

Sept. 6, 1938.

F. R. LAMBERTY

2,129,011

TELEPHONE SYSTEM

Filed Sept. 9, 1936

18 Sheets-Sheet 1

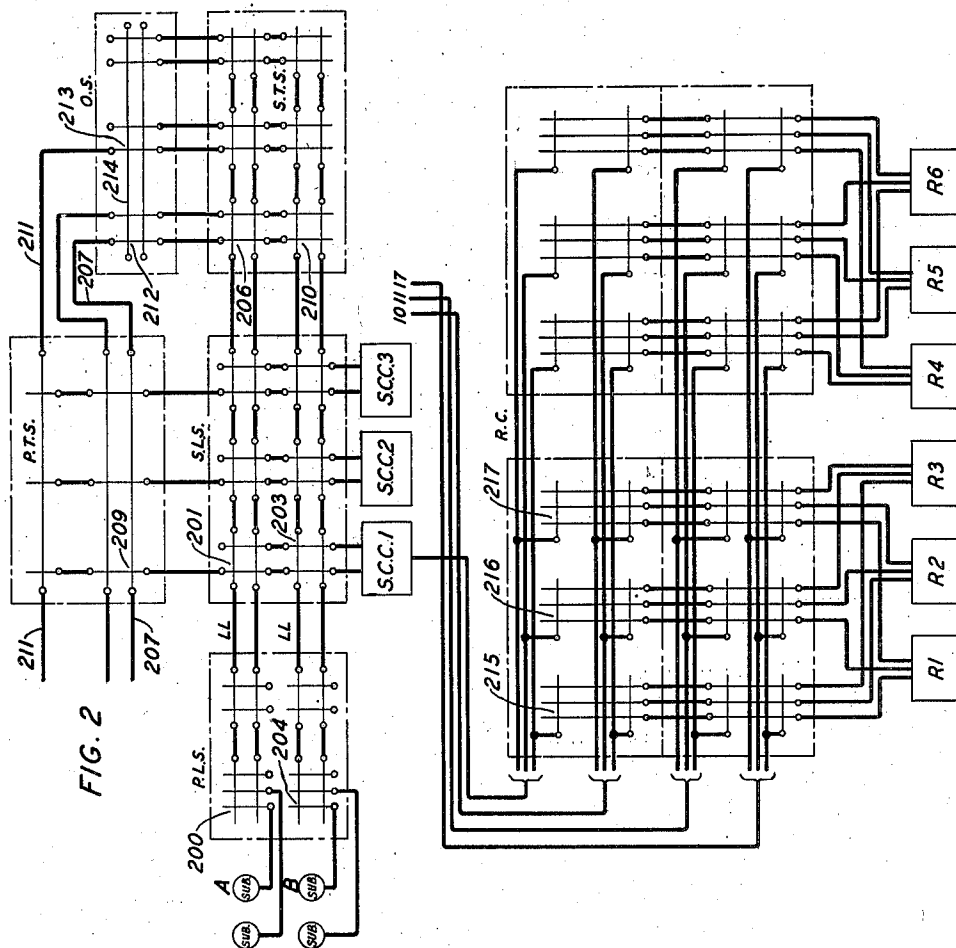


FIG. 1

FIGS. 1 & 2	FIG. 4	FIG. 15
FIG. 3	FIG. 5	FIG. 16
FIG. 6	FIG. 12	FIG. 17
FIG. 7	FIG. 13	FIG. 18
FIG. 8	FIG. 14	FIG. 19
FIG. 9	FIG. 10	FIG. 11

INVENTOR
F. R. LAMBERTY
BY *W. M. McKenney*
ATTORNEY

Sept. 6, 1938.

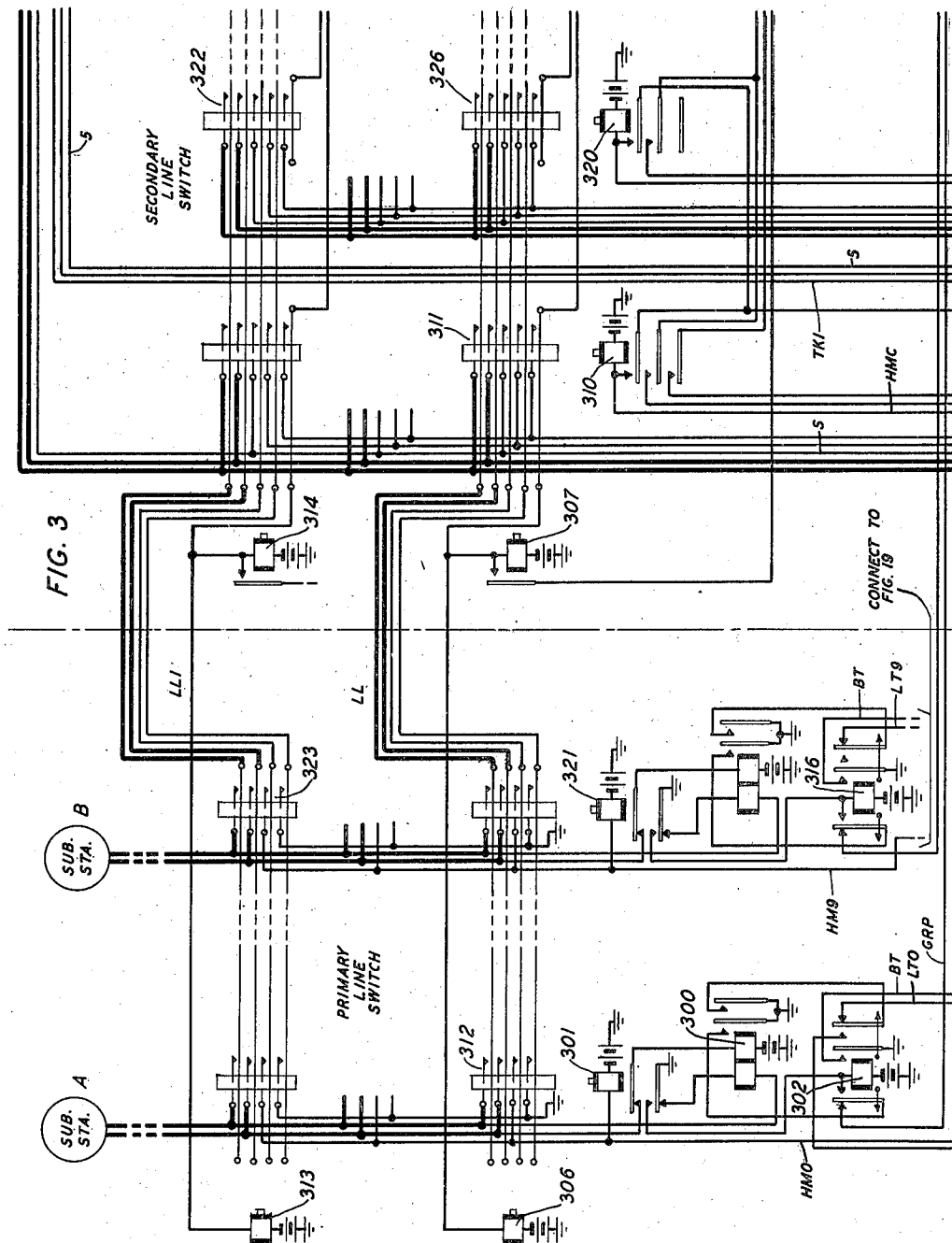
F. R. LAMBERTY

2,129,011

TELEPHONE SYSTEM

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18 Sheets-Sheet 2



INVENTOR
F. R. LAMBERTY
BY *W. P. McKenney*
ATTORNEY

Sept. 6, 1938.

F. R. LAMBERTY

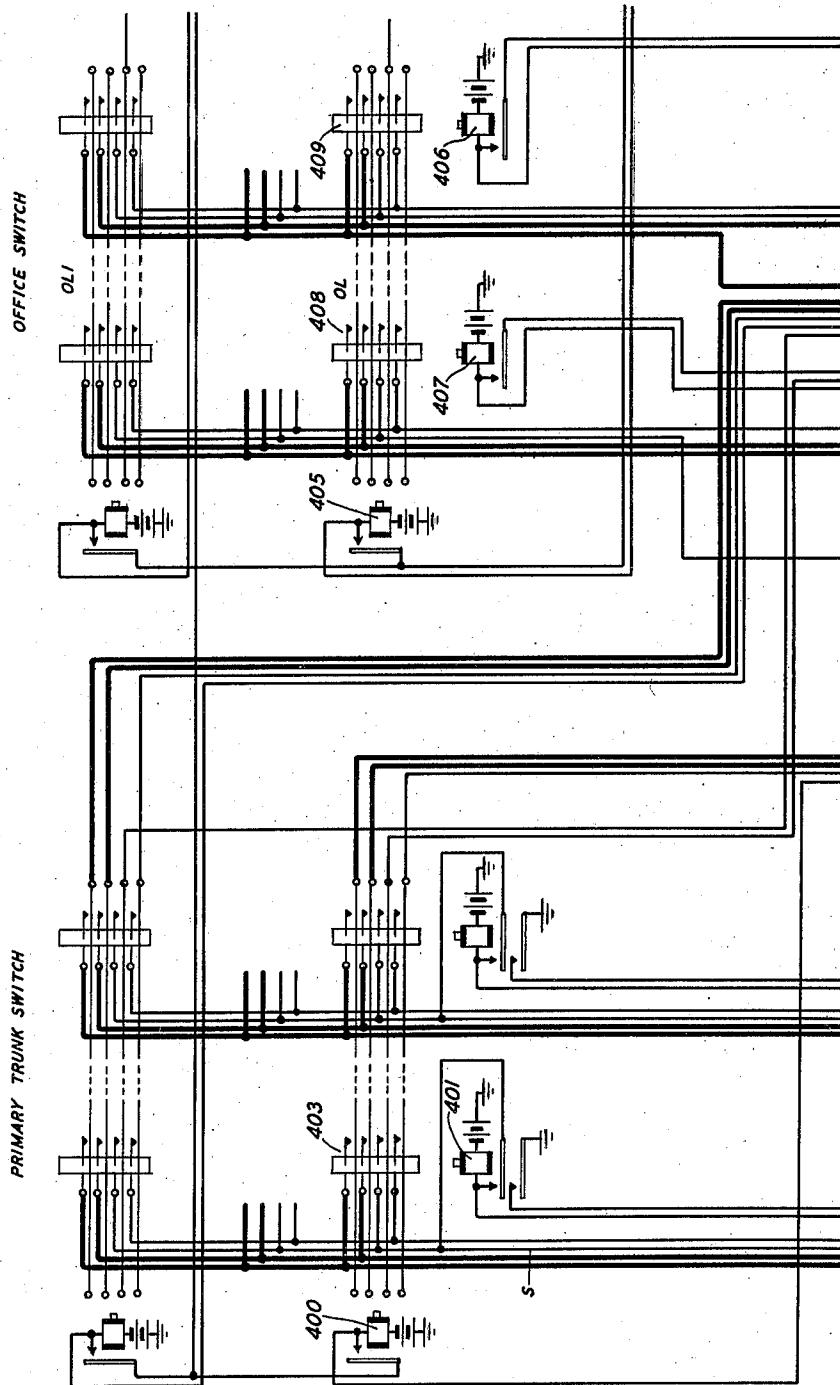
2,129,011

TELEPHONE SYSTEM

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18 Sheets-Sheet 3

FIG. 4



INVENTOR
F. R. LAMBERTY
BY *M. S. Pye*
ATTORNEY

Sept. 6, 1938.

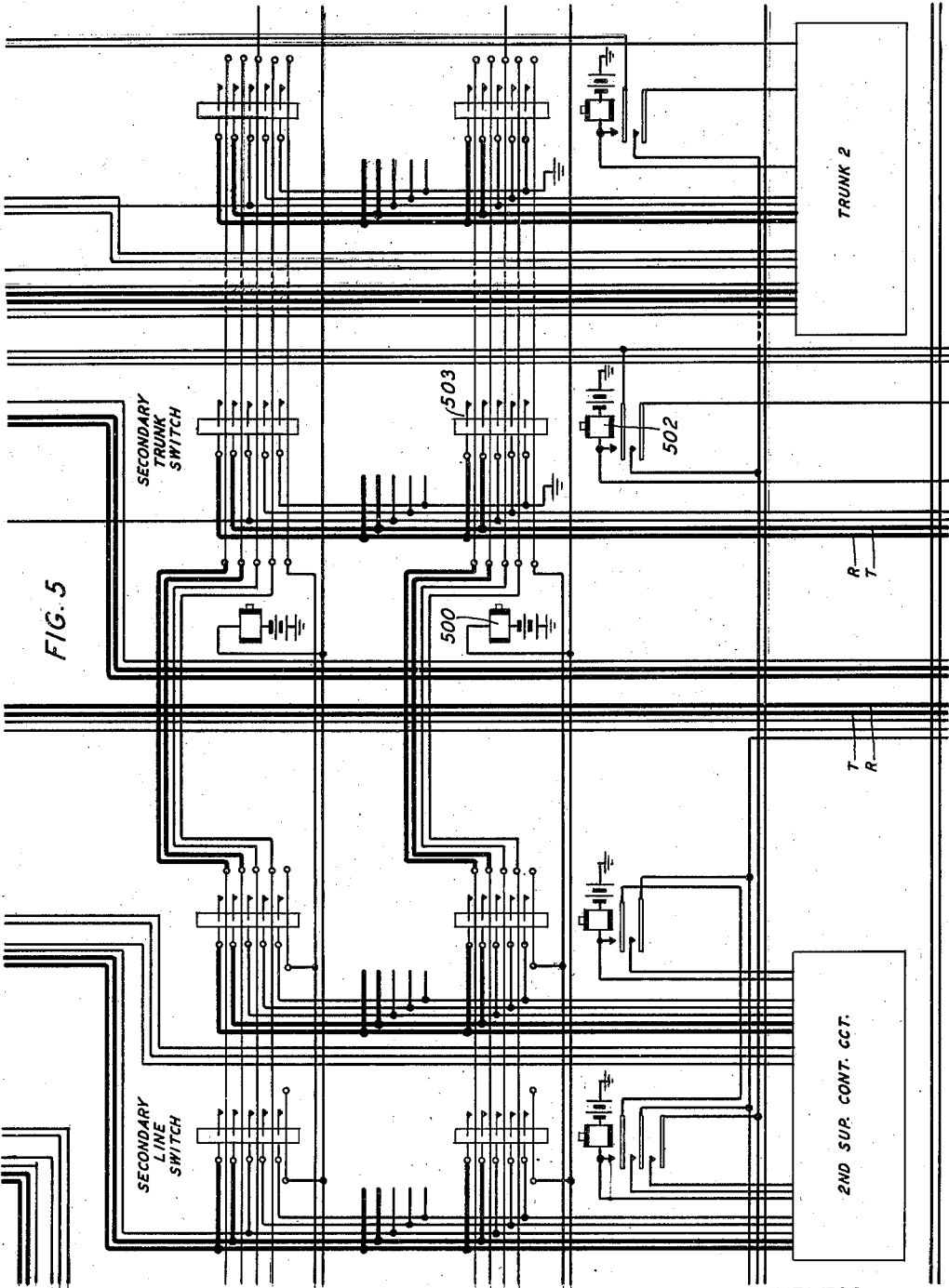
F. R. LAMBERTY

2,129,011

TELEPHONE SYSTEM

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18 Sheets-Sheet 4



INVENTOR
F. R. LAMBERTY
BY *M. P. Kenney*
ATTORNEY

Sept. 6, 1938.

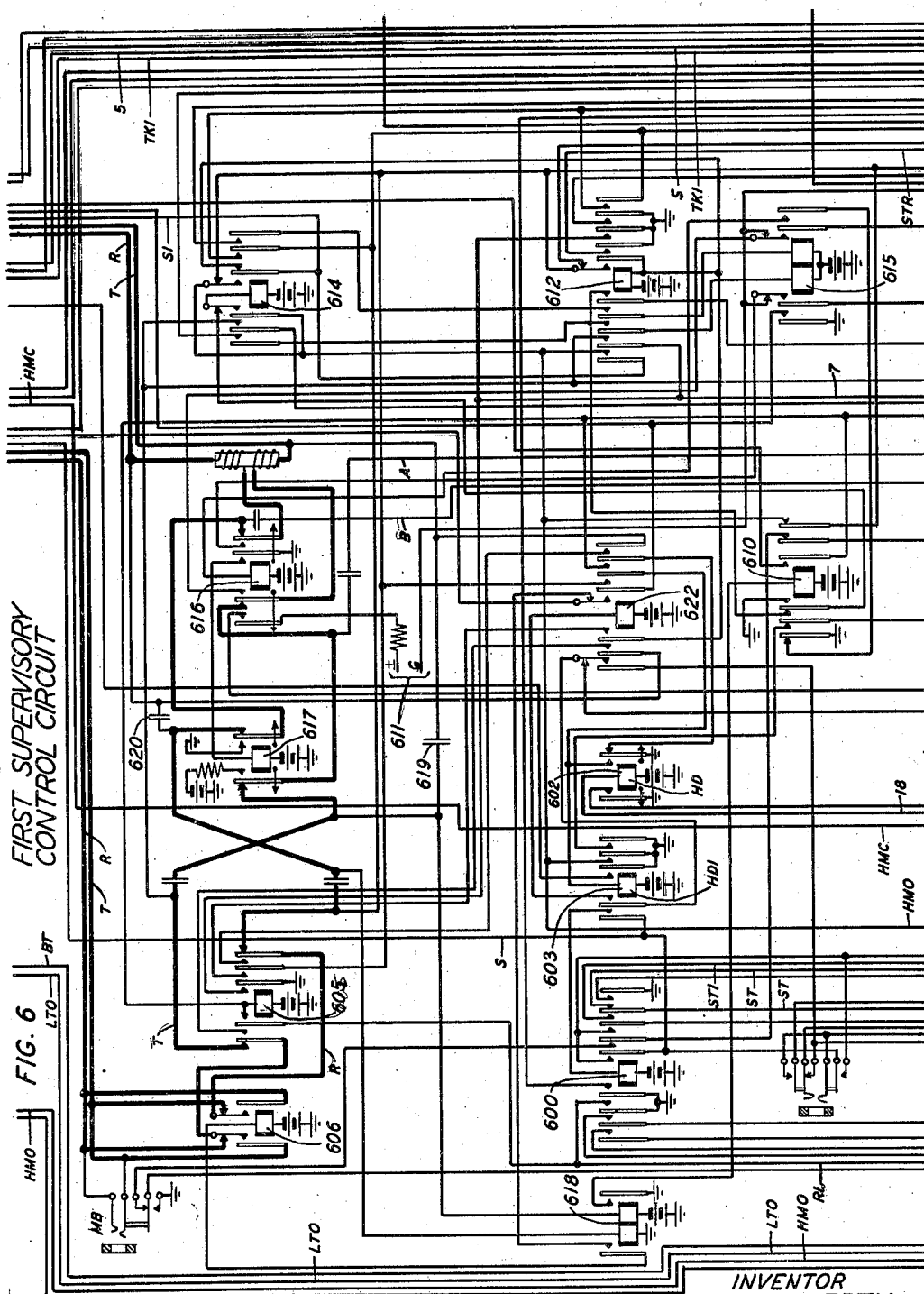
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**FIRST SUPERVISORY
CONTROL CIRCUIT**

FIG 6

INVENTOR
F. R. LAMBERTY

BY *M. J. McInerney*
ATTORNEY

Sept. 6, 1938.

F. R. LAMBERTY

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TELEPHONE SYSTEM

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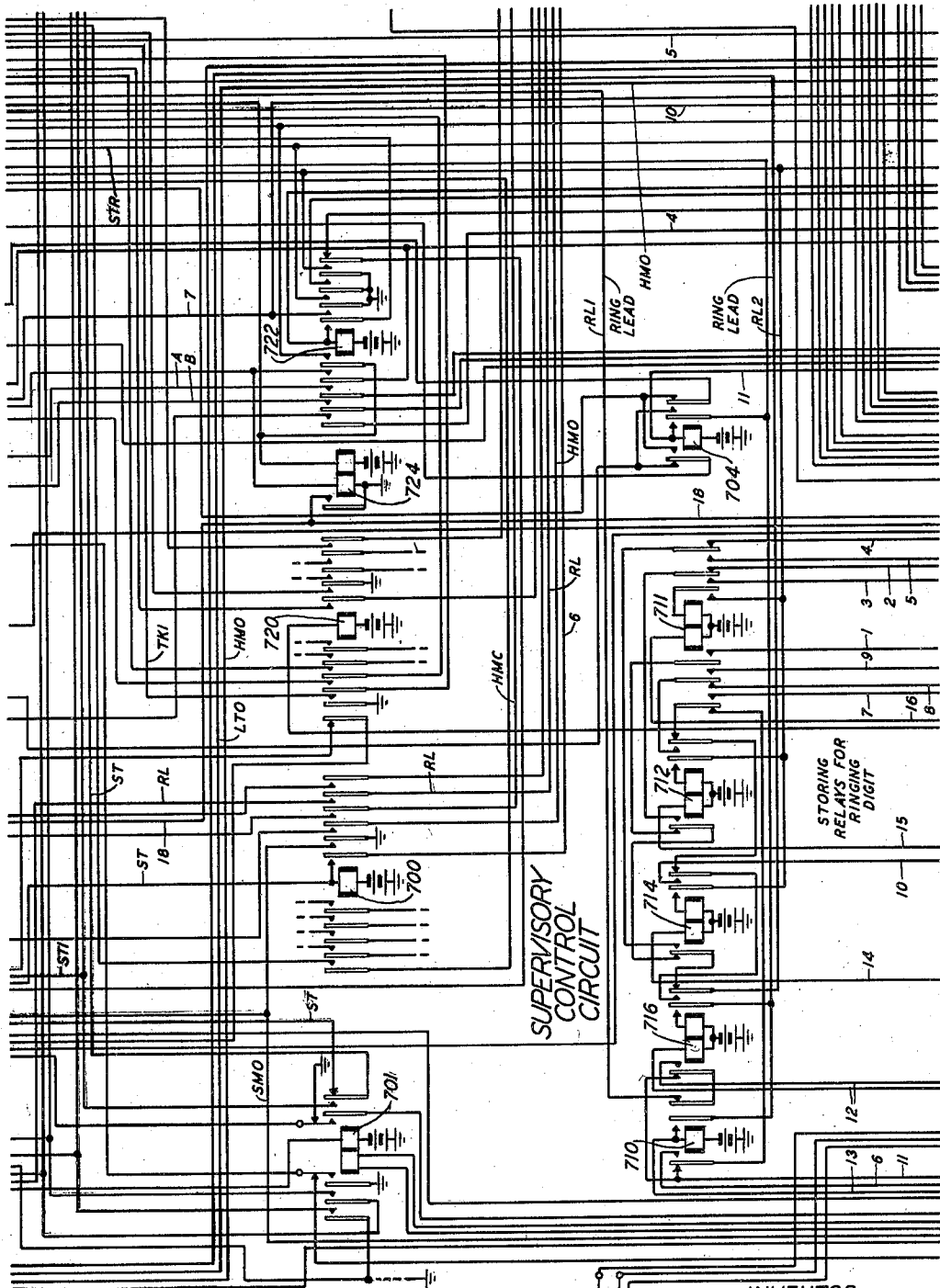


FIG. 7

INVENTOR
F. R. LAMBERTY
BY *W. J. McFadden*
ATTORNEY

Sept. 6, 1938.

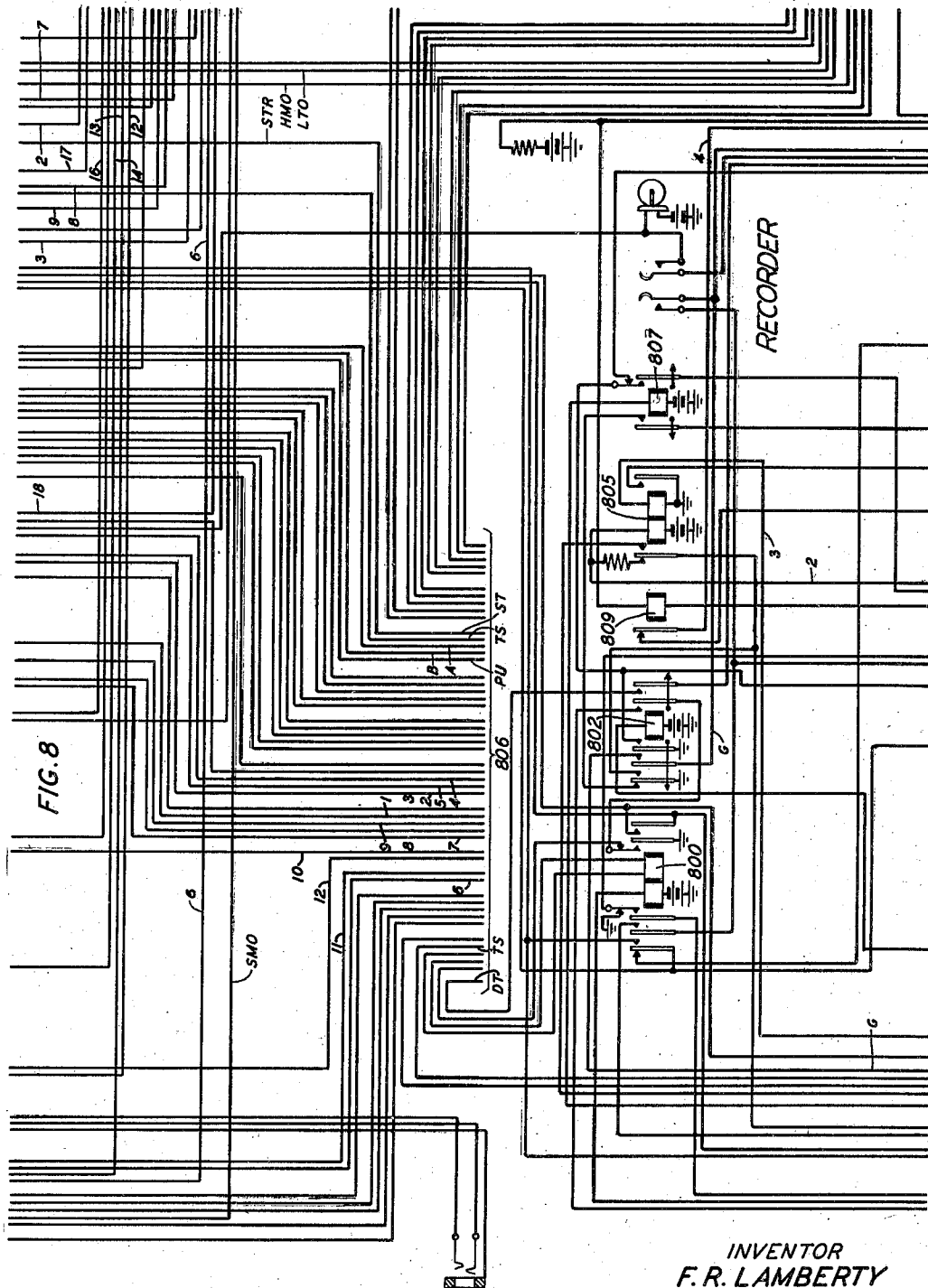
F. R. LAMBERTY

2,129,011

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18 Sheets-Sheet 7



INVENTOR
F. R. LAMBERTY
BY *M. J. McFenney*
ATTORNEY

Sept. 6, 1938.

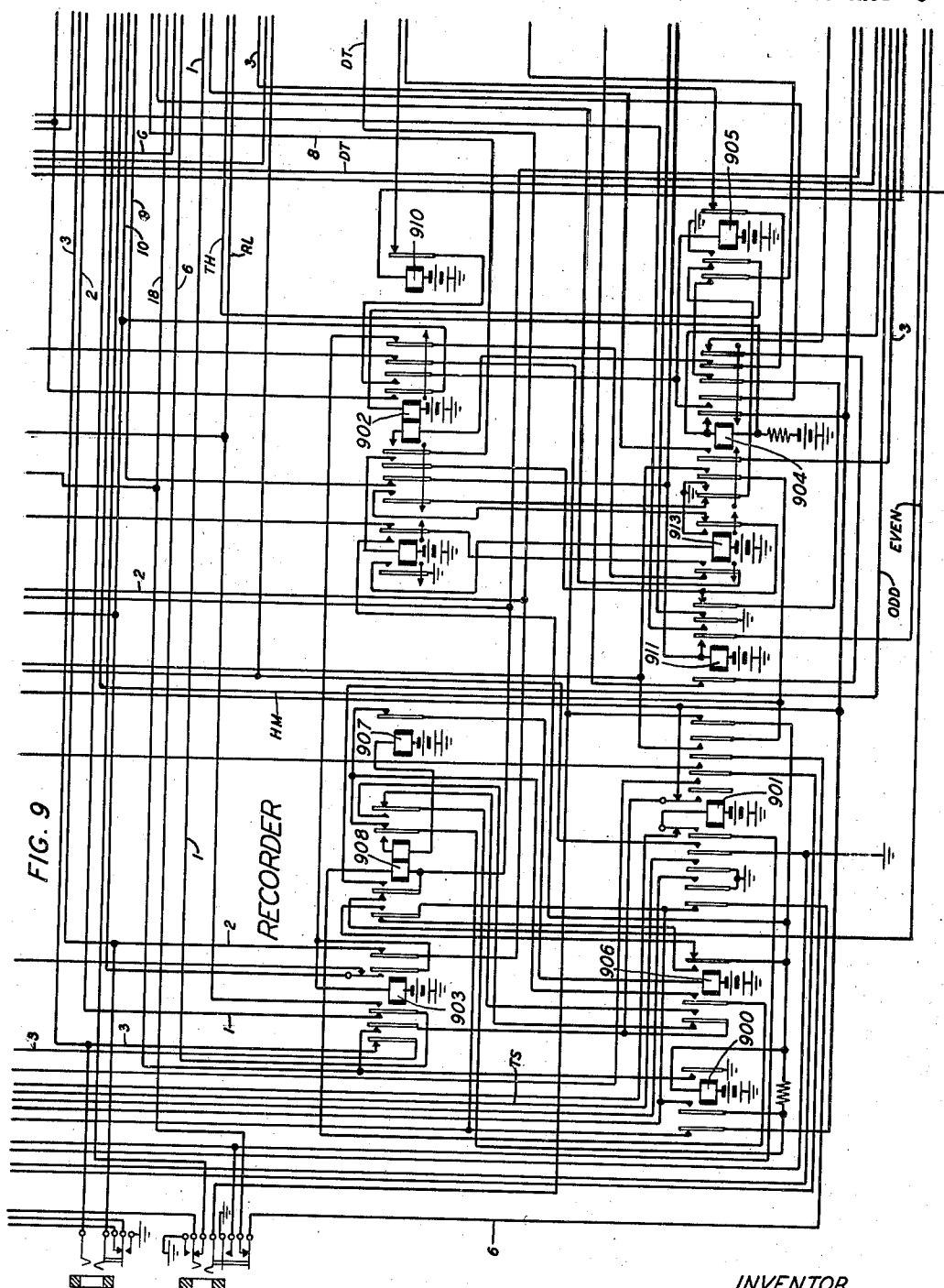
F. R. LAMBERTY

2,129,011

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18 Sheets-Sheet 8



INVENTOR
F. R. LAMBERTY
BY *M. J. McFenney*
ATTORNEY

Sept. 6, 1938.

F. R. LAMBERTY

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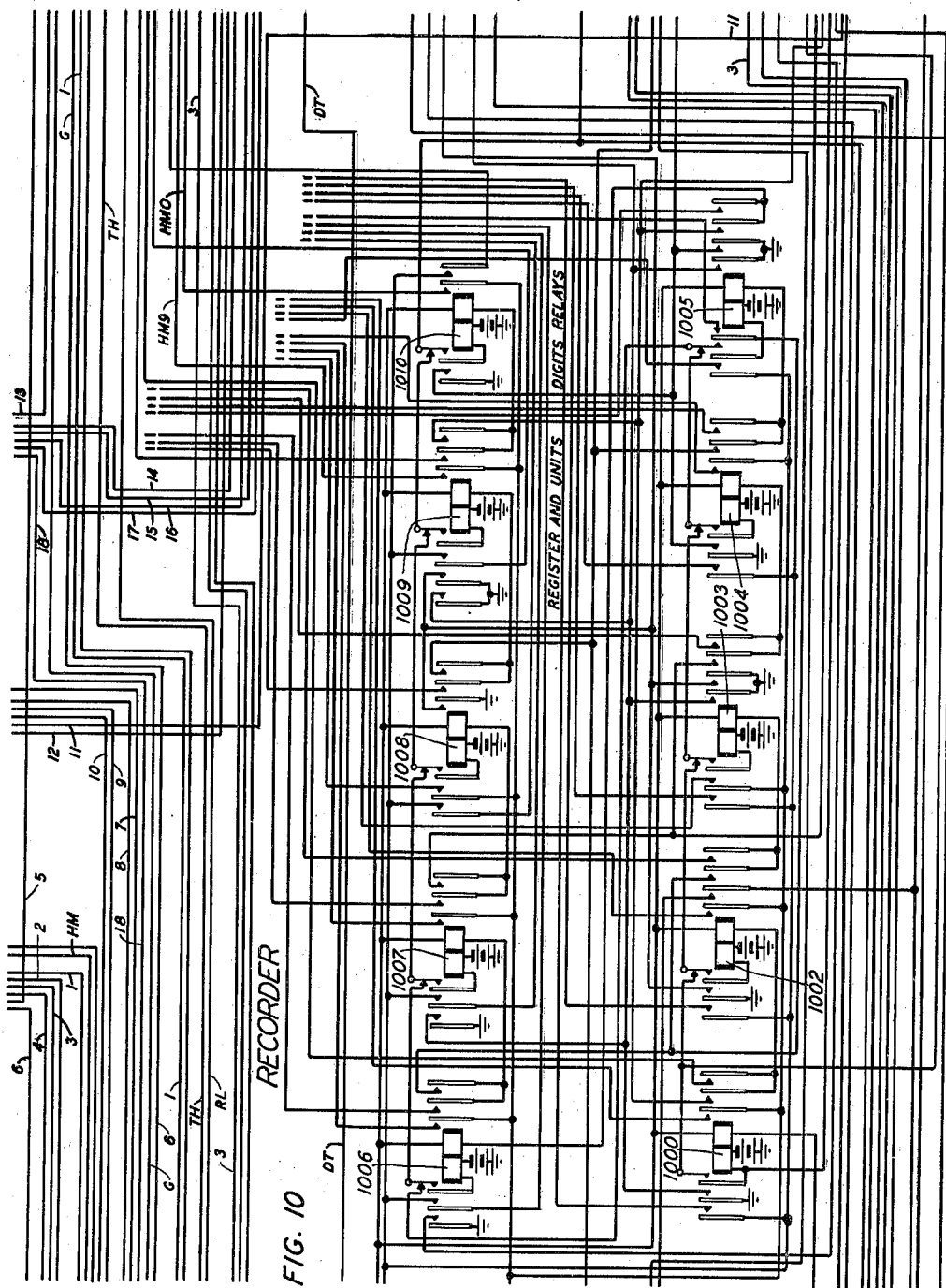


FIG. 10

INVENTOR
F. R. LAMBERTY
BY *W. J. McFenney*
ATTORNEY

Sept. 6, 1938.

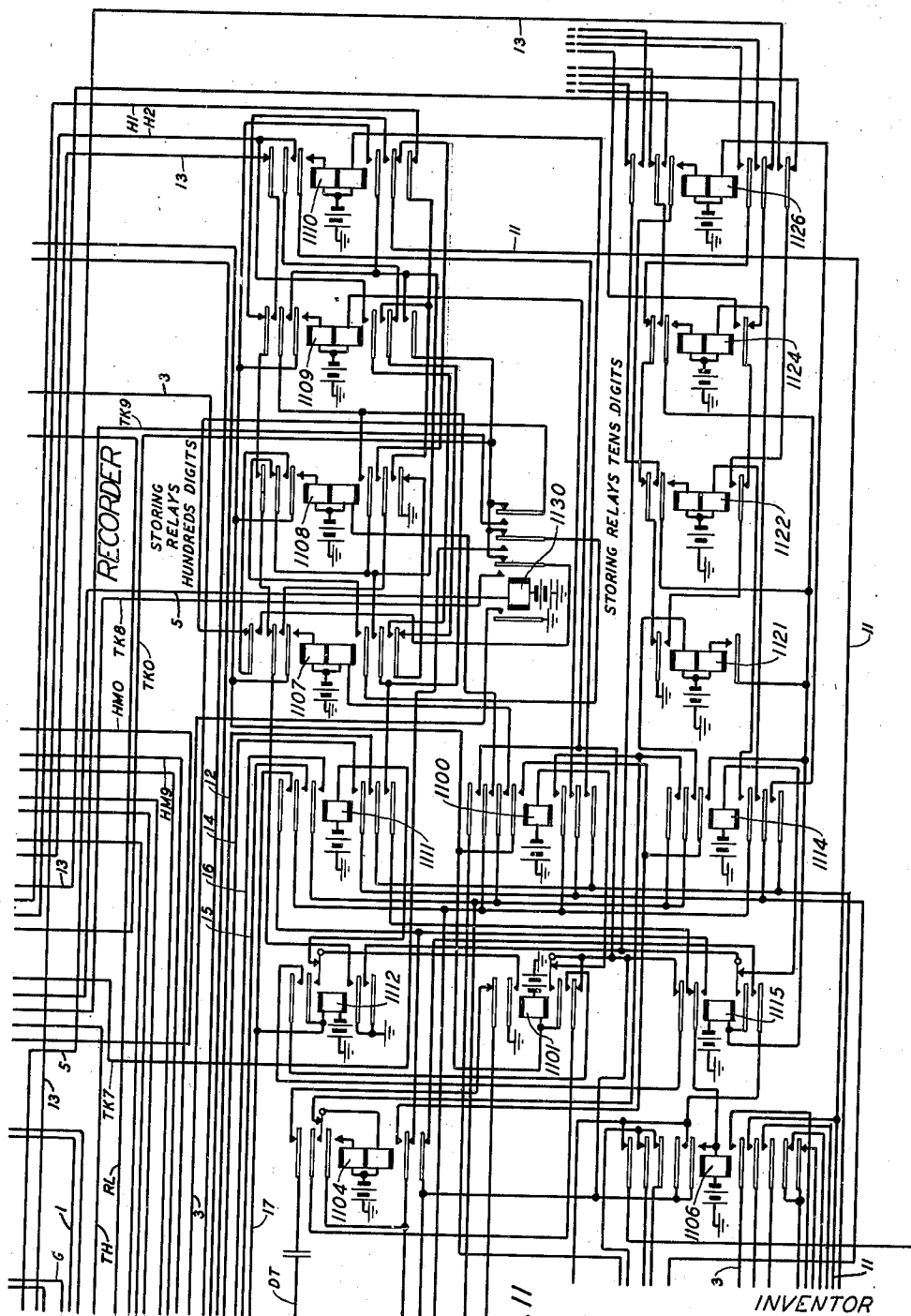
F. R. LAMBERTY

2,129,011

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18 Sheets-Sheet 10



INVENTOR
F. R. LAMBERTY
BY *W. P. McKeeney*
ATTORNEY

Sept. 6, 1938.

F. R. LAMBERTY

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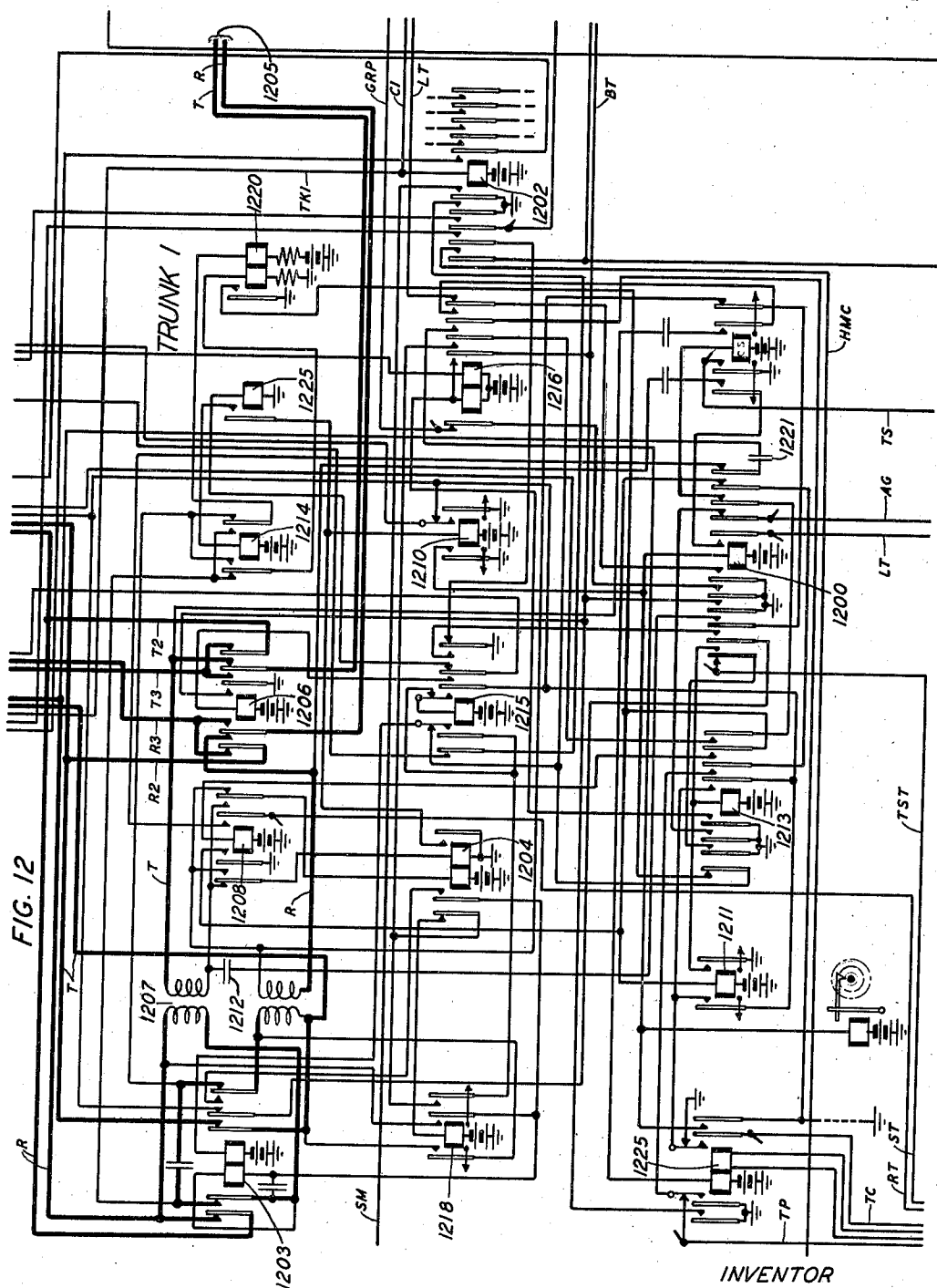


FIG. 12

INVENTOR
F. R. LAMBERTY
BY *W. P. McHenry*
ATTORNEY

Sept. 6, 1938.

F. R. LAMBERTY

2,129,011

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Filed Sept. 9, 1936

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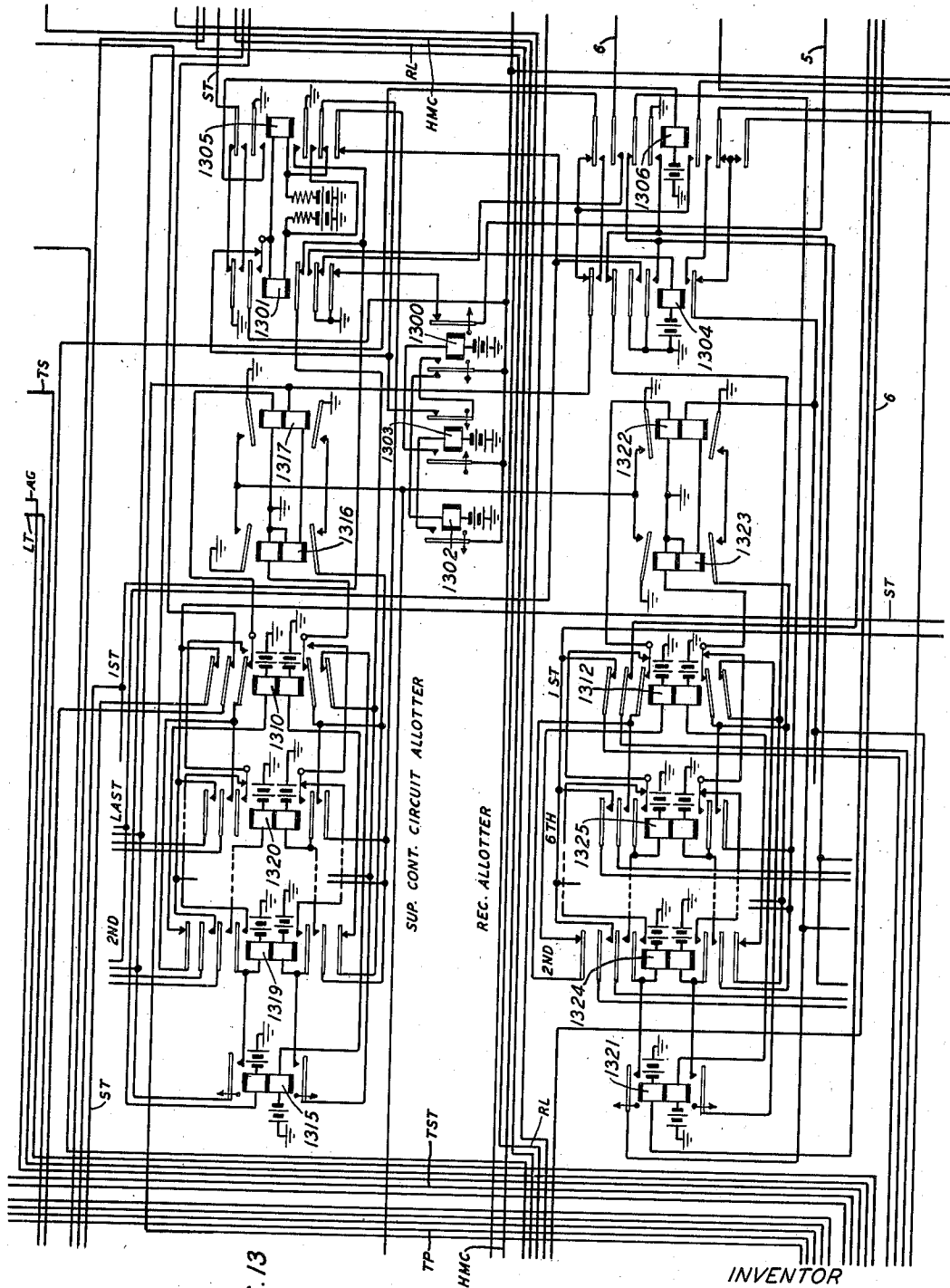


FIG. 13

INVENTOR
F. R. LAMBERTY
BY *M. P. McFadden*
ATTORNEY

Sept. 6, 1938.

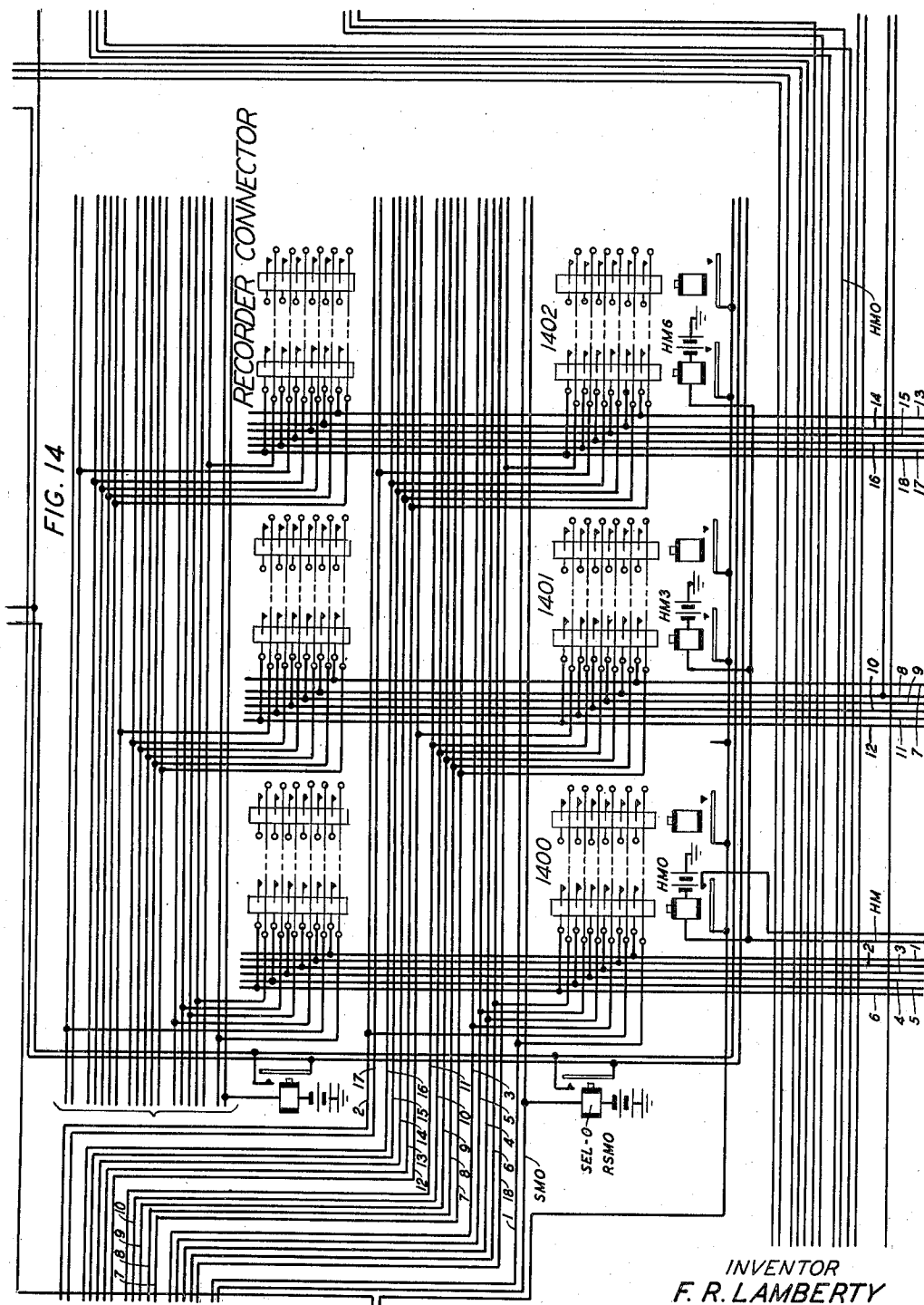
F. R. LAMBERTY

2,129,011

TELEPHONE SYSTEM

Filed Sept. 9, 1936

18 Sheets-Sheet 13



INVENTOR
F. R. LAMBERTY
BY *M. J. M. J. J. J.*
ATTORNEY

Sept. 6, 1938.

F. R. LAMBERTY

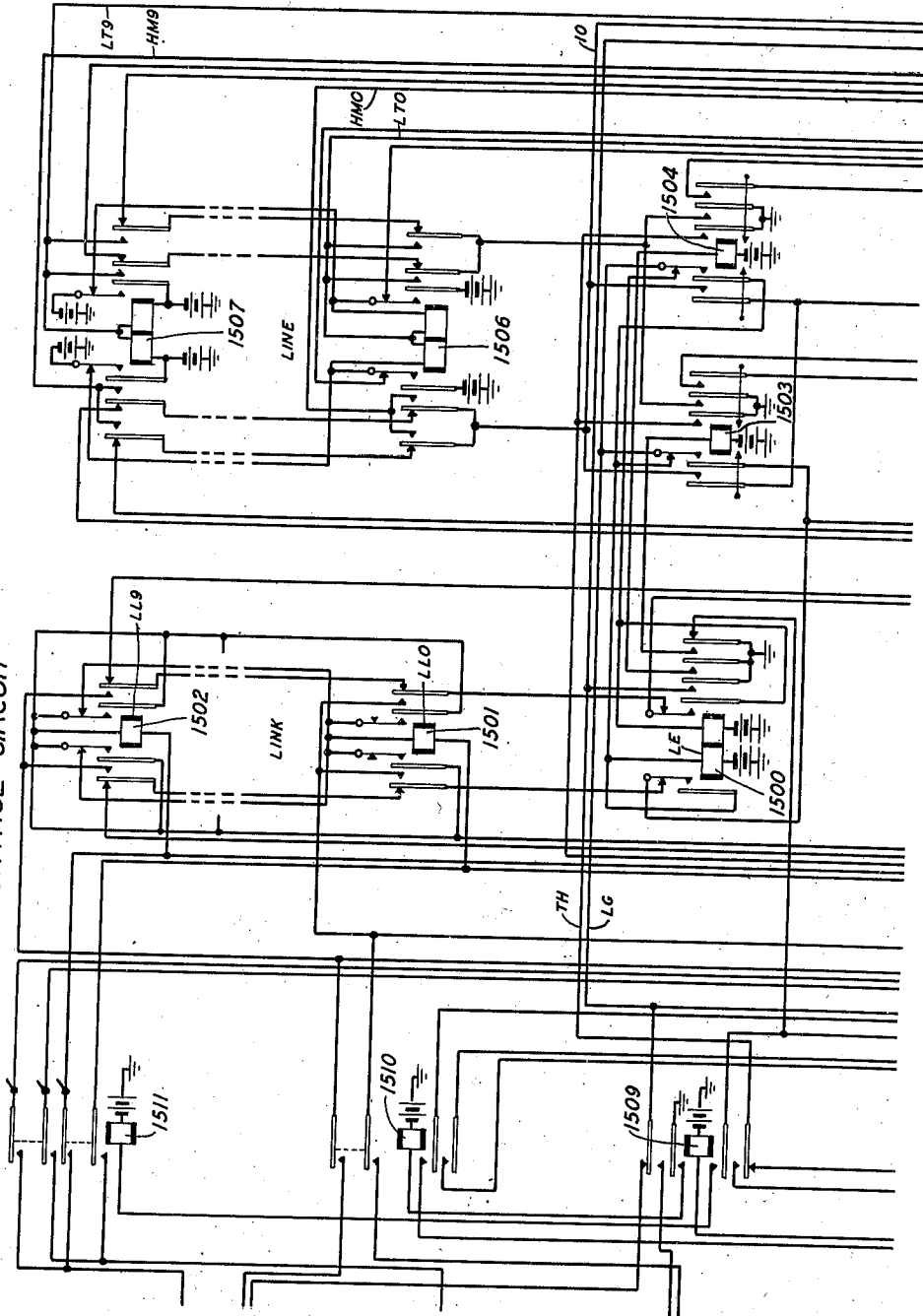
2,129,011

TELEPHONE SYSTEM

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18 Sheets-Sheet. 14

FIG. 15
CONTROL CIRCUIT



INVENTOR
F. R. LAMBERTY
BY *M. J. P. J. J. J. J.*
ATTORNEY

Sept. 6, 1938.

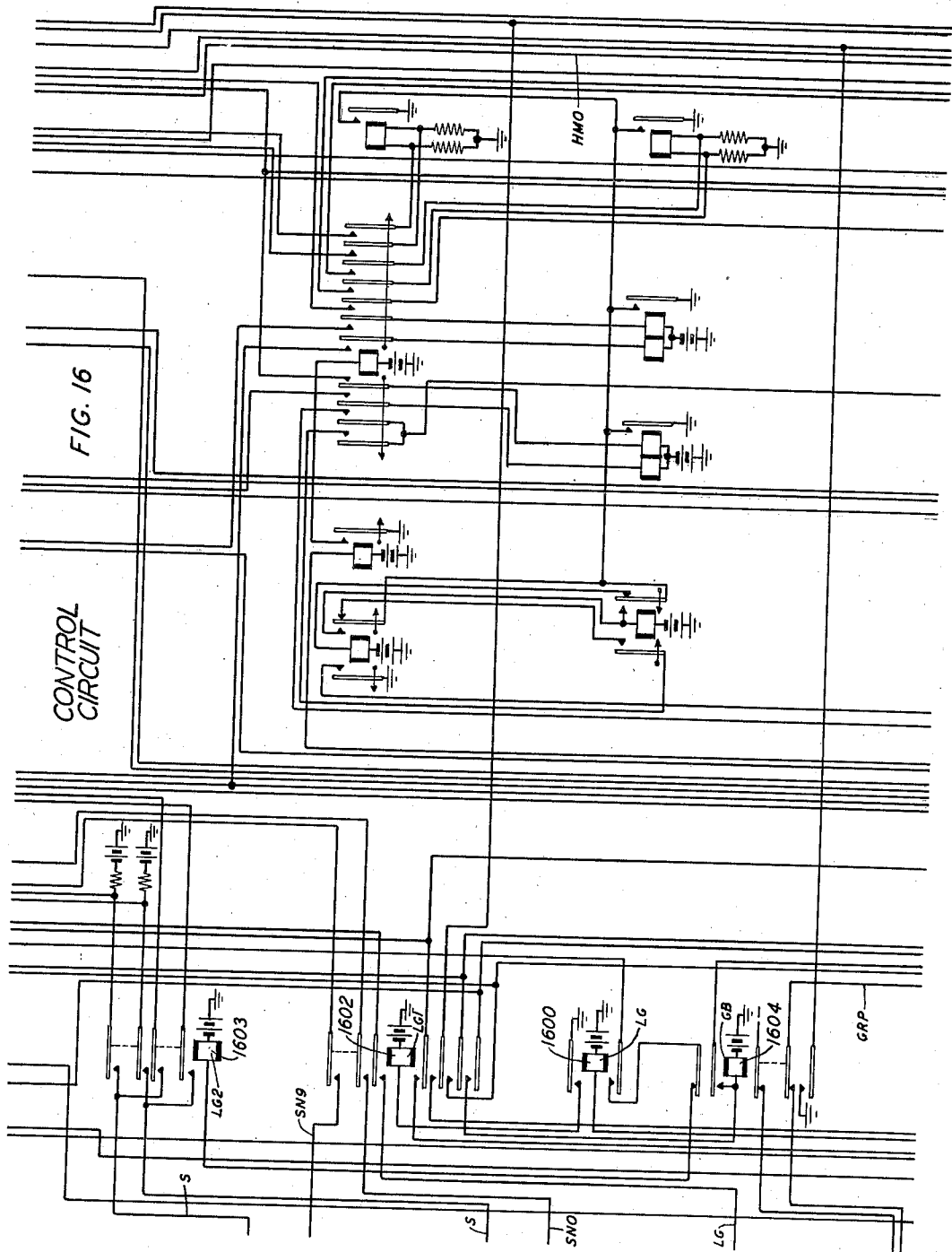
F. R. LAMBERTY

2,129,011

TELEPHONE SYSTEM

Filed Sept. 9, 1936

18 Sheets-Sheet 15



INVENTOR
F. R. LAMBERTY
BY *W. B. McTernan*
ATTORNEY

Sept. 6, 1938.

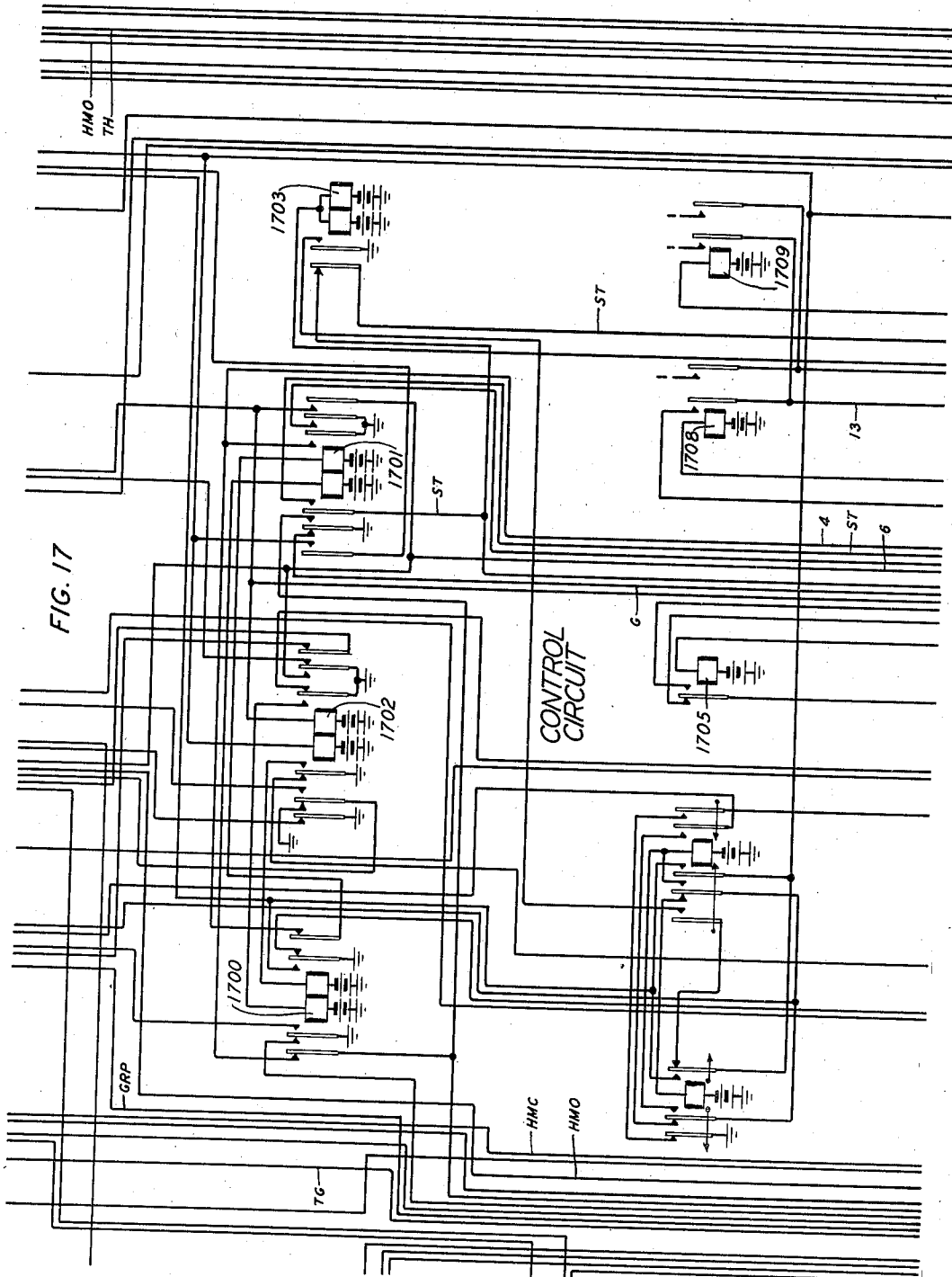
F. R. LAMBERTY

2,129,011

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18 Sheets-Sheet 16



INVENTOR: F. R. LAMBERTY

BY *W. B. McKenney*
ATTORNEY

Sept. 6, 1938.

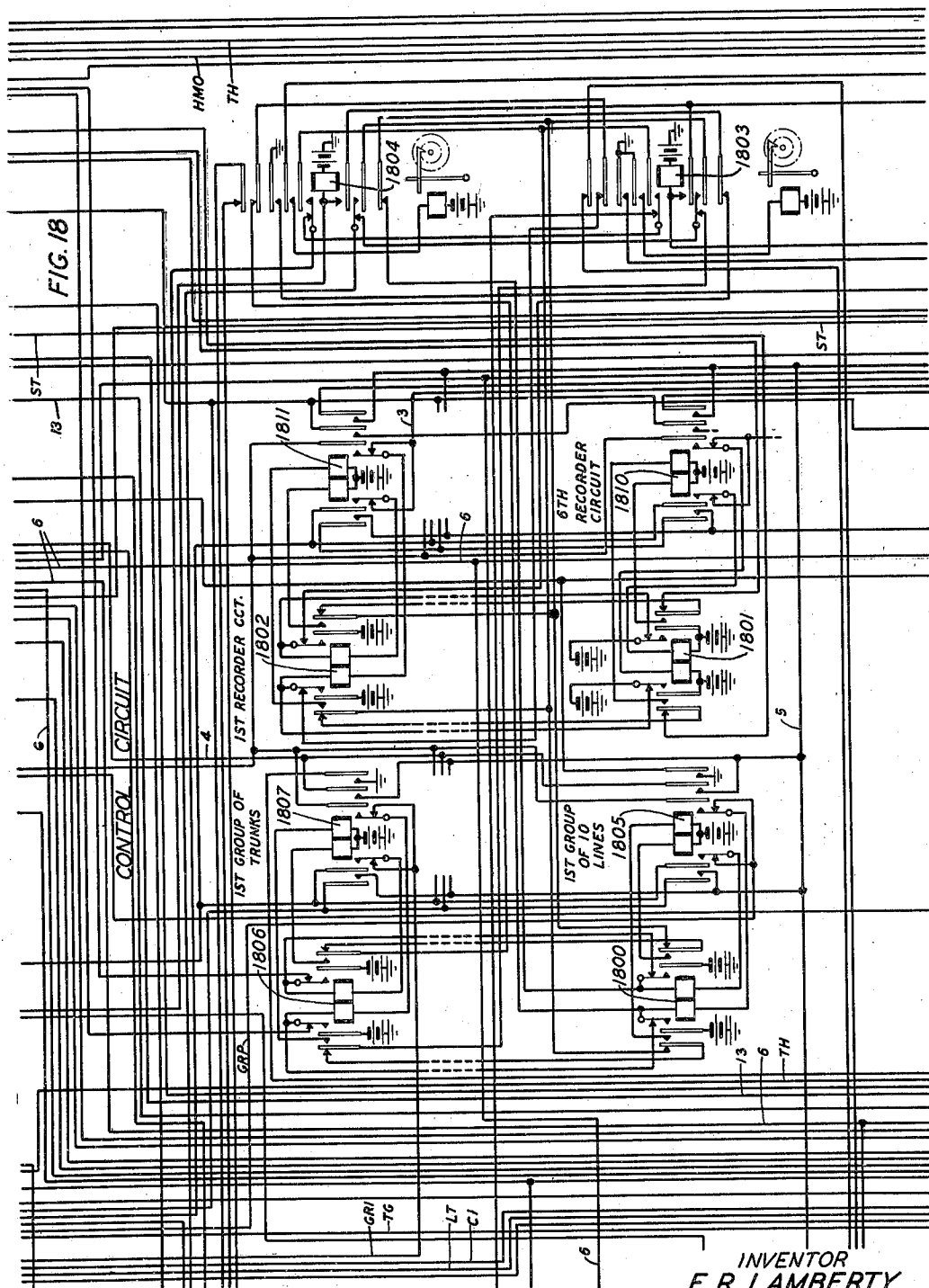
F. R. LAMBERTY

2,129,011

TELEPHONE SYSTEM

Filed Sept. 9, 1936

18 Sheets-Sheet 17



INVENTOR
F. R. LAMBERTY
BY *W. J. McNamee*
ATTORNEY

Sept. 6, 1938.

F. R. LAMBERTY

2,129,011

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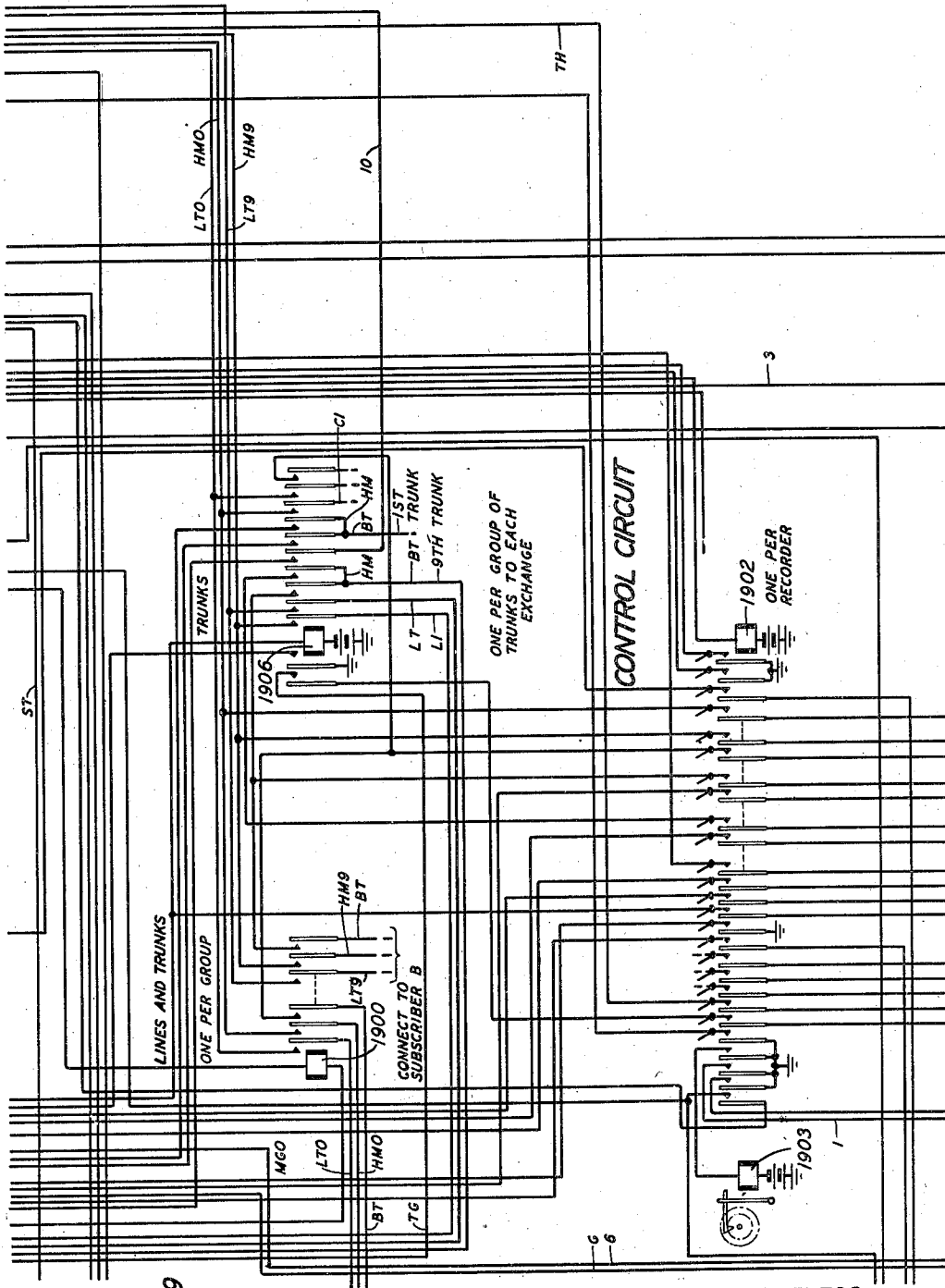


FIG. 19

INVENTOR
F. R. LAMBERTY
BY *M. J. McKeeney*
ATTORNEY

UNITED STATES PATENT OFFICE

2,129,011

TELEPHONE SYSTEM

Frederick R. Lamberty, Brooklyn, N. Y., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application September 9, 1936, Serial No. 99,919

5 Claims. (Cl. 179—18)

This invention relates to telephone systems and particularly to small capacity systems.

An object of the invention is to provide improved and economically arranged small automatic system using cross-bar switches for establishing connections between subscribers' lines and between subscriber's lines and trunks.

Heretofore systems have been provided for establishing connections between subscribers' lines and trunks over links in a single switch, as shown, for example, by the patent to Hinrichsen 1,567,265 of December 29, 1925, and patent to Goodrum 1,515,674 of November 18, 1924. In the copending application of Bowne et al., Ser. No. 95,530, filed August 12, 1936, now Patent 2,104,449 of January 4, 1938, a system has been shown in which connections may be established between subscribers' lines over a switch and between trunks over another switch.

A feature of the present invention is an arrangement in which the connection between subscribers' lines may be established through one switch over links, in which connections from subscribers' lines to trunks may be established over the same type of links to another switch, and in which connections from trunks through subscribers' lines may be established over the same type of links through said other switch.

Another feature of this invention is an arrangement whereby connections between subscribers' lines may be established over links and a control circuit through one switch, whereby connections may be established from subscribers' lines to trunks over the same type of links through another switch with the temporary aid of a control circuit, and whereby connections may be established from trunks to subscribers' lines over the same type of links through said other switch with the temporary aid of a control circuit.

This invention has been illustrated in the accompanying drawings in which the circuits for a small dial office have been shown embodying the features of the present invention.

Fig. 1 shows the arrangement of the figures for the reading of the circuits;

Fig. 2 shows in diagrammatic form the general layout of the switches and circuits;

Figs. 3 to 10 show details of the circuits of the system;

Figs. 3, 4 and 5 show the cross-bar switches employed by two subscribers' lines, two supervisory control circuits and two trunks circuits terminating in these switches;

Figs. 6 and 7 show circuits in detail of one supervisory control circuit;

Figs. 8 to 11 show the circuits of one recorder for recording called numbers;

Fig. 12 shows the details of one of the trunk circuits;

Fig. 13 shows an allotter circuit for the supervisory control circuit and the recorders;

Fig. 14 shows a recorder-connector cross-bar switch for connecting the recorder to the allotted supervisory control circuit when a call is made;

While Figs. 15 to 19 show a common control circuit relay and circuit arrangement employed in establishing of connections.

Referring now to Fig. 2 the circuits may be arranged with the following switches: primary line switches PLS for connecting the subscribers' lines to line link LL; secondary line switches SLS for connecting supervisory control circuits such as SCC₁, SCC₂ and SCC₃ shown to line links LL; secondary trunk switches STS for connecting trunks to line links LL, (Three trunks have been shown); primary trunk switches PTS for connecting the trunks to supervisory control circuits; office switches OS for connecting trunks together in tandem connections; recorder-connector switches RC for connecting recorders R₁ to R₆, to supervisory control circuits during the establishing of connections.

Four types of connections may be made through these switches; calls from one subscriber's line to another, calls from a line to a trunk, calls incoming from a trunk to a subscriber's line, and tandem calls from one trunk to another.

A call may be made from a subscriber's line A by the removal of the receiver from the switch-hook, through a primary line switch PLS at a cross connecting point 200 to a first line link LL to one branch, of a first supervisory control circuit SCC₁ at a cross-connecting point 201. A recorder such as R₁ is normally allotted so that when this connection at point 201 is made a connection is made to this recorder through the recorder-connector switch RC from the seized supervisory control circuit. A subscriber then dials the desired number and when the number has been recorded in the recorder a selection is made in the secondary line switch SLS to connect the outgoing branch of the supervisory control circuit SCC₁ through a cross-connecting point such as 203 to another line link LL and to a called subscriber B through the primary line switch PLS at a cross-connecting point such as 204. The recorder is then released and the connection completed from subscriber A to subscriber B through the supervisory control circuit SCC₁ over the four connecting points 200 to 204.

If a connection is to be made from a line to a trunk, the subscriber at A, for example, establishes a connection through cross-connecting points 200 and 201 to an idle supervisory control circuit and a recorder and dials the number of the desired exchange in which the trunk is located. Then connections are established over the same

line link LL in the secondary trunk switch STC, for example, at cross-connecting point 205 to an idle trunk 207 outgoing to a distant exchange. When this connection is made the supervisory control circuit connected at cross-connecting point 201 is released and by the release of the secondary line switch SLS so that the connection from subscriber A to trunk 207 now extends over the line link LL through the two connecting points 200 and 206.

If a connection is to be made from a trunk to a line for example, from trunk 207 to the subscriber at A, the trunk 207 is connected through the primary trunk switch PTS to a supervisory control circuit such as SCC₁ at the cross-connecting point 209. The number is then dialed over this trunk through the allotted recorder such as R₁ and a connection is made over the outgoing branch of the supervisory control circuit SCC₁ at the cross-connecting point 203 for example in the secondary line switch SLS to connect with an idle line link LL having access to the called line. Connections are then made at a cross-connecting point 204 in the primary line switch PLS to the subscriber at B from line link LL and at a cross-connecting point 210 in the secondary trunk switch STS between the calling trunk and the line link LL. The supervisory control circuit SCC₁ is released by the release of the secondary line switch SLS and the primary trunk switch PTS at the points 203 and 209 as soon as the called subscriber answers the ringing and the talking connection is maintained over points 204 and 210.

If a tandem trunk connection is to be made, for example from the trunk 207 to trunk 211, trunk 207 seizes a supervisory control circuit and is connected thereto at the point 209 in the primary trunk switch PTS and the desired trunk connection is then dialed. A connection is thereby made over the supervisory control circuit to establish connections in the office switch OS to connect the incoming calling trunk 207 with a called trunk 211 over a link in the office switch as for example the cross-connecting points 212 and 213 over the link 214. When these connections are established the supervisory control circuit is released by the release of the primary trunk switch PTS. To establish a connection from a recorder to a supervisory control circuit, connections are made at a number of cross-connecting points as the number of leads between the recorder and the supervisory control circuit is quite numerous and it will be noted that in the recorder-connector circuit shown in Fig. 14, there are eighteen leads for each recorder. This requires three connecting points for each recorder to a supervisory control circuit such as the points 215, 216 and 217 from the recorder R₁ through the supervisory control circuit SCC₁, with six leads connected up at each point, each group of six leads is symbolized by a single vertical line through the cross-bar switch.

Descriptions of these various calls will now be made in connection with Figs. 3 to 19.

It is now assumed that a call is made from the substation A to substation B. The subscriber at station A will lift his receiver from the switchhook and thus cause an idle supervisory control circuit, an idle line link, and a recorder to be seized and connected to the calling line. When a calling line is connected over a line link to a supervisory control circuit, a dial tone is sent for the dialing. The lifting of the receiver from the switchhook by the subscriber at A closes a circuit

for the operation of relay 300, from battery through the right-hand winding of this relay, contacts of the holding magnet 301 over the subscriber's loop through the left-hand winding of relay 300, contacts of relay 301 to ground. This relay in operating closes a connection to ground for the GRP and LT leads. The ground on the GRP lead closes a circuit for the operation of relay 1800 in the control circuit. This relay is associated with the subscriber's group of ten lines in which the calling line A is located and the circuits of this relay may be traced from battery, contacts of relays 1801, 1802, 1803 and 1804, windings of relay 1800, contacts of relay 1805 over the GRP lead to ground at relay 300 over contacts of relay 302. It will be noted that a set of relays such as 1800, and 1805 are provided for each group of ten lines, relays 1800 and 1805 being provided for the first group of ten lines. Similar relays such as 1806 and 1807 are provided for each group of ten trunks. It should be understood that similar relays are provided for other groups of ten lines and ten trunks. For the sake of simplicity no other similar relays have been shown in the circuit. In the same manner relays such as 1801 and 1810 are provided for each recorder. These two relays are provided for the sixth recorder and relays 1802 and 1811 are provided for the first recorder. When relay 1800 operates a circuit is closed for the operation of relay 1805 from battery through the windings of this relay, contacts of relay 1800 through corresponding contacts of unoperated relays, not shown, between relays 1800, and 1805 through contacts of relays 1806, 1803, 1804 to ground at relay 1700. Relay 1800 locks to battery through its own armatures and front contacts, contacts of relay 1805 to ground at release relay 1702 independent of the ground on the GRP lead. Relay 1800 disconnects battery and ground from the armatures and contacts of the corresponding relays for other groups of ten lines so that relays of higher numbered groups and lower numbered groups of ten lines cannot be operated. Therefore but one relay such as 1805 can operate at a time. Relay 1805 closes a circuit for relays 1900 and 1600 in series over a circuit from battery through the winding of relay 1600, winding of relay 1900, contacts of relay 1805 to ground. There is provided one of each of these relays 1900, 1600, 1602, 1603 and 1604 hereinafter mentioned for each line group. Relay 1805 also connects leads 4 and 5 to the allotter circuit in Fig. 13 for the operation of the start relay 1701 from battery through the windings of relay 1701, contacts of relays 1700, 1805, 1300 to ground at contacts of relay 1301. Relay 1701 provides a locking circuit for itself through its windings and contacts of relay 1700 to ground at contacts of relay 1701. The operation of relay 1600 closes an obvious circuit for relay 1602 and also a circuit for relay 1603 from battery through the winding of this relay, contacts of relays 1604, 1600 and 1500 to ground. Of these relays 1600, 1602 and 1603 associated with the group of line switches in which the calling line appears, relay 1603 connects battery to the sleeves of the ten line links LL, and LL1 and others not shown in this group and causes the operation of relays 1501 and 1502 which represent the first and the last links in this group of ten, and other intermediate relays omitted. Now any line link that is busy will have a ground on its sleeve from the supervisory control circuit and such of the relays as 1501 or 1502 which are connected to this sleeve will not operate.

ate because both ends of their windings are connected to ground. The line links that are idle, however, will have no potential on the sleeve and the corresponding relays such as 1501 or 1502 will operate over circuits as follows: From battery through a resistance, contacts of relay 1603, windings of relays 1501 and 1502 if idle to ground at contacts of relay 1702. Thus, all relays such as 1501 and 1502 testing idle line links will operate while those testing busy line links will not operate. Relay 1602 in operating closes the ten leads SNO to SN9 from the contacts of the ten relays 1501 and 1502 and others to the selector magnets associated with the group of switches on which the line link test is being made. The lowest numbered operated relay such as, for example 1501, will therefore operate the selecting magnets such as 306, 307 and 500 of the associated line link on the primary and secondary line switches PLS and SLS and the secondary trunk switch STS if the first line link LL is busy. This circuit may be traced from battery through the winding of the select magnets 306, 307 and 500, lead SNO, contacts of relays 1602, 1501 and 1500 to ground at contacts of relay 1702. The reason this relay 1501 operates may be due to the fact that it is the lowest numbered operated relay while the others in the group may be busy and consequently do not operate. If any of the other relays such as 1502 and others operate they will immediately release due to the operation of relay 1501. It is assumed that relay 1501 is assigned to the first link LL. The select magnet 307 of the secondary line switch SLS will extend this ground from contacts of relay 1702 back over lead LG, contacts of relays 1503 and 1504 through windings of relay 1500 to battery. Relay 1500 locks through its windings and armatures and front contacts to ground at contacts of relay 1702 and thus switches a ground on the LG lead to hold operated all the select magnets 306, 307 and 500 operated. Relay 1500 opens the original operating circuit for the select magnets 306, 307 and 500 through the make contacts of relay 1601 and causes the release of relay 1603. Relay 1500 also closes an obvious circuit for the operation of relays 1503 and 1504 which connect the LG lead permanently to ground at relay 1702. Relay 1603 disconnects the ten test leads from the sleeve and releases relay 1501.

Returning now to the above-mentioned operation of relay 1805, it should be remembered that a circuit was closed by this relay for the operation of the start relay 1701. The operation of this relay closes a locking circuit for both of its windings under control of relay 1700 and connects ground to the cross-bar wire STL in order to lock certain relays in the supervisory control circuit as will be hereinafter mentioned and also closes a ground connection for the allotter timing relays in Fig. 13 to start these relays functioning to release the connection in case the link and recorder are not properly connected. Relay 1302 operates first from battery through the winding of this relay, contacts of relay 1300, contacts of relay 1701 to ground. Relay 1302 operates relay 1303 and this relay in turn operates relay 1300. The operation of relay 1300 disconnects the operating ground for relay 1302 and thus causes the release of relays 1302 and 1303. The release of relay 1303 now operates relay 1301 before relay 1300 releases over a circuit from battery, winding of relay 1301, make-before-break contacts of this relay, contacts of relays 1303 and 1300 to the ground at contacts of relay

1701. Relay 1301 locks directly to this ground at relay 1701 and causes the operation of relay 1304 over an obvious circuit. Now when relay 1300 releases it again operates relays 1302 and 1303 and causes the operation of relay 1305 as relay 1302 removes a short circuit to battery for the winding of relay 1305. The circuit for relay 1305 may be traced from battery through the winding of this relay, contacts of relay 1301 to ground at relay 1701. This relay in turn closes a circuit for the operation of relay 1306 and the relays 1302, 1303 and 1300 then repeat the above cycle of operations and the release of relay 1303 short-circuits relay 1301 which releases and causes the release of relay 1304. Relay 1305 remains locked until its release by the release of relay 1300. The release of the relay 1305 causes the release of relay 1306. The above cycle is then repeated as long as ground is maintained on the lead from relay 1701. If the link and recorder do not function properly before relays 1302, 1303 and 1300 have gone through two full cycles then on the release of the relay 1301 with relay 1306 operated a ground will be supplied on lead 6 to the control circuit for the operation of relay 1702 from battery, left-hand winding of this relay, contacts of relay 1701, lead 6 contacts of relay 1306 to ground at contacts of relay 1301 and this causes the operation of relay 1702 which now releases the control circuit as will be hereinafter described in connection with the regular release of this circuit.

It should be noted that on the operation of relay 1900 which is provided for the subgroup of 10 lines in which the calling line is located, as hereinbefore described this relay closes through the ten LT leads from the ten lines in the subgroup in which the calling line is located to the ten relays such as relays 1506 and 1507 and others not shown. Relay 1506 is the relay associated with the first line and relay 1507 with the last line. The relay 1506 corresponding to the calling line will now operate from the ground over the LG lead from the line circuit to battery over the battery chain to the relays 1506 and 1507 and other relays over a circuit traced in detail as follows: From battery, contacts of relay 1507, windings of relay 1506, the LCO lead, contacts of relay 1900, contacts of relay 302 to ground at relay 300. Relay 1506 now locks in a local circuit over its own armatures and front contacts from battery to ground over contacts of relays 1503 and 1504. This relay in operating disconnects battery from the windings of the lower numbered relays of this group, but as this relay is the first relay in the group, it disconnects locking ground from relays 1503 and 1504 so that no other relay can be maintained operated. This relay 1506 in operating closes a circuit from ground supplied at relays 1503 and 1504 for the HMO lead. It should be noted that on the operation of relay 1701 a circuit was completed for the operation of relay 700 from battery through the winding of this relay, over the ST lead, contacts of relays 600 and 701, contacts of the operated allotter relay 1310, assuming that the first supervisory control circuit was allotted, contacts of relays 1703, 1701, 1305 and 1301 to ground. Relay 700 locks over its inner right-hand armature and front contact over lead 6 to the ground on the ST lead at relay 1301 as hereinbefore traced. Relay 700 in operating closes a circuit for the select magnet of the recorder connector for connecting a recorder to the seized supervisory control circuit from battery over the select magnet

RSMO, the SMO lead to ground at relay 700. This select magnet chooses the vertical level in the recorder connector for connecting a recorder to the first supervisory control circuit. The operation of the select magnet RSMO closes a circuit from the ground on the ST lead for the operation of relay 900 from battery through the winding of this relay, contacts of relays 901, 902, 800, contacts of the operated allotter relay for allotting a recorder, in this case relay 1312, contacts of select magnet RSMO to the start lead ST, to ground at relay 1301, as hereinbefore traced. Relay 900 closes a locking circuit for itself over lead 6 and the start lead ST to ground at relay 1301. Relay 900 in operating also closes a circuit for the operation of relay 1100 from battery through the winding of this relay, contacts of relays 1101, 901 and 903 to ground at relay 900. Relay 1100 in operating closes a circuit for the operation of relay 904 from battery, winding of this relay, contacts of relays 1100, 901 and 908 to ground at relay 900. Relay 904 in operating closes a circuit for the operation of the busy tone relay 902 from battery through the right-hand winding of this relay, contacts of relays 905, 904 to ground. Relay 904 closes a circuit for the holding magnets of the recorder connector HF0, HM3 and HM6 from ground through the windings of these magnets over the HM lead, contacts of relay 904 to ground at contacts of relay 800. The operation of these magnets causes the recorder connector to connect the recorder, shown in Figs. 8 to 11, to the chosen supervisory control circuit at the cross-connecting points 1400, 1401 and 1402 for the eighteen leads required for controlling the circuits. A circuit is now completed through the recorder connector for the operation of relay 602 from battery and winding of this relay over lead 18, through the cross-connecting point 1402 to ground at contacts of relay 900. This relay in turn operates relay 1703 from battery, windings of this relay, contacts of relay 700 to ground at relay 602. Relay 603 is also operated over an obvious circuit and relay 603 closes circuits for the operation of the holding magnet 301 to connect the calling subscriber's line through the primary line switch PLS to the idle link LL at the cross-connecting point 312, and the holding magnet 310 for connecting the link LL through the secondary line switch SLS to the chosen supervisory control circuit at the cross-connecting point 311. The circuit for the holding magnet 301 is extended from battery through the winding of this magnet, over the HMO lead, through contacts of relays 1900, 1506, 1503, 1504, 700 and 603 to ground. The operation of the holding magnet 310 is established over a circuit from battery through the winding of this magnet, contacts of relay 700, the HMC lead, contacts of relay 1602, lead 10, over the HMO lead through contacts 1503 and 1504, relay 700 to ground at relay 603. On the closure of these connections through contact points at 312 and 311 a circuit is closed for the operation of relay 600 from battery through the winding of this relay, contacts of relay 603, the sleeve lead S through connections at the cross-connecting points 311 and 312 to ground over the HMO lead at relay 603 as hereinbefore traced. Relay 300 is released while relay 302 is operated by the operation of magnet 301. Relay 302 closed a connection to ground for the busy test lead BT to prevent seizure of this line by some other subscriber or from a trunk, and the release of relay 300 dis-

connects the ground connection from the LTO and GRP leads. The operation of relay 600 transfers the connection from the ST lead to operate the allotter in Fig. 13 to allot another link and another recorder for the next call.

The first operation that takes place is that of relay 1315 in the allotter circuit from battery through the upper winding of relay 1315, contacts of relays 1804, 1310, 600, 1306, 1304, lower windings of relays 1317 and 1316 to ground. The operation of relay 1315 closes circuits for the operation of the next allotter relay for the next link in this case relay 1319 from battery through the upper windings of this relay, contacts of relay 1315, lower windings of relays 1317 and 1316 to ground. This operation of relay 1319 releases relay 1310 and relay 1319 locks through its windings over contacts of relays 1320, 1310 through the windings of relays 1316 and 1317 and relay 1315 is released. The supervisory control circuit allotter is then prepared for the next supervisory control circuit. Similarly the recorder allotter is operated to assign the next recorder for the next call. This operates in the same manner by the operation of relay 901 as will hereinafter be described which closes a circuit for relay 1321 from battery through its upper winding, contact of relays 1803 and 1312, 901, 1306, 1304, windings of relays 1322 and 1323 to ground. Relay 1321 causes the operation of relay 1324 from battery through the upper winding of this relay, contacts of relay 1321, windings of relays 1322 and 1323 to ground. Relay 1324 releases relay 1312 and relay 1312 releases relay 1321 while relay 1324 locks through contacts of relays 1325 and 1312 to ground through windings on relays 1322 and 1323. The recorder allotter is now prepared for the next recorder. The control circuit shown in Figs. 15 to 19 may now be released as no further use for this circuit is required in the establishing of connections from the calling subscriber to the supervisory control circuit. Therefore on the operation of relay 600 a circuit is closed for the operation of relay 1702 from battery through the left-hand winding of this relay, over the RL lead contacts of relay 700, contacts of relay 600 to ground. Relay 1702 locks over the right-hand winding and its own contacts under control of relay 1401 and causes the operation of relay 1700. Relay 1700 releases the start relay 1701. Relay 1702 releases the operated relays 1800 and 1805 for the first group of ten lines operated as hereinbefore described. Relay 1805 releases relays 1900 and 1600, the latter relay releasing relay 1602. Relay 1805 also opens the holding circuit for relay 1500 which releases and in turn causes the release of relays 1503 and 1504. These relays in turn cause the release of relay 1506. Relay 1506 causes the release of relay 1702 which causes the release of relay 1700. Relay 1702 in releasing opens the holding circuit for the select magnets 306, 307 and 500 of primary and secondary line switch PLS and SLS and the secondary trunk switch STS. Ground is also removed from the lead that causes the timing release means to operate by the operation of relay 1302 so that this timing release means will be restored to normal. The locking circuit for relay 700 is opened by the release of relay 1301 causing relay 700 to release. Relay 1701 causes a ground to be applied on the G lead, the purpose of which will be described presently. Relay 700 in releasing causes the release of relay 1703. The relays in the control circuit are now all returned to normal position.

It should be observed that when the holding

magnet HM₀, HM₃, and HM₅ for the recorded connector were operated and after relay 600 was operated a circuit was completed for the operation of a relay 802 in the recorded circuit from battery through the winding of this relay, contacts of relay 903, lead 10 through the cross-connecting point 1401 to ground at relay 600, and as the tip and ring conductors of the calling subscriber's line are now connected to the tip and ring leads through the link LL and the tip and ring leads of the incoming branch of the line of the supervisory control circuit, a relay 805 is operated from battery and ground through the windings of this relay, contacts of relay 903 over leads 2 and 3 through the cross-connecting point 1400 of the recording connector to the tip and ring conductors of the supervisory control circuit, contacts of relays 805 and 606, through the cross-connecting point 311, the line link LL, cross-connecting point 312 through the tip and ring conductors over the subscriber's loop at A. This circuit is prepared for the dialing of the desired number. The dial tone is also transmitted to the calling line over the ring conductor after the operation of relay 802. Relay 805 in operating provides a locking circuit for relay 900 at its left-hand armature and front contact and a locking circuit for relay 602 at its right-hand armature and front contact. As previously described a ground was supplied over the G lead on the return of the control circuit to normal and this now causes the operation of relay 901 from battery through the winding and contacts of this relay, contacts of relay 802 over the G lead to ground at relay 1701. This relay opens the circuit for lead 6 of the control circuit and closes a circuit for advancing the recorder allotter as hereinbefore described. It will be noted that this relay 901 closes a circuit to ground for a TS lead to the tone, ringing and alarm circuit terminating at 806, but not shown for starting a dial tone to the calling subscriber's line. Dial tone is now, therefore, transmitted to the calling subscriber from the DT lead on which tone is then supplied from the tone, ringing and alarm circuit at 806, from contacts of relays 802, 1101 and 1104 through a condenser, contacts of relays 903, over the ring conductor to the calling subscriber. When the calling subscriber hears the dial tone he will proceed to dial the desired subscriber's number.

The operation of the circuit in connection with the dialing of this number will now be described. If now the calling subscriber at A dials the desired subscriber's number, the first pulse of the first digit will release relay 805 and thus cause the release of relay 900. The release of relay 900 causes the operation of relay 807 from battery through the winding of this relay, contacts of relay 900, to ground at relay 802. Relay 906 is also operated from battery through the winding of this relay, contacts of relays 907, 908, 900 to ground at relay 802. When the impulse ceases relay 805 is reoperated. The operation of relay 805 closes a circuit for the operation of relay 900 from battery through the winding of this relay, contacts of relays 906, 908, 805 to ground at relay 802. The operation of relay 900 opens the circuit for relay 807. This relay will not release unless there is only one impulse in the first digit. If another impulse is coming, relay 807 will not release as it is slow to release. Relay 900 removes the short circuit for the left-hand winding of relay 908 to ground, through the inner right-hand armature and back contact, of relay 908 to ground at relay 802. Consequently, relay 908 will operate from

battery through the winding of relay 906, contacts of relays 907 and 906, winding of relay 908, contacts of relay 807, ground at relay 802. This applies a ground on the odd lead for the operation of the first register relay 1000 from battery through the winding of relay 905, contact of busy test relay 902, contact of relay 910, right-hand winding of counting relay 1000 contact of relays 904, 911, 1106 over the odd lead, contacts of relays 908, 807 to ground at relay 802. Relay 905 in operating closes a holding circuit for relay 902. As now the second impulse is received, relay 805 is released causing the release of relay 900 which causes the operation of relay 907 from battery through the winding of this relay, right-hand winding of relay 908, contacts of relay 900 to ground at relay 802. The operation of relay 907 causes the release of relay 906 which prepares a path for reoperating relays 805 and 900 when the relay 805 is again operated and prepares a locking path for relay 900. At the end of the second impulse, relay 805 reoperates and causes the reoperation of relay 900, which causes the release of relays 907 and 908. On the release of relay 908 the second pulse registering relay 1002 operates from a battery through the winding of relay 905, contacts of relays 902 and 910, right-hand winding of relay 1002, contacts of relays 1000, 1106 over the even lead through contacts of relays 908, 807 to ground at 802. The operation of relay 1002 opens the locking circuit for relay 1000 which was closed from battery through the left-hand winding of relay 1000 and its left-hand armature and front contact, make-before-break contacts of relays 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009 and 1010, and 807 to ground at relay 802. Register relay 1002 locks over the same circuit through its left-hand winding and inner left-hand armature and front contact. The operation of the second register relay 1002 closes a circuit for the operation of relay 911, from battery through the winding of this relay, contact of relays 1002, 1106 and 807 to ground at relay 802. Relay 911 locks through its inner right-hand armature and front contact to ground at 802 independent of the connection through relay 1002. The succeeding impulses received by the operation and release of relays 805 and 900 will alternately operate and release, relays 906, 907, 908 so that the impulses are received on the odd and even leads alternately to operate the succeeding odd and even register relays 1003 to 1010 and as each register relay operates the preceding register relay releases. At the end of the first digit the relay 807 releases causing the release of relay 911 and the register relay or relays operated at this time.

It will be remembered that when the recorder was first seized, a circuit was closed by the operation of relay 802 for the operation of relay 1100 from battery through the winding of this relay, contact of relays 1101, contact of relay 802 to ground. This relay in operating prepares a circuit for relay 1107 of the first digit storing relays so that when the first register relay 1000 is operated this relay 1107 will operate from battery through the lower winding of this relay, contacts of relays 1100, and 1000 to ground. When the second impulse was received, storing relay 1103 is operated from battery, lower winding of this relay, contacts of relay 1100, contacts of relay 1002 to ground. It should be noted that relay 1104 also operates on the second impulse from battery through the lower winding of this relay and its make-before-break contacts, contacts of

relay 1100 to ground at relay 1002. Relay 1104
 locks from battery through its lower winding and
 upper-middle armature and front contact, con-
 tacts of relay 1101 to ground at relay 802. When
 5 relay 1108 operates, relay 1107 is released due
 to the release of relay 1000. When the third
 impulse is received causing the operation of reg-
 ister relay 1003, the recording relay 1007 is op-
 10 erated from battery through its lower winding,
 contacts of relay 1100 to ground at a register relay
 1003. When the fourth register relay 1004 is
 operated, recording relay 1109 is operated from
 battery through its lower winding, contacts of
 relays 1100 and 1004 to ground. Relays 1007 and
 15 1108 are released on the release of relay 1003.
 When the register relay 1005 operates storing re-
 lay 1107 is operated and 1109 is maintained op-
 erated. When register relay 1006 operates, stor-
 ing relay 1110 is operated and relays 1107 and
 20 1109 are released. Relay 1110 is locked from bat-
 tery through its upper winding and upper inner
 armature and front contact, to ground at relay
 802. Then when register relay 1007 operates,
 storing relay 1107 is operated. When register re-
 25 lay 1008 is operated, the storing relay 1108 is
 operated and the storing relay 1107 is released.
 When register relay 1009 is operated, the storing
 relays 1107 and 1108 are operated and when sepa-
 rate relay 1110 is operated storing relay 1109
 30 is operated and 1107 and 1108 are released. Thus
 it will be seen that the relays 1107 to 1110 are
 operated in different combinations for the hun-
 dred digit. If the digit is over six, relay 1110 is
 maintained operated as described. At the end of
 35 this digit relay 807 is released and opens the lock-
 ing circuit for the operated register relay and for
 relay 911 which release. It also closes a circuit
 for locking the relays 1107 to 1110 that are op-
 erated at that time under control of relay 802.
 40 For example, if relays 1110 and 1107 are operated,
 that is if the first digit is seven, relays 1107 and
 1110 will be locked over a circuit from battery
 through their upper windings, upper inner arma-
 ture and front contact of relay 1100, contacts of
 45 relays 1104, 807 and 802 to ground. It will be
 noted that relay 1101 is also operated in this
 locking circuit from battery through the winding
 of this relay, to ground at relay 802 over con-
 tacts of relays 1100 and 1104. Relay 1104 is also
 50 locked from battery through its upper winding
 and upper inner armature and front contact to
 this ground at relay 802. Relay 1101 locks from
 battery through its lower inner armature and
 front contact, directly to ground at relay 802,
 55 independent of relay 807, and this locking ground
 is extended to lock storing relays 1107 and 1110.
 Relay 1101 causes the release of relay 1100. Re-
 lay 1101 also closes a circuit for the operation of
 relay 1111 from battery through the winding of
 60 this relay, contacts of relays 1112 and 1101 to
 ground. The operation of relay 1111 connects
 leads 12, 14, 15, 16 and 17 to the storing relays
 for the second digit in the supervisory control
 circuit so that when the second digit is dialed to
 65 operate the register relays of the corresponding
 storing relays in the supervisory control circuit
 will be operated. The second digit is in this case
 the ringing code digit. The operation of the relay
 807 when the second digit begins causes the re-
 70 lease of relay 1104 and the release of this relay
 prepares a path for operating the relay 1112 at
 the end of this digit. The first digit of the called
 subscriber's number determines whether ringing
 75 is to be sent out over the tip of the ring conductor
 and whether one of the first ten or one of the

second ten ringing codes is to be used. If ring-
 ing current is to be sent out over the tip, the
 recorder circuit grounds the lead 11. For exam-
 ple, if a first digit was three relays 1107 and 1108
 were operated and in this case there would be
 5 ground on lead 11 from contacts of relay 1112
 over contacts of relays 1107, 1108, 1110. Also in
 case the first digit was six relay 1110 will be op-
 erated so that this ground from contacts of relay
 1112 will extend over contacts of relays 1107, 10
 1108, 1109, 1110. This operates relay 704 in the
 supervisory control circuit from battery through
 the winding of this relay over lead 11 to the
 ground at relay 1112 as described. Relay 704
 locks under control of relays 610 and 603, and
 15 reverses the ground on the generator leads from
 the ringing circuit as indicated at 611 as will be
 described hereinafter. Therefore, when either of
 these two digits is dialed, the ringing current will
 go out over the ring conductor and when any of
 20 the other digits are dialed, the ringing current
 will go out on the tip conductor of the line as
 relay 704 is not operated. Returning to the dial-
 ing of the second digit, the impulses for this
 digit will operate relays 710, 711, 712, 714 and
 25 716 in various combinations to connect the lead
 from the ringing circuit at 806 that will have
 the proper series of impulses applied on this lead
 to ring the corresponding party. If one single
 impulse is received as the second digit, the relay
 30 711 will be operated from battery through the
 left-hand winding of this relay over lead 16
 through the connected point at 1402 of the re-
 cording connector through contacts of relay 1111
 to ground at relay 1000. If two pulses are re-
 35 ceived, relay 712 will operate. If three impulses
 are received relays 711 and 712 will be operated.
 If four impulses are received, 714 will be operated.
 If five impulses are received, 711 and 714 will be
 operated. If six impulses are received, relay 716
 40 will be operated and this relay will lock through
 its right-hand winding, inner right-hand arma-
 ture, and front contact, contacts of relays 610 and
 603 to ground. Then if seven impulses are re-
 ceived in addition to relay 716 being operated,
 45 relay 711 will be operated. If eight pulses are
 received, relays 716 and 712 will be operated. If
 nine impulses are received, 716, 711, and 712
 will be operated and if ten impulses are received,
 relays 716 and 714 will be operated. At the end
 50 of the second digit, ground will be placed on lead
 17 on the release of relay 807 for the locking of
 the particular relay that is operated for exam-
 ple, if one impulse is received as a second digit,
 relay 710 will lock from battery through its right-
 55 hand winding and inner right-hand armature
 and front contact over lead 17 through the cross-
 connecting point 1402, contacts of relays 1112 and
 1101 to ground. The operation of the relay 1112
 to apply this ground on lead 17 is accomplished
 60 when relay 807 is released at the end of the sec-
 ond digit, from battery winding of this relay, con-
 tacts of relay 1111, contacts of relays 807 and
 802 to ground. Relay 1112 causes the release
 of relay 1111 and locks to ground at relay 1101.
 65 Relay 1112 also closes a circuit for the operation
 of relay 1114 from battery through the winding
 of this relay, contact of relay 1116, to ground at
 relay 1112. The operation of relay 1114 closes
 leads from the register relays to operate the third
 70 or tens digit relays 1121, 1122, 1124, 1126 and
 to prepare a circuit for the operation of relay
 1104 at the beginning at this third or tens digit.
 At the first impulse of the third digit, relay 1104
 is operated from battery through its lower wind- 75

ing, its make-before-break contact, contacts of relay 1114, to ground at relay 1000. Relay 1104 is locked through its lower winding and second upper armature and front contact, contacts of relays 1101, 1112, 1115 to ground at contacts of relay 802. The impulses of the third digit are received on the storing relays 1121, 1122, 1124, 1126 as follows. If one impulse is received, relay 1121 is operated; if two are received 1122 is operated; if three are received 1121 and 1122 are operated; if four are received 1124 is operated; if five are received 1121 and 1124 are operated; if six impulses are received 1126 is operated. This relay then locks from battery through its upper winding, upper inner armature and front contact to ground at the relay 1112. This relay remains operated during the succeeding impulses. In addition, on the reception of seven impulses, relay 1121 is operated, on eight impulses relay 1122 is operated, on nine impulses 1121 and 1122 are operated and on ten impulses 1124 is operated. At the end of the third digit the relay 807 is released and holds relay 1104 locked from battery through its upper winding, upper inner armature and front contact, contacts of relay 807 to ground at relay 802. While relay 1115 is operated from battery through its winding, contacts of relay 1114, contacts of relay 1104 to the ground at relay 802 as described, this ground also locks whichever storing relay or relays 1121, 1122, or 1124 that are operated. The operation of relay 1115, however, causes the release of relay 1114, and locks the storing relays and itself to ground at relay 1112 and prepares a circuit for the subsequent operation of relay 1106. If now the unit digit is received, that is, the fourth digit, the operation of relay 807 causes the release of relay 1104 which now closes a circuit for locking the register relays independent of the relay 807 from ground at relay 802, contacts of relays 1104, 1115, and contacts of the operated register relay to battery through its left-hand winding so that the fourth digit will be registered and stored on a register relay.

At the end of the fourth digit the release of relay 807 closes a circuit for the operation of relay 1106 from battery through the winding of this relay, contact of relays 1115, 1104, 807, to ground at 802. The operation of relay 1106 opens the operating path for the register relays so as to make further dialing ineffective and provides a substitute locking path to ground for the register relay operated through the second upper armature and front contact.

Relay 1106 also grounds leads for seizing of the control circuit shown in Figs. 15 to 19. One of the relays 1801 or 1802 depending on which recorder circuit is used is operated. It is assumed that the first recorded circuit is used, hence relay 1802 is operated from battery, contacts of relay 1802, windings of relay 1803, contacts of relay 811, lead 3 contacts of relays 904, 1106 to ground at relay 911. Relay 1802 in operating locks to battery at its inner right-hand armature and left-hand armatures and front contacts, disconnects battery from the same contacts on the relays such as 1801 and from all relays of the groups in which relays 1800 and 1806 are located. If relay 1802 was one belonging to, for example, the second or third recording circuits, it would disconnect battery from the chain contacts on the lower numbered relays and disconnect ground from the chain contacts of the higher numbered relays. As it is the lowest numbered relay in the group, belonging to the first recorder, bat-

tery is disconnected from the transfer chain contacts of all the other higher numbered relays such as 1801 and others not shown. The operation of relay 1802 closes a circuit for the operation of relay 1811 from battery through the windings of this relay, contacts of relays 1802, 1800, 1806 and intermediate relays, contacts of relays 1803 and 1804, contacts of relay 1700 to ground. Relay 1811 disconnects relay 1802 from the ground connection or lead 3 supplied by the operation of relay 1106 from contacts of relays 911 and locks the relay 1802 under control of relay 1700. If the timing relays 1300 to 1306 are in normal position at this time, relay 1902 will operate from battery through the winding of this relay, contacts of relay 1811, lead 5, contacts of relays 1300 and 1301 to ground. Relay 1902 closes through various leads between the control circuit and the recorder and locks itself through its inner left-hand armature and front contact to ground. Relay 1902 also closes an obvious circuit for the operation of relay 1705 and starts the operation of the peg count register 1903. Relay 1902 now closes a circuit for the operation of relay 720 in the supervisory control circuit over a circuit from battery through the winding of this relay, over lead 1 and through the cross-connecting point 1409, contacts of relay 903, to ground at contacts of relay 1902. Relay 720 connects a number of H leads such as HMC to provide a path for selecting the group in which the called subscriber's line is located as determined by the setting of the storing relays 1107 to 1110. In the present system, only two relays such as 1708 and 1709 have been shown to indicate two groups of one hundred subscribers' lines each. The desired subscriber's line is marked B and belongs as shown in the same group of one hundred lines as the subscriber's line A. This group is assumed to be the first group of one hundred lines hence relay 1708 will be operated. This relay will be operated if the hundred digits 2 or 4 are dialed and the circuit for this relay therefore extends from battery through the winding of relay 1708, lead H1 through contacts of relays 1110 and 1108 to ground for digit 2 or 1110, 1109, 1107 and 1108 to ground for digit 4. If the called subscribers' lines have been located in a second group of a hundred lines, relay 1709 would have been operated from battery through the winding of this relay, contacts of relays 1110, 1109, 1107 and 1108 if digit 6 had been dialed or 1109, 1107, 1108 to ground, if the digit five had been dialed. The operation of relay 1708 connects the associated relay 1900 to the recorded circuit and this relay will operate in series with the associated relay 1600 of the group of ten lines in which the called subscriber's line is located. This is determined by the operation of the storing relays for the tens digit 1121 to 1126. As the called subscriber is assumed to be in the same group as subscriber A, the relay 1121 of the storing relays for the tens digit operates. The circuit may be traced from battery, windings of relays 1600, 1900, contacts of relays 1708, lead 13, contacts of relays 1126, 1124, 1122, 1121 to ground. The operation of relay 1900 connects up the associated LT, HM and BT leads from the ten lines in this group to the recorder circuit and the operation of the relay 1600 causes the operation of relay 1602 and 1603 to connect the SN and LG leads. The selection of an idle line link LL and the operation of the select magnet for this link and the relay 1590 is the same as hereinbefore described in connection with the link LL when the calling subscriber

took his receiver off the switchhook. It is assumed that the line link LL1 is idle and consequently the select magnet 313 for the primary line switch and 314 for the second line switch are operated by the operation of the corresponding relay, in this case 1502 in the same manner as the select magnets for link LL were operated by the operation of relay 1501.

Due to the setting of the register relays, busy test will be performed for the called line. In the circuits shown it is assumed that the called line is the ninth line in this group of ten so that the register relay 1009 will be operated and if it is assumed for the moment that this line is busy there will be a busy ground on the BT lead. A busy tone will then be applied to the calling subscriber's line as this ground on the BT lead will hold the busy tone relay 902 operated from battery and in series with the busy tone relay 722 in the link circuit. The circuit for these relays may be traced from battery through the winding of relay 722, lead 8, the cross-connecting point at 1401, inner left-hand armature and front contact of relay 902 through the left-hand winding of this relay, relays 904, 905, 1009, 1902 and 1900 over the BT lead to ground, due to the operation of the relay 316 of the called line. Relay 722 in operating locks through its inner right-hand armature and front contact, contacts of relays 612, 610 to ground at relay 603. Relay 722 closes through the leads A and B to the busy tone source at 806 to the tip and ring conductors of the link and of the calling subscriber and grounds the start tone lead TS. Relay 722 in closing this locking circuit shortcircuits the left-hand winding of relay 902 so that this relay will now release. Relay 722 also connects ground to relay lead 7 to cause the operation of the release relay 903 in the recorder from battery through the winding of this relay contacts of relay 902 when it releases, contacts of relay 913, over lead 7, the cross-connecting point 1401 in the recorder to ground at relay 722. Relay 903 locks through its inner right-hand armature and front contact to ground over lead 10 and through cross-connecting point 1401, contact of relay 600 to ground. Relay 903 closes a connection for the operation of the release relay 1402 in the control circuit from battery through the left-hand winding of this relay 1402, contacts of relays 1811, and 903 to ground at relay 1902. The control circuit is thereby released as hereinbefore described. The recorder is also released as the operation of relay 903 disconnects relay 805 from the calling line and releases it. Relay 802 is also released and causes the release of relays 901 and 1106 and the operated storing relays and register relays. The release of relay 901 opens the circuit for the holding magnet HM0, HM2, and HM6 to release the recorder connector and this in turn causes the release of relays 1112 and 903. The release of 1112 releases relay 1115 and the tens digit storing relays, thus the recorder circuit is restored to normal.

If on the other hand it is assumed that the called line is idle it will be noted that on the operation of the select magnet 314 relay 1500 is operated in the same manner as it was operated when the select magnet 307 was operated. This relay, in turn, causes the operation of relays 1503 and 1504 as usual. This causes the release of relay 904 by closing a short circuit for the winding of this relay from battery over the TH lead, contacts of relays 1503 and 1504 to ground at relay 1702. Hence, relay 904 in releasing

causes the release of relay 905 and this, in turn, causes the release of relay 902 which closes a circuit for the operation of relay 911 from battery through the winding of this relay, contacts of relay 902, lead 9, through the cross-connecting point 1401, contacts of relay 722 to ground at contacts of relay 600. Relay 911 in operating now causes the operation of the holding magnet 320 to connect the terminating end of the supervisory control circuit to the link LL1 through the secondary line switch and also causes the operation of the holding magnet 321 to connect the link LL1 to the called subscriber's line. The circuit for the holding magnet 320 may be traced from battery through the winding of magnet 320, contacts of relays 720, 1602, 1902 and 911 to ground. This magnet locks through contacts to ground at relay 603. The circuit for the holding magnet 321 may be traced from battery through the winding of this magnet, over the HM9 lead, contacts of relays 1900 and 1902 and the register relay 1009, assuming that the called subscriber is the ninth in the group, through contacts of relays 905 and 904 to ground at relay 911. Relay 612 is now operated from battery through the winding of this relay, contacts of relay 614 over the sleeve S1 through the cross-connecting point 322 over the link LL1 through the cross-connecting point 323 to the ground at relay 911 as before traced for the operation of the holding magnet 321. Relay 612 locks through its inner right-hand armature and front contact, contacts of relay 610 to ground at relay 603. The holding magnet 321 is now also held independent of the ground at relay 911. The holding magnet 320 is locked directly to ground at relay 603. The ground on relay 911 will be removed when the recorder is released and this will now take place by the operation of relay 903 from battery through the winding of this relay, contact of relays 902 and 913, lead 7 through the cross-connecting point 1401 at the recorder connector, contacts of relay 612 to ground. Relay 903 releases the recorder as before described, and this relay in turn causes the release of the control circuit by the operation of relay 1702 as hereinbefore described. Relay 612 also grounds the STR lead to the ringing circuit at 806 to start the ringing interrupter relays to transmit the ringing code to the called party according to the setting of the storing relays 710, 716, 714, 712 and 711 by dialing. It will be noted that the locking circuit for these relays is now held by the ground supplied at the fourth outer right-hand armature and front contact of relay 612 to maintain these relays operated when the original holding ground is removed by the release of the recorder and control circuit. The subscriber B may, of course, be a single subscriber and the particular code for this kind of line will be transmitted in accordance with the storing relay operated, but arrangements may also be made whereby as many as twenty parties may be connected to the same line and the code ringing arrangement that may be connected at 806 will transmit different codes over different leads from the source at 611 by the operation of relay 615 according to these codes over leads RL1 and RL2 and over the tip or ring conductors of the called line depending on the operation or non-operation of relay 704 as determined by the impulse received over conductor 11 in accordance with the first digit dialed. At the beginning of a ringing cycle a pulse occurs on the PU lead and relay 614 is operated from battery through the winding of

this relay and its left hand make-before-break contacts, contacts of relays 610, 612 to the PU lead. Relay 614 locks to ground at relay 603. The operation of relay 614 closes a circuit from the ringing interrupter at 806 for the windings of relay 615. The ringing interrupter circuit connects short ground impulses to the leads 1 to 10 in order to provide ringing codes having only short rings, while long ground impulses are connected to leads 11 and 12 in order to provide ringing codes having long rings. The combination of the relays 711, 712, 714, 716 and 710 operated, determines which impulses may operate the relay 615 and therefore which ringing code will be sent out over the line. The relay 710 in non-operated condition will establish connections to one winding of relay 615 from the leads 11 or 12 or both, while the other winding will be connected to one of the other ten leads 1 to 10. During the interval when the lead 11 or 12 is grounded, long rings will be sent out, and any short pulses received by the other winding of relay 615 during this interval will be ineffective. Leads 1 to 10 consist of combinations of such long rings and short rings. When relay 710 is operated, combinations of short ring will be sent out. These combinations constitute codes 11 to 20. The operation of the relay 615 by these various codes operates relay 616 from battery through the winding of this relay, contact of relays 615, and 610 to ground. This relay 616 in turn operates relay 617 and opens the tip and ring connection and connects ringing current to one side of the line and ground to the other side of the line from source 611 as determined by the setting of the relay 704 as hereinbefore described. The release of relay 615 disconnects ringing current from the line by short-circuiting the ringing source at 611 and opens the circuit to the relay 616. Ringing is disconnected from the line in this manner in order to reduce induc-

tive kick received by the subscriber if he should answer a call during the ringing interval. The release of the relay 616 opens the circuit for relay 617 and connects the tip and ring to the front contacts of the relay 617 to ground and battery respectively. The relay 617 is slow to release and while it is releasing the charge left by the ringing current on the condensers in the subscriber's set or sets is drained and these condensers are charged to the voltage at the battery. The release of the relay 617 then closes the tip and ring through to the relay 618 and as the condenser in the subset is charged to this voltage from the battery, relay 618 will not operate falsely. Ringing tone is returned to the calling subscriber through the condensers 619 and 620. Now when the call is answered by the called subscriber, relay 618 is operated over the tip and ring conductors and relay 610 is thereby operated over a circuit from battery, its winding to ground at contacts of relay 618. The operation of relay 610 operates relay 614 if the subscriber answers before 614 has operated from the PU lead, that is, in case the subscriber answers before the start of the first series of code signals and causes the release of relay 612 and 704, thus tripping ringing and disconnects the ground lead from the AG lead to the alarm and timing circuits. Talking battery is supplied to the called line through the windings of relay 618. The calling subscriber receives his talking battery through the windings of relay 724 which is connected through contacts of relay 614 held operated under control of relay 603.

To further illustrate how the codes are transmitted, reference is now made to the following table of ringing codes and relays operated to produce these codes. It will be noted that on a single line there may be twenty parties with twenty different codes.

Code No.	Code signals	Leads from ring interrupter	1st or 100 storing relays up	2nd ringing digit storing relays up	1st digit or 100 storing relay 4 ringing current on—	
					T	R
1	—	1—11	Any other digit but 4 relays	711	If 1st digit is 3, 1107	If any other digit than 3 and 6 in 1st digit is dialed, codes will go out on R, alternating current on R as relay 704 will be up, or if 1st digit is 6 then 1110 is up and code will go out on tip, alternating current on T.
2	— —	2—11	1107 digit 1	712	1108 up	
3	— — —	3—11	1108 digit 2	711—712	then codes will go out on tip, alternating current on T as relay 704 will be up, or if 1st digit is 6 then 1110 is up and code will go out on tip, alternating current on T.	
4	— — — —	4—11	1107 digit 3	714		
5	— — — — —	5—11	1108 digit 3	711—714		
6	— — — — —	11—12	1107 digit 5	716		
7	— — — — —	7—12	1109 digit 5	716—711		
8	— — — — —	8—12	1110 digit 6	716—712		
9	— — — — —	9—12	1110 digit 7	716—711—712		
10	— — — — —	10—12	1107 digit 7	716—714		
11	— — — — —	1	1110 digit 8	710—711		
12	— — — — —	2	1107 digit 8	710—712		
13	— — — — —	3	1110 digit 9	710—711—712		
14	— — — — —	4	1107 digit 9	710—714		
15	— — — — —	5	1108 digit 9	710—711—714		
16	— — — — —	6	1110 digit 10	710—716		
17	— — — — —	7	1109 digit 10	710—716—711		
18	— — — — —	8	Digit 4 Relay 1109 up	710—716—712		
19	— — — — —	9		710—716		
20	— — — — —	10		711—712		
				710—716—714		

If the first digit is any numeral except 4, the codes 1 to 10 will be transmitted and if the first digit is 4 codes 11 to 20 will be transmitted, if the first digit is 3 or 6 the ringing current will go out on the tip side of the line and if the first digit is any other numeral the ringing current will go out over the ring side of the line. To transmit any of the codes 11 to 20, the first digit must be 4 as stated which causes the operation of storing relay 1109, which in turn causes the operation of relay 710 from battery through the winding of this relay, lead 13, contacts of relays 1110, 1109, 1108, 1107 to ground at relay 1112. This prevents impulses from the interrupter 806 from being transmitted over lead 11 to the leads RL1 and to RL2. In case any other digit but 4 is dialed at the first digit, relay 710 will not operate and the long impulses received over lead 11 will be transmitted over leads RL1, RL2 to control relay 715. To give an example of the codes transmitted it is assumed that code No. 1 is to be transmitted. Then relay 710 will not be operated and the only one of the storing relays that operates is relay 711. Consequently, the long impulses will be received over lead 11 to cause the operation of relay 615 from battery, left hand winding of relay 615, contacts of relays 612 and 614, lead RL1, contacts of relays 710 and 716 to lead 11. It will be noted that at the same time impulses are received over lead 1, in this case three impulses, through contacts of relays 711, 712, 714 and 716 over lead RL2, contacts of relays 614 and 612 through the left hand winding of relay 615 to battery. These latter impulses, however, have no effect on relay 615 as they are blotted out by relay 615 being maintained operative during the sending of the impulses by the long impulse over lead RL1. Therefore, code No. 1 consists of one long impulse. Another example may be code 11 which consists of three short impulses. In this case the first digit will be 4 which causes the operation of relays 1109, 710 and 711. In this case the three impulses received over lead 1 and transmitted over contacts of relays 711, 712 and 714 to lead RL2 cause relay 615 to operate three times, as the long impulse on lead 11 will have no effect on relay 615 due to the operation of relay 710. It has previously been explained how the circuit functions when the called subscriber answers and conversation between a calling and a called subscriber may now take place through the supervisory control circuit.

When the called subscriber hangs up the receiver at the end of the conversation, relays 618 and 610 are released and when the calling subscriber hangs up his receiver relay 724 is released which causes the release of relays 602, 603 and 614 and the release of the holding magnet 321, 320, 310 and 301 thus restoring the supervisory control circuit to normal condition and releasing the subscribers from the connection through the links in the primary and secondary line switches.

A description will now be made of a call from a subscriber's line to a trunk outgoing to a distant exchange. These trunks may be arranged in groups to different exchanges and the system may be so arranged that a trunk group may be seized by dialing the single digits 7, 8, 9 or 0. That is, trunks to four different exchanges may be selected and an idle trunk to a selected exchange may be hunted for and connected with. The operations are the same as hereinbefore described as far as the calling subscriber seizing a

control circuit, a supervisory control circuit and a recorder and the dialing of a single digit is concerned. When the dialing of the trunk digit is completed, relays 1107 to 1110 have been set and then relays 806 and 911 release while relay 1101 operates and the operated register relays are released in the usual manner. This causes the operation of relay 1111 which in turn causes the operation of relay 1106 and the locking of this relay by relay 802. Trunk group selection and trunk hunting will then begin. The first register relay 1000 operates to test, as hereinafter will be described, the first trunk in the group to be selected as to whether it is idle or busy. The circuit for this relay 1000 may be traced as follows: From battery through the left-hand winding of relay 1000, contact of relay 1106, make-before-break contacts of relay 1002 to 1011, contacts of relay 1103 to ground at contacts of relay 802. This relay 1000 locks through its left-hand armature and front contact on the same ground. It should be observed, however, that ground is also provided on lead 3 by the operation of relay 1106 to the control circuit to seize it to cause the operation of relay 1892 individual to the sixth recorder. This circuit may be traced from battery through contacts of relays 1801, windings of relay 1892, contacts of relays 1811 over lead 3, contacts of relay 904, 1006 to ground at relay 911. Relay 1892 causes the operation of relay 1811 from battery through the winding of this relay, contacts of relays 1802, 1800, 1806, 1803 and 1834 to ground at contact of relay 1700. Relay 1892 is now operated from battery through the winding of this relay, contacts of relays 1811, 1300 and 1301 to ground. Relay 1902 connects the control circuit to the recorder as usual. Relay 720 in the link circuit is now operated from battery through the winding of this relay over lead 1 through the connecting point 1400 of the recorder connector, contact of relays 903 and 1902 to ground. Relay 1906 of the proper group of trunks in which the called trunk is located, is now operated in a circuit from battery through the windings of relay 1906, contacts of relay 1902 over the TK0 lead through certain ones of the storing relays 1107 to 1110 to ground as described below. As already described, the trunk group may be called with a number 7, 8, 9 or 0. If digit 7 is dialed relay 1107 operates. The circuit may in this case, therefore, be traced from the TK0 lead through contacts of relays 1130, 1107, 1108 and 1107 to ground at relay 802. Relay 904 will now be released due to a short circuit applied by the operation of relays 1906 from battery over the TH lead, contact of relays 1902, 1509 to ground at relay 1906. The release of relay 904 causes the release of relay 905 which in turn causes the release of relay 902, if the first trunk in the selected group is idle, and this relay closes a circuit for the operation of relay 911 from battery. If on the other hand the first trunk is busy, relays 902 and 905 will not release and trunk hunting will take place to find an idle trunk. It will be noted that the HM and BT leads of the trunks are connected together and then if any of the trunks are busy the HM lead will be grounded from the BT lead. As relay 1000 has operated as hereinbefore described, the HM lead for this trunk is grounded and relay 1002 will be operated from battery, winding of relay 905, contacts of relays 902 and 910, right-hand winding of the register relay 1002, contacts of relays 1000, 1902 and 1705, thence over the BT lead to ground at a relay corresponding to

relay 1200 in the trunk shown in Fig. 12 if the first trunk is busy. Relay 905, therefore, remains operated and holds relay 902 operated. The operation of this second register relay 1002 releases relay 1000 and connects the circuit for the operation of the third register relay 1003. If the second trunk is busy hunting proceeds in this manner until a line is found where the HM lead is ungrounded at which time the relay 906 releases as a busy test is made on this line. Relay 902 is then released and assuming that, for example, the ninth trunk was idle, register relay 1009 is locked. Then relay 905 releases and causes the release of relay 902, through winding of relay 911, contacts of relay 902 over lead 9 through the cross-connecting point of 1401 at the recorder connector, contacts of relay 722 to ground at relay 600. The operation of this relay now closes a circuit for relay 1202 in the selected idle trunk circuit, which is shown in Fig. 13, from battery through the winding of this relay over the C1 lead contacts of relay 1906 over the HM9 lead, contacts of relays 905, to ground at relay 911. The select magnet of the secondary trunk switch is now operated due to the operation of relay 1202 from battery through the winding of this magnet which is numbered 500, contacts at the cross-connecting point at 311 of the secondary line switch, contacts of relay 720 over the SM lead to ground at relay 1202 and the select magnet 400 of the primary trunk switches also operated due to the operation of relay 1202 from battery through the winding of this magnet 400, contact of relay 1202, contact of relay 1215 to ground. The selecting magnet 400 of the primary trunk switch closes the circuit from ground at 1215 over its armature and front contact, to the LG lead over contacts of relay 1509, windings of relays 1503 and 1504 to battery through the windings of relay 1500 which now operates. This relay in turn operates relays 1503 and 1504, which causes the holding magnet 502 for the first line link on the secondary trunk switch to operate to connect the trunk through to the chosen link LL. The circuit for this magnet may be traced from battery through the winding of this magnet, contacts of relay 1202, contacts of the holding magnet 310 of the secondary line switch through contacts of relay 720, contacts of relay 1202 to ground at relays 1603 and 1604. This connects the called trunk at the cross-connecting point at 503 to the link LL and the relay 605 in the supervisory control circuit is now operated from battery through its winding, contact of relay 720, contact of holding magnet 310 of the secondary line switch through contacts of the holding magnet 502 of the secondary trunk switch, contacts of relay 1215 to ground at relay 1202. Relay 605 closes a circuit for relay 903 in the recorder and the recorder and a control circuit are thereby released by the release of relays 602, 603, 600 and when relay 600 releases the holding magnet 310 of the secondary line switch is released causing the release of the switch select magnet 500 of the secondary trunk switch. A connection is now established from the calling subscriber through the cross-connecting point at 312 over the link LL, the cross-connecting point 503 of secondary trunk switch to the trunk in Fig. 12 and as relay 1202 is released on the release of the control circuit, the select magnet 400 of the primary trunk connection is also released, causing the release of relays in the control circuit such as 1600, 1603 and 1604. When the connection is established through to the trunk from the calling

line, relay 1220 is operated over a tip and ring conductor to contacts of relays 1214, 1203 through the cross-connecting points of 503 and 1312 through the calling subscriber's loop. Relay 1220 operates relay 1211 and this in turn operates 1213 which closes a circuit from relay 1208. Relay 1208 reverses the connection to the trunk out over the tip and ring conductors at 1205 to signal the operator at the distant end of this selected trunk. When the operator answers this call, relay 1204 operates which in turn operates relays 1210 which operates relay 1200. Relay 1210 closes a circuit at its right-hand armature and front contact to ground for holding the holding magnet 502 operated in place of the circuit for operating it which is opened when relay 1202 is released on the release of the recorder and control circuit. Relay 1200 closes a circuit for the BT lead to ground to make the trunk busy and closes a locking circuit for relay 1213 through its outer left-hand armature and front contact to ground at relay 1213. Relay 1216 is operated by the operation of relay 1213 from battery through the left-hand winding of this relay, contacts of relay 1213 to ground to open the GRP lead and relay 1216 is locked by relay 1200. Conversation between the calling subscriber and the operator may never take place and the operator may extend the connection to a desired subscriber's line in the usual manner.

In disconnecting, if the calling subscriber disconnects first relay 1220 will release causing the release of relays 1208 and 1211. The release of 1208 reverses the battery and ground over the trunk to give the disconnect signal to the operator and when the operator disconnects relays 1204, 1210, 1200 and 1213 and 1216 are released and this restores the circuit to normal. The release of relay 1210 causes the release of the holding magnet 500 and the holding magnet 301 and thereby releases the primary line switch and the secondary trunk switch. In case the operator disconnects first relay 1204 is released and this relay in turn releases relay 1210. Relay 1210 releases relay 1200 and transfers the holding magnets 500 and 301 under control of relay 1213. The release of relay 1200 connects the ringing start lead ST to ground and thereby causes the tone equipment at 806 to be operated to send a ringing tone over the RT lead from equipment at the 806 through the condensers 1221 through the subscriber's line. When the subscriber then disconnects, relay 1220 is released releasing relays 1211 and 1208, relay 1211 releasing relay 1213 which in turn releases relay 1216 and the holding magnet 503 to restore the circuit to normal.

A description will now be made of a call from a trunk to a subscriber's line. When a call comes in over the tip and ring conductors at 1205 from the distant office, relay 1204 operates from battery and ground, contacts of relay 1208, right-hand windings of repeating coil 1207, contacts of relay 1205, to the tip and ring conductors at 1205. This relay in operating closes a circuit for the operation of relay 1210 from battery, through the winding of this relay, contacts of relay 1204 to ground. Relay 1210 in turn operates relay 1200 over an obvious circuit. Relay 1210 closes a circuit for the operation of relay 1203, from battery through the right-hand winding of this relay, contacts of relays 1215 and 1213 to ground at 1210. The operation of relay 1200 closes a circuit for the operation of relay 1806 which with its companion relay 1807 are assigned for the particular group of trunks in which the calling trunk is lo-

cated, it having been designated the first group of trunks. Other relays corresponding to these relays 1806 and 1807 are provided for other groups of trunks. Relay 1806 operates over a circuit from battery, contacts of 1801, 1802, 1803 and 1804, 1300, windings of 1806, contacts of relay 1807 to ground over the LT lead through contacts of relays 1216 and 1200. Relay 1806 closes a circuit for the operation of relay 1807 from battery through its winding, contacts of relays 1803, 1804 and 1806 to ground at relay 1700. Relay 1807 closes an obvious circuit for the operation of relay 1906 which connects a number of leads from the trunk to the group of relays 1506 and 1507 and others representing individual trunks in groups in the same manner as when these relays represent individual lines in groups of lines when the relay 1900 was operated. If it is assumed that the calling trunk is the ninth in the group in which it is located, relay 1507 will be operated from battery through its windings over the LT9 lead, contacts of relay 1906, over the LT lead, contacts of relay 1215 to ground at relay 1200. Another circuit is closed by the operation of relay 1807 for seizing an idle supervisory control circuit. This is accomplished by the operation of the start relays 1701 from battery through the left-hand winding of this relay, contacts of relays 1700, 1807, and 1300 to ground at 1301. The operation of relay 1701 closes a circuit for the operation of relays 700 in the idle supervisory control circuit, from battery through the winding of this relay over the same circuit as hereinbefore traced for the operation of this relay when this circuit was seized by a calling subscriber, the circuit terminating at ground on contacts of relay 1301. A selector magnet RSM0 is now operated in the same manner as usual and relays 900, 1100, 904, 902 are operated as usual to close the connection for the operation of the holding magnets HM0, HM2 and HM6 to connect the recorder to the supervisory control circuit. The operation of relay 900 operates relays 602 and 603 as usual. In this case, however, the relay 1202 is operated over the circuit from battery through the winding of this magnet over the C1 lead to contacts of relay 1906, HM9 leads, contacts of relays 1507 and 1506, lead 10 back through contacts of relay 1906, contacts of relay 700 to ground at the contacts of relay 603. Relay 1202 now closes a circuit for the select magnets in the primary trunk switch to connect the idle link with the trunk. The circuit may be traced from the select magnet 400, contacts of relay 1202 to ground at relay 1215. Magnet 400 now closes a circuit at its armature and front contact from this ground at relay 1215 for the operation of relay 1500 from battery through the windings of relay 1500, contacts of relays 1503, 1504 and 1509 over the LG lead, armature and front contact of select magnet 400 to ground at relay 1215. Relay 1500 causes the operation of relays 1503 and 1504 as usual and these relays now close a circuit for the holding magnet 401 on the primary trunk switch to connect the supervisory control circuit to the trunk. This circuit may be traced from battery through the holding magnet 401, contacts of relay 700, lead HMC, contacts of relay 1202 to ground at the contacts of relays 1503 and 1504. The holding magnet extends through its inner lower armature and front contact, the ground on the sleeve through the cross-connecting point 403 to operate relay 1216. Relay 1216 disconnects the GRP and LT leads from ground. The operation of the holding mag-

net 401 also extends the ground connection from relays 1503 and 1504 over the sleeve leads, contacts of relay 603 through the winding of relay 600 to battery causing this relay to operate. Relay 600 in operating extends the ground through contacts of relay 701 for the sleeve leads, so that the holding magnet 401 is now held from this ground under control of relay 600 which is itself held operated through the same ground. This causes the release of the control circuit as usual over the RL lead by the operation of relays 1702, 1700 and the release of relays 1701, 1500, 1503, 1504, 1507 and then the release of relays 1702 and 1700, the select magnet 400 of the primary trunk switch and relay 1202 in the trunk circuit. The release of these relays has been explained hereinbefore in connection with the release of the control circuit in a call from one subscriber to another. The circuits are now in condition for the reception of the dial tone over the trunk in the usual manner over the tip and ring conductors from the link as hereinbefore described to notify the operator at the distant end that dialing of the desired subscriber's number may begin. Relay 1216 in operating as described closes a locking circuit for itself through its inner left-hand armature and front contact to ground at relay 1200. The operation of this relay also closes a circuit for the pulsing relay 805 in the recorder. The circuit for this relay extends from battery and ground through the winding of this relay, contacts of relay 903, leads 2 and 3 through the cross-connecting point 1400, to the tip and ring conductors of the supervisory control circuit, contacts of relays 605 and 606 through the cross-connecting point 403 at the primary trunk switch, contacts of relays 1203 and 1204 through the left-hand winding of the repeating coil 1207. When now dialing begins relay 1204 will respond to the pulsing. Relay 1210 which is controlled by relay 1204 is slow to release and will remain operated during dialing. Relay 1218 operates on the release of relay 1204 from battery through the winding of this relay, contacts of relay 1204 to ground through contacts of relays 1216, 1213 and 1210. Relay 1218 in operating shunts out the left-hand windings of the repeating coil 1207 in the tip and ring connection for the pulsing relay 805 and remains operated during dialing so that when relay 1204 responds to the call on the trunk a tip and ring connection will be controlled for relay 805 through the inner left-hand armature and front contact of relay 1204. Relay 1218 closes a circuit for the operation of relay 1215 from battery, the winding and right-hand make-before-break contacts of this relay, contacts of relays 1218, 1216 and 1213 to ground at relay 1210. Relay 1215 shifts the control of the secondary or left-hand winding of relay 1203 to relay 1218 and at the end of each digit relay 1218 releases removing the short circuit from the left-hand winding of the repeating coil 1207 and the primary winding of relay 1203 and opens the circuit to the secondary winding of relay 1203. Relay 1203 remains locked on its right-hand winding over the tip and ring leads. At the end of each digit relay 1218 releases. When dialing is completed in the usual manner in response to the operation of the pulsing relay 805, as described in connection with a call from one subscriber to another, the relay 1106 operates as usual and relays 1802 and 1811 are operated as usual to cause relay 1902 to operate as described. Then relay 720 is operated from battery through the winding of this relay over lead 1, the cross-

connecting point 1400, contacts of relay 903 to ground at contacts of relay 1902. This causes the operation of the relay 1202 in the trunk circuit from battery through the winding of this relay over the TK1 lead, cross-connecting point 403 of the primary trunk switch to ground at contacts of relay 720. When relay 1902 operates either relay 1708 or 1709 will operate depending on which hundreds group the called subscriber's line is located in and this is determined by the setting of the storing relays 1107 to 1110. If the first hundreds group is selected relay 1408 operates over a circuit from battery through the winding of this relay, contacts of relay 1902, contacts of the storing relay 1110 over the H1 lead, relays 1109, 1108, 1107, to ground. A circuit is now completed for a relay such as 1900 to pick the group of ten lines in which the called line is located as determined by the setting of the relays 1121 to 1126 and this relay operates in series with the corresponding relay 1600. This circuit may be traced from battery through the winding of relay 1600, winding of relay 1900, contacts of relays 1488 and 1902, lead 13, contacts of storing relays 1126 and 1124, 1122 and 1121 to ground. The particular lead connected indicates that the called subscriber's line is located in the first group of ten. Relay 1600 causes the operation of relay 1602. This relay in turn closes a circuit for relay 1603. Now one of the relays 1502, 1501 or any of the corresponding relays operate depending on an idle available link, for example, link LL. If this link is idle and it is the lowest numbered one that is idle this is indicated by the operation of relay 1501 from battery, contacts of relay 1603, winding of relay 1501, contacts of intermediate relays and relay 1502 to ground at relay 1702. The operation of this relay now causes the operation of the select magnets of the primary line switch and secondary line switch of link LL from battery through the winding of these magnets 306 and 307, SMO lead contacts of relays 1602, 1501, 1500 to ground at relay 1702. When select magnet 307 of the secondary line switch is operated the ground is extended through its armature and front contact for the operation of relay 1500 from battery, windings of this relay, contacts of relays 1503 and 1504, the LG lead through contacts of relay 1602, armature and front contact of select magnet 307 to the ground at 1702 as hereinbefore described for the operation of this select magnet. Relay 1500 releases relay 1603 and this in turn releases the operated relay 1501 and any other relays that may be operated in the group and also causes the operation of relays 1603 and 1604. The select magnets 306 and 307 are now held over the ground through contacts of relays 1603, 1604 and 1702. It will now be noted that relay 904 will be released by a short circuit being established from battery over the TH lead through contacts of relay 1902 to ground at relay 1500. The release of relay 904 causes the release of relay 905 and this in turn causes the release of relay 902. Relay 911 is then operated over a circuit from battery through the winding of this relay, contacts of relay 902, cross-connecting point 1401, lead 9, contacts of relay 722 to ground at relay 600. A circuit is now completed for operating the holding magnet of the primary line switch to connect the called subscriber's line to the chosen line link. The circuit for this magnet may be traced from battery through the winding of the magnet 301 of the called subscriber A, as determined by the setting of the

register relays in the recorder in accordance with a unit digit which may be set so that relay 1010 is operated indicating that the tenth subscriber in the group is the one selected. This circuit is traced from battery winding of relay 301 over the HMO lead, contacts of relay 1900 of the group of ten lines through contacts of relay 1902 over the HMO lead, contacts of relays 1010, 905, 904 to ground at relay 911. This connects the called line A to link LL. A circuit is also completed by the release of relay 905 for the connection of the terminating or outgoing end of the supervisory control circuit to the link LL. This is for the purpose of ringing as will be hereinafter described and in this case there will be a circuit completed for the operation of holding magnet 320 from battery through the winding of this magnet, contacts of relay 720, relays 1602, 1902, relay 911 to ground. It should be noted that on the operation of the holding magnet 320 the holding magnet 502 of the secondary trunk circuit will be operated from battery through the winding of this magnet, contacts of relay 1202, contacts of magnet 320 to ground at contacts of relay 720. Ringing is now transmitted in the usual manner to the called subscriber over the tip and ring conductors through the link and through the cross-connecting point 326 and link LL and cross-connecting point 312 of the primary line switch to the called subscriber's line at A.

When the subscriber answers relay 618 operates which causes the operation of relay 610 as usual and this, in turn, closes a circuit for the operation of relay 605 from battery through the winding of this relay, contacts of relay 610 through the cross-connecting points at 326 of the secondary line switch to ground at the cross-connecting point 503 of the secondary trunk switch. Relay 605 will lock under control of relay 600 and cause the release of relay 805. This in turn causes the release of relays 602 and 600 and the release of relay 600 in this case causes the release of the holding magnet 320 of the secondary line switch to disconnect the supervisory control circuit from link LL. The supervisory control circuit is also disconnected from the calling trunk by the release of the holding magnet 401 of the primary trunk switch by the release of relay 600. Relay 605 in operating opens the connection to the tip and ring conductors and consequently relay 1203 is also released and the connection is thereby established from the trunk at 1205 through the repeating coil 1207 through cross-connecting point 503 over the link LL and cross-connecting point 312 over the primary line switch to the called subscriber. The release of relay 1203 closes a circuit for the operation of relay 1220 to provide talking battery for the called subscriber through the winding of this relay. Relay 1220, in turn, closes a circuit for the operation of relay 1211 and this relay operates relay 1213. Relay 1213 closes a circuit for relay 1208 from battery through the winding of this relay, contacts of relay 1213, to ground at relay 1220. Relay 1208 reverses battery and ground through the windings of relay 1204 over the trunk to notify the operator that the called subscriber has answered. Conversation between the operator and the called subscriber may now take place. It should be noted that the holding magnet 301 of the primary line switch is held over the sleeve connection through cross-connecting points 312 and 503 of the primary line and secondary trunk switches through contacts of relays 1211 and 1213 to ground at contacts of relay 1225. It will be

noted also that the holding magnet 502 of the secondary trunk switch is locked to ground at relay 1210.

If the called subscriber disconnects, first relay 1220 will release causing the release of relays 1211 and 1208. Relay 1208 again reverses the connection to battery and ground through relay 1204 over the trunk 1205 to give the operator a disconnect signal. The operator then disconnects and releases relay 1204 which, in turn, releases relay 1210. Relay 1210 also releases relay 1200 and this, in turn, causes the release of relay 1213. Relay 1200 causes the release of relay 1216 and restores the circuit to normal. The release of relay 1213 opens the circuit for holding magnet 502 of the secondary trunk switch and the release of this switch causes the release of the holding magnet 301 of the primary line switch, thus freeing the called subscriber from the connection to the trunk. Should the operator disconnect first, relay 1204 will release and then release relay 1210. Relay 1210 in releasing causes the release of relay 1200 and transfers the holding lead for the magnet 502 to contacts of relay 1213 to the make-before-break contact of relay 1210, contacts of relay 1213 to ground at relay 1225. The release of relay 1200 establishes a connection to the TST lead from ground at relay 1213. This lead goes to the ringing and tone signal circuits at 806 and thus causes ringing tone to be applied over the RT lead through contacts of relay 1208 from the ringing tone source 806 over the RT lead through contacts of relay 1208, contacts of relay 1200, condenser 1221 over the ring conductor to the called subscriber. Then when the called subscriber disconnects relay 1220 is released causing the release of relays 1208 and 1211, relay 1211 releasing relay 1213 which releases the relay 1216 and opens a holding circuit for holding magnet 502 thus freeing the called subscriber from the connection to the trunk by releasing this magnet and the holding magnet 301 and restoring the primary line and secondary trunk switches to normal.

In the case of a tandem connection, that is, the connection from one trunk to another, the calling trunk such as the one disclosed in Fig. 12 seizes a link, is connected to a recorder and dialing is started over this trunk and registered in the recorder in the usual manner. When dialing is completed, relay 1106 is operated as usual to cause the operation of the first counting relay 1000. Relays 1802 and 1811 are then operated as usual to cause the operation of relay 1902 to connect the recorder to the control circuit. Then the relay 1906 or a similar relay for the group of trunks in which the called trunk is located is operated as usual. It should now be noted that on the operation of the holding magnet 401 when the calling trunk in Fig. 12 is connected to the supervisory control circuit a circuit was completed for the operation of relay 1130 in the recorder when the recorder was seized. This circuit may be traced from battery through the winding of this relay over the lead 5 through the cross-connecting point 1400 in the recorder connector to ground at contacts of holding magnet 401. Now, therefore, when relay 1906 is operated, the relay 1509 becomes operated over a circuit from battery through the winding of this relay, contact of relay 1902 to ground at relay 1130, which prepares a circuit so that the office switch will be operated to connect the calling trunk to establish a tandem connection instead of the relays 1600,

1602 and 1603 as in a call from one line to another. Relay 1509 closes a circuit for the operation of relay 1510 from battery through the winding of this magnet, contacts of relay 1509 and for the operation of relay 1511, from battery through the winding of this magnet, contact of relay 1509 to ground at relay 1500. A test is now made for an idle office link OL or OL1 or any other by the operation of the relays 1501 and 1502 as usual, the busy links preventing the corresponding relays from operating and the lowest numbered idle link is chosen in the same manner as the link LL or LL1 was chosen in connecting a subscriber's line to the primary and secondary link switch and the secondary trunk switch. Assuming that relay 1501 is operated, the select magnet 405 is operated from battery through the winding of this magnet, contacts of relay 1510, contacts of relay 1501, 1500 to ground at relay 1702. Thus a first office link OL is chosen for the establishing of the connections. The operation of the select magnet 405 extends this ground connection through its armature and front contact over the contacts of relay 1509, lead LG, contacts of relays 1503, 1504 to battery through the windings of relay 1500 causing this relay to operate. Relay 1500 releases relays 1511 and 1501. Relay 1500 also causes the operation of relays 1503 and 1054 as usual and extends the ground over the TH leads to short-circuit relay 904 causing it to release. This relay causes the release of relay 905 which then releases relay 902 and relay 911 is operated if the first trunk in the selected group is idle. If it is busy, trunk hunting takes place as usual. The relay corresponding to relay 1202 in the idle trunk seized is then operated due to the operation of relay 911. This causes the operation of the holding magnet 406 of the called trunk if the called circuit is considered as trunk No. 2 shown in Fig. 4. This circuit may be traced from battery through the winding of this holding magnet through contacts of the relay corresponding to relay 1202 in trunk No. 2 through contacts of relay 1510, 1902 over lead 8 to ground at relay 911. As the relay 1202 in the calling trunk is also operated, the holding magnet 407 will be operated over the same circuit in this case, of course, from battery through the magnet 407 through the contacts of relay 1202 to the ground at relay 911. The calling and the called trunk are now, therefore, connected through the link OL in the office switch and as relay 1215 is operated in the calling trunk, the relay 1206 in the calling trunk is operated in series with the relay in the called trunk corresponding to relay 1225 as shown in trunk No. 1. This circuit may be traced from battery through the winding of relay 1206, contact of the operated relay 1215, over the cross-connecting points 408 and 409 to the link OL of the office switch over the corresponding lead in the called trunk through contacts of the corresponding relay 1215 in the called trunk which is not operated through a corresponding relay 1225 to ground. In the called trunk, the relay corresponding to relay 1220 is then operated over the loop to the calling trunk. The called trunk then functions as usual and when the called operator answers at the distant end of the called trunk, a relay corresponding to relay 1204 will operate. This, in turn, will operate the relay corresponding to relay 1214 over a circuit from battery through the winding of this relay, contact of relay corresponding to relay 1215 which is not operated as noted in the called trunk. This reverses battery connections over the trunk to the calling

trunk to give the calling operator supervision. The release of the trunks are as in ordinary calls involving the trunk. In the calling trunk on the operation of relay 1206, relay 1204 is released and this releases, in turn, relays 1200 and 1210 which causes as hereinbefore described the release of the supervisory control circuit and recorder used in the setting up of connection so that the connection between the calling trunk and a called trunk now extend only through the office switch through cross-connecting points 408, 409 through the link OL.

What is claimed is:

1. In a telephone system a first switch, a second switch, links appearing in both of said switches, subscribers' lines, trunks, means for establishing a connection between a calling subscriber's line and a called subscriber's line over links through said first switch, means for establishing a connection from a subscriber's line to a trunk over a link through said other switch including a temporary connection through said first switch for the link used, and means for establishing a connection from a trunk to a subscriber's line over a link through said other switch.

2. In a telephone system a first switch, a second switch, links appearing in both of said switches, control circuits connectable to said links through said first switch, subscribers' lines, trunks, means for establishing a connection between a calling subscriber's line and a called subscriber's line over links and a control circuit through said first switch, means for establishing a connection from a subscriber's line to a trunk over a link through said other switch with the temporary aid of a control circuit connected through said first switch to the link used, and means for establishing a connection from a trunk to a subscriber's line over a link through said other switch with the temporary aid of said control circuit.

3. In a telephone system a first switch, a second switch, links appearing in both of said switches, control circuits connectable to said link through said first switch, subscribers' lines, trunks, means for establishing a connection between a calling subscriber's line and a called subscriber's line over links and a control circuit through said first switch, means for establishing a

connection from a subscriber's line to a trunk over a link through said other switch with the temporary aid of a control circuit connected through said first switch to the link used, means for establishing a connection from a calling trunk to a subscriber's line over a link through said other switch including the temporary connection from the calling trunk over a control circuit through said link and the temporary control by said control circuit over said second switch to establish said connections from the calling trunk to a subscriber's line over said link and said other switch.

4. In a telephone system, a first switch, a second switch, a third switch, links appearing in both the first and the second switch, control circuits, subscribers' lines, trunks, means for establishing a connection between a calling subscriber's line and a called subscriber's line over a link and a control circuit through said first switch, means for temporarily associating a control circuit with a calling subscriber's line through said first switch and for establishing a connection from said subscriber's line to a trunk over a link through said second switch with the temporary aid of the associated control circuit, means for temporarily associating a control circuit with a calling trunk through said third switch, and means for establishing a connection from said calling trunk to a subscriber's line over a link through said second switch with the aid of the control circuit temporarily associated with said calling trunk.

5. In a telephone system, a first switch, a second switch, links appearing in both of said switches, subscribers' lines, trunks, a plurality of common control equipments, means for establishing a connection between a calling subscriber's line and a called subscriber's line over two links through said first switch, said connection including a portion of one of said common control equipments, means for establishing a connection from a subscriber's line to a trunk over one link through said second switch including the temporary employment of one of said common equipments connected through said first switch to the link used.

FREDERICK R. LAMBERTY.