

July 8, 1941.

A. J. BUSCH

2,248,566

TELEPHONE SYSTEM

Filed April 19, 1939

14 Sheets-Sheet 1

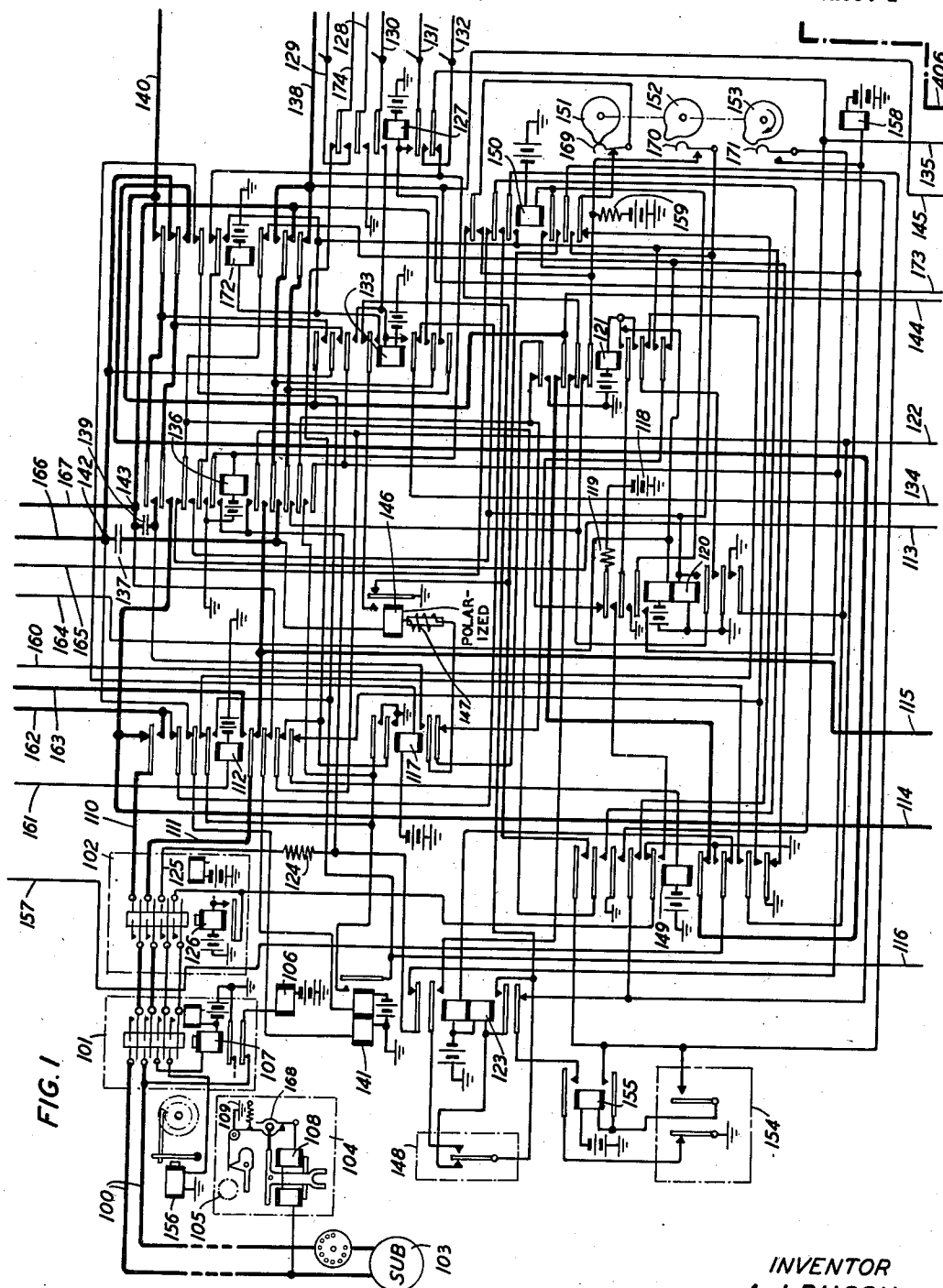


FIG. 1

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14 Sheets-Sheet 2

FIG. 2

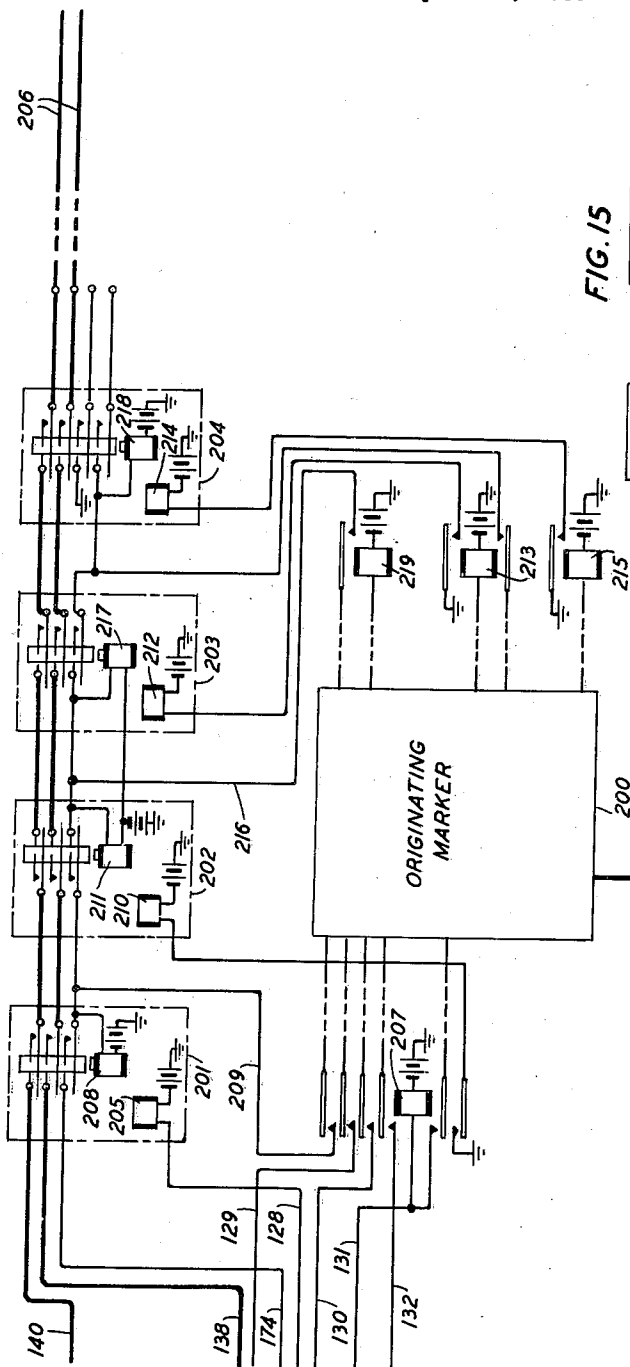
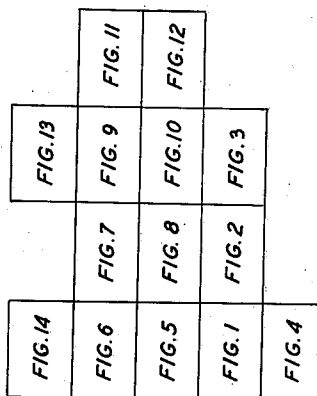


FIG. 15



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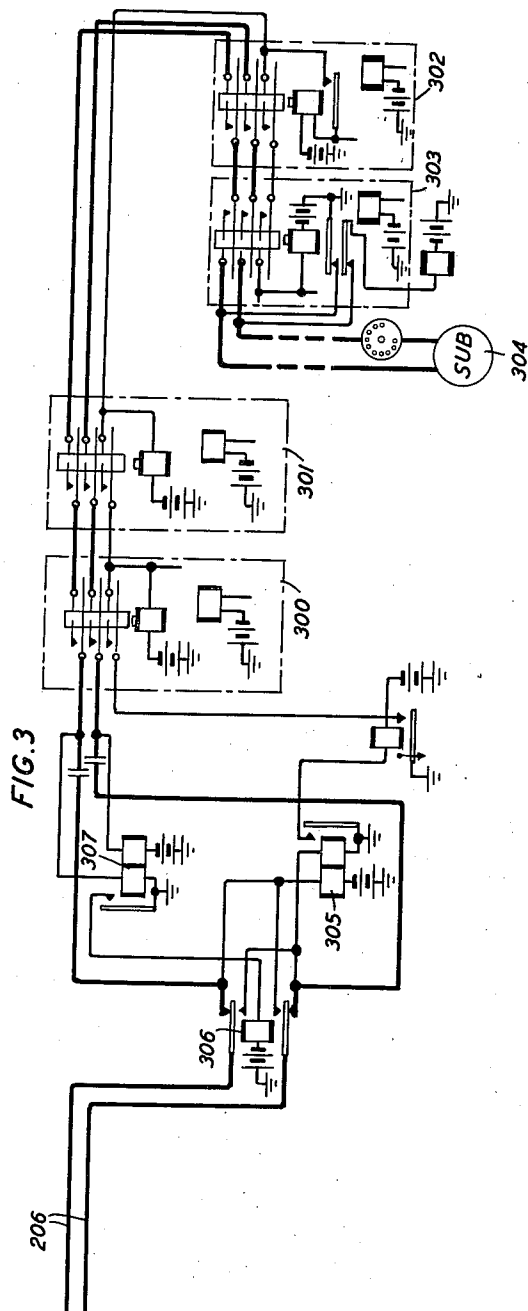
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14 Sheets-Sheet 4

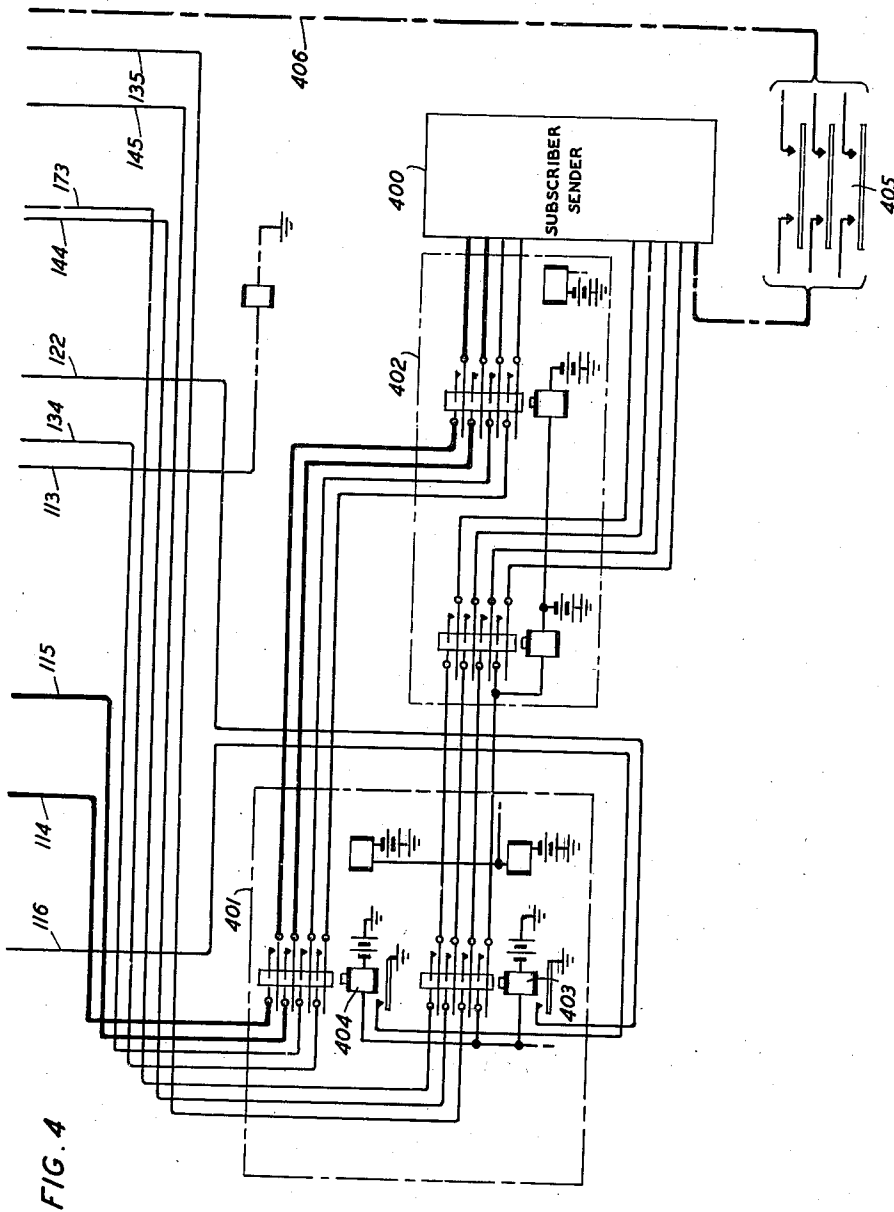


FIG. 4

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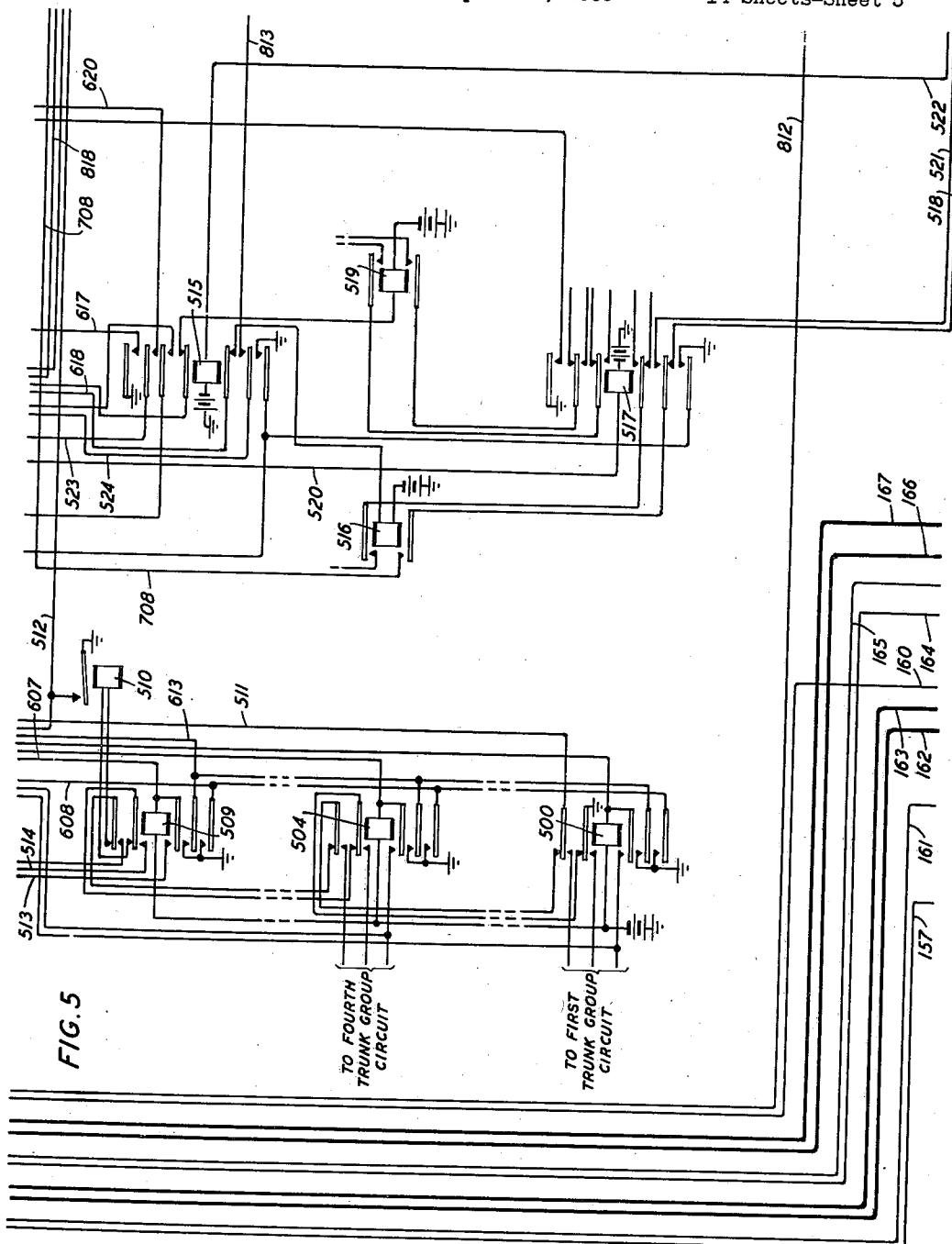
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14 Sheets-Sheet 6

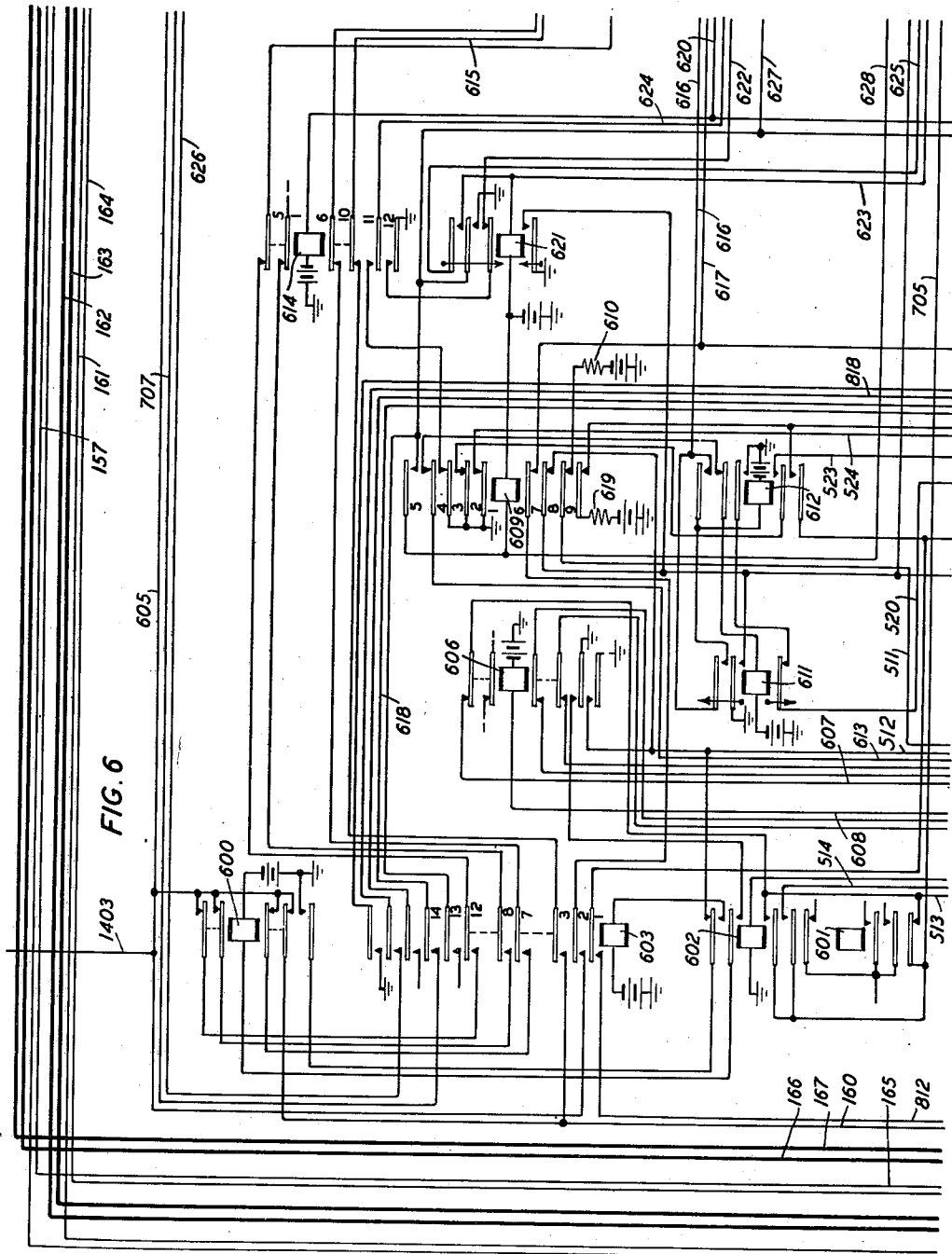


FIG. 6

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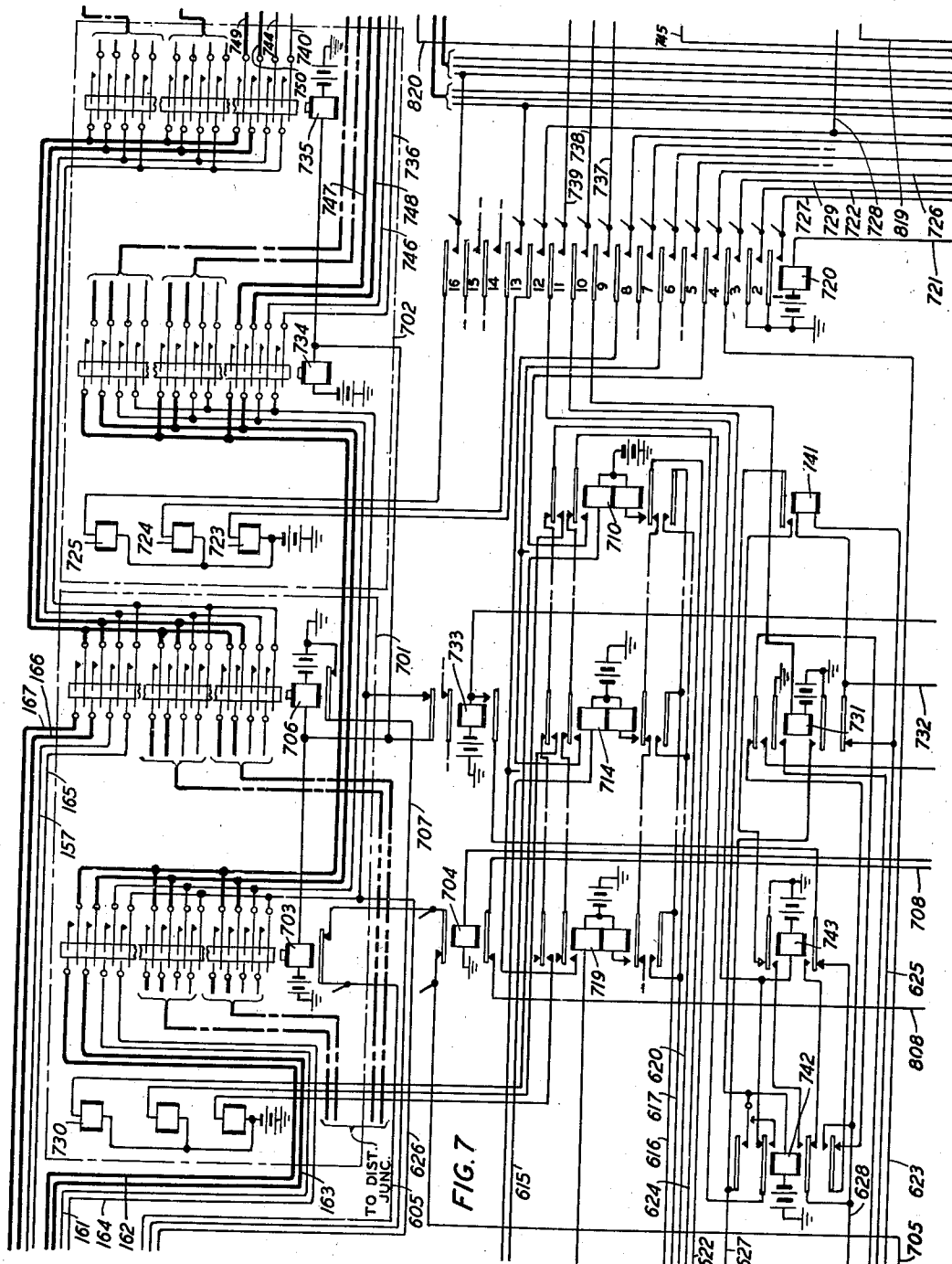
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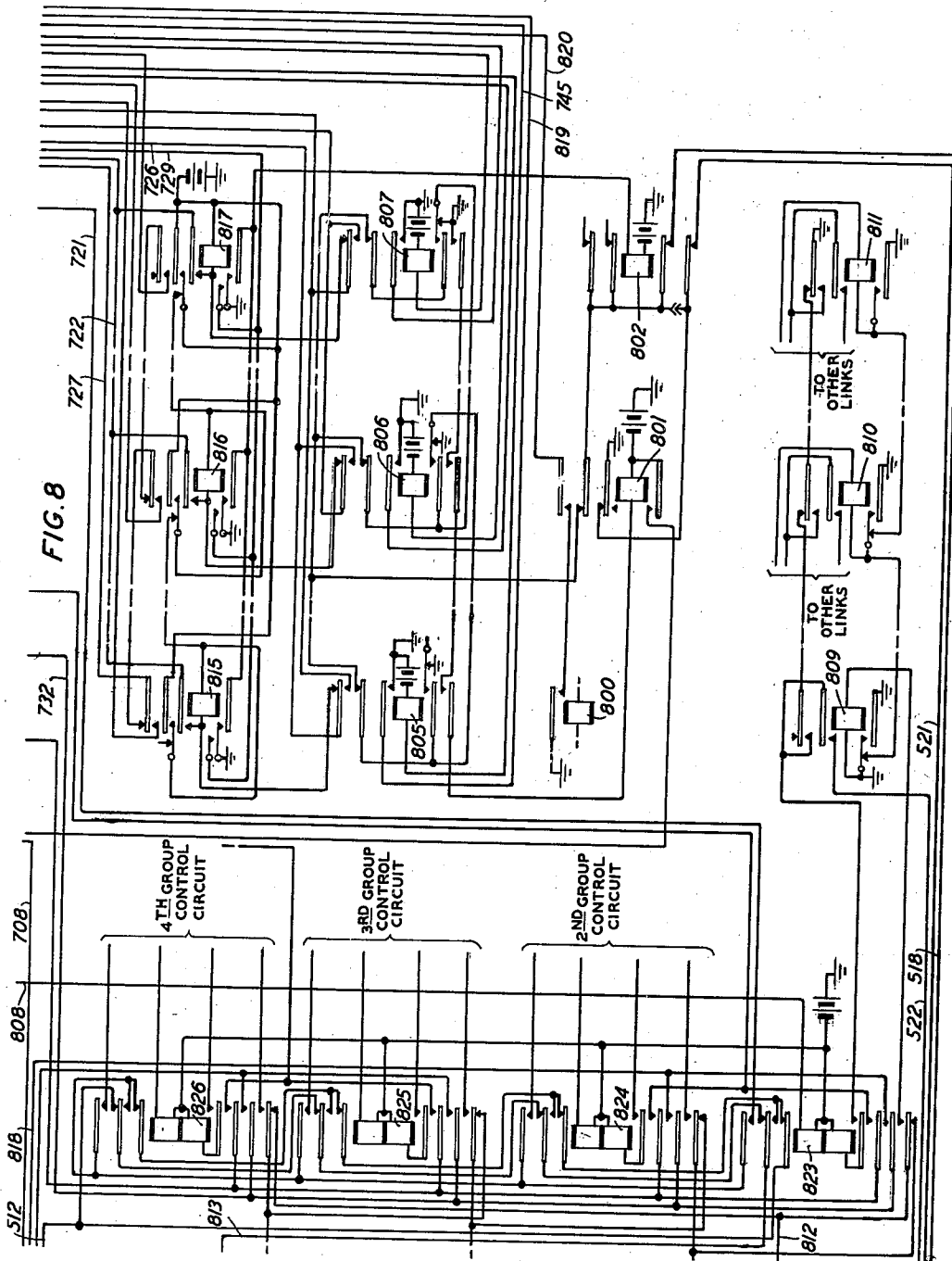
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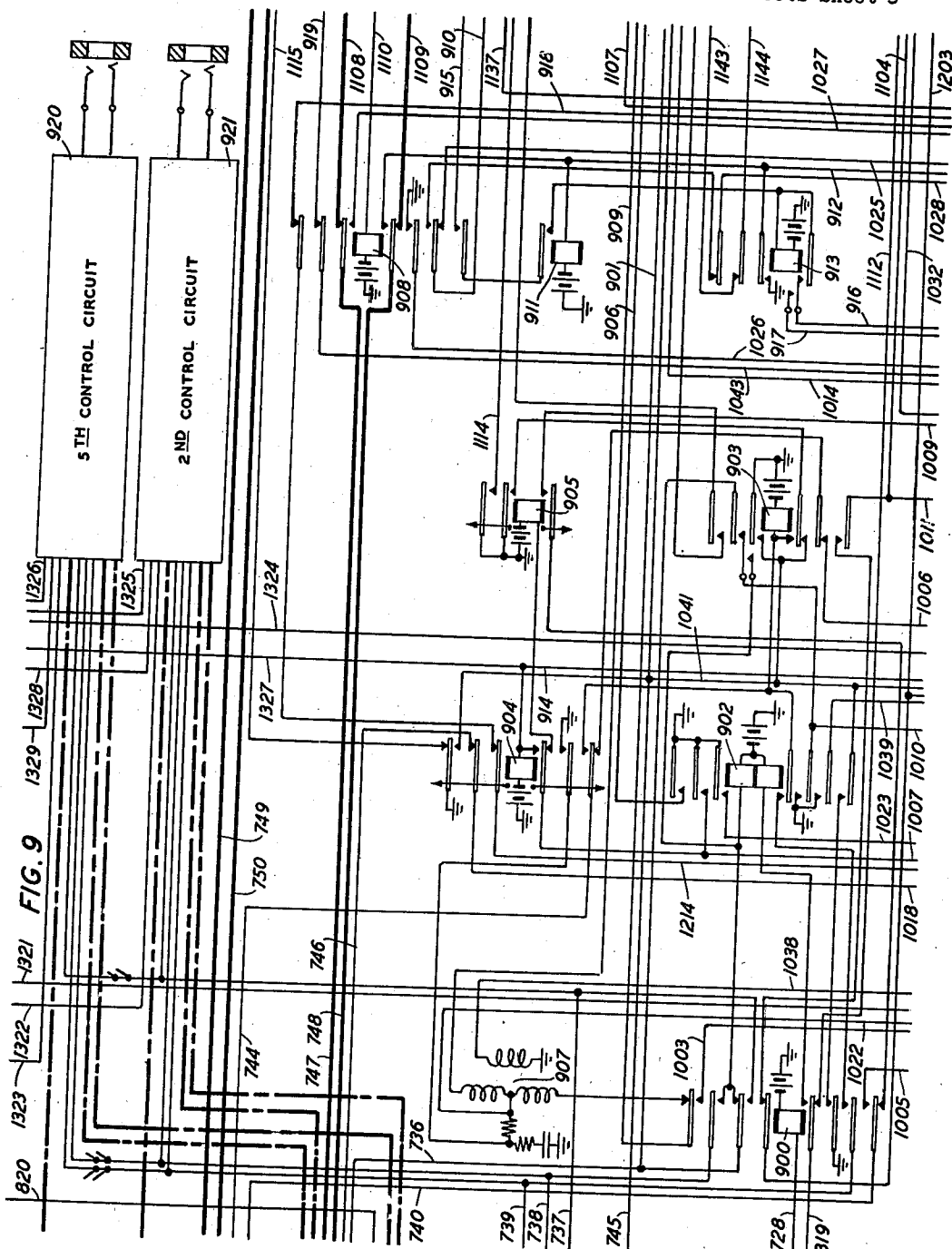
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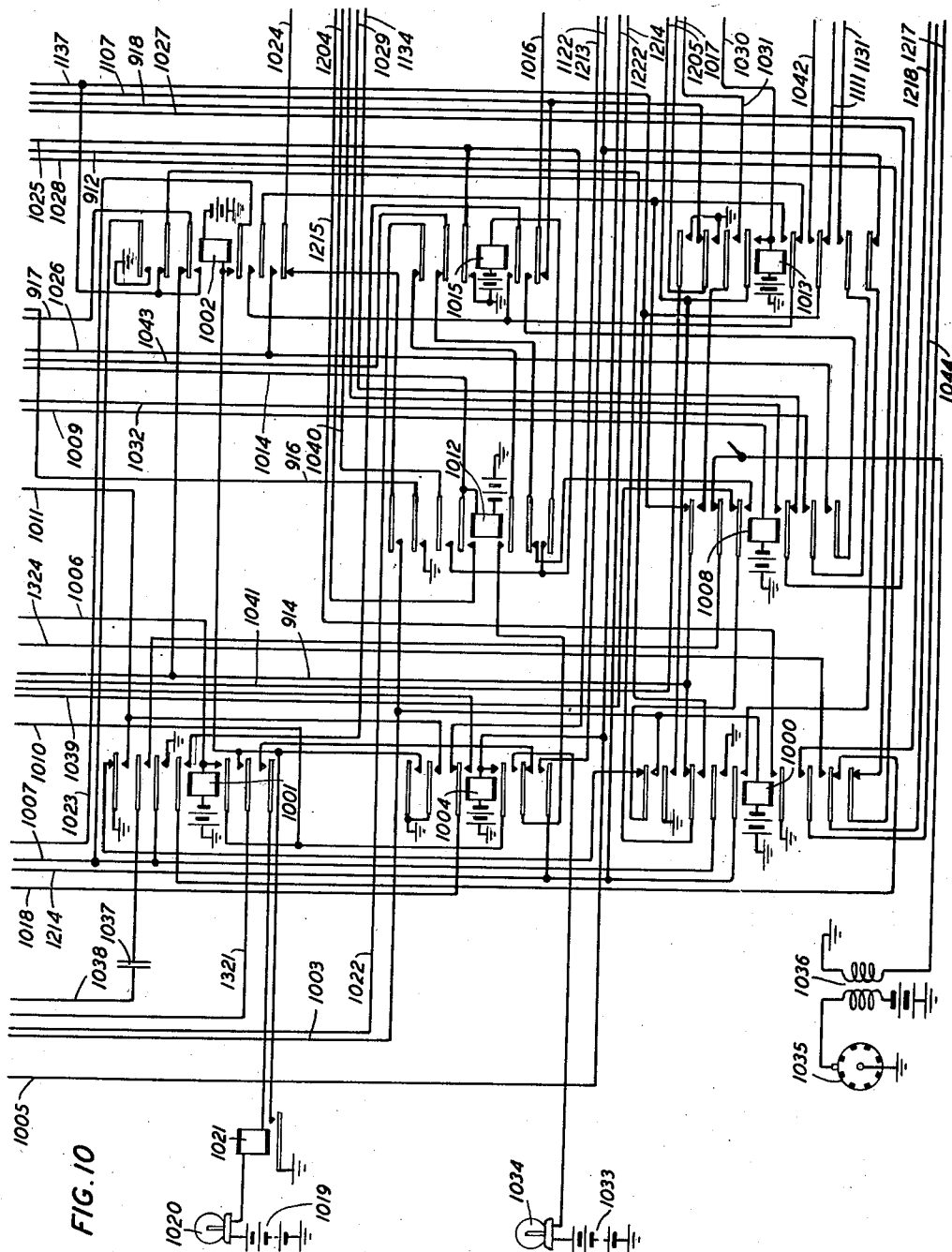
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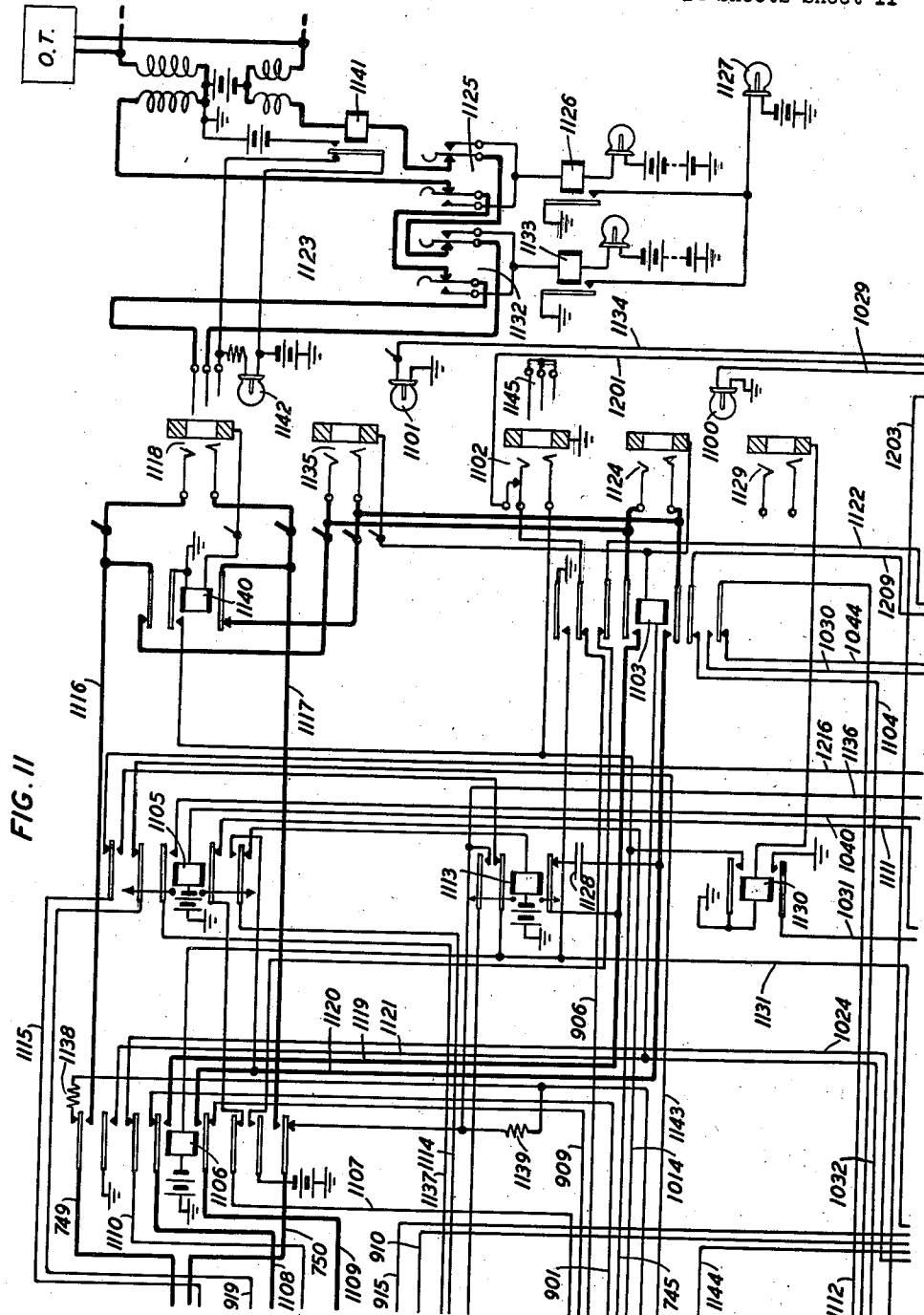
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14 Sheets-Sheet 12

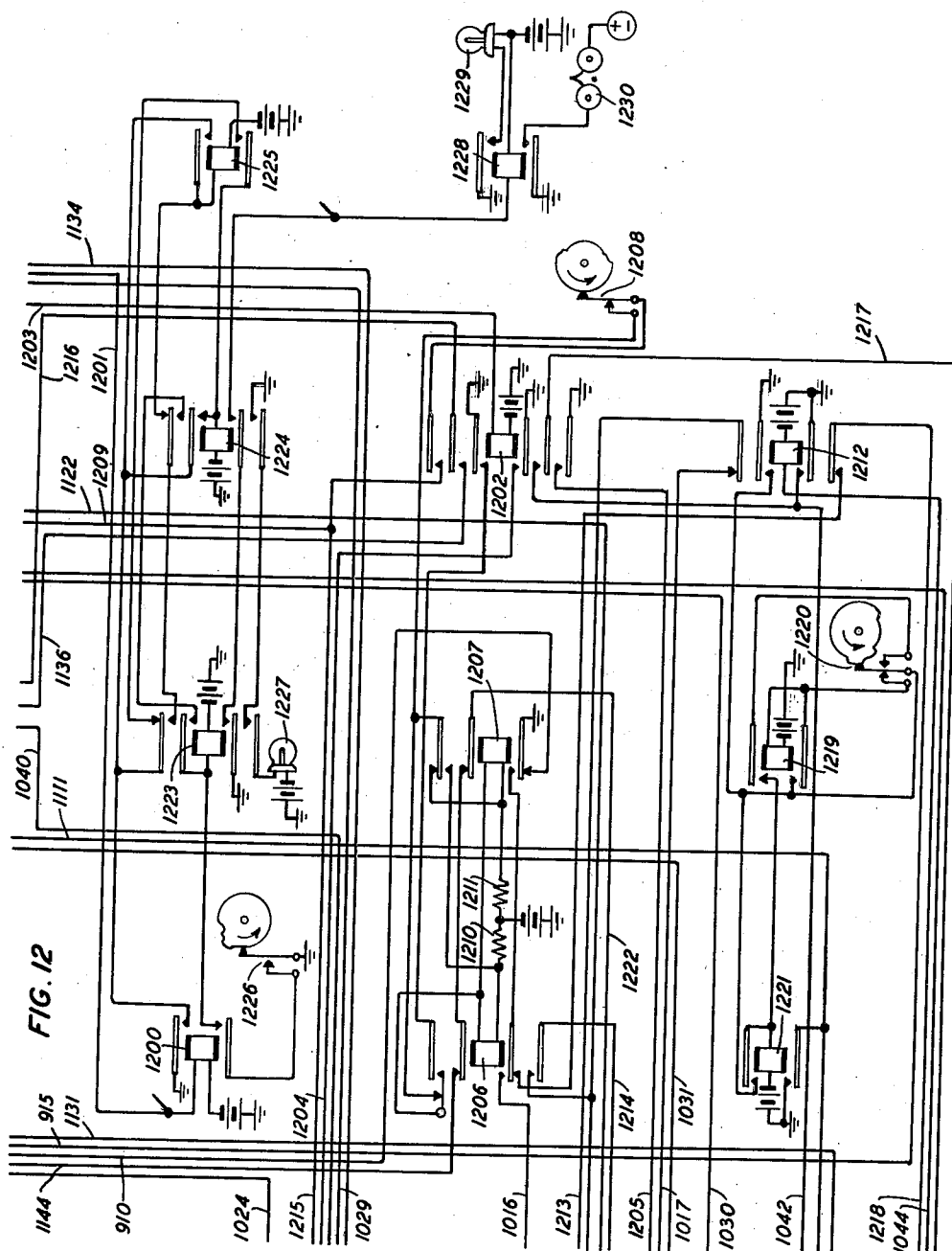


FIG. 12

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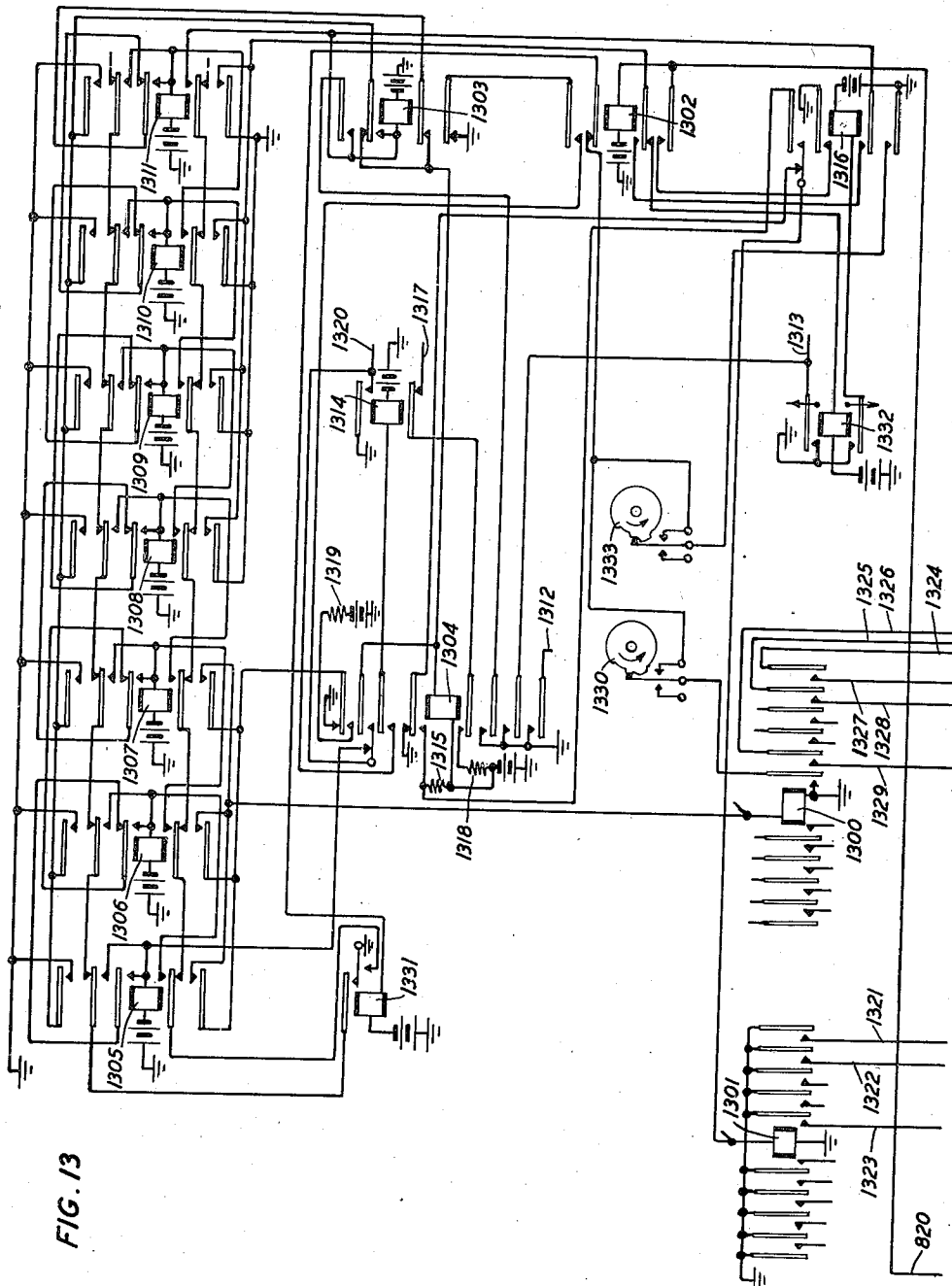
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14 Sheets-Sheet 13



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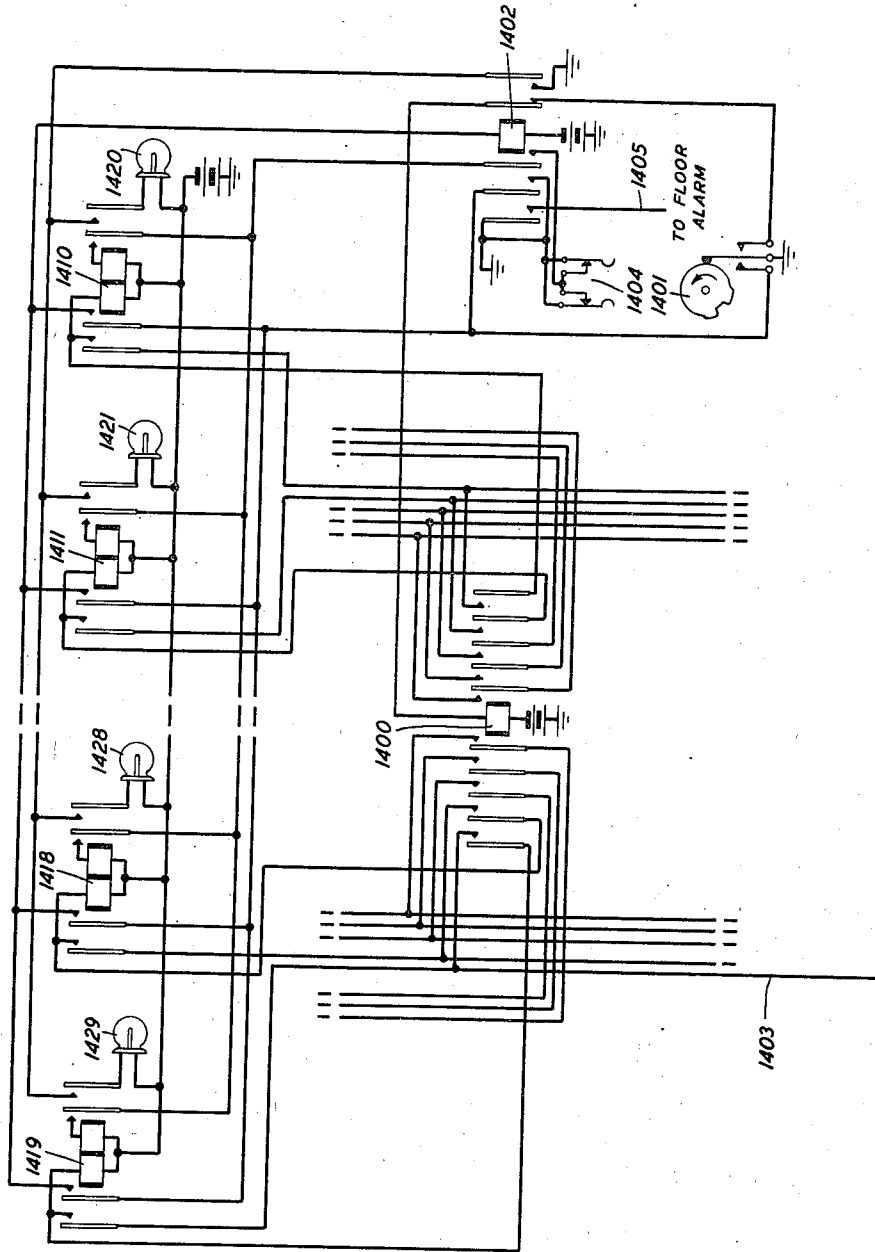
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TELEPHONE SYSTEM

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FIG. 14



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UNITED STATES PATENT OFFICE

2,248,566

TELEPHONE SYSTEM

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Application April 19, 1939, Serial No. 268,651

12 Claims. (Cl. 179—6.31)

This invention relates to telephone systems and more particularly to systems in which automatic switching equipment is employed for establishing connections.

It has been the practice heretofore in automatic telephone systems to provide a plurality of coin-control mechanisms at the central office common to the coin district trunks in the central office, any one of which may be seized over an idle link circuit by a trunk having a call thereon established from a coin box substation, for a brief interval near the end of each period of conversation and an idle one of which may be seized for a brief interval at the end of each such period. When the control mechanism is connected to a trunk near the end of a conversational period, it proceeds to collect the coin that was previously deposited at the calling substation in payment for the conversational period. At this time the control mechanism also transmits a warning tone to the calling subscriber advising him that the conversational period is about to expire and that he should deposit an additional coin if he wishes to continue the conversation. On its subsequent connection to the trunk, namely, at the end of the full conversational period, the control mechanism makes a test to determine whether the calling subscriber has deposited an additional coin for the next conversational period. If the mechanism fails to find a deposited coin when it attempts to collect on its first association with the trunk near the end of the conversational period, a monitoring operator is signaled and she makes connection with the calling line by way of a jack which is individual to the control mechanism and challenges the calling subscriber requesting him to deposit a coin. When he does so she immediately collects the coin and withdraws from the connection. If the coin-control mechanism fails to find a coin when it tests the line at the end of any conversational period, it signals the monitoring operator and she makes connection with the calling line and requests the calling subscriber to deposit the coin in payment for the next conversational period. When the subscriber deposits an additional coin or advises the operator that he has already done so, she withdraws from the connection.

The control mechanism is also arranged to make a retest of the calling line for the presence of a coin after the monitoring operator withdraws from the connection following her request that the calling subscriber deposit an additional coin for the next conversational period. If on

the retest the control mechanism finds that a coin has been deposited, the mechanism is disconnected and returns to common use, but, if the retest shows that no coin is present in the coin box, the mechanism again signals the monitoring operator and she returns to the connection and requests the calling subscriber to deposit a coin. On each withdrawal of the monitoring operator, the control mechanism tests the line for the presence of the coin and will not retire from the connection until the test has been satisfied.

Since the monitoring operator obtains connection to any calling coin line by way of jacks which are individual to the common control mechanism rather than by way of connecting circuits individual to the central office trunks, the operator's positions are concentrated.

The object of the present invention is to improve the service rendered by circuits of the character disclosed in the event that peak load conditions occur.

A feature of the present invention is the provision of a coin-control release circuit common to a plurality of coin-control mechanisms which functions to release all coin overtime calls which have been unanswered by a monitoring operator and to cancel the test for the presence of deposited coins on coin collect calls when all coin-control mechanisms have become busy due to a peak load condition, whereby coin-control mechanisms will be made available for use for regular coin collect and coin return service.

A further feature is the provision whereby an alarm and a visible signal are operated when a coin district trunk is excessively delayed due to the fact that no link circuit is available for connecting such trunk to a coin-control mechanism to identify the delayed group of coin district trunks to a maintenance man.

These and other features of the invention will be described more fully in detail in the following description and will be set forth in the appended claims.

Referring to the drawings which accompany the detailed description:

Fig. 1 shows a district junctor circuit arranged to function with a coin-control circuit and connected conventionally with a coin box subscriber's station by a line link and group control circuit consisting essentially of cross-bar switches;

Fig. 2 shows in abbreviated schematic form the connection of the district junctor of Fig. 1 to a district link frame and thence through an office link frame to an outgoing trunk;

Fig. 3 shows in abbreviated form the termina-

tion of the trunk of Fig. 2 and its connection through the cross-bar switches of incoming link and line-link circuits to a called subscriber's line;

Fig. 4 illustrates in abbreviated manner, the connection of the district junctor of Fig. 1 through a subscriber link and control circuit to a subscriber sender conventionally represented by a box;

Figs. 5, 6, 7 and 8 placed with Fig. 6 above Fig. 5, Fig. 7 to the right of Fig. 6 and Fig. 8 beneath Fig. 7, illustrate a link and control circuit whereby a connection between the district junctor circuit of Fig. 1 and the coin-control circuit of Figs. 9 to 12, inclusive, may be established, portions of other links and control circuits being disclosed in Fig. 8;

Figs. 9, 10, 11 and 12 placed with Fig. 10 beneath Fig. 9, Fig. 11 to the right of Fig. 9 and Fig. 12 beneath Fig. 11, illustrate a coin-control circuit, other coin-control circuits being schematically indicated by the boxes in Fig. 9;

Fig. 13 illustrates a coin-control release circuit in accordance with the present invention, common to a plurality of coin-control circuits;

Fig. 14 shows a link busy alarm circuit; and,

Fig. 15 is a diagram showing the manner in which the several figures of the drawings should be arranged to show the complete circuit.

General description

The invention is illustrated in an automatic telephone system in which automatic switches of the cross-bar type are used as a medium for extending connections from subscribers' lines over trunks to other subscribers' lines. These cross-bar switching mechanisms are controlled by register senders at the central office which receive the designations of wanted lines from the calling subscriber's dial and by decoder markers which are connectable to the sender for receiving information from the sender and which are connectable to the proper switch frame for the purpose of testing the outgoing trunk, for testing the connecting link and for operating the magnets of the cross-bar switches to establish the connection.

While the system disclosed is not limited to the use of cross-bar switches of any particular type, reference may be had to the patent to Reynolds 2,021,329, of November 19, 1935, for an understanding of the construction and operation of a switch suitable for use in such systems. Because of the complicated nature of these systems and since it is not necessary for an understanding of the invention that the system in all of its details be disclosed, much of the circuits and equipment has been eliminated in the present disclosure for the sake of simplicity and in the following description reference will be made to numerous operations which are not fully disclosed in all their details. Whenever such references occur it will be understood that the circuits and equipment so referred to are already known and in particular are disclosed and completely described in Carpenter Patent 2,093,117, granted September 14, 1937, and Carpenter application Serial No. 214,356, filed June 17, 1938.

The subscribers' lines, such as line 100, are connected to verticals of the primary cross-bar switches indicated conventionally by the apparatus of box 101 and thence extended through secondary switches such as switch 102 to district junctor circuits. The connections to the district junctor circuit are effected by means of a

line link and group control circuit and a subscriber sender link and control circuit. The circuit details (not shown) whereby these connections to the district junctor circuit are effected may be the same as in Carpenter Patent 2,093,117 and in Carpenter application Serial No. 214,356, above mentioned.

When the connection to the district junctor, which is one of a group of similar junctors (not shown) is established as above outlined, the subscriber sender 400 through a link circuit represented schematically by primary and secondary cross-bar switches 401 and 402, functions in connection with a marker circuit indicated by the box 200 to establish a connection to an outgoing trunk 206 in accordance with the office code dialed at the calling station 103 and recorded by the sender 400. This connection is established through district frame cross-bar switches 201 and 202 and office frame switches 203 and 204.

When the outgoing trunk 206 is thus seized, a connection is established through an incoming link and connector circuit consisting of cross-bar switches 300 and 301 and line-link circuit consisting of cross-bar switches 302 and 303 to the line of the called subscriber 304. After the subscriber of station 304 answers, this condition is registered in the district junctor of Fig. 1.

The district junctor of Fig. 1 has common access to a group of coin-control circuits one of which is shown in Figs. 9 to 12, inclusive. The connection to a selected coin-control circuit is made by means of the link and control circuit of Figs. 5 to 8, inclusive, which consists essentially of primary and secondary cross-bar switches 701 and 702.

The district junctor circuit of Fig. 1 is arranged to summon the coin-control circuit of Figs. 9 to 12, inclusive when required as follows:

(a) To collect a coin after a completed connection immediately after the calling subscriber has disconnected;

(b) To collect a coin during conversation at the end of a predetermined interval;

(c) To return a coin after an incomplete connection immediately after the calling subscriber disconnects or on a free call;

(d) To test for the presence of an additional coin at the beginning of an overtime period and in case no coin is found to summon an operator for overtime monitoring on the connection.

In the case of condition (a) the coin-control circuit makes a test to determine the presence or non-presence of a coin in the coin box 104 and to determine whether or not the coin box 104 has been properly cleared after the application of coin collect current. For either of these conditions lamp 1100 is flashed to inform an operator of the failure to collect the coin. For condition (b) should the coin-control circuit fail to find the coin, lamp 1101 is immediately flashed to inform the operator of this condition. For condition (c) lamp 1100 is lighted steadily if the coin box is not properly cleared after the application of coin return current. For condition (d) the operator is summoned by the steady lighting of lamp 1101 if the test indicates that no coin is present.

In the event of a peak load causing all coin-control circuits to become busy thereby indicating that no coin-control circuit is then available for the use of another district junctor, a chain circuit is closed over contacts of relays 800, 801, etc., individual to the link control circuits to start the coin-control release circuit of

Fig. 13 which is first effective to operate a multi-contact relay, such as 1390, to close loop circuits to all of the coin-control circuits and to operate other multicontact relays, such as 1301, to ground other conductors extending to coin-control circuits. The release circuit then proceeds to measure a time interval of 60 to 90 seconds. If during this time interval any one of the coin-control circuits has been seized on an overtime call, and its overtime relay 1000 is thus operated, it will be immediately released provided the coin-control circuit is still awaiting the response of a monitoring operator. It is assumed that at the expiration of this time interval, the peak load condition of all coin-control circuits being busy will have passed or be sufficiently relieved so that upon the release of the multicontact relay 1300, the coin-control circuit may again serve coin overtime traffic.

Following the measurement of this time interval, a further interval of 6 to 8 minutes is measured, during which the multicontact relays 1301 are maintained operated. During this interval the operation of the coin-collect relay 1001 of any coin-control circuit will cause the operation of the no-coin test relay 1092 of such coin-control circuit on all coin collect calls to cancel the test for a deposited coin whereby the coin-control circuit will be released immediately following the application of coin collect current without waiting to test for the presence of a coin or to signal the operator in the event no coin has been deposited. If at any time during the latter interval, a peak load condition again occurs and all coin-control circuits become busy, the coin-control release circuit is arranged to start another coin-control release interval.

Detailed description of operation

The operation of the system will now be described in detail and for this purpose let it be assumed that the calling subscriber of station 103 initiates a call by depositing a coin 105 in the coin box 104 and by removing the receiver from the switchhook of the substation equipment of station 103. A circuit is thereby closed for operating relay 106 which circuit may be traced from battery through the winding of relay 106, lowermost contact of cross-bar switch hold magnet 107, over the ring conductor of line 100 through the switchhook contacts of station 103 and the winding and associated contacts 168 of coin collect magnet 108 to ground at 109. Line relay 106 functions in cooperation with the line link and group control circuit of Fig. 1, the subscriber sender link and control circuit and subscriber sender circuits of Fig. 4 to effect the selection of an idle district junctor circuit, of an idle line link extending thereto and of the circuit closure of said link. The idle condition of the district junctor circuit is indicated by the presence of battery on busy test conductor 113. The circuit details whereby this is accomplished are shown in the aforementioned application of W. W. Carpenter Serial No. 214,356, filed June 17, 1938.

The selection before stated having been made, cross-bar switch contacts of the primary switch 101 and of the secondary switch 102 are closed extending the conductors of line 100 to conductors 110 and 111 which terminate respectively on the upper outermost and lower innermost back contacts of relay 112 through which contacts connection is made over conductors 114 and 115, through the cross-bar switch contacts of

the sender link and control circuit represented diagrammatically by boxes 401 and 402, to subscriber sender 400. Dial tone is now furnished over these conductors as an indication to the subscriber at station 103 that dialing may be started. Ground is also connected at this time by the hold magnet 404 of the sender link and control circuit to conductor 116 whereby relay 117 is operated over a circuit which may be traced from battery through the winding of relay 117, next to upper innermost back contact of relay 172 to ground on conductor 116. Relay 117 upon operating performs no useful function at this time except to disconnect busy test battery 118 from test conductor 113, this circuit being traced from battery 118 through resistance 119, upper outer back contacts of relays 120 and 121, lower back contact of relay 117, lower back contact of relay 121, inner lower back contact of relay 172, upper back contact of relay 136 to conductor 113. This disconnection of battery 118 makes the district junctor test busy to the sender link and control circuit on subsequent calls. Hold magnet 403 of the sender link and control circuit also connects ground to conductor 122 which is extended through the upper outer back contact of relay 123 through resistance 124 to sleeve conductor 125 thereby supplying holding ground for the line-link hold magnets 107 and 126 while the sender 400 is connected to the district junctor circuit.

While the connection is being established from the calling line 100 to the sender circuit 400, the subscriber's sender link and control circuit of Fig. 4 is momentarily connected to sender circuit 400 and during this interval, sender circuit 400 is furnished with the "class of service" information of line 100 and is also informed of the number of the district link and connector frames associated with the district junctor circuit to which the sender 400 is connected. The line link and group control circuit and the subscriber sender link and control circuit are used only momentarily to connect line 100 to an idle district junctor circuit and to a subscriber sender circuit and are then released to serve other calls but the connections through the cross-bar switches 101, 102, 401 and 402 which these circuits have established are held by the sender circuit 400 under the control of the calling subscriber. After the office code has been dialed, sender 400 connects to the originating marker 200 by means of a connector circuit 405 over a group of conductors represented by the broken line 406. The sender circuit 400 registers in the marker circuit 200, the office code, the "class of service" information of the calling line 100 and the number of the district link and connector frame serving the district junctor circuit involved in the call. The marker 200 then furnishes the sender 400 with the necessary information which it requires to control the progress of the call. Marker 200 then selects an office link and connector frame on which the desired trunk 205 leading to the called destination appears, connects itself thereto and also to the district link and connector frame that is associated with the district junctor circuit involved in the call. After this has been successfully done marker 200 connects ground to a conductor which is extended through connector 405, sender 400 and the sender link circuit consisting of switches 401 and 402 to conductor 173, thereby operating district junctor relay 127. Relay 127 upon operating connects ground over its

upper middle contact to conductor 128 thereby operating select magnet 205 of the primary switch 201 of the district link and connector frame serving the district junctor of Fig. 1 and connects ground over its inner lower contact to conductor 131 thereby operating relay 207 which is common to a group of district juncctors served by the primary switch represented by box 201. The operation of relay 207 extends conductors 129, 130, 131, 132 and 209 through contacts of a marker connector relay to the marker circuit 200 selected for handling the call being established. This connector relay (not shown) being indicated only by the broken lines is individual to the marker circuit 200 and is operated each time that marker 200 is selected for service in establishing a connection to the district frame represented by Fig. 2. Conductor 129 is used by marker 200 to determine when the primary switch 201 has operated, from ground supplied by the marker over conductor 209. This is effected by the extension of the aforesaid ground through the lowermost primary switch contact associated with magnet 208 over conductor 174 through the uppermost front contact of relay 127 over conductor 129 through the next to upper contact of relay 207 and a contact of the aforesaid marker connector relay (not shown) to marker 200. Conductor 130 is grounded by marker 200 and is extended through the next to inner upper contact of relay 207 and the upper innermost front contact of relay 127 to operate relay 133 for calls to an operator. Conductor 131 is used by the marker 200 to hold relay 127 operated through its lower innermost contact until the marker 200 releases as hereinafter described and conductor 132 is extended over the inner upper contact of relay 207 and through the lower contacts of relay 127 and conductor 135 to give the sender 400 a trouble release signal if a trouble condition has been encountered by marker 200 in establishing the connection. If the relay 133 is operated, it will lock through its lower inner contact to ground supplied by the sender 400 over conductor 134.

Marker 200 now establishes the connection through the district and office switches to trunk 206. Select magnet 210 of secondary district switch 202 is operated by ground on the lower contacts of relay 207. Select magnet 212 of the primary office switch 203 is operated by ground on the upper contact of relay 213 and select magnet 214 of the secondary switch 204 by ground on the contacts of relay 215, both of which relays are operated by marker 200. The link between the secondary district and primary office switches is established when relay 219 is operated by marker 200 and operates hold magnets 211 and 217 from ground over conductor 216. The link between the primary and secondary switches of the office frame is completed when hold magnet 218 is operated from ground in the marker over the lower contacts of relay 213.

After the marker 200 has established connection with the trunk 206 as before described, it releases relay 127 by removing ground from the winding of relay 207. Relay 127 releases and closes the sleeve conductor 174 to the ground on the inner upper front contact of relay 117. Marker 200 tests for this ground and if it finds it, disconnects. Relay 117 was operated over conductor 176 when the sender link and control circuit connected sender 400 to the district junctor of Fig. 1. Relay 127 upon releasing opens conductors 128, 129, 130, 131 and 132 extending to

the district link and connector circuit and connects conductor 135 over its lower back contact to the winding of relay 136 so that the sender may later operate this relay. When the marker has established connection to the outgoing trunk 206, sender 400 then cooperates with the incoming apparatus of Fig. 3 to complete the connection to the line of the called subscriber 304. In connection with this incoming apparatus, a terminating sender and terminating marker (not shown in Fig. 3) are provided. As soon as the connection to trunk 206 is established, a circuit is closed for operating relay 305 over back contacts of relay 303, conductors 138 and 140 to conductors 144 and 145 extending into the subscriber's sender 400. The operation of relay 305 at first closes a start lead (not shown) that causes the terminating sender aforesaid to be connected. After this the terminating sender receives from the sender 400 the necessary information for completing in cooperation with the aforesaid terminating marker the connection to the line of the called subscriber 304.

After the sender 400 has completed its function in establishing the connection as above outlined, it connects ground to conductor 135 to operate relay 136 over the lowermost back contact of relay 127. When relay 136 operates, it locks under control of relay 172 in a circuit from battery through its winding and the inner upper back contact of relay 172 to ground over the next to inner upper front contact of relay 136. Relay 136, in operating, closes the talking circuit to station 103. This may be traced from conductor 110 over the uppermost back contact of relay 112, next to uppermost front contact of relay 136, next to upper back contact of relay 172, condenser 137, lower middle front contact of relay 136 and outer lower back contact of relay 172 to conductor 133; also from conductor 111, over the inner lower back contact of relay 112, next to inner lower front contact of relay 136, middle lower back contact of relay 172, condenser 139, upper front contact of relay 136 and upper back contact of relay 172 to conductor 140. Relay 136 also closes a holding circuit for relay 133, if this relay has been previously operated by the marker 200 for an operator class of call, and furnishes talking battery through the windings of relay 141 to line 100. For this purpose ground is supplied through the left winding of relay 141, next to inner upper back contact of relay 112 to junction point 142 and battery is supplied through the right winding of relay 141, next to inner lower back contact of relay 112, to junction point 143.

After the sender 400 has completed its functions and has operated relay 136 over conductor 135 as before stated, it releases. This causes cross-bar switches 401 and 402 of the sender link circuit of Fig. 4 to be released which opens the connection to conductors 114, 115, 134, 122, 173, 144, 145 and 135. The established connection is now placed under control of the district junctor circuit of Fig. 1 and is held under the control of relay 117 which remains operated provided the calling subscriber's receiver is off the switch-hook at station 103 and relay 141 is thus maintained operated over the line loop. Relay 141 holds relay 117 operated over a circuit that may be traced from ground over the upper front contact of relay 117, contacts of relay 141, next to inner upper back contact of relay 172, through the winding of relay 117 to battery.

After the connection to the trunk 206 has been

established a circuit is completed for operating the bridged impedance relay 305 of the incoming trunk circuit over the loop extending to the calling district junctor circuit of Fig. 1 which may be traced through the windings of relay 305, upper and lower back contacts of the reversing relay 306 over trunk 206, contacts of cross-bar switches 204, 203, 202 and 201 over conductors 140 and 138, outermost back contacts of relay 172, upper and lower middle front contacts of relay 136, winding of polarized relay 146 and retardation coil 147 and the inner lower front contact of relay 117. Relay 305 operates in this circuit, but polarized relay 146 does not operate at this time.

When the called subscriber at station 304 answers, a circuit is established for operating bridged impedance relay 307 which may be traced from battery and ground through the windings thereof over the tip and ring talking conductors and contacts of cross-bar switches 300 and 301 of the incoming link circuit and the cross-bar switches 302 and 303 of the line link circuit to the line leading to the called station 304. Relay 307 upon operating closes an obvious circuit for reversing relay 306 which, upon operating, reverses battery and ground over trunk 206 thereby causing polarized relay 146 of the junctor circuit of Fig. 1 to operate. Relay 146 upon operating connects ground to the armature of interrupter 148 through the inner upper back contact of relay 133. When thereafter the interrupter 148 connects ground through the lower winding of relay 123, relay 123 operates and locks to the operating ground through its lower inner front contact. After a predetermined short interval, say two seconds, interrupter 148 closes a circuit for operating charge relay 149 over a circuit from battery through the winding of relay 149, outer lower back contacts of relays 112 and 150, off-normal contacts 169 of interrupter cam 151, upper back contact of relay 150, next to inner upper back contact of relay 121, upper inner contact of relay 123 through the right contact of interrupter 148 to ground on its armature. Interrupter 148 thus insures against the possibility of that charge relay 149 might operate on a momentary line closure and thereby cause the deposited coin at station 103 to be improperly collected.

Relay 149, upon operating, (a) locks under control of relay 112 in a circuit from battery through the winding of relay 149, lower back contact of relay 112 to ground on the lower front contact of relay 149; (b) partially prepares a path for starting an automatic release circuit to be hereinafter described by connecting the back contact of polarized relay 146 over its uppermost contact to interrupter 154; (c) partially prepares a path for operating relay 172 by connecting the winding of relay 172 over its next to inner upper contact and the lower back contact of relay 123 to the upper contact of relay 155; (d) provides an auxiliary holding circuit for relay 136 which is required when the automatic release circuit arrangement releases the district junctor circuit by operating relay 172, this holding circuit extending from battery through the winding of relay 136, lower back contact of relay 127 to ground over the upper middle contact of relay 149; (e) partially closes over its upper inner front contact the circuit for operating message register 156; (f) opens at its lower inner back contact the tip conductor of the trunk toward relay 172 so that the trunk will start to release when relay 172 is operated

by the automatic release circuit; (g) connects ground over its next to inner lower front contact to conductor 157 to be used later by the coin-control circuit as a signal to collect the coin deposited in the coin box 104; and (h) closes a circuit for operating the magnet 158 to start timing the call. This circuit may be traced from battery through the winding of magnet 158, next to outer lower front contact of relay 149, inner upper back contact of relay 112 to ground on the upper front contact of relay 117.

It is now in order to describe the operation whereby a coin deposited in coin box 104 is collected or returned or an operator is summoned to monitor on an overtime call or in response to a failure of the calling subscriber to deposit the coin or in response to a stuck coin condition.

The collection of the deposited coin due to the disconnection of the calling party, prior to the expiration of the time allowed for a conversational period will now be discussed. When the calling subscriber at station 103 disconnects, relay 141 releases which in turn releases relay 117. Relay 146 releases, releasing relay 123, when the called subscriber disconnects or when relay 117 releases. When relay 117 releases, it causes relay 120 to operate in a circuit which may be traced from ground through the lower winding of relay 120, upper middle front contact of relay 136, next to upper front contact of charge relay 149, lower back contact of relay 121, lower back contact of relay 117, upper back contact of relay 121, next to lower front contact of relay 136, inner upper back contact of relay 121, to battery through resistance 159. Relay 120 operated, locks over its inner lower front contact and the inner upper back contact of relay 121 to battery through resistance 159; connects ground over its lower middle front contact to the middle lower back contact of relay 121 to start conductor 160 to cause a coin-control circuit to be connected to the district junctor circuit, and furnishes a holding circuit for relay 136 extending from ground over the lower front contact of relay 120, the upper back contact of relay 123 and the inner upper front contact and winding of relay 136 to battery.

When ground is connected to start conductor 160 as aforesaid, the link and control circuit of Figs. 5 to 8, inclusive, functions to cause an idle coin-control circuit such as is disclosed in Figs. 9 to 12, inclusive, to be connected to the district junctor of Fig. 1. The district junctors are divided into groups of ten, one half of which groups have normal access through an A group of link circuits and the other half of which groups have normal access through a B group of link circuits to a plurality of coin-control circuits. A link control circuit is provided common to the A links and a similar control circuit is provided common to the B links, each control circuit being provided with ten group relays 500 to 509, inclusive, corresponding to the ten groups of district junctors having access to the links controlled thereby and each group of ten district junctors is provided with a group of relays such as 600 to 603, inclusive. For the sake of clarity only one of the link circuits, one of the two control circuits and the group relays of one district junctor group have been disclosed.

Upon the connection of ground to conductor 160, assuming that the district junctor is in the tenth subgroup having normal access to a link circuit of the A group and assuming that there is a path available over the link disclosed to a

coin-control circuit, a circuit is established for the No. 9 group relay 509 which may be traced from conductor 160 over a back contact of relay 600, conductor 605, back contact of the hold magnet 703 of the primary link switch 701, upper back contact of relay 704, conductor 705, back contact of relay 601, upper back contact of relay 606, conductor 607, winding of relay 509, individual to the calling junctor subgroup, to battery. On calls from other junctor subgroups, similar circuits would be extended to the windings of other group relays such as 500 and 504 individual to such groups. The relays 500 to 509, inclusive, are arranged in a chain so that when simultaneous calls from different subgroups of junctors are received only that group relay is effective which corresponds to the lowest numbered group of junctors in the order of preference.

It being assumed that both control circuits are idle, and that group relay 509 is the only group relay operated, the following circuits are established: (a) from ground through the winding of relay 602, upper front contact of relay 509 and upper back contacts of other group relays such as 504 and 500, conductor 511, No. 8 back contact of relay 609 through resistance 610 to battery; (b) from battery through the winding of relay 606, conductor 608, to ground at the lower front contact of relay 509; (c) from battery through the winding of relay 611, upper back contact of relay 612, No. 4 back contact of relay 609, conductor 613 to ground at the middle lower front contact of relay 509 and (d) at its upper back contact opens the circuit of relay 510 which releases to apply ground to conductor 512 for starting a timing operation. With relay 602 operated, a locking circuit is established for relay 509 which may be traced from battery through its winding and inner lower front contact, conductor 513, lower front contacts of relay 602, conductor 514, inner upper front contact of relay 509 and over the inner upper back contacts of other relays such as 504 and 500 to ground.

Relay 606 upon operating opens the operating circuits of relays 500—509, and with relay 602 operated as described, closes a circuit for operating relay 600, extending from ground over its next to lower front contact, the inner upper front contact of relay 602 to battery through the winding of relay 600. Relay 600, upon operating operates relay 603 in a circuit from battery through its winding, the upper front contact of relay 602 to ground at the front contact of relay 600 and individualizes the start conductors such as 160 of the subgroup of junctors in which the calling junctor is located so that they become available for identifying the junctor which is calling. With relay 603 operated, the start conductors from the calling subgroup of junctors are extended to the operating windings of relays 710 to 719, inclusive and assuming that the district junctor of Fig. 1 is the first junctor of the subgroup, a circuit is effective for operating relay 710 extending from ground applied to the start conductor 160, No. 3 contact of relay 603, No. 10 back contact of relay 614, conductor 615, upper winding of relay 710 to battery. If there is more than one simultaneous call in the subgroup one or more of relays 710 to 719, inclusive, may operate. The operation of any one of these relays establishes a circuit for relay 612 extending from battery through the winding of relay 612, upper front contact of relay 611, conductor 616, lower

front contacts of operated relays 710 to 719, inclusive, conductor 617, No. 6 back contact of relay 609, No. 2 front contact of relay 603, conductor 605, thence as traced to conductor 705, lower front contact of relay 602, conductor 514, inner upper front contact of relay 509, and over the inner upper back contacts of other group relays including relays 505 and 500 to ground. Relay 612 locks over its upper front contact to the operating circuit just traced independent of relay 611; at its upper back contact opens the operating circuit of relay 611 which starts to release and at its inner lower front contact prepares a locking circuit for an operated relay of the groups 710 to 719, inclusive, and an operating circuit for relay 614 as later described.

With the link circuit disclosed idle, as assumed, relay 603 upon operating establishes a circuit from ground over the lower back contact of hold magnet 703 of the primary link switch 701, conductor 707, No. 14 contact of relay 603, conductor 618, lower back contact of relay 515, winding of relay 516 to battery. If relay 602 is not operated, indicating that the first group of five coin-control circuits in which the control circuit disclosed in Figs. 9 to 12, inclusive, is located, is not being held by another link and control circuit and two or more coin-control circuits of the group are idle, a circuit will be established upon the operation of relay 516 extending from battery through the upper winding of relay 823, conductor 808, lower back contact of relay 704, conductor 708, contact of relay 515, lower back contact of relay 517, conductor 518, next to lower back contact of relay 802, upper back contact of relay 801 and to ground over chain contacts controlled by the coin-control circuit busy relays 805 to 807, inclusive of the group. Similar test circuits are established by the operation of relay 516 or of relay 519 to determine if there are two or more idle coin-control circuits in the three other groups to which the link circuits have access and if such idle control circuits are found, the corresponding coin-control circuit group relays 824 to 826 will also be operated.

It will be recalled that upon the operation of relay 612, slow-to-release relay 611 started to release. As soon as relay 611 is fully released and closes its back contact, a circuit is thereupon established for relay 517 extending from battery through the winding of relay 517, conductor 520, back contact of relay 611 to ground at the inner upper front contact of relay 612. If any group of coin-control circuits is not being held busy by another link and control circuit or if the coin-control group busy relay 801 is not operated, the corresponding group relays 823 to 826 will be operated. For example, the relay 823 will be operated in a circuit from battery through its upper winding, thence as traced over the front contact of relay 516, middle lower front contact of relay 517, conductor 521, outer lower back contact of relay 802 to ground at the inner upper back contact of relay 801.

When one or more of the group relays 823 to 826, inclusive, have operated on either the first or second test, a circuit is closed for operating one of relays 809 to 811 individual respectively to the several link and control circuits. In the present instance relay 809 will be operated in a circuit extending from ground through its winding, lower front contact of group relay 823, conductor 812, No. 1 front contact of relay 603, lower front contact of relay 612, No. 9 back contact

of relay 609, resistance 619 to battery. Relay 809, upon operating, locks over its lower transfer contacts; opens the operating circuits of other relays such as 810 and 811 associated with the group relays 824 to 826 of the control circuit disclosed and the operating circuits of similar relays of the other control circuits, closes a circuit for operating relay 515 extending from battery through the winding of relay 515, conductor 522, upper front contact of relay 809 and upper back contacts of relays 810—811 to ground and establishes a locking circuit for the operated group relay 823 extending from battery through the lower winding and inner lower front contact of relay 823, upper contact of relay 809 and thence to ground as traced at the upper back contact of relay 811. With no other relay such as 810 or 811 operated, no locking circuits for other operated group relays 824 to 826 will be established.

Relay 515 upon operating (a) opens the circuits of relays 516 and 519 which release in turn opening the operating circuits of all group relays 823 to 826, inclusive; (b) closes a locking circuit for the lowest numbered operated relay of the groups 710 to 719, in the case assumed relay 710, which may be traced from battery through the lower winding and inner lower front contact of relay 710, conductor 620, next to upper front contact of relay 515, conductor 523, inner lower front contact of relay 612 to ground over the No. 2 back contact of relay 609; (c) closes the operating circuit of relay 614 from ground applied to conductor 620, thence through the winding of relay 614 to battery; (d) establishes a locking circuit for relay 612 extending from ground at its uppermost front contact over conductor 617, lowermost front contact of relay 710, conductor 616, upper front contact of relay 612 and through the winding of relay 612 to battery; (e) by-passes over its next to inner upper front contact the lower contacts of relay 612 included in the operating circuit of relay 809; and (f) establishes the operating circuit of relay 720 associated with the operated group relay 823 which may be traced from battery through the winding of relay 720, conductor 721, upper front contact of relay 823, inner upper back contacts of relays 826, 825 and 824, inner upper front contact of relay 823, conductor 813, middle lower front contact of relay 515, conductor 524 to ground over the No. 1 back contact of relay 609.

Relay 720 upon operating connects ground to conductor 722 over its No. 2 front contact; over its Nos. 4 to 8 front contacts connects the inner front contacts of relays 710 to 719 with the upper armatures of relays 805 to 807; prepares over its Nos. 12 to 16 front contacts circuits from the select magnets 723 to 725 of the secondary link switch 702 to the upper front contacts of relays 815 to 817 and prepares circuits over its Nos. 9, 10 and 11 front contacts extending in multiple to five coin-control circuits such as is disclosed in Figs. 9 to 12, inclusive. Relays 805 to 807 will be operated at this time if their corresponding coin-control circuits are busy. The connections to the upper armatures of relays 805 to 807 are connected in a chain circuit through the contacts of relays 710 and 719, inclusive, so as to operate relays 815 to 817 with a preference in accordance with which the ten district junctors is being served as determined by the lowest numbered operated relay of relays 710 to 719, inclusive.

It has been assumed that relay 710 has been

operated. It will now be assumed that the first coin-control circuit of the selected or first group is idle and that therefore relay 805 is not operated and with relay 710 operated, a circuit is now established from ground over the No. 12 front contact of relay 614, upper back contact of relay 621, conductor 622, inner upper front contact of relay 710, No. 4 front contact of relay 720, conductor 726, upper back contact of relay 805, winding of relay 815, inner upper normal contacts of relays 816—817 to battery. Relay 815 upon operating (a) locks over its inner upper front contact and conductor 722 to ground over the No. 2 front contact of relay 720; (b) opens at its next to inner upper normal contacts the operating circuit of the preceding relay of the group 815 to 817, in the case assumed no preceding relay; (c) connects the No. 1 contact of relay 720 over conductor 727, the upper front contact of relay 815 to conductor 728 extending to the selected coin-control circuit and over the No. 12 front contact of relay 720 to battery through select magnet 723 of the secondary link switch 702. Relay 815 also closes a circuit for relay 621 which may be traced from battery through the winding of relay 621, conductor 623, the No. 3 front contact of relay 720, conductor 729, to ground over the lower front contacts of relay 815, and over these contacts also completes the circuit of relay 802 causing it to operate and make the five coin-control circuits of the group selected to test busy to other links and control circuits. Relay 802 remains operated until all operated relays 815 to 817 have released. When relay 614 operated with relay 710 operated, a circuit was closed for the select magnet 730 of the primary link switch 701 extending from ground over the No. 3 back contact of relay 609, No. 11 front contact of relay 614, conductor 624, upper front contact of relay 710, through the winding of select magnet 730 to battery. As soon as the coin-control circuit to be used has been selected, the ground applied to conductor 623 for operating relay 621 is connected over the upper front contact of relay 621, conductor 625, lower back contact of relay 731, conductor 732, thence to the next to outer lower front contact of relay 823, conductor 818, the next to upper front contact of relay 603, conductor 626, upper back contact of relay 733 to battery through the hold magnets 703 and 706 of the primary link switch 701 and through the hold magnets 734 and 735 of the secondary link switch 702. Upon the operation of the hold magnets the district junctor is connected through the cross-points of the primary and secondary link switches to the selected coin-control circuit.

When the link and control circuit selected the coin-control circuit of Figs. 9 to 12, inclusive by applying ground to conductor 728, relay 900 operated (a) connecting the winding of relay 1000 over conductor 1003 and its upper front contact to conductor 901 so that this relay may operate if ground is applied to this conductor by a district junctor that requires overtime monitoring service as will be hereinafter described; (b) over its inner upper front contact connects together conductors 736 and 737 thereby operating relay 731 over a circuit which may be traced from ground on conductor 626 over the sleeve cross-point contacts closed by hold magnet 734, conductor 736, contacts of relay 900, conductor 737, No. 9 contact of relay 720, winding of relay 731 to battery; (c) connects the upper winding of relay 902 over the next to outer upper front con-

tact of relay 900 to conductor 733; (d) prepares at its next to outer lower contact a circuit for operating relay 903 over conductor 739 and (e) over its outer lower contact connects the winding of relay 1004 over conductor 1005 to conductor 740 so that this relay may operate for coin return service as will be hereinafter described.

Relay 731 upon operating removes at its lower back contact the shunt circuit of relay 741 and relay 741 operates in the operating circuit of relay 621 previously traced in turn establishing the circuit of relay 742 extending from battery, winding of relay 742, front contact of relay 741 to ground at the back contact of relay 743. Relay 742 locks over its upper front contact and conductor 627 to ground at the middle upper front contact of relay 621, prepares over its inner lower front contact the operating circuit of link and control release relay 609 and over its inner and outer upper front contacts connects ground from conductor 627 over the No. 11 front contact of relay 720 to conductor 739.

Assuming that ground has been connected to conductor 157 by the action of the district junctor circuit of Fig. 1 as before described to thereby establish the condition for coin collection, relay 1001 operates in a circuit from battery through its winding, conductor 1006, lower middle back contact of relay 903, outer lower back contact of relay 904, conductor 744, through contacts of cross-bar switches 701 and 702 to said ground on conductor 157. Relay 1001 upon operating establishes a circuit for relay 905 extending from ground on the next to inner upper front contact of relay 1001, conductor 1007, inner lower back contact of relay 904, winding of relay 905 to battery. Relay 905 upon operating connects ground over its inner upper front contact the inner lower back contact of relay 903, conductor 745, through the winding of busy relay 805 which operates to make the coin-control circuit busy to subsequent calls and to connect ground over its inner upper front contact over conductor 819 and the inner lower front contact of relay 900 to the lower winding of relay 902 and battery causing relay 902 to operate. Relay 905 also causes the operation of relay 1008 in a circuit from battery through the winding of relay 1008, conductor 1009, lower contact of relay 905, lower back contact of relay 900 when this relay releases as hereinafter described, conductor 749 through the cross-bar switches 701 and 702, conductor 165, upper middle back contact of relay 150 to ground on the lower back contact of relay 149, when this relay releases after its locking circuit is opened by the operation of relay 112 as hereinafter described. Relay 902 in operating supplements the operating ground for relay 905 with a holding ground connected over the upper middle contact of relay 902 and lower innermost back contact of relay 904. This is necessary to avoid a premature disconnection of the coin-control circuit in connection with overtime monitoring as will be later described. Relay 902 also establishes a circuit from ground over its upper front contact, conductor 906, upper back contact of relay 1103, normal contacts of jack 1102, conductor 1201 through the winding of the timing signal relay 1200 to battery. The operation of this relay will be described later. Relay 902 also connects ground from the next to inner lower front contact of relay 900, lower front contact of relay 902 to conductor 745, closes a holding circuit for coin collect relay 1001, extending from battery through the winding and inner lower front con-

tact of relay 1001, conductor 1010, to ground at the next to inner lower front contact of relay 902 and closes a circuit from ground applied as previously described to conductor 739, thence over the next to the lower front contact of relay 900, inner lower front contact of relay 902, to battery through the winding of relay 903.

Relay 903 operated (a) locks over a circuit from battery through its winding and inner lower front contact to ground on the inner upper front contact of relay 905; (b) connects ground from the next to inner lower front contact of relay 902 over the inner upper front contacts of relay 903 to the sleeve conductor 730; (c) establishes an energizing circuit through the upper winding of relay 902 over the inner upper contacts of relay 903 to ground at the next to inner lower front contact of relay 902; (d) applies this same ground over the next to upper front contact of relay 900, conductor 738, No. 10 contacts of relay 720, winding of relay 743 to battery; (e) partially prepares the operating circuit of relay 1202 by connecting ground from the upper front contact of relay 1001, conductor 1011, lower front contact of relay 903 to the inner upper back contact of relay 900 and thence over conductor 1293 to the winding of relay 1202 and (f) over its inner upper front contact connects ground to conductor 745 to further hold the busy relay 805. Relay 743, upon operating, completes a circuit from ground over its upper front contact, inner lower front contact of relay 742, conductor 638, winding of release relay 609 to battery. Relay 609, upon operating, opens the circuits of relays 602, 720, 809 and primary select magnet 730 which thereupon release, opens the holding circuits of relays 710 and 614 and locks over its upper front contact to ground supplied by relays 621, 731, 517 and 603. Relay 809, upon releasing, releases relays 823 and 815 and relay 602, upon releasing, releases relays 603 and 509. Relay 606 releases if not held by another operated relay of the group 500 to 509. Relay 720, upon releasing, releases relays 731 and 743 and the operated select magnet 723. Relay 815, upon releasing, releases relay 802 and opens the operating circuit of relay 900 which now releases. The link control circuit is now completely released and is available for the use of other district junctor circuits.

Relay 900, upon releasing, disconnects conductors 736, 737 and 739 and closes the previously traced circuit for relay 1202 which now operates. For coin collect calls, relay 1001 operated as described hereinbefore and locks to ground on the next to inner lower front contact of relay 902. Relay 1292, upon operating, closes the holding circuit of relay 1012 which extends from ground over the inner lower front contact of relay 1202 and conductor 1204 to the inner upper front contact of relay 1012; closes the holding circuit of relay 1013 which extends from ground over the lower front contact of relay 1202 and conductor 1205 to the inner upper armature of relay 1013 and closes a holding circuit from ground over the inner upper front contact of relay 1202 to the upper make contact of relay 1206. Relay 1202 also connects the interrupter 1208 over a circuit from the interrupter over the upper front contact of relay 1202, conductor 1209, middle lower back contact of relay 1103, conductor 1104, conductor 1011 to ground at the upper front contact of relay 1001 whereby, at the first closure of the contacts of interrupter 1208, relay 1206 operates through its upper normally closed contacts and winding and resistance 1210 to battery and locks

through its upper make contacts to ground at the upper inner contact of relay 1202. Relay 1207 is shunted by ground connected to its winding through its upper back contact and does not operate with relay 1206 at this time. When the interrupter contacts open and remove ground from the upper back contact of relay 1207, relay 1207 operates in a circuit from battery through resistance 1211, winding of relay 1207 to ground over the upper front contact of relay 1206. Relay 1207, upon operating, causes the operation of relay 1012 over a circuit extending from battery through its winding, conductor 1014, inner lower back contact of relay 1105, lower back contact of relay 1106, conductor 1107, lower back contact of relay 1015, conductor 1016, inner lower front contact of relay 1206 to ground over the lower front contact of relay 1207. The application of ground to conductor 1107 by relay 1207 also completes a circuit extending from conductor 1107, upper back contact of relay 1013, conductor 1017, upper back contact of relay 1212, conductor 1213, upper back contact of relay 1004, conductor 1018, middle upper back contact of relay 904, conductor 746 through contacts of cross-bar switches 701 and 702, conductor 161, winding of relay 112 to battery, thereby operating relay 112.

Relay 1012, upon operating, locks over the previously traced circuit under the control of relay 1202; partially prepares a circuit for relay 1015 over its lower front contact and connects coin collect battery 1019 through resistance lamp 1020, winding of relay 1021, lower front contact of relay 1001, lower back contact of relay 1004, inner lower front contact of relay 1012, upper back contact of relay 1015, conductor 1022 to the center terminal of the primary winding of transformer 907, thence through the lower half of the winding, upper back contact of relay 900, conductor 901, inner upper back contact of relay 1106, conductor 1108, upper back contact of relay 908 to conductor 747 and from the center terminal of the transformer through the upper half of the primary winding, over conductor 909, inner lower back contact of relay 1106, conductor 1109, inner lower back contact of relay 908 to conductor 748. Conductors 747 and 748 are extended through the cross-bar switches 701 and 702 of Fig. 7, over conductors 162 and 163, through the upper and inner lower front contacts of operated relay 112, over the conductors of line 100 to the subscriber's station 103.

Relay 1021 operates in this circuit, provided a coin has been deposited in the coin box 104 which has thereby connected ground 109 through coin box contact 168 and the winding of coin magnet 108 to the tip conductor of line 100 and through the switchhook contacts of the station 103 to the ring conductor of the line. Coin collector magnet 108 is now operated and collects the coin 105 in a manner well known in the art. Relay 1021, upon operating, establishes a circuit for operating relay 1002 which may be traced from ground over the contacts of relay 1021, through the winding of relay 1002 to battery. Relay 1002, upon operating, locks over its inner lower front contact and conductor 1023 to ground over the inner upper front contact of relay 902; connects holding ground over its upper front contact, conductor 1007 and inner lower back contact of relay 904 to the winding of relay 905 and partially prepares a circuit through its lower front contact over conductor 1024, the next to upper back contact of relay 1006, conductor 1110 through the winding of relay 908.

At the second closure of the contacts of interrupter 1208, relay 1206 is shunted by ground connected through the upper front contact of relay 1207 to a point between the winding of relay 1206 and resistance 1210, whereupon relay 1206 releases but relay 1207 is held operated through the upper normal contacts of relay 1206 to ground over the interrupter contacts. When the interrupter contacts again open, relay 1207 releases and establishes a circuit for relay 1015 extending from battery through the winding of relay 1015, lower front contact of relay 1012, conductor 1025, lower back contact of relay 908, conductor 910 to ground at the lower back contact of relay 1207. Relay 1015, upon operating, locks to ground over its upper front contact; opens at its upper back contact the circuit over which coin collect battery was applied, thus releasing relay 1021, and operates relay 1105 over a circuit extending from battery, through the winding of relay 1105, conductor 1111, next to inner lower back contact of relay 1013, upper middle back contact of relay 1002, inner lower back contact of relay 1013, inner lower front contact of relay 1015, upper inner front contact of relay 1001, next to lower back contact of relay 1000, conductor 1044, lower back contact of relay 1103, conductor 1112, inner lower back contact of relay 900, conductor 819 to ground at the inner upper front contact of relay 805. If relay 1002 has operated in response to the operation of relay 1021, as before described, thus indicating the presence of ground at the coin box 104, a test is now made to determine whether the coin box 104 has been satisfactorily cleared as it should normally be cleared by the operation and release of the coin magnet 108.

Under this condition, at the beginning of the third closure of interrupter contacts 1208, relay 1206 operates but relay 1207 is shunted and does not operate, as before described in connection with the first closure of the interrupter contacts. When the interrupter contacts again open, relay 1207 also operates and a circuit is now established from battery through the winding of relay 908, over the circuit previously prepared by the closure of the lower front contact of relay 1015, thence over conductor 1016 and front contacts of relays 1206 and 1207 to ground. Relay 908, upon operating, locks over its operating circuit previously traced to conductor 1024, thence over the lower front contact of relay 1002, conductor 1026 to ground at the next inner lower front contact of relay 908; partially prepares a circuit for operating relay 904, as will be hereinafter described, by closing its lower front contacts and closes a circuit for charging the condenser of station 103 and the line capacity through the winding of relay 911, which circuit may be traced from battery through the winding of relay 911, inner lower front contact of relay 908, the ring conductor 748 and thence over the ring of the established connection and another circuit for the winding of relay 911 over conductor 912, lower back contact of relay 1000, conductor 1027 and inner upper front contact of relay 908 to tip conductor 747 and thence over the tip of the established connection. Relay 911, even though the coin box has been successfully cleared, due to the capacity charging, may operate momentarily but its contacts are ineffective to operate relay 913 until relay 1206 releases at the beginning of the fourth closure of interrupter contacts 1208. Assuming that relay 911 does not operate effectively due to the

successful clearing of the coin, then a circuit is closed for relay 904 which may be traced from battery through the winding of relay 904, conductor 914, upper middle back contact of relay 1000, conductor 1020, upper back contact of relay 913, next to lower front contact of relay 908, conductor 910 to the lower back contact of relay 1207 when it releases after the end of the fourth closure of interrupter contacts 1208. The coin-control circuit is then released, as will be hereinafter described. If, however, relay 911 operates steadily due to a stuck coin, then when relay 1205 releases at the beginning of the closure of the interrupter contacts 1208, then a circuit is closed for operating relay 913 which may be traced from battery through the winding of relay 913, contacts of relay 911, lower front contact of relay 908, conductor 915, lower back contact of relay 1212, lower back contact of relay 1206 to ground at the lower front contact of relay 1207. Relay 913, upon operating, locks over its lower front contact and conductor 916 to ground at the next to upper front contact of relay 1012; connects ground over its inner upper front contact to the winding of relay 911, thereby discharging the capacity of the subscriber's line 100 to prevent bell tapping when relay 911 is disconnected from conductors 747 and 748, and closes a circuit for operating relay 1105 which extends from battery through the winding of relay 1105, conductor 1111, next to inner lower back contact of relay 1013, inner upper front contact of relay 1002, conductor 917, lower front contacts of relay 913, to the holding ground for relay 913.

The previous discussion describes a condition on a coin collect call which exists when a coin is found in the coin box and is either cleared or not cleared. The condition when a coin is not found will now be described. If no coin is found, relay 1021 fails to operate and, consequently, relay 1002 does not operate. When relay 1015 operates, a circuit is therefore closed for operating relay 1105 which may be traced from battery, through the winding of relay 1105, conductor 1111, next to lower back contact of relay 1013, upper back contact of relay 1002, inner lower back contact of relay 1013, inner lower front contact of relay 1015, inner upper front contact of relay 1001, next to lower back contact of relay 1000, conductor 1044, lower back contact of relay 1103, conductor 1112, inner lower back contact of relay 900 to ground on conductor 819. Relay 1105, operated, releases relay 1113 which operated over the lower back contact of relay 1105 and conductor 1114 to ground at the upper contact of relay 905 when relay 905 operated. Relay 1105, operated, removes ground applied to conductor 746, as previously traced, over its inner lower back contact, thereby releasing relay 112 of the district junction circuit of Fig. 1. Relay 1113 is slow to release to permit relay 112 to release before relay 1106 is operated to avoid clicks at the calling station. Relay 1106 is operated in a circuit from battery through its winding, upper back contact of relay 1113, upper front contact of relay 1105, conductor 1115 to ground on the upper back contact of relay 904 and, upon operating, connects transmission conductors 749 and 750 over its outer upper and outer lower front contacts to conductors 1116 and 1117 extending to the line splitting jack 1118 but these conductors are not used for stuck coin conditions; connects conductors 1103 and 1109 over its inner upper and in-

ner lower front contacts to conductors 1119 and 1120 extending to make contacts of relay 1103; partially prepares the operating circuit for relay 1103 by connecting ground over its next to upper front contact to conductor 1121; releases relay 903 by opening its operating circuit at its next to inner upper back contact and partially prepares a circuit for lighting lamp 1100 by connecting battery over its next to lower front contact, over the inner upper back contact of relay 1103, conductor 1122, lower front contact of relay 1206, conductor 1214, inner upper back contact of relay 904, upper back contact of relay 908, conductor 912, inner lower front contact of relay 1508, conductor 1029, lamp 1100 to ground. Due to the interrupted action of relay 1206, lamp 1100 will flash as a signal to the operator that the coin-control circuit has failed on a coin collect call which may be due either to no coin in the coin box or to failure to collect, assuming that the coin is present.

Accordingly, the plug of the cord circuit 1123 is inserted in jack 1124 associated with lamp 1100, completing the circuit for relay 1103, prepared by relay 1106, over the sleeves of the plug and jack, whereupon relay 1103 operates and extinguishes the lamp 1100. The operator will now endeavor to collect the coin by operating coin collect key 1125 which will connect coin collect battery to the tip and ring of the line. If a coin is present, pilot relay 1126 will operate lighting pilot lamp 1127, but if no coin is present, relay 1126 will not operate and lamp 1127 remains unlighted. If lamp 1127 lights, the operator will close the circuit a second time and, if it remains lighted, it is an indication that the coin is stuck and can not be collected. Relay 1103, upon operating, also connects condenser 1128 across the tip and ring conductors under the control of relay 1113; holds relay 1106 operated over a circuit to ground at its upper front contact; operates relay 1013 over a circuit extending from battery through the winding of this relay, conductor 1030 and the lower front contact of relay 1103 to ground on conductor 1112 and opens at its upper back contacts the circuit of alarm relay 1200 so that an alarm will not be unnecessarily given if the operator keeps the plug of the cord circuit 1123 in the jack 1124 for a long interval. The purpose of relay 1013 for the type of call being considered is to guard against premature disconnection should the operator inadvertently plug into the release jack 1129 instead of into monitoring jack 1124. Relay 1013, upon operating, locks over its inner upper front contact to ground on conductor 1205; releases relay 1105 by opening the operating circuit hereinbefore traced, thereby causing relay 1113 to operate; partially prepares the circuit for operating relay 904 extending from battery through the winding of relay 904, conductor 914, upper front contact of relay 1008, next to upper front contact of relay 1013, conductor 1031 to ground over the lower contact of relay 1130 which operates when the operator plugs into the release jack 1129 and closes a holding circuit for relay 1106 which may be traced from battery through the winding of relay 1106, conductor 1131, lower front contact of relay 1013, middle lower front contact of relay 1008, conductor 1032 to ground at the next to upper front contact of relay 1106. When the operator removes the plug from jack 1124, relay 1103 releases and relights lamp 1100 until the operator inserts the plug into release jack 1129 which operates relay 1130. Relay 1130,

upon operating, operates release relay 904 over the circuit previously traced and connects ground over its upper front contact to conductor 745 extending to the link and control circuit, thereby keeping relay 805 operated and causing the coin-control circuit to be inaccessible to other district junctors requiring service until the operator removes the plug of cord circuit 1123 from jack 1129. The coin-control circuit is released from its connection with the district junctor circuit of Fig. 1 when relay 904 operates in a manner to be described hereinafter.

The operation of the coin-control circuit for coin return after the calling subscriber has disconnected will now be described. Assuming that connection of the coin-control circuit has been established with the district junctor circuit of Fig. 1 in the manner previously described, ground over the lower back contact of relay 149 will be connected over the middle upper back contact of relay 150, to conductor 155, thence through contacts of cross-bar switches 701 and 702 to conductor 740. Coin return relay 1004 is then operated from battery through the winding of relay 1004, conductor 1005, lower front contact of relay 900 to said ground on conductor 740. Relay 1004, upon operating, locks over its inner lower front contact and conductor 1010 to ground on the next to inner lower front contact of relay 902; connects coin return battery 1033 through resistance lamp 1034, middle lower front contact of relay 1004, thence over the circuit path before described for coin collection to the coin box 104 of the calling line; closes a circuit for relay 1002, from ground over its upper front contact through the winding of relay 1002 to battery and closes at its next to upper front contact the previously traced circuit for relay 1202. For an official or free call the completing trunk, not shown, is arranged so that relay 146 and, consequently, relay 149 do not operate and the circuits therefor function as for an incompleting call.

The operation of coin return relay 1004, as before described, causes the coin at coin box 104 to be returned, the circuit functioning in a manner similar to that for the coin collection condition. If, however, there should be no coin in box 104, or should the coin be stuck, then the coin control circuit functions as described for the coin collection condition except that lamp 1100 now lights steadily since the lower front contacts of relay 1206 which furnished interrupted battery for the coin collect condition are now short-circuited over the lower front contact of relay 1004 and conductors 1122 and 1214. The operator observing the steadily lighted lamp 1100 now knows that the coin should be returned and, accordingly, operates return key 1132. If there is a coin present, relay 1133 operates and lights pilot lamp 1127. If the coin clears, lamp 1127 is not lighted on the second attempt, but if lamp 1127 is relighted, this indicates that the coin is stuck and cannot be returned.

The operation of the system will now be discussed for the condition whereby after the expiration of a predetermined time interval following the establishment of the conversational connection between the calling and called subscribers, the deposited coin is automatically collected during conversation and a warning tone is connected to the calling line to indicate that the expiration of the time limit is approaching. It has been found convenient to collect the coin at the end of approximately four and one-half

minutes, that is, one-half minute before the end of a five minute period covered by the initial coin deposit. It is to be understood, however, that any other time interval that may be desired can be used. At the end of this five minute interval, if no additional coin has been deposited, an overtime monitoring operator is called in to supervise the connection.

Let it be assumed now that the called subscriber has answered and that cams 151, 152 and 153 have begun to time the call. As soon as the timing device moves off normal, normally closed contacts 169 open. At the end of two hundred and sixty-five seconds, pick-up contacts 171 close and thereby provide a circuit for holding operated rotary magnet 158 after the charge relay 149 releases, as will be described hereinafter. Almost five seconds later, that is, at the expiration of four and one-half minutes, contacts 170 close, thus operating relay 120 over a circuit which may be traced from ground through the lower winding of relay 120 and contacts 170 to battery through resistance 159. Relay 120 operates and then operates relay 150 in a circuit from battery through the winding of relay 150, upper inner front contact of relay 120, lower front contact of relay 136 to ground through the upper contacts of relay 177. Relay 120, upon operating (a) connects battery 118 through resistance 119, upper outer front contact of relay 120, upper inner front contact of relay 149 to line register 153, through contacts of the line link cross-bar switches 151 and 102 and register 156 to ground which operates to indicate the completion of a call over its associated line; (b) partially prepares over its upper middle front contact a ground connection for holding relay 121 operated when this relay subsequently operates; (c) locks through its lower winding and inner lower front contact and the upper inner back contact of relay 121 to battery through resistance 150; (d) connects ground over its lower middle front contact through the lower middle back contact of relay 121 to start conductor 160 to summon a coin-control circuit; and (e) closes an auxiliary folding ground for relay 136 which may be traced from ground over the lower outer front contact of relay 120, through the lower and upper inner front contacts and winding of relay 136 to battery. This has no useful function at this time.

When the connection to the coin-control circuit is established as before described in connection with the operation of the system for coin control after the calling subscriber disconnects, relay 121 operates and the coin-control circuit receives a signal over conductor 157 to collect the coin. When this signal is received, the coin-control circuit functions as before described except that now relay 1008 is not operated since there is no ground on conductor 740 because the calling subscriber has not disconnected. With relay 1008 not operated, a warning tone will be superimposed upon conductors 747 and 748 through the windings of transformer 937. This tone is produced by battery impulses furnished by interrupter 1035 and transmitted through transformer 1036, upper middle back contact of relay 1008, next to upper front contact of relay 1001, condenser 1037, conductor 1038 and transformer 937 to the coin box control circuit path before traced. When relay 1015 operates as before described, it operates release relay 904, provided a coin has been found in the coin box 104 over a circuit from battery

through the winding of relay 904, upper back contact of relay 1008, middle lower front contact of relay 1002, inner lower front contact of relay 1015, inner upper front contact of relay 1001, next to lower back contact of relay 1000, conductor 1044 and thence, as previously traced, to ground on conductor 819. Relay 904, upon operating, releases the coin-control circuit as hereinafter to be described. The stuck coin test using relay 911, which test was hereinbefore described, is not made at this time so as to avoid interrupting the conversation. This test is made after disconnection. However, if the coin-control circuit finds that no coin has been deposited, as evidenced by the non-operation of relay 1021 and, consequently, of relay 1002, then a circuit is closed for immediately flashing the overtime monitoring lamp 1101. This circuit may be traced from ground through lamp 1101, conductor 1134, inner lower back contact of relay 1008, thence over the circuit before traced for coin-control lamp 1100. When the operator observes the flashing lamp 1101, she inserts the plug of cord 1123 in the overtime monitoring jack 1135, relay 1103 operates, and the circuits function as before described. Relay 112 of the district junctor circuit of Fig. 1 operates as before described in connection with a stuck coin condition and the calling line is connected to conductors 162 and 163. The called subscriber's station is bridged across the connection by means of conductors 166 and 167. For this condition the operator requests the deposit of a coin which she immediately collects by the operation of the cord circuit collect key 1125.

The operation of the system for overtime monitoring by an operator will now be described. When the test indicates at the end of a five minute period that the coin has been deposited, the coin-control circuit is released and conversation through the district junctor is uninterrupted. If no coin is found, then the monitoring operator is signaled with a steadily lighted lamp and the operator, upon answering the signal, requests that the calling subscriber deposit a coin in payment for the succeeding overtime interval or permits the calling subscriber to disconnect if the conversation is to be terminated. If the calling subscriber maintains that a coin has been deposited or disconnects, the operator removes the cord circuit plug from the monitoring jack and the coin-control circuit is then required to verify that a coin has been deposited or that disconnection has occurred. If neither of these conditions is found to exist, the coin-control circuit signals the operator a second time indicating that the subscribers are still talking and that a coin has not yet been deposited for the overtime interval. The operator then repeats the procedure and if the calling subscriber fails to respond, the operator may interrupt the conversation by use of the line splitting jack 1118. When the operator disconnects a second time, the coin-control circuit repeats the procedure of verifying disconnection or the presence of a coin at the calling station. When a coin is found to be present, the coin-control circuit dismisses the district junctor. If disconnection is effected, the coin-control circuit is required to proceed with coin return service to insure that the coin box has been properly cleared.

The operation of the system for overtime monitoring will now be discussed in detail. It will be assumed that the district junctor of Fig. 1 has cooperated with the coin-control circuit to collect, at the end of the four and one-half minute period,

the coin deposited in the coin box 104. The timing mechanism continues to revolve since a locking circuit for rotary magnet 158 is maintained through contacts 171, lower contacts of relay 136 to ground on the upper contacts of relay 117. Relay 150 also remains operated being locked over its inner lower front contact to ground on the operating circuit of magnet 158. A small interval before the timing device completes a cycle of five minutes contacts 169 reclose and a circuit is closed for operating relay 120, which relay released when ground was removed from conductor 164 following the dismissal of the coin-control circuit after the four and one-half minute period. The circuit of relay 120 may be traced from ground through its lower winding, outer lower front contact of relay 150, contacts 169, upper front contact of relay 150 through resistance 159 to battery. The operation of relay 120 summons a coin-control circuit as before described and closes a circuit for holding relay 150 and magnet 158 energized after contacts 171 open at the end of the five minute interval. This holding circuit for relay 150 may be traced from battery through the winding of relay 150, upper inner front contact of relay 120, lower front contact of relay 136 to ground on the upper contacts of relay 117. Magnet 158 is held to the same ground through the lower inner front contact of relay 150 and the timing device continues to function. However, the actual timing of the call will not be resumed until the coin-control circuit is released. When this occurs holding ground on conductor 164 is removed and relay 120 releases thereby releasing relay 150. The release of relay 150 opens the operating circuit of magnet 158 which is so constructed that it now immediately restores to normal and the timing of the call is resumed. If, however, assuming an extreme condition that the coin-control circuit should be held until contact 171 reclosed, thereby maintaining the operation of magnet 158, the district junctor must then wait until contacts 171 open, that is, until the timing mechanism has restored to normal before timing is resumed. As before stated, the presence of ground on conductor 162 is a signal to the coin-control circuit that overtime monitoring is required. This ground is connected over the lower back contact of relay 149, upper middle front contact of relay 150 and next to upper back contact of relay 112 to conductor 162 through the cross-bar switches 701 and 702, conductor 747, inner upper back contact of relay 908, conductor 1108, inner upper back contact of relay 1106, conductor 901, upper front contact of relay 900, conductor 1003, through the winding of overtime relay 1000 to battery. Relay 1000 operates, locks when relay 902 operates in a circuit over its upper front contact, inner upper back contact of relay 1008, conductor 1039 to ground over the next to outer lower front contact of relay 902. After the link and control circuit has operated relay 903 it causes the release of relay 900 as before described.

When relay 900 releases, relay 1202 operates from battery through its winding, over conductor 1203, the inner upper back contact of relay 900, the lower front contact of relay 903, conductor 1104, middle lower back contact of relay 1103, conductor 1209, conductor 1215 to ground at the inner lower front contact of relay 1000. Relay 1202 upon operating connects ground from conductor 1215 over its upper front contact to interrupter 1208, supplies locking ground for relay 1012 and operating ground for relay 1206

as previously described and connects ground to ring conductor 750 to guard against clicks to the subscribers when the transmission circuit of the district junctor circuit is interrupted to permit testing the calling station for the presence of the overtime deposit. This circuit may be traced from conductor 750 over the lower back contact of relay 1106, conductor 1136, middle upper front contact of relay 1202, conductor 1216, upper back contact of relay 1105, conductor 1115 to ground at the upper back contact of relay 904. Relays 1206 and 1207 now operate and release in response to the operation of interrupter contacts 1208. When relay 1206 operates, it operates relay 1012 and connects ground to conductor 746 over circuits previously traced. Ground on conductor 746 causes relay 112 of the district junctor to operate which connects the calling station to conductors 162 and 163 extending to the coin-control circuit. Relay 1012 upon operating causes the operation of relay 908 in a circuit from battery through the winding of this relay over the circuit previously traced through the upper front contact of relay 1012 to the holding ground of relay 1000. Relay 1012 also partially prepares a circuit for relay 1015 which may be traced from battery through the winding of relay 1015 through the lower and next to upper front contacts of relay 1012, conductor 1040, inner upper normally open contacts of relay 1105, conductor 1137, middle upper front contact of relay 1000, conductor 1028, upper back contact of relay 913, next to lower front contact of relay 908, conductor 910 to ground at the lower back contact of relay 1207. Relay 908 operated partially prepares a circuit for operating release relay 904 by closing its next to lower front contact; closes the circuit for charging the station condenser and the capacity of the connection through the winding of relay 911 which has its contacts made ineffective for a short interval to guard against false operation of relay 913 on line surges and prepares a circuit for operating relay 913 if the coin is present in coin box 104, all of which has been described in connection with the operation for stuck coin conditions. If relay 911 should operate on any line surges at this time, it should release before its contacts are made effective when relay 1206 releases at the beginning of the second closure of interrupter contacts 1208. If a coin has been deposited, relay 911 will operate as soon as relay 908 operates so that when relay 1206 releases, relay 913 will operate immediately. Relay 913 operated connects ground to ring conductor 748 over a circuit from ground at the inner upper front contact of relay 913 and inner lower front contact of relay 908 to prevent bell tapping on subscriber coin lines when relay 911 is disconnected from the calling line and operates release relay 904 over conductor 914, inner upper back contact of relay 1002, conductor 917 and lower contacts of relay 913 to the operating ground for relay 913. Relay 904 upon operating releases the coin-control circuit as will be hereinafter described.

If a coin has not been deposited, relay 911 and consequently relay 913 will not be operated when the contacts of relay 911 are made effective when relay 1206 releases at the beginning of the second closure of interrupter contacts 1208. When relay 1207 releases at the end of the second closure of interrupter contacts 1208 a circuit is closed for operating relay 1105 which may be traced from ground on the lower back contact of relay 1207, conductor 910, next to the lower

front contact of relay 908, upper back contact of relay 913, conductor 1028, middle upper front contact of relay 1000, next to the inner lower back contact of relay 1013, conductor 1111, winding of relay 1105 to battery. Relay 1105 upon operating locks to ground in a circuit from battery through its winding over conductor 1111, next to inner lower back contact of relay 1013, conductor 1137, inner upper front contact of relay 1105, conductor 1040, next to the inner upper front contact of relay 1012, to ground at the inner upper front contact of relay 1015. The operation of relay 1105 opens at its lower back contact the circuit of relay 1113 which releases and closes a circuit for operating relay 1106 which may be traced from battery through the winding of relay 1106, upper back contact of relay 1113, upper front contact of relay 1105, conductor 1115, to ground at the upper back contact of relay 904 which did not operate to release the coin-control circuit since by assumption no coin was found in the coin box 104.

The signaling of the operator due to the non-detection of the overtime coin deposit will now be discussed. With relay 1106 operated, the shunt consisting of the serially connected resistances 1138 and 1139 is disconnected by the outer back contacts of relay 1106 from the talking conductors 749 and 750. This shunt is used to reduce clicks at the station of the calling subscriber. Relay 1105 operated also prevents ground from being connected to conductor 746 thereby avoiding the operation of relay 112 in the district junctor circuit of Fig. 1 which would interrupt the conversation between the subscribers while awaiting the response of the monitoring operator. This circuit path which is kept open may be traced from conductor 746 through the upper middle back contact of relay 904, conductor 1018, upper back contact of relay 1004, conductor 1213, upper back contact of relay 1212, conductor 1017, upper back contact of relay 1013, conductor 1107, next to inner lower back contact of relay 1106, (which relay operates after relay 1105), inner lower back contact of relay 1105, conductor 1014 to the locking ground of relay 1012. Relay 1105 also connects the talking conductors 749 and 750 over its outer front contacts and over conductors 1116 and 1117, to the line splitting jack 1118; releases relay 908 by opening the operating circuit thereof previously traced at its next to inner upper back contact; connects conductors 1108 and 1109 over its inner front contacts to conductors 1119 and 1120 which extend to the innermost contacts of relay 1103 and lights lamp 1101 steadily when relay 908 releases. This circuit may be traced from ground through lamp 1101, conductor 1134, inner lower back contact of relay 1008, conductor 918, upper back contact of relay 908, inner upper back contact of relay 904, conductor 1214, inner upper front contact of relay 1000, lower back contact of relay 1013, conductor 1122, inner upper back contact of relay 1103, to battery over the next to lower front contact of relay 1106.

The operator answers the call by inserting the plug of cord circuit 1123 into the overtime monitoring jack 1135 and relay 1103 operates over the sleeve circuit. Relay 1103 operated (a) opens the circuit of lamp 1101 thereby extinguishing it; (b) connects condenser 1128 under the control of relay 1113 across talking conductors 1119 and 1120 to guard against clicks to the operator as well as to the subscribers while the connection is being established from the

calling line to the operator's position and also while the transmission battery is being removed by relay 112 of the district junctor which operates later; (c) furnishes a holding circuit for relay 1106 over its upper front contact so that relay 1106 will remain operated as long as the cord circuit is plugged into jack 1135; (d) operates relay 1013 over conductor 1030, the lower front contact of relay 1103 to ground on conductor 819; (e) opens at its upper back contact the circuit of time alarm relay 1200 to prevent the sounding of an alarm if the plug should be kept in jack 1135 for an abnormal length of time; and (f) releases relay 1202 by opening at its middle lower contact the previously traced operating circuit of relay 1202. Relays 1206 and 1207 continue to function while the operator is being awaited but perform no useful function at this time. However, these relays release when relay 1202 releases due to the disconnection of operating and locking ground therefor. Relays 1012 and 1015 also release due to the disconnection of ground at the inner lower contact of relay 1202. The operation of relay 1013 connects ground over its next to upper front contact, conductor 1017, upper back contact of relay 1212, conductor 1213, upper back contact of relay 1004, conductor 1018, middle upper back contact of relay 904 to conductor 746 thereby causing the operation of relay 112 of the district junctor circuit. Relay 112 operated, disconnects at its next to inner upper and next to inner lower back contacts the transmission battery supplied through the windings of relay 141 for the calling line and connects over its outer upper and lower inner front contacts conductors 110 and 111 to conductors 162 and 163, respectively, so that the operator may talk to the calling subscriber while the called subscriber is listening to the conversation over conductors 166 and 167, the extensions of conductors 162 and 163 and of conductors 166 and 167 in Fig. 11 being connected together over the back contacts of relay 1140. This arrangement also permits the operator to have cord supervision by the functioning of supervisory relay 1141 and lamp 1142. The operation of relay 1013 also opens the operating circuit of relay 1105 which releases and reoperates relay 1113, the latter disconnecting condenser 1128; connects ground over its upper front contact and conductor 1041 to conductor 745, thereby maintaining a busy condition for the coin-control circuit as long as the cord circuit is plugged into jack 1135 and opens at its lower back contact the shunt circuit around the lower contacts of relay 1206 which was established through the inner upper front contact of relay 1000 thereby partially preparing a circuit for flashing lamp 1101 should the subsequent repeat test for the coin overtime deposit as hereinafter described show that a coin has not been deposited.

The operations whereby the repeat test for the overtime coin deposit is made will now be discussed. When the monitoring operator removes the plug of cord circuit 1123 from jack 1135, relay 1103 releases and the coin-control circuit proceeds to verify the presence of the overtime deposit to determine if the calling subscriber has disconnected. Relay 1103 upon releasing partially prepares the circuit for lighting lamp 1101 by closing its inner upper back contacts, releases relay 1106 by removing holding ground at its upper front contact, recloses the circuit of time alarm relay 1200 at its upper back contact and

closes a circuit for reoperating relay 1202 which may be traced from battery through the winding of relay 1202, conductor 1203, inner upper back contact of relay 900, lower front contact of relay 903, conductor 1104, inner lower back contact of relay 1103, conductor 1209 to ground at the inner lower front contact of relay 1000. The operation of relay 1013 causes the test for the overtime coin as before described to be repeated. However, at the conclusion of the repeat test, relay 1013 is already operated so that the circuit will delay lighting the lamp 1101 if no coin has been detected until a time interval has been measured as hereinafter described to permit disconnection by the calling subscriber to be recognized. Assuming that the repeat test did not disclose the presence of the overtime coin deposit, then the release of relay 1207 at the completion of the test, connects ground over conductor 910, through the next to outer front contact of relay 908, upper back contact of relay 913, conductor 1028, middle upper front contact of relay 1000, next to inner lower front contact of relay 1013, conductor 1042, middle lower front contact of relay 1202, conductor 1217, next to inner lower front contact of relay 1000, conductor 1218, through the winding of relay 1212 to battery. Relay 1212 operates and locks in a circuit from battery through its winding, over conductor 1218 through the next to inner lower front contact of relay 1000, conductor 1217, the middle lower front contact of relay 1202 to ground at the lower front contact of relay 1212; partially prepares the operating circuit of relay 1219 by connecting ground over its upper front contact through the swing contact of interrupter 1220 and connects ground to the lower front contact of relay 1219 and to the upper front contact of relay 1221. Relay 1212 operated also opens at its upper back contact the circuit of relay 112 which relay releases and permits the district junctor to record a possible disconnection of the calling subscriber. If the calling subscriber has disconnected, this will be detected by the district junctor which will connect ground over the lower back contact of relay 149, upper middle back contact of relay 150 to conductor 165 thereby operating relay 1008 which will cause the connection to be released as hereinafter described. This action will occur before relay 1221 operates. While the district junctor is recognizing disconnection, relay 1219 operates to ground applied over the left contact of interrupter 1220 and locks to ground on the upper front contact of relay 1212. Ground is then connected to the right contacts of interrupter 1220 after a predetermined interval, say two seconds, which is sufficient to assure the release of the connection and the unnecessary signaling of the operator if the disconnection has been recognized. The aforesaid ground on the right contacts of interrupter 1220 if the connection has not been released due to the disconnection of the calling subscriber, causes the operation of relay 1221 in a circuit from battery through the winding of relay 1221, upper front contact of relay 1219, right contact of interrupter 1220 to ground at the upper front contact of relay 1212. Relay 1221 upon operating locks over its upper front contact to ground at the upper front contact of relay 1212 and at its lower front contact connects ground to conductor 1111 thereby causing the operation of relay 1105. Relay 1105 upon operating releases

relay 1113 which in turn causes the operation of relay 1106 over the circuit previously traced. Relay 1106 upon operating releases relay 908 by opening the circuit thereof extending over conductor 1110 and connects battery over its next 5 to lower front contact over the next to inner upper back contact of relay 1103 and conductor 1122 to the lower front contact of relay 1206 for flashing lamp 1101. Relays 1206 and 1207 10 continue to operate and while the operator is awaited flashes lamp 1101 which is a signal to the operator that the calling party is still holding the connection and has not yet deposited a coin for the overtime interval.

When the operator plugs into the monitoring 15 jack 1135, relay 1103 operates extinguishing lamp 1101 and releasing relay 1202 which in turn effects the release of relays 1206, 1207, 1012 and 1015 all as before described. Relays 1212, 1219 and 1221 also release due to the release of relay 1202. The release of relay 1221 releases relay 20 1202. The release of relay 1212 closes the previously traced circuit over its upper back contact for operating relay 112 of the district junctor circuit which in turn connects the calling 25 line to conductors 162 and 163 so that the operator can again converse with the calling subscriber with the called subscriber listening as before over conductors 166 and 167. If the calling subscriber still fails to make the overtime coin deposit the operator may insert a plug into the 30 splitting jack 1118 thereby operating relay 1140 which opens at its back contacts the conversational connection between the calling and called subscribers. Relay 1140 also connects ground 35 over its front contact to conductor 745 thereby causing the coin-control circuit to test busy to link and control circuits as long as the plug is in the jack 1118. When the plug is removed from the monitoring jack 1135, relay 1103 releases in turn 40 releasing relay 1106 and then a second repeat test is made by the coin-control circuit. Assuming that at the end of the second repeat test the overtime coin deposit is detected, the release relay 904 will operate and lock when relay 913 45 operates indicating the presence of a coin. The locking circuit of relay 904 may be traced over its inner lower front contact to ground at the upper middle front contact of relay 902. Release will then take place as will be hereinafter described. Assuming that no coin deposit has been 50 detected but that the calling subscriber has disconnected, then relay 1008 operates when the district junctor connects ground to conductor 165 as before described.

The functioning of the coin-control circuit will now be described when disconnection is recognized and the operator is being awaited for overtime monitoring calls. If the calling subscriber should disconnect while awaiting the operator 60 with lamp 1101 lighted, the coin-control circuit functions to extinguish lamp 1101 and to set up the cycle of operations for a coin return call to insure that the coin box is cleared. This is done since it is possible that the calling subscriber may 65 have deposited a coin after the overtime coin deposit test was made but before the operator has answered in which case the coin should be refunded. When the district junctor circuit recognizes that the calling subscriber has disconnected, it connects ground to conductor 165 thereby 70 operating relay 1008 as before described. Relay 1008 upon operating releases relay 1000 which was previously operated by ground connected to conductor 162 at the district junctor and which 75

was held operated over its upper front contact, inner upper back contact of relay 1008, conductor 1029 to ground over a lower contact of relay 903; extinguishes monitoring lamp 1101 by opening its inner lower back contact; partially prepares the circuit for lighting lamp 1100 used for the stuck coin test and partially prepares the circuit for operating the coin return relay 1004. When relay 1000 releases it releases relay 1202 10 which in turn releases relays 1012, 1015, 1206, 1207, 1105 and 1196. When all of these relays have released a circuit is closed for operating relay 1004 which may be traced from ground over the upper back contact of relay 1001, upper back 15 contact of relay 1000, inner upper front contact of relay 1008, lower back contact of relay 1012, next to upper back contact of relay 1015, conductor 1043, middle upper back contact of relay 902, conductor 919, middle upper back contact of relay 1105, conductor 1143, middle upper back 20 contact of relay 913, conductor 1144, inner upper back contacts of relays 1206 and 1207, conductor 1222, through the winding of relay 1004 to battery. Relay 1004 operates and causes the circuit to function for coin return as hereinbefore 25 described.

The release of the coin-control circuit will now be discussed. For the various operating conditions hereinbefore described, release relay 904 30 was operated whenever a release condition was established. Relay 904 upon operating (a) removes ground at its middle upper back contact from conductor 745, thereby releasing relay 112 of the district junctor circuit; (b) connects 35 ground over its upper front contact to conductor 745 thereby causing the coin-control circuit to test busy until relay 904 has restored to normal; (c) connects conductor 744 over its lower front contact to the winding of relay 903 as a check 40 for a trouble ground condition on conductor 744, which is the conductor that is used to signal a coin collect condition; (d) releases relay 905 by opening its inner lower back contact; (e) locks through its inner lower front contact to ground 45 supplied over the middle upper front contact of relay 902 or over conductor 1007 from the next to inner upper front contact of relay 1001 or the upper front contact of relay 1002 as a check that these relays are normal before the circuit is restored to normal; (f) connects ground during 50 the releasing time of relay 905 from the inner upper front contact of relay 905, over the inner lower front contact of relay 903 and the lower front contact of relay 904 over conductor 744 55 through the cross-bar switches 701 and 702 to conductor 157 to operate relay 123 of the district junctor which in turn releases the connection from the line of station 103 through the district junctor for early release calls, that is, calls abandoned by the calling subscriber before sender 60 400 has completed its function; and (g) opens at its inner upper back contact the circuit of lamp 1100. Relay 905 is slow to release to allow relay 123 aforesaid to operate and at its upper 65 back contact to release hold magnets 107 and 125 thereby releasing the line link connection. When relay 905 releases, it releases relay 903 provided no trouble ground exists on conductor 744 and at its lower front contact opens the conductor 70 740 to avoid breaking any circuit flow on this conductor at the cross-points of the switches 701 and 702. When relay 903 releases, it removes ground at its inner upper front contact from busy conductor 745; removes ground at its middle upper front contact from sleeve conductor 75

736 thus releasing hold magnets 703, 706, 734 and 735 of the link and control circuit which break connection between the district junctor and the coin-control circuit and releases relay 902 by opening the holding circuit through the upper winding thereof. Relay 902 upon releasing removes ground from conductor 745 and also from the winding of time alarm relay 1200; opens at its inner upper front contact the locking circuit of relay 1002, thereby releasing relay 1002 if relay 1001 is not operated; opens the locking circuit of relays 1001 and 1004 at its next to inner lower front contact and whichever one of these relays has previously operated now releases. When relay 1000 has released due to the operation of relay 1008 or also when relays 1001 or 1002 and 913 have released, relay 904 releases. The release of relay 1012 as before described releases relay 913 if it has been previously operated. Relay 1012 releases relay 1015 if this relay is operated at this time. Relay 1106 releases provided that the operator has removed the plug from jack 1124 or jack 1135 thereby releasing relay 1103. Relay 1130 releases when the operator removes the plug from the release jack 1129. Relay 1113 releases when relay 905 releases and removes ground from conductor 1114. When ground is removed from conductor 745, relay 805 releases removing ground from conductor 819 and if relay 900 is operated, it releases relay 902 to open the circuit of time alarm relay 1200.

The release of the district junctor circuit of Fig. 1 including that of the connection through the cross-bar switches 101 and 102 of the line link circuit will now be discussed. When the calling subscriber disconnects, relay 141 releases which in turn releases relay 117. Relay 146 releases when the called subscriber disconnects or when relay 117 releases. When relay 117 releases, it releases rotary timing magnet 158 and relay 150 if these are operated at the time by opening its upper contacts and operates relay 120. Relay 120 operated locks under the control of relay 121; connects ground to conductor 160 to summon a coin-control circuit and furnishes holding ground for relay 136. When a coin-control circuit is connected to the district junctor ground is supplied to conductor 164 thereby operating relay 121 as previously described. Relay 121 operates and causes relay 172 to operate in a circuit from battery through its winding, lower outer front contact of relay 121, lower back contact of relay 117 to ground on the upper front contact of relay 121. Relay 172 upon operating locks through its inner upper front contact to ground on the next to inner upper front contact of relay 136. The coin-control circuit then connects ground to conductor 161 to operate relay 112 as before described whereupon relay 112 operates, opens at its lower back contact the locking circuit of relay 149 if this relay was operated in response to a completed call for which a coin is to be collected and removes ground at its next to outer lower front contact supplied over the lower front contact of relay 120 over the upper back contact of relay 127 to sleeve conductor 174 thereby releasing the connection through the district and office switches of Fig. 2 to the outgoing trunk 206. When the coin-control circuit has completed its functions, it releases as hereinbefore described and thereby removes ground from conductors 161 and 164 releasing relays 112 and 120. When relay 120 releases, it opens at its upper middle front contact the locking circuit of relay 121 which thereupon releases, at its lower

front contact opens the locking circuit of relay 136 which releases and removes ground from sleeve conductor 125 releasing the connection through the line link and group control circuit to the calling line 100. When relay 136 releases, it releases relay 172 and the district junctor circuit is then in normal condition.

The operation of the system when the services of an operator are required will not be described herein since the system functions for this type of call in the manner fully described in my application, Serial No. 214,348, filed June 17, 1938.

Should the coin-control circuit be held for an abnormal length of time without receiving the attention of a monitoring operator, an alarm signal 1227 is lighted by the operation of apparatus disclosed in Fig. 12. Ground is connected to conductor 906 as soon as the coin-control circuit is seized and is extended over the upper back contact of relay 1103, normal contact of make-busy jack 1102 to conductor 1201 and thence through the winding of relay 1200 which operates. Relay 1200 upon operating remains operated during the entire time that the coin-control circuit is off-normal except for the time that its circuit is opened by the operation of relay 1103 by an operator inserting a plug in jack 1124 or in jack 1135. Relay 1200 operated furnishes a holding ground through its upper contact for relays 1223, 1224 and 1225 and also connects the winding of relay 1223 over its lower contacts to the make contacts of interrupter 1226. When the interrupter closes its contacts for the first time and relay 1223 operates, relay 1225 also operates in a circuit from battery through its winding over the upper back contact of relay 1224 and the upper front contact of relay 1223 to ground at the upper contact of relay 1200 and locks over its upper front contacts to ground at the upper contact of relay 1200. When the interrupter opens its contacts, relay 1223 releases and closes a circuit for relay 1224 from battery through its winding over the lower front contact of relay 1225 and the upper back contact of relay 1223 to ground over the upper contact of relay 1200. Relay 1224 upon operating locks over its inner upper front contact to ground on the upper contact of relay 1200. When the interrupter closes its contacts a second time, relay 1223 again operates and now locks over its inner upper front contact, the outer upper front contact of relay 1224 and the outer upper front contact of relay 1223 to ground over the upper contact of relay 1200; closes a circuit for lamp 1227 over its lower front contact and the lower front contact of relay 1224 and closes a circuit from ground over its inner lower front contact and the inner lower front contact of relay 1224 through the winding of alarm relay 1228 to battery. Relay 1228 operates to light lamp 1229 and to operate alarm bell 1230. The group of coin-control circuits in trouble is identified by the lighting of lamp 1227. It has been found in practice that a coin-control circuit of the type disclosed has a normal holding time of approximately two seconds. The timing of interrupter 1226 may be suitably predetermined so that an alarm is not indicated until after about forty-five seconds. This arrangement insures that there will be no alarm unless there is a case of actual trouble. When ground is removed from the winding of relay 1200, relays 1200, 1223, 1224 and 1225 release, releasing the time alarm circuit to normal. Relay 1228 if not operated from another circuit also releases.

The make-busy jack 1102 is provided to per-

mit removal of the coin-control circuit from service. When it is desired to make the circuit busy, the plug 1145 having its tip, ring and sleeve elements connected together is inserted in the jack 1102 causing the break contacts of the jack to open, disconnecting alarm relay 1200 to avoid sounding an alarm for this type of busy condition and connecting the ground on the sleeve of the jack to conductor 745 thereby preventing a link and control circuit from seizing the coin-control circuit.

When a coin district junctor requires a connection to a coin-control circuit and there are no links available to serve it, the link busy alarm circuits of Fig. 14 function to operate an alarm and to light a subgroup lamp to indicate to a maintenance man the subgroup of junctors in which the delay has occurred. Relay 1400 operates when interrupter 1401 closes its right contact, in a circuit extending over the back contact of relay 1402 and connects the left windings of subgroup relays 1410—1419, inclusive, allocated to the ten subgroups of junctor circuits having access to the link circuits to the multiplied back contacts of ten relays such as relay 600 of Fig. 6, and thence to the start conductors of the district junctors. Thus, for example, the left winding of relay 1419 will be connected over the outer left contact of relay 1400 and conductor 1403 to the back contacts of relay 600 allocated to the No. 9 subgroup of ten district junctors in which the junctor of Fig. 1 was assumed to be located. Those subgroups of junctors having unanswered waiting calls will have ground connected from their start conductors such as 160 over back contacts of their subgroup relays such as 600 to conductors such as 1403, thus causing the operation of corresponding relays 1410 to 1419, inclusive. When any relay such as relay 1419 operates, it locks over its left winding and outer left front contact to its operating circuit independent of relay 1400 until a call is served in the associated subgroup of district junctors. It will be assumed that relay 1419 thus operates and locks. When interrupter 1401 opens its right contact, relay 1400 releases and as soon thereafter as the interrupter closes its left contact, a circuit is established from ground thereover, over the inner left contact of relay 1419 or any other operated relay of the group 1410—1419, inclusive, thence through the winding of relay 1402 to battery. Relay 1402 operates and locks in a circuit extending from battery through its winding, the inner left contact of relay 1419, the middle left front contact of relay 1402 to ground; establishes a circuit for the group lamp 1429 extending from battery through the lamp, over the outer right front contact of relay 1419 to ground at the right front contact of relay 1402; establishes a locking circuit for relay 1419 extending from battery through the right winding and inner right front contact of relay 1419, the inner left front contact of relay 1402, thence through the normally closed contacts of release key 1404 to ground; over its outer left front contact establishes a circuit over conductor 1405 to the floor alarm circuit and over its right back contact opens the circuit of relay 1400 to prevent the subsequent operation thereof.

The operation of the floor alarm equipment over conductor 1405 causes the lighting of an aisle pilot lamp and a minor audible alarm to signify to the maintenance man that a trouble condition has arisen and the lighting of the group lamp 1429 identifies the subgroup of district

junctors in which a call for coin service has been delayed. If other subgroups of links are similarly busy, other lamps of the group 1420 to 1429 will be lighted. When the release key 1404 is operated, the locked relays 1410 to 1419, inclusive, will release provided ground is not still present on their respective operating conductors, such as 1403. When all relays 1410 to 1419, inclusive, are released, relay 1402 releases in preparation for its next attempt to disclose abnormally delayed coin district calls.

It has been found desirable during periods when peak load conditions arise and all coin-control circuits are busy to release all coin-control circuits which have been taken into service by district junctor circuits to serve coin overtime calls, to improve the service rendered by the coin-control circuit on coin collect and return traffic. For this purpose the common release circuit of Fig. 13 is provided.

When all coin-control circuits to which a link and control circuit have access become busy, the busy relays of such coin-control circuits such as 805—806—807 will be operated and will over their lower contacts establish the circuit of group busy relay 801 of Fig. 8. Similarly when all coin-control circuits accessible from other link and control circuits are busy, corresponding group busy relays such as 800 will be operated. Thus if all coin-control circuits are busy, a circuit will be established from ground over the chain connected contacts of such group busy relays 800, 801, etc., conductor 820 through the winding of relay 1302 to battery. Relay 1302 upon operating establishes a circuit from ground over the lower back contact of relay 1303, upper front contact of relay 1302, next to upper normal contacts of relay 1304 through the winding of counting relay 1305 to battery. Relay 1305 upon operating locks over its inner upper front contact, over the inner upper back contacts of counting relays 1306 to 1311, inclusive, inner lower and inner upper back contacts of relay 1303 to ground at its own upper front contact and extends this locking ground to the winding of relay 1304. Relay 1304 now operates (a) locks over its next to upper front contact and the upper front contact of relay 1302 to ground at the lower back contact of relay 1303 and applies this locking ground over the inner lower back contact of relay 1303 and thence over the circuit previously traced over back contacts of counting relays 1306 to 1311, inclusive, over the inner upper front contact of relay 1305 to battery through the winding of relay 1305 to hold relay 1305 operated; (b) connects ground over its lower front contact to conductor 1312 to light a lamp and to operate an audible alarm on the coin-control circuit make-busy frame (not shown); (c) connects ground over its next to lower front contact and conductor 1313 to the district junctor automatic test circuit (not shown); (d) prepares the circuit of relay 1314 over its next to inner upper front contact; (e) closes circuits for relay 1301 and other similar relays multiplied thereto extending from battery through resistance 1315, the inner upper front contact of relay 1304, the upper normal contacts of relay 1316 and through the winding of relay 1301 to ground; (f) connects battery through resistance 1318 over its inner lower front contact and the back contact of relay 1314 to conductor 1317 for lighting a lamp at the monitor position of the "A" switchboard as an indication to the supervisor that all coin-control circuits are busy; and (g) closes circuits

for relay 1300 and other similar relays multiplied thereto extending from battery through resistance 1319, upper front contact of relay 1304, lower front contact of relay 1305 through the winding of relay 1300 to ground. When the supervisor desires to extinguish the lamp lighted over conductor 1317, she depresses a key at her position which applies ground to conductor 1320 thereby completing the circuit of relay 1314 which operates; locks in a circuit through its winding, next to inner upper front contact of relay 1304 to ground at the front contact of relay 1314 and opens the circuit for the lamp extending over its back contact.

The operation of relay 1301 and other similar relays multiplied therewith connects ground to conductors 1321, 1322 and 1323 extending to all of the coin-control circuits. One coin-control circuit to which conductor 1321 extends is shown completely in Figs. 9 to 12, inclusive, and two other coin-control circuits are indicated by the boxes 920 and 921 in the upper portion of Fig. 9. The connection of ground to these conductors causes all coin-control circuits to cancel the test for the presence of a coin on all "coin collect" traffic served by the coin-control circuit by operating the relay 1002 in each such circuit which has its coin-collect relay 1001 operated. It will be recalled that relay 1002 ordinarily operates to cancel the coin test if a deposited coin is found in a coin box and relay 1021 operates. For example, the connection of ground to conductor 1321 with relay 1001 operated completes a circuit over the middle lower front contact of relay 1001 through the winding of relay 1002 to battery. This action is necessary in order to avoid erroneous lamp signals before the monitoring operator for those calls served by district junctors for which the calling subscribers have failed to make coin deposits for any over-time intervals.

The operation of relay 1300 and other similar relays multiplied therewith connects conductors such as 1324, 1325 and 1326 to conductors such as 1327, 1328 and 1329, respectively. This action prepares all coin-control circuits for automatically releasing all "coin overtime" calls served by the control circuits which are not engaged in talking connections with monitoring operators. The circuit for releasing the coin-control circuit of Figs. 9 to 12, inclusive, may be traced from battery through the winding of release relay 904, conductor 1327, outer right front contact of relay 1300, conductor 1324, next to lower front contact of overtime relay 1000 which is operated if this coin-control circuit is serving a district junctor on a coin overtime call, conductor 1044, lower back contact of relay 1103, which will not be operated if the monitoring operator is not talking on the connection to the district junctor associated with the coin-control circuit, conductor 1112, inner lower back contact of relay 900 to ground on conductor 819. Relay 904 will thus operate and as previously described release the coin-control circuit to render it available for another coin service call. Similar circuits are established for the release relays of other coin-control circuits such as those typified by the boxes 920 and 921.

As previously stated, the operation of relays such as 1300 serve to automatically release "coin overtime" calls being served by the coin-control circuits. The interval during which this condition is maintained is from sixty to ninety sec-

onds and is controlled by counting relays 1305, 1306 and 1307 which record pulses supplied by interrupter 1330. When any relay such as 1300 operates, it applies ground over its inner right front contact to the cam spring of interrupter 1330 which upon the first closure with its right spring completes a circuit over the upper back contact of relay 1302, which relay releases as soon as the coin-control circuit was released and in turn released its make-busy relay, such as 805, through the winding of relay 1331 to battery. Relay 1331 upon operating closes a holding circuit for relay 1305 extending from battery through the winding and middle upper front contact of relay 1305 to ground at the front contacts of relay 1331 and closes a circuit for operating counting relay 1306 extending from battery through the winding of relay 1306, inner lower front contact of relay 1305 to ground over the front contacts of relay 1331. Relay 1306 upon operating locks in a circuit extending over its inner upper front contact, thence over the inner upper back contacts of relays 1307 to 1311, inclusive, inner lower and inner upper back contacts of relay 1303 to ground over its own upper front contact and at its inner upper back contact opens the first traced locking circuit of relay 1305. When interrupter 1330 opens its contacts, relay 1331 releases thereby opening the second locking circuit of relay 1305 and the operating circuit of relay 1306 whereupon relay 1305 releases.

On the second closure of the contacts of interrupter 1330, relay 1331 again operates and with relay 1305 released, and relay 1306 operated, establishes an operating circuit for counting relay 1307 extending from battery, winding of relay 1307, inner lower contact of relay 1306, inner lower back contact of relay 1305 to ground over the contacts of relay 1331 and a second locking circuit for relay 1306 extending from battery through the winding and middle upper contact of relay 1306, middle upper back contact of relay 1305 to ground over the contacts of relay 1331. Relay 1307 upon operating locks over its inner upper front contact over the inner upper back contacts of relays 1308 to 1311, inclusive, over back contacts of relay 1303 to ground over its own upper front contact and at its inner upper back contact opens the first traced locking circuit of relay 1306. On the next opening of the contacts of interrupter 1330, relay 1331 releases thereby opening the second locking circuit of relay 1306 and the operating circuit of relay 1307, whereupon relay 1306 releases.

On the third closure of the contacts of interrupter 1330, relay 1331 again operates and with relays 1305 and 1306 released and relay 1307 operated, establishes an operating circuit for counting relay 1308 extending from battery through the winding of relay 1308, inner lower front contact of relay 1307, inner lower back contacts of relays 1306 and 1305 to ground over the contacts of relay 1331 and a second locking circuit for relay 1307 extending from battery through the winding and middle upper contact of relay 1307, middle upper back contacts of relay 1306 and 1305 to ground over the contacts of relay 1331. Relay 1308 upon operating locks over its inner upper front contact and the inner upper back contacts of relays 1309 to 1311, inclusive, over back contacts of relay 1303 to ground over its own upper front contact and at

its inner upper back contact opens the first traced locking circuit of relay 1307.

Relay 1308 upon operating establishes a circuit for operating relay 1332 which may be traced from battery through the winding of relay 1332, lower back contact of relay 1302, lower front contact of relay 1308 to ground. Relay 1332 upon operating connects ground to conductor 1313 for the purpose previously stated and closes an obvious operating circuit for relay 1316 which at its lower front contact applies ground to the cam spring of interrupter 1333 for the purpose of counting additional impulses for operating counting relays and performs other functions to be described later. On the next opening of the contacts of interrupter 1330, provided the contacts of interrupter 1333 are open at this time, relay 1331 releases thereby opening the second locking circuit of relay 1307 and the operating circuit of relay 1308, whereupon relay 1307 releases. As soon as relay 1307 releases and since relays 1305 and 1306 are also released, the circuit for operating relay 1300 and similarly multiplied relays is opened ending the interval during which the coin-control circuits serving coin overtime calls are dismissed. It is assumed that the peak load condition of all busy coin-control circuits has passed or is sufficiently relieved when relays 1300, etc., released so that the control circuit can again serve the "coin overtime" traffic offered by district junctors. If the peak load again causes all coin-control circuits to become busy after the sixty to ninety seconds interval has elapsed, the circuit functions as described hereinafter to restart another coin-control release interval.

As before stated, "coin overtime" calls are automatically released during peak load conditions for an interval of sixty to ninety seconds. It is therefore necessary that the coin-control circuits cancel the test for the presence of coins on all subsequent coin-collect calls for an interval which insures that no erroneous lamp signals will appear at the monitoring position for such calls. This interval must be at least four and one-half minutes after the automatic release of "coin overtime" calls has ceased. Hence counting relays 1309, 1310 and 1311 and relay 1303 are used to count four impulses supplied by interrupter 1333 which amounts to from six to eight minutes of time. The closure of contacts of interrupter 1333 will operate relay 1331 thereby causing the operation of relay 1309 over a circuit extending from battery through the winding of relay 1309, inner lower front contact of relay 1308, inner lower back contacts of relays 1307, 1306 and 1305 to ground over the contacts of relay 1331 and closes a second locking circuit for relay 1308 extending through the winding and middle upper front contact of relay 1308 over middle upper back contacts of relays 1307, 1306 and 1305 and thence over contacts of relay 1331 to ground. Relay 1309 upon operating locks in a circuit extending over its inner upper front contact, thence over the inner upper back contacts of relays 1310 and 1311 and back contacts of relay 1303 to ground over its own upper front contact and at its inner upper back contact opens the first traced holding circuit of relay 1308. When the interrupter 1333 opens its contacts, relay 1331 releases thereby opening the second locking circuit of relay 1308 and the operating circuit of relay 1309 whereupon relay 1308 releases.

On the second closure of the contacts of interrupter 1333, relay 1331 again operates and

establishes an operating circuit for relay 1310 from battery through the winding of relay 1310, inner lower front contact of relay 1309, inner lower back contact of relay 1308, and thence as traced to ground over the contacts of relay 1331 and closes a second holding circuit for relay 1309 extending through the winding and upper middle front contact of relay 1309, middle upper back contact of relay 1308 and thence as traced to ground over the contacts of relay 1331. Relay 1310 upon operating locks in a circuit extending over its inner upper front contact, thence over the inner upper back contact of relay 1311 and back contacts of relay 1303 to ground over its own upper front contact and at its inner upper back contact opens the first traced locking circuit of relay 1309. When the interrupter 1323 opens its contacts, relay 1331 releases thereby opening the second locking circuit of relay 1309 and the operating circuit of relay 1310 whereupon relay 1309 releases. On the third closure of the contacts of interrupter 1333, relay 1331 again operates and establishes an operating circuit for relay 1311 from battery through the winding of relay 1311, inner lower front contact of relay 1310, inner lower back contact of relay 1309 and thence as traced to ground over the contacts of relay 1331 and closes a second holding circuit for relay 1310 through the winding and middle upper front contact of relay 1310, middle upper back contact of relay 1309 and thence as traced to ground over the contacts of relay 1331. Relay 1311 upon operating locks in a circuit over its inner upper front contact and the back contacts of relay 1303 to ground over its own upper front contact and at its inner upper back contact opens the first traced locking circuit of relay 1310. When the interrupter 1333 opens its contacts, relay 1331 releases thereby opening the second locking circuit of relay 1310 and the operating circuit of relay 1311, whereupon relay 1310 releases. On the fourth closure of the contacts of interrupter 1333, relay 1331 again operates and establishes an operating circuit for relay 1303 extending from battery through its winding, the inner lower front contact of relay 1311, the inner lower back contact of relay 1310 and thence as traced to ground over the contacts of relay 1331 and closes a second locking circuit for relay 1311 extending through the winding and middle upper front contact of relay 1311, middle upper back contact of relay 1310 and thence as traced to ground over the contacts of relay 1331. Relay 1303 upon operating locks over its inner upper front contact to ground over the upper front contact of relay 1311; at its inner lower and inner upper back contacts opens the first traced locking circuit of relay 1311 and opens the circuit of relay 1304 which releases in turn releasing relay 1314 if operated. When interrupter 1333 again opens its contacts, relay 1331 releases in turn releasing relay 1311. Relay 1311 upon releasing releases relays 1303 and 1332 and relay 1332 in turn releases relay 1316. With relay 1316 released, relay 1301 and similar relays multiplied thereto release and the automatic release circuit is then entirely restored to normal. If all coin-control circuits are busy when relay 1303 releases, then the timing cycle previously described is repeated. Ordinarily the peak load condition will have passed by the time that relay 1303 operates to restore the circuit to normal.

As previously described, all unanswered "coin overtime" calls are immediately dismissed from the coin-control circuits during the sixty to

ninety seconds interval after the coin-control circuits become busy, and the period of six to eight minutes is measured during which the coin test on "coin collect" traffic served by the coin-control circuits is canceled. If at any time during this latter period the peak load again causes all coin-control circuits to become busy, the circuit functions to restart another coin-control release interval. As previously described, relay 1322 operates upon the operation of counting relay 1308 at the end of the release interval and in turn operates relay 1316. Relay 1316 operated partially prepares over its next to the lower front contact a circuit for operating relay 1303 should relay 1302 reoperate; transfers over its upper contacts the operating circuit of relay 1301 from the control of relay 1304, directly to battery; prepares over its inner upper front contact a locking circuit for relay 1302 and connects ground over its lower front contact to the cam spring of interrupter 1333. If relay 1302 operates at this time due to all coin-control circuits becoming busy, it locks under the control of relay 1316 over its lower front contact; opens at its lower back contact the circuit of relay 1332 which starts to release; establishes an operating circuit for relay 1303 which extends from ground over the lower front contact of any one of relays 1308 to 1311, inclusive, inner lower front contact of relay 1302, inner lower front contact of relay 1316, through the winding of relay 1303 to battery; prepares at its upper front contact the operating circuit for relay 1305 and at its upper back contact opens the circuit of relay 1331 to prevent any impulse from the interrupters 1330 or 1333 from interfering with the immediate release of counting relays 1307 to 1311, inclusive. With relay 1331 released and relay 1303 operated, relay 1304 and any of relays 1307 to 1311, inclusive, which may be operated are released, whereupon relay 1303 releases thus reclosing the circuit for reoperating relay 1305. Relay 1305 operated, locks under the control of relay 1303 and causes relay 1304 to reoperate, thus restarting the timing for another coin-control release interval. Relay 1332 is slow to release in order to allow sufficient time before it releases to cover the recycling interval from the time that relay 1302 operates until relay 1304 reoperates. At the completion of this interval, relay 1332 releases and in turn releases relay 1316.

What is claimed is:

1. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks of said group, a plurality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said mechanisms, means in each of said mechanisms for causing the collection of a deposited coin, means for testing to determine if the coin has been deposited, and means common to said mechanisms operable when all of said mechanisms are busy for cancelling the coin test in each of said mechanisms.

2. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks of said group, a plu-

5 rality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said controlling mechanisms, means in each of said mechanisms for causing the collection of a deposited coin, means for then causing the release of said mechanism from the trunk with which it is associated, means effective at the end of each conversational period for causing an idle controlling mechanism to be connected to said trunk to determine if another coin has been deposited, means effective if the test indicates that another coin has been deposited for disconnecting said mechanism from said trunk, and means common to said mechanisms operable when all of said mechanisms are busy for cancelling the test in each of said mechanisms for additionally deposited coins.

3. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks of said group, a plurality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said controlling mechanisms, means in each of said mechanisms for causing the collection of a deposited coin, means for then causing the release of said mechanism from the trunk with which it is associated, means effective at the end of each conversational period for causing an idle controlling mechanism to be connected to said trunk to determine if another coin has been deposited, means effective if another coin has been deposited for disconnecting said mechanism from said trunk, means common to said mechanisms operable when all of said mechanisms are busy for cancelling for a predetermined period the test in each of said mechanisms for additionally deposited coins, and counting means associated with said common means for determining the length of said period.

4. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks in said group, a plurality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said controlling mechanisms, means in each of said mechanisms for causing the collection of a deposited coin, means for then causing the release of said mechanism from the trunk with which it is associated, an operator's position, means controlled by said mechanism if it fails to find a deposited coin for signaling the operator at said position, means at said position to enable the operator to establish a conversational connection with the calling line, and means common to said mechanisms operable when all of said mechanisms are busy for releasing all mechanisms which have been seized on overtime calls and are awaiting the response of the operator.

5. In a telephone system, a plurality of pay

station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks of said group, a plurality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said controlling mechanisms, means in each of said mechanisms for causing the collection of a deposited coin, means for then causing the release of said mechanism from the trunk with which it is associated, an operator's position, means controlled by said mechanism if it fails to find a deposited coin for signaling the operator at said position, means at said position to enable the operator to establish a conversational connection with the calling line, means common to said mechanisms operable when all said mechanisms are busy for automatically releasing all mechanisms that have been seized on overtime calls and are awaiting the response of the operator, and means associated with said common means for determining the length of the period during which said automatic release means shall remain effective.

6. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks of said group, a plurality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said mechanisms, means in each of said mechanisms for causing the collection of a deposited coin, means for thereafter releasing said mechanism from the trunk with which it is associated, means effective at the end of each conversational period for causing an idle mechanism to be connected with the trunk to test for the deposit of an additional coin, an operator's position, means controlled by said mechanism if it fails to find any deposited coin for signaling the operator, means at said position to enable the operator to establish a connection with the calling line, and means common to said mechanisms operable when all of said mechanisms are busy for cancelling the deposited coin test at each of said mechanisms and for releasing all mechanisms which are awaiting the response of the operator on overtime calls.

7. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks of said group, a plurality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said mechanisms, means at each of said mechanisms for causing the collection of a deposited coin, means for thereafter releasing said mechanism from the trunk with which it is associated, means effective at the end of each conversational period for causing an idle mechanism to be connected to the trunk to test for the deposit of an additional coin, an operator's position, means controlled

by said mechanism if it fails to find a deposited coin for signaling the operator, means at said position to enable the operator to establish a connection with the calling line, and means common to said mechanisms operable when all of said mechanisms are busy for measuring a time interval and for releasing all mechanisms which are awaiting the response of the operator on overtime calls during said interval and for measuring an additional time interval and cancelling the deposited coin test at each of said mechanisms during said latter interval.

8. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks of said group, a plurality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said mechanisms, means in each of said mechanisms for causing the collection of a deposited coin, means for thereafter releasing said mechanism from the trunk with which it is associated, means effective at the end of each conversational period for causing an idle mechanism to be connected with the trunk to test for the deposit of an additional coin, an operator's position, means controlled by said mechanism if it fails to find a deposited coin for signaling the operator, means at said position to enable the operator to establish a connection with the calling line, and means common to said mechanisms operable when all of said mechanisms are busy for measuring a time interval and for releasing all mechanisms which are awaiting the response of the operator on overtime calls during said interval, for measuring an additional time interval and cancelling the deposited coin test at each of said mechanisms during said latter interval and for arresting the measurement of said latter interval and restarting the measurement of said first interval should all mechanisms again become busy during the measurement of said latter interval.

9. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks of said group, a plurality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said mechanisms, means in each of said mechanisms for causing the collection of a deposited coin, means for thereafter releasing said mechanism from the trunk with which it is associated, means effective at the end of each conversational period for causing an idle mechanism connected with the trunk to test for the deposit of an additional coin, an operator's position, means controlled by said mechanism if it fails to find a deposited coin for signaling the operator, means at said position to enable the operator to establish a connection with the calling line, and a release circuit common to said mechanisms comprising counting relays, two interrupters, means operable when all of said mechanisms become busy for successively operating certain of said relays under the control of one of said interrupters to measure a first time

interval, means operable during said interval for releasing all mechanisms which are awaiting the response of an operator on overtime calls, means for thereafter successively operating other of said relays under the control of the other of said interrupters to measure a second time interval, and means operable during both of said intervals for cancelling the deposited coin test at each of said mechanisms.

10. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a group of trunks, means for extending conversational connections from said lines over trunks of said group, a plurality of controlling mechanisms common to said group of trunks, timing means for measuring periods of conversation, means rendered effective during each period of conversation for connecting a trunk involved in a conversational connection with an idle one of said mechanisms, means in each of said mechanisms for causing the collection of a deposited coin, means for thereafter releasing said mechanism from the trunk with which it is associated, means effective at the end of each conversational period for causing an idle mechanism to be connected with the trunk to test for the deposit of an additional coin, an operator's position, means controlled by said mechanism if it fails to find a deposited coin for signaling the operator, means at said position to enable the operator to establish a connection with the calling line and a release circuit common to said mechanisms comprising counting relays, two interrupters, means operable when all of said mechanisms become busy for successively operating certain of said relays under the control of one of said interrupters to measure a first time interval, means operable during said interval for releasing all mechanisms which are awaiting the response of an operator on overtime calls, means for thereafter successively operating other of said relays under the control of the other of said interrupters to measure a second time interval, means operable during both of said intervals for cancelling the deposited coin test at each of said mechanisms, and means operable if all mecha-

nisms are found to be busy during the second interval to arrest the measurement of said second interval and to restart the measurement of said first interval.

11. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a plurality of trunks divided into a plurality of subgroups, means for extending conversational connections from said lines over trunks of said groups, a plurality of control mechanisms common to said groups for controlling the collection of deposited coins, means rendered effective for connecting trunks involved in conversational connections with idle ones of said mechanisms, and means common to said groups of trunks having trunk subgroup signals, alarm operating means and means operative if there is an abnormal delay in connecting any of said trunks with idle mechanisms for operating said alarm operating means and for selectively operating said subgroup signals to indicate the subgroups of trunks in which abnormal delays have occurred.

12. In a telephone system, a plurality of pay station lines, means at said pay station lines for collecting deposited coins, a plurality of trunks divided into a plurality of subgroups, means for extending conversational connections from said lines over trunks of said groups, a plurality of control mechanisms common to said groups of trunks for controlling the collection of deposited coins, means rendered effective for connecting trunks involved in conversational connections with idle ones of said mechanisms and means common to said groups of trunks having timing means, subgroup signals, alarm operating means and means under the control of said timing means for operating said alarm operating means and for selectively operating said subgroup signals to indicate the subgroups of trunks in which there are trunks requiring the services of said mechanisms if such trunks fail to become connected with said mechanisms during the interval measured by said timing means.

ALOYSIUS J. BUSCH.