of relay 124, winding of vertical stepping magnet 115, lower back contact of relay 117, and front contact of relay 123 to ground at the inner upper front contact of relay 121. The operation of magnet 115 steps the two sets of brushes, 101 to 104 inclusive and 105 to 108 inclusive, up to the first level of the associated terminal banks and opens the operating circuit of relay 123. If the trunk circuit CT is not connected to a set of terminals in the first level, relay 123 releases when stepping magnet 115 operates thereby causing the release of magnet 115. In this case the release of stepping magnet 115 again closes the circuit through the lower winding of stepping relay 123, thereby causing the reoperation of relay 123; and the vertical stepping magnet 115 is again energized to step the brushes up to the next level of the terminal

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banks. Thus the stepping relay 123 and vertical stepping magnet 115 cooperate to step the brushes to the level in which the trunk CT is terminated. Assuming the trunk CT to be connected to the terminals of the first level of the bank of the trunk finder TF1, the stepping relay 123 is held operated, when the brushes are stepped up to the first level, in a circuit which is traced from battery through the outer lower back contact of relay 124, lower winding of relay 123, back contact of rotary stepping magnet 116, upper winding of relay 117, commutator brush 113 and the engaged first segment of the commutator, to ground at the upper front contact of the group relay 100. Relay 123 is thus held operated and relay 117 is energized sufficiently by the current through its upper winding to close its inner lower front contact and thereby energize its lower winding in series with the winding of the vertical stepping magnet 115. The stepping magnet 115 is not operatively energized in this circuit. Relay 117 is slow in operating to delay the first rotary step to prevent snagging of the brushes due to vibration. The operation of relay 117 transfers the stepping circuit from the vertical to the rotary magnet, the rotary magnet being energized in a circuit traced from battery through its winding, the outer front contact of relay 117, front contact of relay 123 to ground at the inner upper front contact of relay 121. The operation of rotary stepping magnet 116 advances the brushes into engagement with the first set of terminals in the selected level and opens the circuit through the lower winding of relay 123 to cause the release of this relay. The release of the stepping relay 123 causes the release of the rotary stepping magnet 116 thereby again closing the circuit for energizing the lower winding of relay 123. Relay 123 and rotary stepping magnet 116 thus cooperate to advance the brushes, step-by-step, until the brushes engage the terminals to which the coin trunk circuit CT is connected; whereupon a circuit is closed from ground at the outer upper front contact of relay 121, upper winding of relay 123, upper back contact of relay 124, resistor 119, upper winding of relay 109, brush 103 of trunk finder TF1, conductor 93, through the inner lower front contact of relay 64 and winding of cut-off relay 65 of timing circuit TC, to battery. Relay 123 is held operated by the current in this circuit so as to hold the rotary magnet 116 energized to prevent further stepping. Relay 109 is sufficiently energized by the current through its upper winding to close its inner lower front contact, thereby energizing its lower winding to complete the actuation of all of its contacts. The circuit for energizing the lower winding of relay 109 includes the front contact of the rotary stepping magnet 116 and the front contact of relay 123. The complete operation of relay 109 closes a short circuit across resistor 119 to cause the operation of the marginal cut-off relay 65 of timing circuit TC, closes a holding circuit for relay 64, closes a circuit for operating relay 161 of coin collect and monitor circuit CCM, and closes a circuit for operating relay 124. Relay 65 locks to conductor 93 independent of relay 64, opens the operating circuit of relay 64, and disconnects ground from conductor 99 so as to release group relay 100 if no other coin trunk, which is connected to the same level, is then awaiting connection to a coin collect and monitor circuit. The circuit for holding relay 64 includes the locking contact of relay 64, conductor 94, trunk finder brush 104, a front

contact of relay 109, conductor 134, to ground at a back contact of relay 164 of the coin collect and monitor circuit CCM. The circuit for operating relay 161 includes a back contact of relay 160, conductor 143, a front contact of relay 109, trunk finder brush 107, conductor 97, and a front contact of relay 44 of coin trunk CT, to ground potential on conductor 53. After relay 65 operates, conductor 97 is connected through a front contact of relay 65 to conductor 53, whereby relay 14 of coin trunk CT and relay 161 of coin collect and monitor circuit CCM are held operated independent of relay 44 under the control of relay 65. The aforementioned circuit for operating relay 124 is traced from battery through the upper winding of relay 124, lowermost front contact of relay 109, to ground at the upper front contact of the vertical off-normal springs 111, these springs being actuated as soon as the shaft of the trunk finder moves out of its normal position. The operation of relay 124 causes the release of relays 121, 123 and 117 and the release of rotary stepping magnet 116, and transfers the start conductor ST from the trunk finder TF1 to the next trunk finder in the group in usual and well-known manner. With relay 124 operated, relay 109 is locked through its inner lower front contact, inner upper front contact of relay 124, conductor 146, to ground at a front contact of relay 161 in the coin collect and monitor circuit CCM. The ground at the lower front contact of relay 161 is also connected through a back contact of relay 160, conductor 145, outer upper front contact of relay 124, inner upper front contact of relay 109, trunk finder brush 103 to conductor 93 to hold cut-off relay 65 of timing circuit TC. Relay 121 is slow in releasing so that conductor 145 is connected to ground at the outer upper front contact of relay 121 until after ground is connected to this conductor by the operation of relay 161 of coin collect and monitor circuit CCM. The aforementioned operation of relay 65 of timing circuit TC opens the direct connection between conductors 51 and 52 and conductors 67 and 68 so that the talking connection between the calling and the called subscribers' lines includes the talking conductors of trunk finder TF1 and coin collect and monitor circuit CCM. The operation of relay 65 connects ground at the lowermost front contact of relay 64, through the lowermost front contact of relay 65, to conductor 53 to maintain ground on this conductor to prevent release of the connection until the coin collect and monitor circuit has collected the coin. The operation of relay 65 also disconnects battery from conductor 54, thereby causing the release of relay 44 of the coin trunk circuit. Relay 165 of the coin collect and monitor circuit CCM is operated in series with the calling line, this circuit being traced from battery through the lower winding of relay 85 of connector C1, the upper front contact of relay 84, conductor 81, brush 71 of selector S1, conductor 67, conductor 95, brush 105 of trunk finder TF1, a front contact of relay 109, conductor 141, lowermost back contact of relay 185, inner lower back contact of relay 155, conductor 131, a front contact of relay 109, brush 101 of trunk finder TF1, conductor 91, conductor 51, the uppermost front contact of relay 39, winding of relay 37, lower front contact of relay 14, conductor 12, middle brush of line finder LF1, lower conductor of line L1, through the telephone at station A, back over the upper conductor of line L1, upper brush of line finder LF1, conductor 11, upper front con-

tact of relay 14, winding of relay 38, lowermost front contact of relay 39, conductor 52, conductor 92, brush 102 of trunk finder TF1, a front contact of relay 109, conductor 132, inner upper back contact of relay 155 of coin collect circuit CCM, winding of relay 165, back contact of relay 166, inner upper back contact of relay 185, conductor 142, a front contact of relay 109, brush 106 of trunk finder TF1, conductor 96, conductor 68, brush 72 of first selector S1, through the lower front contact of relay 84 and upper winding of relay 85, to ground. Thus polarized relay 165 is operated in series with the calling subscriber's line and in series with the windings of relay 85 of connector switch C1 as long as relay 84 remains operated due to the answer of the called subscriber at station B. The aforementioned operation of relay 161 connects the lower contact of interrupter springs 170, through the inner upper front contact of relay 161, outer lower back contact of relay 164 and lower back contact of relay 159 to the lower winding of relay 159. The upper and lower contacts of interrupter 170 are alternately closed for half a second; and, as soon after the operation of relay 161 as the lower contact of the interrupter springs is closed, the lower winding of relay 159 is operatively energized. Relay 159 closes a locking circuit, through its uppermost front contact, inner upper back contact of relay 164, conductor 162, and the inner upper front contact of relay 161; and closes a connection from ground at the inner lower back contact of relay 164, through the inner lower back contact of relay 164, resistors 157 and 154, inner upper front contact of relay 159 and inner lower back contact of relay 155 to conductor 131 and through the outer lower back contact of relay 185 to conductor 141. As soon after relay 161 operates as the upper contact of interrupter springs 170 is again closed, ground is connected through the lower front contact of relay 159 to the lower winding of relay 153, thereby operatively energizing relay 153. Relay 153 closes a circuit through the upper winding of relay 159 for holding relay 159 operated, short-circuits resistor 154, short-circuits resistor 151 and condenser 152, connects ground to conductor 134 to maintain the energization of relay 64 of timing circuit TC, closes a circuit for operating relay 155, and connects the common tone source 150 in series with the right winding of transformer 175. The operation of relay 155 bridges the left windings of transformer 171 across conductors 131 and 132, so as to transmit to the calling subscriber's station, a tone indicating that the first interval for which a coin has been deposited is almost completed; and connects the coin collect battery CC, through the uppermost back contact of relay 164 and both left windings of transformer 171 to conductors 131 and 132, thereby effecting the operation of the coin magnet 7 at the calling subscriber's station A to collect the deposited coin. Relay 155 also bridges the resistor 156 across conductors 141 and 142 to hold the line relay 85 of the connector C1. This bridge is traced from conductor 141, through the lowermost back contact of relay 185, resistor 156, the middle upper front contact of relay 155, winding of relay 165, back contact of relay 166, and inner upper back contact of relay 185, to conductor 142. The operation of relay 155 also short-circuits resistor 157 and closes a holding circuit for operatively energizing the upper holding winding of relay 153. When the lower contact of the interrupter springs 170 is again closed, ground is connected through

this contact, the inner upper front contact of relay 161, a front contact of relay 153 and a back contact of relay 169 to operate relay 164. Relay 164 locks through conductor 162 to ground at a front contact of relay 161, disconnects coin collect battery CC from conductors 131 and 132; connects ground at the inner lower back contact of relay 169, through the middle lower front contact of relay 164, a lower front contact of relay 153, inner upper front contact of relay 159, and outer lower back contact of relay 185, to conductor 141; and causes the release of relay 155. The release of relay 155 opens the bridge comprising resistor 156 across conductors 141 and 142, disconnects the left winding of tone transformer 171 from conductors 131 and 132, recloses the talking circuit between the calling and the called stations, and permits relay 153 to release. The release of relay 153 opens the short circuits across resistors 152 and 154, disconnects ground from conductor 134 to release relay 64 of timing circuit TC, and permits the release of relay 159. The release of relay 159 disconnects ground from conductors 131 and 141. Thirty seconds after the closing of the contacts of cam 62 of timing circuit TC effects the connection of the trunk circuit CT to the coin control and monitor circuit CCM for collection of the coin at the calling station A, the cam 61 closes its contact thereby connecting ground from conductor 53, through the uppermost front contact of relay 65, conductor 97, back contact of relay 63, outer upper front contact of relay 57, contacts of cam 61, inner upper front contact of relay 57, back contact of relay 64, conductor 94, brush 104 of trunk finder TFI, a front contact of relay 109, conductor 134, back contact of relay 153, inner upper front contact of relay 164, through the continuity contact and winding of relay 169 to battery, thereby operatively energizing relay 169 of the coin collect and monitor circuit CCM. Relay 169 locks under control of relay 161 and opens the operating circuit of relay 164, relay 164 being held operated under control of relay 161. As soon after relay 169 operates as the lower contact of interrupter springs 170 is closed, ground is connected through this contact, inner upper front contact of relay 161, outer lower front contact of relay 164, middle lower back contact of relay 172, a front contact of relay 169, and lower back contact of relay 159 to the lower winding of relay 159. Relay 159 operates; and it locks through its outer upper front contact, middle upper front contact of relay 169, and inner lower back contact of relay 172, to ground at the uppermost front contact of relay 161. The operation of relay 159 again connects ground to conductors 131 and 141, this connection being traced from conductor 141 through the outer lower back contact of relay 185, and from conductor 131 through the inner lower back contact of relay 155, thence through the inner upper front contact of relay 159, resistors 154 and 157, outer lower back contact of relay 172, to ground at the inner lower front contact of relay 169. As soon after the operation of relay 159 as the upper contact of interrupter springs 170 is again closed, ground is connected through this contact and the lower front contact of relay 159, to reoperate relay 153. Relay 153 again closes the holding circuit for relay 159, short-circuits resistor 154, short-circuits resistor 151 and condenser 152, connects ground to conductor 134, and closes a circuit for operating relay 153. Relay 153 also connects tone source 150 to the right winding of transformer 171; but no

tone is transmitted to the calling station when relay 155 operates, because the operation of relay 169 disconnected the left windings of this transformer from the inner front contacts of relay 155. Relay 155 connects conductor 131 through its inner lower front contact, outer lower front contact of relay 169, and winding of relay 173 to the coin collect battery CC; and connects conductor 132 through its inner upper front contact, uppermost front contact of relay 169, through resistor 168 to coin collect battery CC. If the subscriber at the station A has already deposited another coin, ground is connected through contact 6 and magnet 7 to the conductors of line L1 to effect the operation of relay 173 without operating the coin control magnet 7; but, if no coin has been deposited, relay 173 does not operate. As soon as the lower contact of interrupter springs 170 is again closed, ground is connected through this contact, inner upper front contact of relay 161, a front contact of relay 153 and a front contact of relay 159, to the winding of relay 172. Relay 172 operates; and it locks through its continuity front contact, under control of relay 185, through conductor 162, to ground at a front contact of relay 161. The operation of relay 172 causes the release of relays 155, 153 and 159 thereby again establishing the talking circuit between the calling and called lines. If no coin was deposited, and relay 173 has not operated, the operation of relay 172 closes a connection from ground at the inner upper back contact of relay 158, through the middle upper front contact of relay 172, back contact of relay 173, upper back contact of relay 167, inner lower back contact of relay 185, outer upper back contact of relay 158, lower back contact of relay 166 to conductor 193, to effect the operation of relay 215 to signal a monitoring operator as hereinafter described. If relay 173 operates, due to the deposit of another coin, it is held operated through resistor 174 and the outer lower front contact of relay 173, to ground at a front contact of relay 172. The operation of relay 173 closes a circuit for operatively energizing the lower winding of relay 160, this circuit being traced through the inner lower front contact of relay 173, middle upper contact of relay 172, to ground at a back contact of relay 158. Relay 160 locks through its upper winding and front contact to ground at the front contact of relay 161, disconnects ground from conductor 145 to release relay 65 of timing circuit TC, disconnects the winding of relay 161 from conductor 143 to cause the release of relay 161, and connects ground to conductor 143. The release of relay 161 disconnects ground from conductor 146 causing the release of relay 109 of trunk finder TFI. The release of relay 65 reconnects conductors 67 and 68 to conductors 51 and 52 to maintain the connection between the calling and called lines after the trunk finder TFI is restored to normal. The release of relay 65 disconnects conductor 97 from conductor 53 and reconnects battery to conductor 54 to effect the reoperation of relay 44. The release of relay 109 of trunk finder TFI closes a circuit for operating release magnet 114 of the trunk finder, this circuit being traced through the lower front contact of the vertical off-normal springs 111, upper back contact of relay 117, lower back contact of relay 109 and lower back contact of relay 121, to ground at the upper front contact of the vertical off-normal springs 111. The operation of release magnet 114 causes the brushes of the trunk finder to be restored to normal; and, when the shaft of the

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trunk finder switch reaches normal position, the vertical off-normal springs are restored to normal position, thereby causing the release of magnet 114. Relay 161 of the coin collect and monitor circuit CCM is slow in releasing so as to insure the release of relay 65 in the timing circuit TC before relay 161 disconnects ground from conductor 146. The release of relay 161 also opens the holding circuit for the upper winding of relay 160, relay 160 being slow in releasing so as not to reclose the operating circuit of relay 161 until the trunk finder has been released. Relay 161 also disconnects ground from conductor 162 thereby causing the release of all other operated relays in the coin collect and monitor circuit CCM.

If the connection between the calling station A and called station B is maintained after relay 65 of timing circuit TC is released, relay 57 remains operated and starts a new cycle of operation of the timing circuit. Thus the coin trunk circuit CT is reconnected to a coin collect and monitor circuit CCM four and one half minutes after the new timing cycle is started. The coin is collected and, at the end of a five minute interval, the test is made for the deposit of another coin.

If the called subscriber restores the receiver to normal, relay 84 releases. The release of relay 84 reverses the current through conductors 51 and 52 so that relay 38 reoperates and relay 37 releases, thereby short-circuiting the winding of relay 39. The release of relay 39 causes the release of relay 43 and short-circuits the winding of relay 38. The release of relays 38 and 43 short-circuits the winding and causes the release of relay 40. If the call is released by the calling subscriber prior to the expiration of a four and a half minute interval, measured by the timing circuit TC, the coin trunk CT is not connected to a coin collect and monitor circuit CCM and, relay 44 having been operated, the collection of the coin at the station A is effected by the operation of relays 34 and 16 of the coin trunk CT in the manner hereinafter described. When the calling subscriber restores the receiver to normal, relay 85 of the connector CI releases, in turn causing the release of relay 86. The release of relay 86 disconnects ground from conductors 83 and 53 thereby causing the return of selector SI to normal in the usual manner. In case the coin trunk CT is connected to the coin collect and monitor circuit CCM at the time that the connection is released by the calling subscriber, the disconnection of ground from conductor 53 causes the release of relay 161. The disconnection of ground potential from conductor 53 also causes the release of relay 57 of timing circuit TC and causes the release of relay 14 of coin trunk circuit CT. The line finder LF1 is held by ground connected to conductor 13 at the front contact of relay 35. Relay 26 releases when ground is disconnected from conductor 53 and so also do relays 39, 43 and 40 in case these relays have not already been released due to the disconnection of the called subscriber. As soon after relay 26 releases as interrupter relay 17 is released, a circuit is closed from ground at the back contact of relay 17, inner lower front contact of relay 35, continuity back contact and winding of relay 34, to battery at a back contact of relay 26, thereby causing the operation of relay 34. Relay 34 locks under control of relay 35. When the interrupter relay 17 next operates, a circuit is closed from ground at the front contact of relay 17, through the winding of relay 16, outer

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lower front contact of relay 34, and upper front contact of relay 35, to battery at the lower back contact of relay 26. The operation of relay 16 connects coin collect battery CC through the inner lower front contact of relay 44, winding of relay 23, lower front contacts of relay 16, back contacts of relay 14, conductors 11 and 12 and brushes of line finder LF1, to the conductors of line L1 to operate the coin collect magnet 7 to collect the coin. Relay 23 operates in series with the coin collect magnet, thereby insuring that relay 36 is held operated during the time that the coin is being collected. As soon as interrupter relay 17 again releases, ground is disconnected from the winding of relay 16 to cause its release and thereby disconnect the coin collect battery from the conductors of line L1. When relay 17 next reoperates, ground is again connected to operate relay 16 of the coin trunk circuit CT to again apply the coin collect battery to the line L1. If the coin has been collected by the first application of coin collect battery, there is no circuit for operating relay 23; and the operation of relay 16 causes the release of relay 36. The release of relay 36 causes the release of relay 35; and the release of relay 35 disconnects holding ground potential from conductor 13 thereby causing the release of the line finder LF1 in usual and well-known manner. If the application of coin collect battery to the conductors of line L1 fails to dispose of the coin, relay 23 is reoperated each time that the coin collect battery is applied to the line, thereby holding relays 36 and 35. In this case the connection of battery, through the upper front contact of relay 34 and lamp 22, to the alarm relay 21 effects the operation of an alarm a predetermined interval of time after the operation of relay 34.

If the calling subscriber replaces the receiver before the connection is completed, or before the call is answered, the opening of the line loop releases relay 33. The release of relay 33 causes the release of relays 32 and 29 and opens the bridge across conductor 51 and 52 to cause the release of the selector SI and the release of connector CI if the connection has been extended thereto. Holding ground potential is thereby disconnected from conductor 53, causing the release of relay 26; but the line finder LF1 is held by the ground connected to conductor 13 at a front contact of relay 35. The release of relay 26 causes the operation of relay 34 as above described. The operation of relay 34 causes the operation of relay 16 under the control of interrupter relay 17 whereby coin return battery CR is connected through the upper front contact of relay 16, inner lower back contact of relay 44, winding of relay 23, front contact of relay 16, back contact of relay 14, conductors 11 and 12, brushes of line finder LF1 to the conductors of line L1 to operate the coin magnet 7 to return the coin. Relay 23 operates in series with the coin magnet thereby closing a holding circuit for relay 36. When coin return battery is connected to the conductors of line L1 a second time, relay 23 fails to operate if return of the coin was effected by the first application of coin return battery, thereby causing the release of relay 36; and the coin trunk circuit is thereupon restored to normal as above described.

If the calling subscriber does not replace the receiver at the end of the five minute interval for which a coin has been collected by the coin collect and monitor circuit CCM and does not deposit another coin, the connection of ground to

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conductor 193 causes the operation of relay 215 as hereinbefore described. The operation of relay 215 closes a circuit for lighting the lamp 221 at a monitoring operator's position. When a monitoring operator answers the call by inserting a plug 222 of a cord circuit CD1 in the monitoring jack 220, relay 213 is operated through the sleeve conductor. The operation of relay 213 causes the release of relay 215 and closes a circuit through conductor 197 and the outer upper front contact of relay 172 for operating relay 167 of the coin collect and monitor circuit CCM. At its lower front contact, relay 167 closes a circuit for operating relays 158 and 185. Relay 167 also closes a circuit for holding relay 172. Relay 185 locks under control of relay 155; and relay 158 locks to ground at the front contact of relay 161. The operation of relay 158 closes a circuit from ground at the upper back contact of relay 160, through the outer lower front contact of relay 158, conductor 144, a front contact of relay 109, brush 108 of trunk finder TF1, and conductor 98, for operatively energizing the upper winding of relay 63 of timing circuit TC. The operation of relay 63 causes the release of start relay 57 of the timing circuit whereby the timer is restored to normal and further timing is prevented until the monitoring operator has disconnected. Relay 185 connects the talking conductors 131 and 132 through conductors 191 and 192 to repeating coil 209 to complete a talking connection with the answering operator, and bridges the retard coil 186 across conductors 141 and 142 to hold the line relay 85 of connector C1, the talking connection between the calling and called stations being now traced through condensers 181 and 182. Relay 211 is operated in series with the calling subscriber's line, the operating circuit being traced from battery through the lower winding of relay 211, lower back contact of relay 205, upper back contacts of relay 202, upper left winding of repeating coil 209, conductor 191, inner lower front contact of relay 185, inner lower back contact of relay 155, conductor 131, a front contact of relay 109 of trunk finder TF1, brush 101, conductor 91, conductor 51, outer upper front contact of relay 39, winding of relay 37, lower front contact of relay 14, conductor 12, middle brush of finder LF1, lower conductor of line L1, through the subscriber's telephone, back over the upper conductor of line L1, through the upper brush of line finder LF1, conductor 11, upper front contacts of relay 14, winding of relay 38, outer lower front contact of relay 39, conductor 52, conductor 92, brush 102 of trunk finder TF1, a front contact of relay 109, conductor 132, inner upper back contact of relay 155, winding of relay 165, back contact of relay 166, middle upper front contact of relay 185, conductor 192, lower left winding of repeating coil 209, lower back contact of relay 202, upper back contact of relay 205, through the upper winding of relay 211 to ground. The operation of relay 211 opens the circuit through the upper winding of relay 213 thereby increasing the resistance of the circuit through the sleeve conductor of jack 220 to extinguish the supervisory lamp (not shown) associated with the answering plug 222 of cord CD1. In case the subscriber wishes to deposit a coin for an additional period of time, the operator disconnects cord CD1 from the monitoring jack 220 whereupon relay 213 releases. The release of relay 213 causes the release of relay 167. The release of relay 167 closes circuits through resistors 183 and 184 for discharging the condensers 181 and 182 and causes the

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release of relay 172. The release of relay 172 causes the coin collect and monitor circuit CCM to operate as hereinbefore described to test for a coin. Relay 185 is released when relay 155 operates to close the coin test circuit. If there is a coin in the box, relay 173 operates, the coin collect and monitoring circuit CCM is released as hereinbefore described, and the timing circuit TC starts the timing of a new interval. If there is no coin in the coin box, relay 173 does not operate and ground is intermittently connected through the upper contact of interrupter springs 170, inner upper front contact of relay 158, middle upper front contact of relay 172, back contact of relay 173, upper back contact of relay 167, inner lower back contact of relay 185, outer upper front contact of relay 158, front contact of relay 165, back contact of relay 166, conductor 193, and lower back contact of relay 213 to the winding of relay 215, causing the intermittent operation of relay 215 thereby to flash the answering lamp 221 to indicate to the monitoring operator that the called subscriber has failed to deposit a coin after the operator disconnected. The operator again answers the call by inserting the plug 222 of the cord C2 in monitoring jack 220. The operator may also interrupt the talking circuit between the calling and the called subscribers by inserting the plug of a cord in the splitting jack 240. The insertion of a plug in splitting jack 240 causes the operation of the sleeve relay 200. The operation of relay 200 closes a circuit from ground at its front contact, through conductor 198 and the inner upper front contact of relay 167, to operate splitting relay 178. The operation of relay 178 disconnects conductors 141 and 142 from conductors 131 and 132, and closes a talking connection from the tip and ring conductors of the splitting jack 240, through conductors 195 and 196, front contacts of relay 178 and condensers 181 and 182 to conductors 141 and 142, thence through trunk finder TF1, selector S1 and connector C1 to the called subscriber's line L2, thus enabling conversation between the operator and the called subscriber. If the called subscriber then disconnects and the subscriber at the calling station fails to disconnect, the release of relay 84 of connector C1 causes a reversal of the current through the winding of relay 165 of the coin collect and monitoring circuit CCM, thereby causing the release of relay 165. When the monitoring operator disconnects, a circuit is closed for operating relay 166, this circuit being traced through the back contact of relay 165, the outer upper front contact of relay 158, inner lower back contact of relay 185, upper back contact of relay 167, back contact of relay 173, middle upper front contact of relay 172, inner upper front contact of relay 158, to ground through the upper contact of interrupter springs 170. Relay 166 locks through its upper front contact under control of relay 161, and opens the connection between talking conductors 132 and 192, thereby causing the release of relays 85 and 86 of connector C1 so as to disconnect holding ground potential from conductors 83 and 53 to effect the release of the connector C1 and selector S1. Relay 44 having been released when the cut-off relay 65 of the timing circuit operated, the disconnection of ground from conductor 53 causes the coin trunk CT to operate to return any coin in the coin box at the calling station A. If there is no coin in the coin box at station A, relay 36 releases as soon as relay 16 operates to apply the coin return potential; and, since relay 23 does

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not operate, relays 36 and 35 release. The release of relay 35 disconnects ground potential from conductor 13; and the line finder LF1 and coin trunk CT are thereupon restored to normal in the above-described manner.

On a call to the monitoring operator, the monitoring operator may insert the plug 231 of a coin collect or refund cord CCD in jack 230, thereby operating relay 204. The operation of relay 204 causes the operation of relay 202; and the operation of relay 202 connects conductors 191 and 192 to the tip of jack 230. The operation of coin collect key 232 or coin return key 233 connects coin collect or coin return battery potential through the tip of plug 231 and jack 230, front contacts of relay 202, conductors 191 and 192, front contacts of relay 185, to conductors 131 and 132, thence to the calling line LI to operate the coin magnet 7 of the calling subscriber's station to refund or collect the coin, as desired.

On a call from station A to a special service operator, the coin trunk CT operates in the manner hereinbefore described to close a bridge across conductors 51 and 52 to operate the line relay of selector S1; and holding ground potential is connected to conductor 53 in the usual manner. When the digit 0 is dialed by the calling station, the brushes of selector S1 are stepped up to the tenth level. The normal post springs 76 are actuated when the brushes are on the tenth level thereby closing a circuit for operatively energizing the lower winding of relay 63. Relay 63 locks through its front contact and the outer lower back contact of relay 65, to conductor 53. The operation of relay 63 disconnects the winding of start relay 57 of timing circuit TC from conductor 97 so as to prevent the timer cams 61 and 62 from being moved out of normal position on this call. The selector S1 is automatically operated to advance the brushes in the tenth level to hunt for an idle trunk to an operator. Assuming that the selector S1 selects and seizes the terminals connected to the trunk circuit RCT, the aforementioned bridge across conductors 51 and 52 is extended through brushes 71 and 72, conductors 251 and 252, back contacts of relays 254 and 261, left windings of repeating coil 280, and back contacts of relay 272 to the windings of relay 273. Relay 273 operates, closing a circuit for operating relay 274. Relay 274 closes a circuit for lighting the answering lamp 291; closes a connection from ringing current source 275, through the inner lower front contact of relay 274, back contact of relay 264 and condenser 265, to the lower right winding of repeating coil 280 to transmit an audible ringing signal to the calling subscriber to indicate that an operator is being signaled; closes a circuit for operating the slow-to-release relay 267; and connects ground potential to sleeve conductor 253 to hold the selector S1 and to hold relay 26 of the coin trunk circuit CT. When an operator answers the call by inserting the plug of a cord CDI in jack 290, relay 266 is operated due to the energization of its upper, high-resistance winding in a circuit through the sleeve conductor of jack 290. Relay 274 having been operated, the circuit through the lower winding of relay 266 is open; so that the resistance of the sleeve circuit is high enough to cause the supervisory lamp associated with the plug inserted in jack 290 to be extinguished. The operation of relay 266 closes a circuit for operating relay 272. Relay 272 closes a circuit for operating relay 271 and interchanges the connections between the

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windings of relay 273 and conductors 251 and 252, thereby reversing the current through these conductors and conductors 51 and 52 of the coin trunk circuit CT. This reversal is effective to cause the operation of relay 14 to connect the calling line in series with the windings of relay 273. Relay 271 closes a circuit for holding relay 267, closes a circuit for operating relay 264, and opens the circuit for lighting the answering lamp 291. The operation of relay 264 closes a locking circuit under control of relay 267, and opens the circuit for transmitting a ringing tone to the calling station. The answering operator may refund the coin deposited at station A by inserting the plug 231 of a coin control cord CCD in jack 292 thereby operating relays 255 and 254 in succession. Operation of coin collect key 232 or coin return key 233 connects coin collect or coin return battery, through conductor 293 and front contacts of relays 255 and 254 to conductors 251 and 252, thence through selector S1, coin trunk CT and line finder LF1, to the conductors of line LI to operate the coin magnet 7 to effect the collection or return of the coin, as desired.

When the operator releases the connection, relays 266 and 271 release in succession; and when the calling subscriber replaces the receiver, relays 273 and 274 release in succession. With both of relays 274 and 271 released, relays 267, 264 and 272 are released. When relay 267 releases, holding ground potential is disconnected from conductor 253 causing the return of the selector S1, coin trunk CT and line finder LF1 to normal.

In case the recording completing trunk circuits to which the selector S1 has access are arranged for automatic return of the coin at the calling coin station upon answer of the call, the selector S1 is not provided with normal post springs for operating relay 63. Reference may be had to my Patent No. 2,336,866, granted Dec. 14, 1943 for a complete disclosure and description of a recording completing trunk circuit arranged to automatically effect the return of the coin at a calling coin station when the call is answered. When the coin station A is connected to such a recording completing trunk circuit and the call is answered, the reversal of current through conductors 51 and 52 effects the operation of relay 38 and the release of relay 37 of coin trunk circuit CT, thereby causing the operation of relay 44 as hereinbefore described. The operation of relay 44 connects conductor 97 to the grounded sleeve conductor 53 thereby causing the operation of relay 14 so as to connect the calling line directly to the line conductors of the recording completing trunk circuit; and relay 57 operates as hereinbefore described to start the operation of timing cams 61 and 62. As soon thereafter as the recording completing trunk circuit effects the connection of coin return battery to the incoming line conductors, as described in my aforementioned patent, the gas-filled tube 56 of timing circuit TC is energized, causing the operation of relay 55. Relay 55 closes a circuit for operatively energizing the lower winding of relay 63; and the operation of relay 63 causes the release of relay 57 whereby the timer cams are restored to normal and further timing is prevented while the connection between the line LI and the answering operator is maintained.

What is claimed is:

1. In a telephone system, lines and stations, a subscriber's prepay coin station connected to one of said lines, said station comprising a coin control magnet for collecting or refunding coins,

means including a coin control trunk circuit for establishing connections between said one line and a called subscriber's line, timing means individual to said coin control trunk circuit for measuring charging unit intervals of time, an operator's position, a recording completing trunk circuit terminating at said position, means including said coin control trunk circuit for connecting said one line to said recording completing trunk circuit, means including means in said coin control circuit operative in response to answer of a call therethrough for initiating the operation of said timing means, a coin return battery, means in said recording completing trunk circuit effective upon answer of a call therethrough from said coin station by an operator at said position for connecting said battery to said one line, means comprising a gas-filled tube individual to said coin control trunk circuit operatively responsive to the connection of the coin return battery to said one line for preventing the further operation of said timing means while the connection between said one line and said recording completing trunk circuit is maintained.

2. In a telephone system, lines and stations, a subscriber's prepay coin station connected to one of said lines, said station comprising a coin control magnet for collecting or refunding coins, means including a coin control trunk circuit for establishing connections between said one line and a called subscriber's line, timing means individual to said coin control trunk circuit for measuring charging unit intervals of time, an operator's position, a recording completing trunk circuit terminating at said position, means including said coin control trunk circuit for connecting said one line to said recording completing trunk circuit, means including means in said coin control trunk circuit operative in response to answer of a call therethrough for initiating the operation of said timing means, a coin return battery, means in said recording completing trunk circuit effective upon answer of a call therethrough from said coin station by an operator at said position for connecting said battery to said one line, means comprising a gas-filled tube individual to said coin control trunk circuit operatively responsive to the connection of the coin return battery to said coin line for effecting the return of said timing means to normal and for preventing the further operation of said timing means while the connection between said one line and said recording completing trunk circuit is maintained.

3. In a telephone system, lines and stations, a subscriber's prepay coin station connected to one of said lines, an operator's station, a coin control trunk circuit, means including said trunk circuit connecting said prepay station to a called station, a timing device associated with said trunk circuit for timing periods of conversation between said coin station and a called subscriber's station, and means comprising a gas-filled tube in said trunk circuit actuated responsive to answer of a call to said operator's station for preventing the operation of said timing device.

4. In a telephone system, lines and stations, a subscriber's prepay coin station connected to one of said lines, an operator's station, a coin control trunk circuit, means including said trunk circuit connecting said prepay station to a called station, a timing device associated with said trunk circuit for timing periods of conversation between said coin station and a called subscriber's station, means for starting the operation of said timing device responsive to the answering of a call at the called station, and means comprising a gas-filled tube in said trunk circuit for immediately stopping the operation of said timing device on a call to said operator's station.

5. In a telephone system, lines and stations, a subscriber's prepay coin station connected to one of said lines, an operator's station, a coin control trunk circuit, means including said trunk circuit connecting said prepay station to a called station, a timing device associated with said trunk circuit for timing periods of conversation between said coin station and a called station, means for starting the operation of said timing device responsive to the answering of a call at the called station, and means comprising a gas-filled tube in said trunk circuit for immediately effecting the return of said timing device to normal and for preventing its further operation on a call to said operator's station.

6. In a telephone system, lines and stations, a subscriber's prepay coin station connected to one of said lines, an operator's station, a coin control trunk circuit, means including said trunk circuit connecting said prepay station to a called station, a timing device associated with said trunk circuit for timing periods of conversation between said coin station and a called station, relay means in said trunk circuit responsive to the answer of a call at the called station, means for starting the operation of said timing means responsive to the operation of said relay means, and means comprising a gas-filled tube in said trunk circuit actuated on a call from said calling station to said operator's station for preventing the further operation of said timing device.

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