May 18, 1937. J. C. KELLY 2,080,486

TELEPHONE SYSTEM

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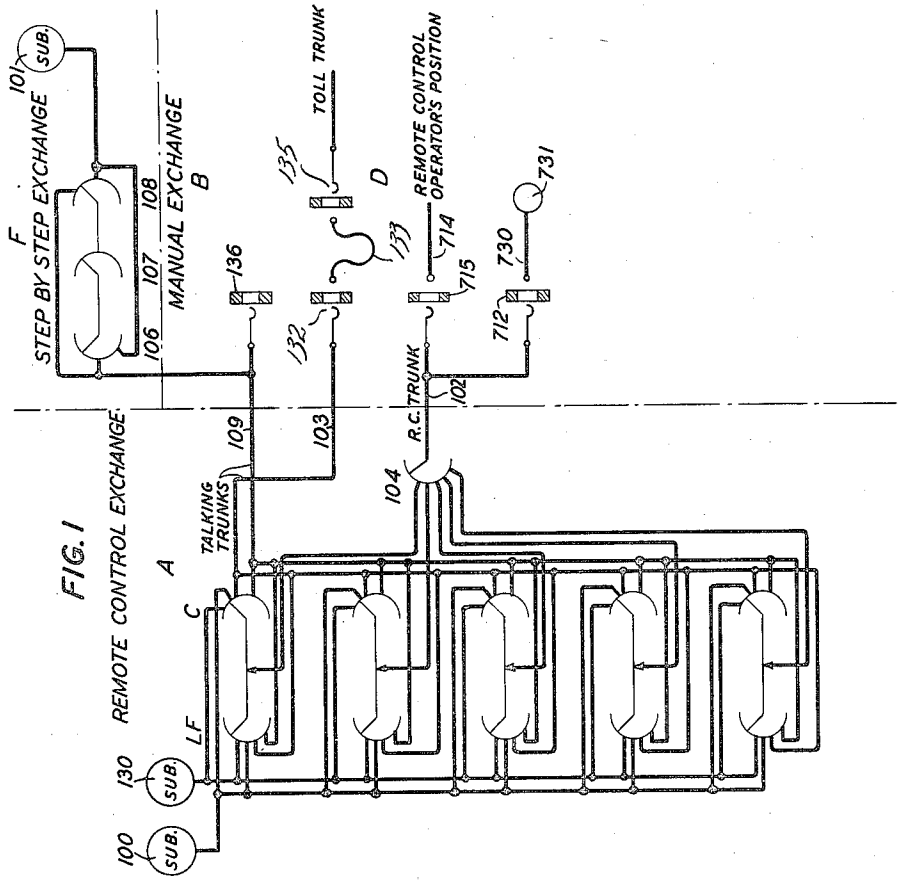


FIG. 1

FIG. 2

FIG. 5	FIG. 7
FIG. 6	

FIG. 3

FIG. 8	FIG. 9
FIG. 6	

FIG. 4

FIG. 5	FIG. 10
FIG. 6	

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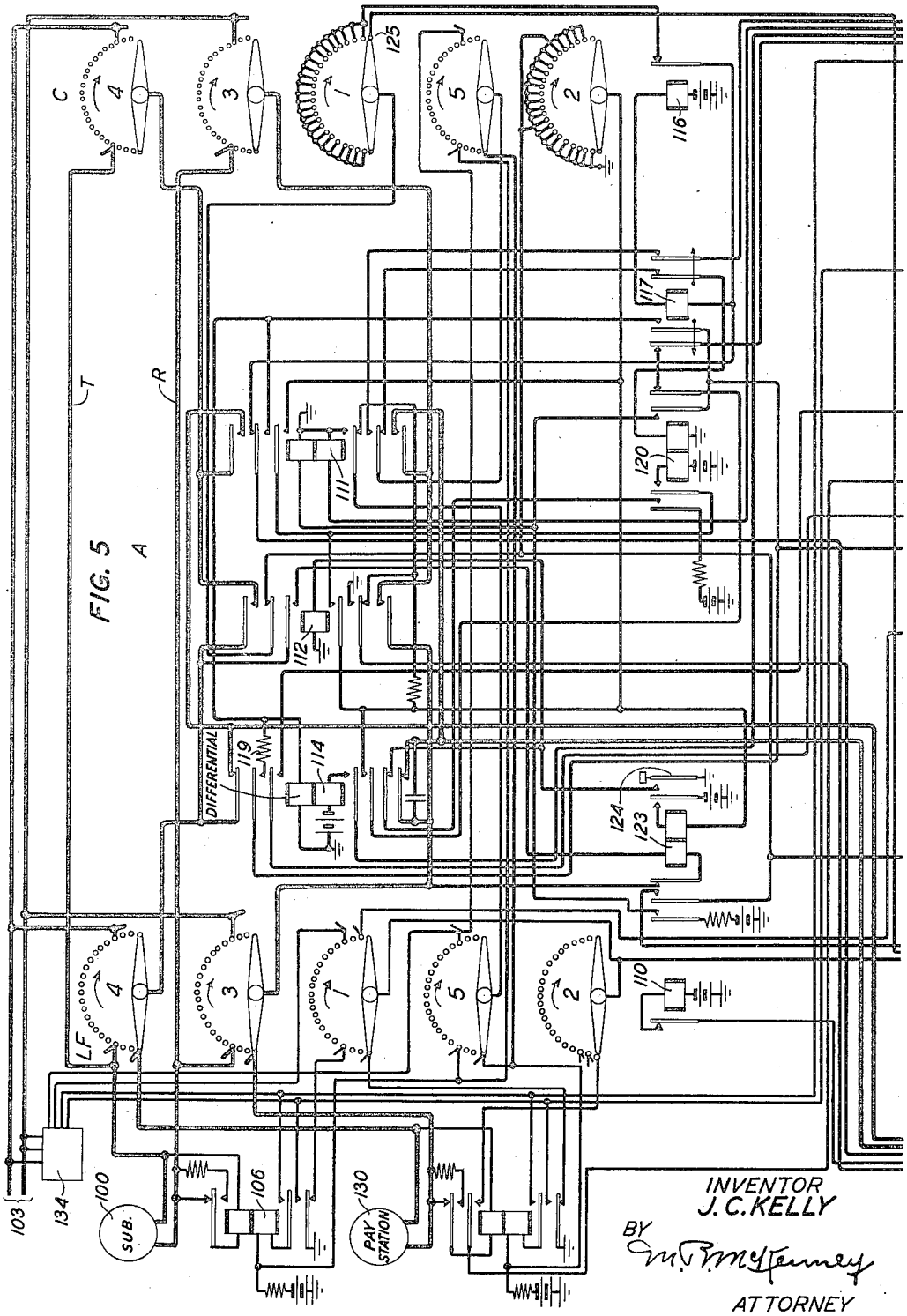


FIG. 5

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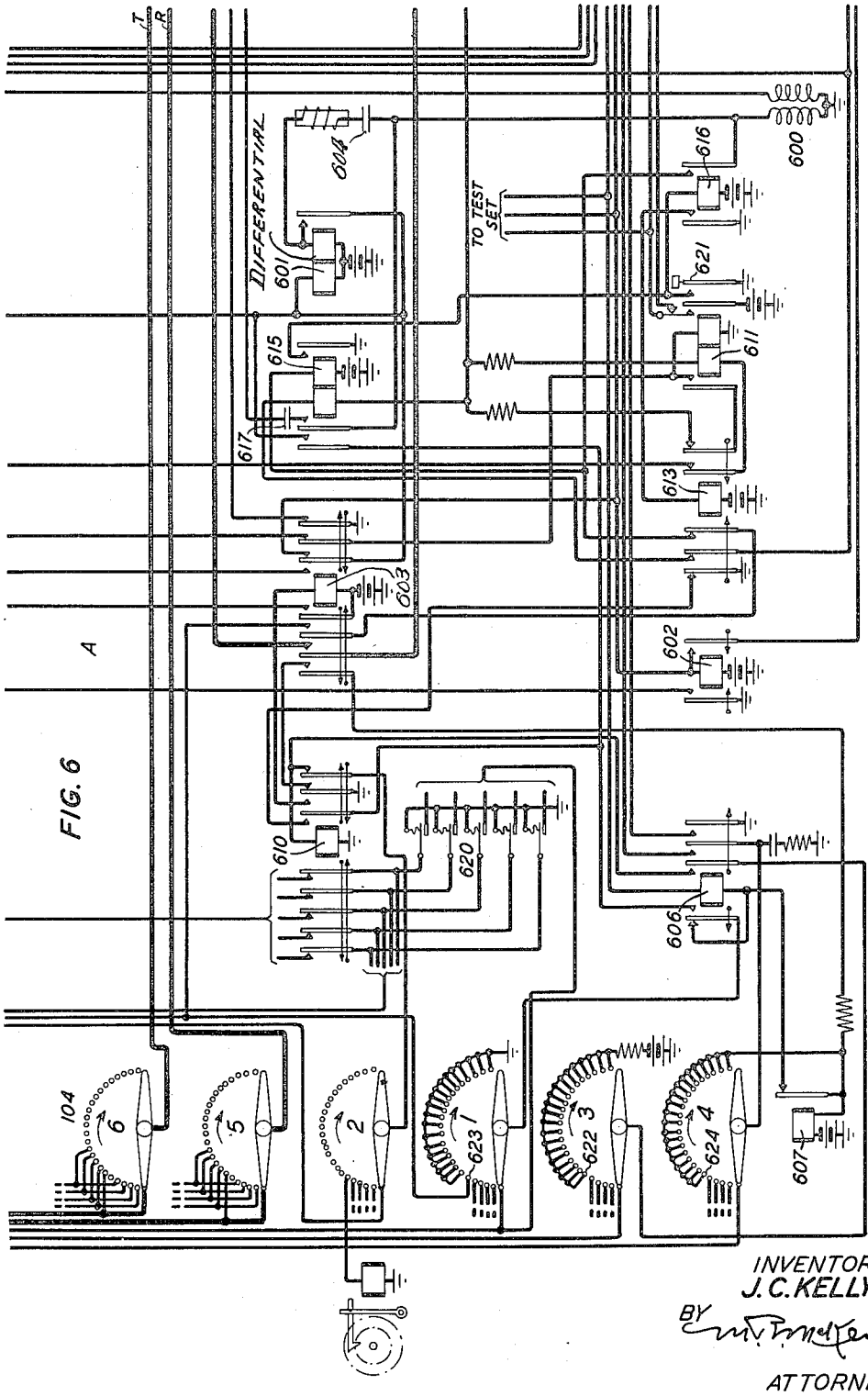


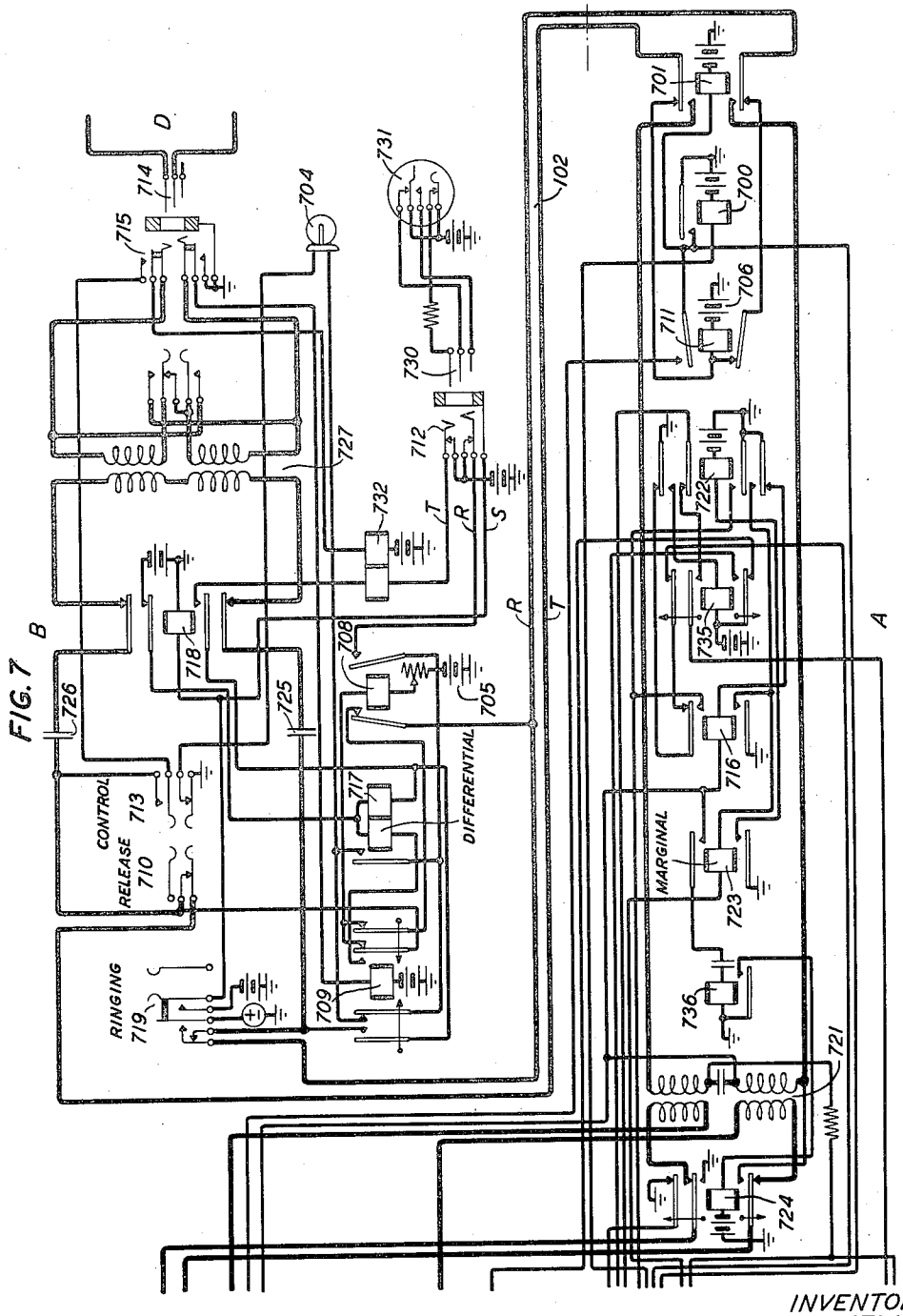
FIG. 6

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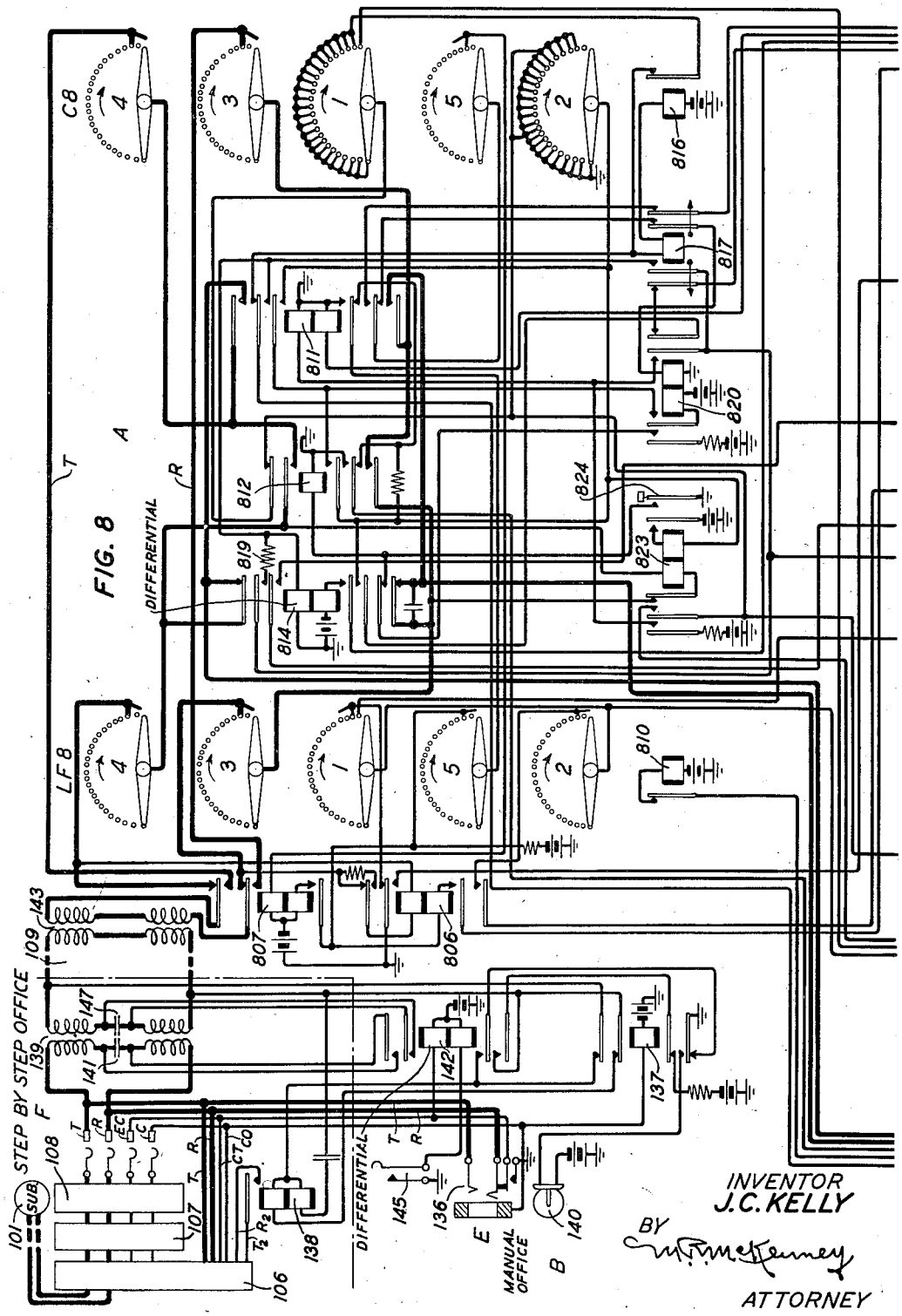


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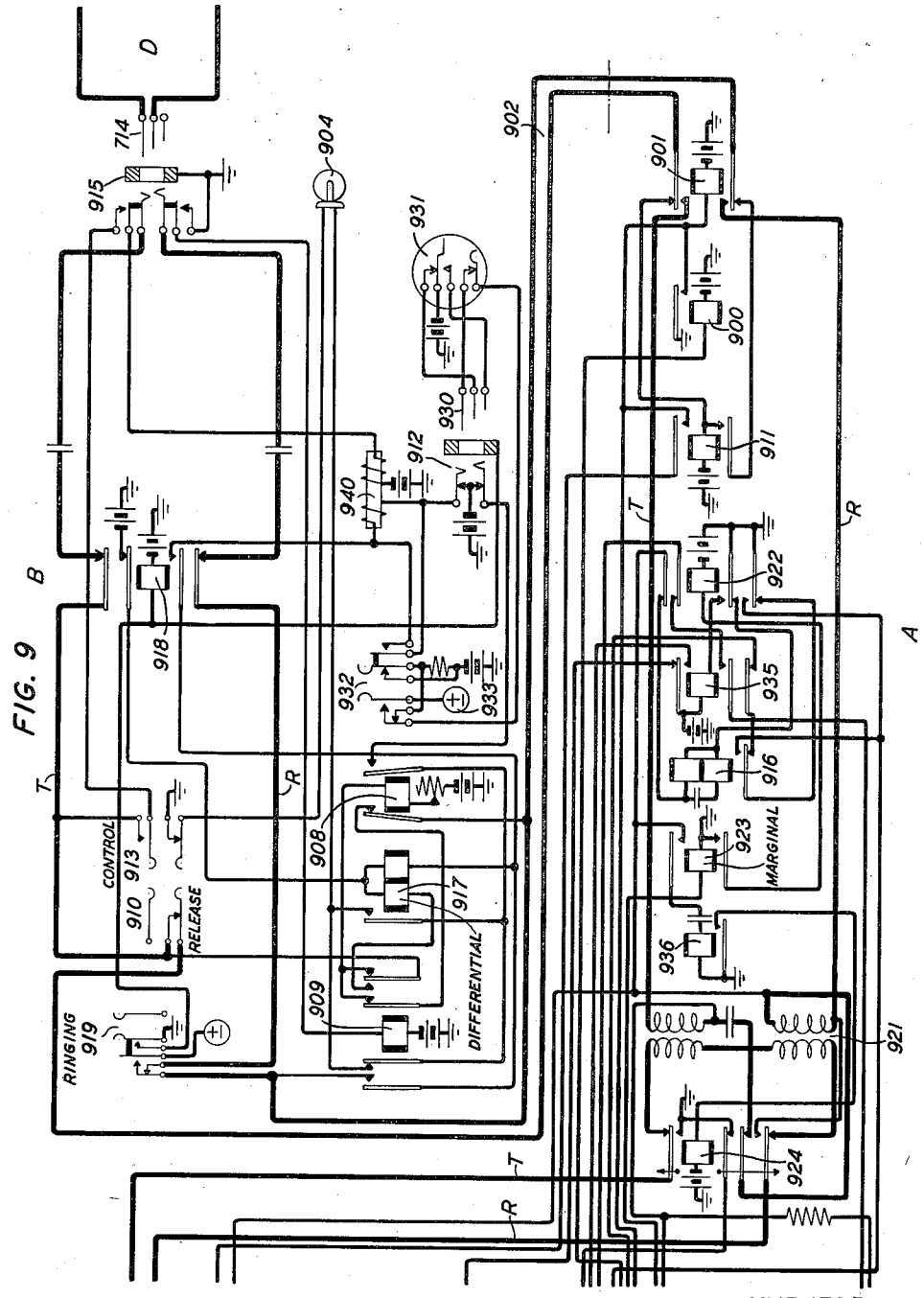


FIG. 9

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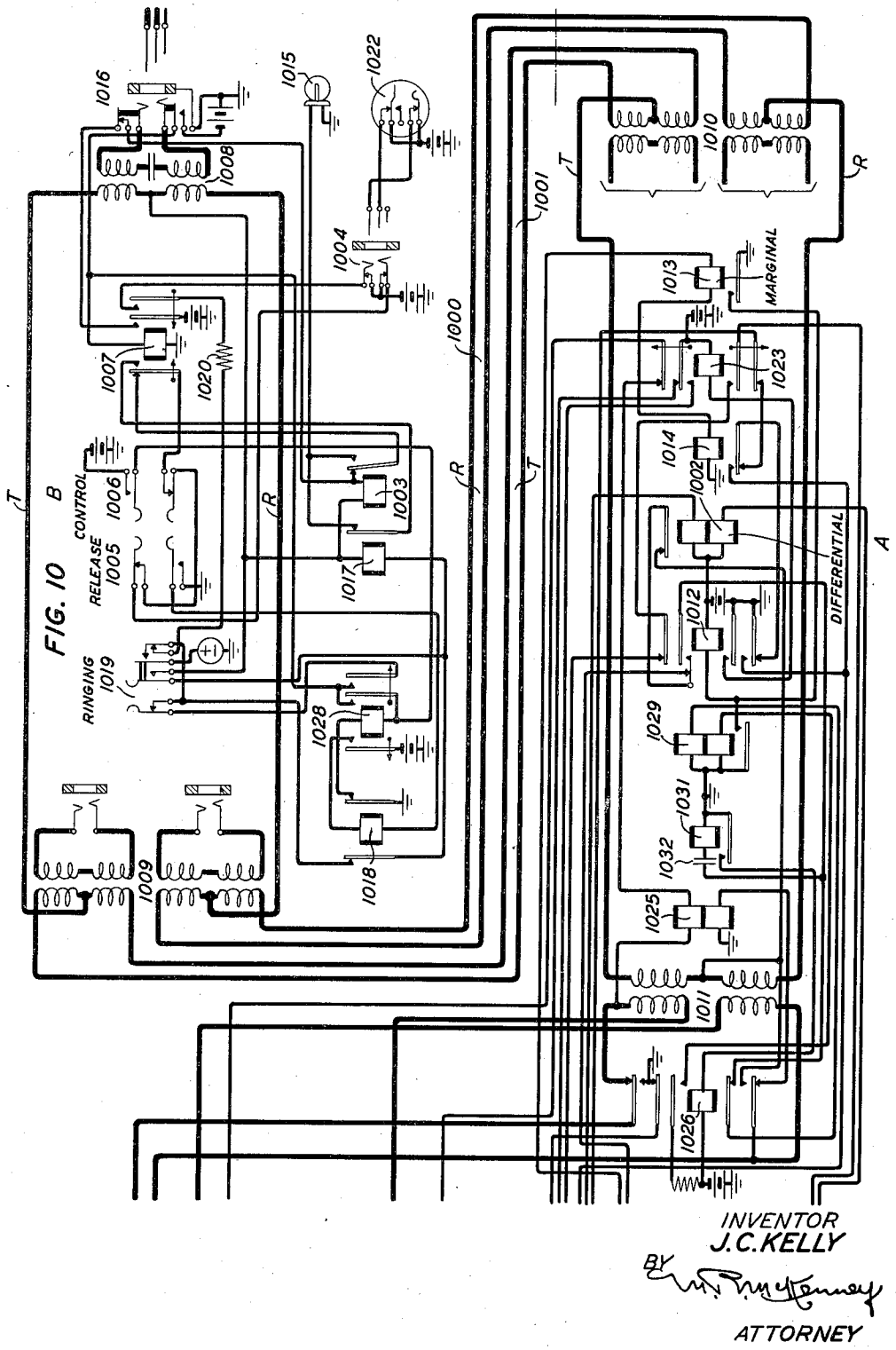


FIG. 10

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UNITED STATES PATENT OFFICE

2,080,486

TELEPHONE SYSTEM

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Application December 18, 1935, Serial No. 55,058

24 Claims. (Cl. 179—26)

This invention relates to telephone systems and particularly to automatic systems in which connections between subscribers' lines in one exchange may be established under control of an operator at a distant exchange.

An object of this invention is to improve and simplify the operation and control of circuit arrangements used in systems of this kind.

Heretofore systems have been provided in which a subscriber at a local exchange may initiate a call by operating his hand generator and thereby cause the finder switch of an idle link in the local exchange to find his line and to signal an operator at the distant exchange over a remote control trunk. The operator answers the call and dials back over the same trunk and thereby causes a connection to be established from the calling subscriber's line over the finder, link and a connector to a called subscriber's line. The operator then rings said subscriber and retires from the connection.

Systems of this type have also been provided in which when a calling subscriber initiates a call the operator at the distant exchange is signaled and when the operator begins to dial a called number the calling subscriber's line is associated with an idle link through the operation of relays and when dialing is finished, the called subscriber's line is associated with said link to establish a connection between the calling line and the called line.

It is a feature of this invention to provide in systems of this kind, means whereby when a calling subscriber initiates a call, the operator is signaled over a remote control trunk without connecting the subscribers' lines to an idle link and when the operator answers the call by connecting a cord to the trunk, an idle preselected link is associated with the calling line for the extension of a connection to a called line. This feature may be employed in a system where a line-finder is operated to connect the calling line to an idle link when the operator answers.

Another feature is an arrangement whereby when the operator starts dialing the called subscriber's number over the remote control trunk, the calling subscriber's line is disconnected in the link from the trunk and whereby if she does not desire to remain on the connection after she has rung the called subscriber's line, the removal of her cord circuit from the trunk causes the connection to be established between the calling line and the called line over the link and the trunk connected with the next idle link, or if the operator does desire to remain on the connection, the operation of a certain key and dialing of a special digit causes the reconnection of the calling line to the trunk in the link and the connection of the calling line with the called line through the link.

Another feature is an arrangement, in which the remote control trunk is normally connected with an idle link, whereby when this link becomes engaged in a connection between a calling line and a called line the trunk may be disconnected from said link and connected to a succeeding idle link. A rotary switch is employed to transfer the trunk and the switch is operated when the operator releases the trunk after it has been used for the establishing of a connection through an idle link.

Another feature is an arrangement whereby if all links are busy they may be tested for busy conditions by the operator over the remote control trunk and if required the connection through a link may be released and the link made idle. If an all link-busy signal is received when the operator seizes the trunk, she may by dialing the digit 1 connect the trunk with the first link and when she has monitored or tested the condition of this link, she may dial the digit 1 again and cause the trunk to be connected to the next link and so on until all links have been tested. If a connection through a link under test is held busy and no conversation is taking place indicating that the subscribers have neglected to release the connection by transmitting a ring-off signal the operator may, by sending such a ring-off signal over the trunk, release said connection.

Another feature is an arrangement whereby the operator may initiate a call to a called subscriber's line over the remote control trunk through the link associated therewith. The seizure of the trunk causes the line-finder of the associated link to advance to a special position to mark the call as incoming over the trunk. This line-finder is returned to normal position when the connection is released.

Another feature is an arrangement whereby if a call is in progress, the remote control trunk lamp at the operator's position is flashed if another subscriber attempts to establish a connection. The arrangement is such that, if the operator is dialing over one of the conductors of the remote control trunk when the second subscriber calls, the trunk lamp is flashed by means including the interrupting of the current on the other conductor of the trunk.

Another feature is an arrangement whereby if a pay station subscriber calls, the remote control trunk lamp signal at the operator's position is lighted, after she has answered the call, for a

short interval to indicate to the operator that a pay station is calling. The calling pay station subscriber at the same time receives a tone. This may be accomplished by means of a circuit closed when the line relay of the pay station line is operated, to effect further circuit operations that cause the signal to be operated and the tone to be applied.

Another feature is an arrangement whereby in case of a call to a busy subscriber when the called subscriber is on a party line and engaged in a revertive call, the operator will not receive the usual busy tone, but the remote control trunk will instead be connected to the called line and the operator will consequently hear the conversation and thereby know that the called line is busy in a revertive call. The calling line will also be connected momentarily to the called line so that the calling subscriber will consequently by hearing the conversation know that the called line is busy in a revertive call. The operator then releases the connection from the called line. This may be accomplished by means whereby the usual busy test relay operates, as if the called line were idle, to cause the establishing of a connection from the trunk to the called line and by means whereby the operator by operating a key, dialing a special digit and transmitting ringing current causes the calling line to be momentarily connected to the called line and the connection to the called line released.

Another feature is an arrangement for establishing incoming toll call connections to a subscriber in the local exchange, whereby an operator at a distant exchange may by seizing a talking trunk line leading to the local exchange cause the operator to be signaled over the remote control trunk, whereby the operator then seizes the remote control trunk and thereby causes an idle link to be associated with the talking trunk, whereby the operator then by dialing the desired subscriber's number and ringing the called subscriber thereby causes a connection to be established to the called subscriber's line and the called subscriber's bell rung, whereby the operator then releases the remote control trunk and thereby causes said trunk to be associated with another idle link and a connection established between a called line and the talking trunk over said first mentioned link and whereby the operator then extends the connection over said talking trunk to a connection beyond, such as a toll trunk over which the connection to the called subscriber's line in the local exchange was desired.

This invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows in diagrammatic form a typical arrangement of a remote control exchange and trunks connected to a manual exchange and to a step-by-step exchange arranged to illustrate the features of the invention.

Figs. 2, 3 and 4 show how the succeeding Figures 5 to 10 may be arranged for the description of the detailed circuit arrangements as shown in the succeeding figures embodying the various features of this invention.

Figs. 5, 6 and 7 arranged in accordance with Fig. 2 show the detailed circuits of the remote control exchange with a remote control trunk and a talking trunk leading to a manual exchange.

Figs. 8, 6 and 9 arranged in accordance with Fig. 3 show the detailed circuits of the remote control exchange with a talking trunk between the remote control exchange and a step-by-step exchange having multiple connections to a manual exchange, a talking trunk between the remote control exchange and the manual exchange and a remote control trunk between the remote control exchange and the manual exchange; and

Figs. 5, 6 and 10 arranged in accordance with Fig. 4 show similar arrangements with a remote control trunk to the manual exchange arranged as a phantom circuit in connection with two ordinary telephone lines or trunks leading to the manual exchange.

Referring now to the drawings and particularly to Fig. 1, three exchanges have been shown in diagrammatic form, a remote control exchange A, a manual exchange B and a step-by-step exchange F. Connections between the subscribers at these exchanges and operators at the manual exchange may be controlled and established over the remote control trunk **102**, the talking trunk **103** and the talking trunk **109**. At exchange A five line-finders LF have been shown connected to links to corresponding connectors C through which connections may be established between subscribers and between subscribers and operators. A switch **104** has been shown through which connections may be established between the remote control trunk **102** and the links.

Detail descriptions will be made as follows of various calls and circuit conditions that are possible with the circuit arrangement shown in the drawings.

With Figs. 5 to 7 arranged as shown in Fig. 2, a call from the subscriber at **100** to another subscriber in exchange A over a line-finder F through the associated link and connector C under control of the operator at D in exchange B, over the remote control trunk **102**.

A call from the subscriber at **100** to another subscriber at exchange A where said other subscriber is on the same line, that is, a revertive call.

A call from the subscriber at **130** to another subscriber at exchange A with the subscriber at **130** equipped with pay station apparatus.

Descriptions will be made of the conditions arising if a call from the subscriber at **100** is attempted and the remote control trunk **102** is busy and if a call from the subscriber at **100** is attempted and all the links are busy.

A call originated by the operator at D in exchange B over the trunk **102** to a subscriber in exchange A.

Description will be made of testing of the links in exchange A by the operator at D in exchange B.

Description will be made of conditions arising if all the links have been taken for use and then one of said links becomes idle, for preparing said idle link for use on the next call by associating the remote control trunk with said link through the switch **104**.

A description will be made of a toll call to a subscriber in exchange A, to be controlled and established by the remote control operator at D in exchange B, and extending from a toll trunk incoming to exchange B through a cord and over the talking trunk **103** to exchange A, and of a toll call from a subscriber in exchange A, controlled and established by the remote control operator at D, and extending over the talking trunk **103** to exchange B through a cord and out over a toll trunk from exchange B.

With Figs. 8, 6 and 9 arranged as shown in Fig. 3, a description will be made of a call from the subscriber at **101** in the step-by-step office F through a line-finder **106**, selector **107** and con-

nector 108 over talking trunk 109, the line-finder LF and associated link and connector C to the subscriber at 100 under control of the remote control operator at D in exchange B.

A call will be described from the subscriber at 100 over line-finder LF, the associated link and connector C in exchange A, over talking trunk 109 through the line-finder 106, selector 107 and connector 108, to the subscriber at 101 under control of the remote control operator at D in exchange B.

A description will be made of a toll call incoming over a toll trunk to the exchange B for a subscriber in exchange A, controlled and established by the remote control operator at D in exchange B, and extending from the toll trunk through a cord and over the trunk 109.

With Figs. 5, 6 and 10 arranged as shown in Fig. 4, descriptions will be made of all the various calls and circuit conditions that are possible as described above in connection with Figs. 5, 6 and 7 arranged as shown in Fig. 2. The only difference in this case is that the remote control trunk is a phantom trunk circuit derived from two ordinary telephone circuits between exchanges A and B.

Referring now first to the arrangement of Figs. 5, 6 and 7 according to Fig. 2, a description will be made of a call from a subscriber at 100 to another single line subscriber in the same exchange. When the subscriber at 100 decides to make such a call he originates it by operating his hand generator. His line relay 106 thereby operates through its upper winding and the conductors to the subscriber at 100 and the upper outer armature and back contact of this relay. When this relay operates it breaks this connection at the upper armature and back contact and locks itself from battery through its lower winding, lower inner armature and front contact and a connection through the secondary winding of the induction coil 600 to ground. Relay 106 in operating removes a ground from the test bank contact of the line-finder LF bank 1. A circuit is also closed by relay 106 for relays 601, 602 and 700. The circuit for 601 extends from battery through the left-hand winding of this relay, lower outer armature and front contact of relay 106 to ground. The circuit for relay 602 extends from battery through the winding of this relay, contacts of relay 603 to ground at relay 106 and the circuit for relay 700 extends from battery through the winding of this relay, contacts of relay 603 to the same ground as relay 106. Relay 601 is a differentially wound relay so that when the circuit through its right-hand winding is closed to the ground at relay 601 it vibrates by the alternate discharges of the condenser 604, and generates a tone in the primary winding of induction coil 600 which is induced in the closed circuit through the secondary winding of the induction coil and the lower winding of relay 106. The tone in this circuit induces a tone in the circuit through the upper winding of relay 106 closed at the upper outer armature and front contact of this relay and the calling subscriber's line and becomes audible to the calling subscriber 100. This tone serves as an indication that the call has registered. Relay 700 in operating closes an obvious circuit for the operation of relay 701 which in turn closes a circuit for the tip and ring conductors of the trunk 102 to the operator at D at the manual office B to light the operator's line lamp 704 to indicate that a call from a subscriber in exchange A is initiated.

It will be noted that normally a circuit is completed from the battery 705 to battery 706 to charge this latter battery when the trunk is not in use. This circuit may be traced from battery 705, winding of relay 708, contacts of relay 709, contacts of key 710 over the tip conductor of trunk 102, upper armature and back contact of relay 701, winding of relay 711 to battery 706, and from battery 705, winding of relay 708, contacts of relay 709, contacts of relay 708, the ring conductor, contacts of relay 701, contacts and winding of relay 711 to battery 706. This normally maintains relays 708 and 706 operated. When relay 701 is operated these circuits are opened and relays 708 and 711 are released. The release of relay 708 closes a circuit for the operation of signal 704 from battery through contact of jack 712, right-hand armature and back contact of relay 706, contact of relay 709, lamp 704 to ground at contacts of control key 713.

When the control operator at D now answers the call by inserting plug 714 of her usual cord circuit in the jack 715, relay 709 is operated over an obvious circuit closed by the springs of jack 715. This opens the circuit for lamp 704 which now is extinguished and the operator may now throw the talking key in her cord circuit to answer the calling subscriber. Relays 716 and 717 are now operated due to the operation of relay 709 over a circuit from battery through contacts of relay 713, righthand winding of relay 717, contacts of relay 709, contacts of key 719, ring conductor, lower armature and front contact of relay 701, lower right-hand winding of induction coil 721, winding of relay 716, contacts of relay 722, to ground. Relay 716 in operating closes a circuit to ground at its lower armature and front contact for relay 723 for the subsequent operation of this relay through the tip conductor over trunk 102 as will hereinafter be described. A circuit is also closed by the operation of relay 716 for the operation of relay 606 from battery, winding and the vibrating contacts of the step-by-step magnet 607 of switch 104, winding of relay 606, upper armature and front contact of relay 716, upper outer armature and back contact of relay 722 to ground. The magnet 607 does not operate in this circuit. Relay 606 in operating places a ground at its outer right-hand armature and front contact through the winding of relay 701 to battery and holds this relay operated. Relay 606 in operating also closes a circuit as follows: battery, winding of the stepping magnet 110 of line-finder LF, self-interrupting contacts of this magnet, first contact and brush of bank 3 of the switch 104, inner right-hand armature and front contact of relay 606, winding of relay 610 to ground. It is assumed that in this case the link shown in Fig. 5 has been preselected by the switch 104. The switch 104 is resting on its first contacts and the link shown in Fig. 5 is therefore the first link. In this circuit there is a provision for four other links of the same kind, which are connected for use by switch 104 as this switch is advanced, in a manner that will be hereinafter described. If the line-finder LF does not have its brushes resting on the terminals of the calling line there will also be a circuit connection made at this time from ground at the lower outer armature and back contact of the line relay that is connected to a contact on bank 1 of the line-finder in whatever position the line-finder may be at this time so that the brush of this bank will extend this ground to the first contact and brush of bank 2

of switch 104 to the outer right-hand armature and back contact of relay R to the winding of relay 610. Thus relay 610 will be short-circuited and will not operate at this time. If as stated the line-finder is not resting on the calling line, the stepping magnet 110 operates and advances the brushes until a terminal on bank 1 on which there is no ground is reached which will be the calling line as relay 106 of this line is operated. The line-finder then stops on the terminals of the calling line and the shunting connection for relay 610 will be removed so that this relay will now operate. The resistance of the winding of relay 610 is such as to prevent further operation of the stepping magnet 110. Relay 610 in operating closes a circuit for the operation of relay 603 from battery through the winding of this relay middle right-hand armature and front contact of relay 610 to ground. Relay 610 also shunts the line relay 106 so that it releases, the shunt circuit in this case extending from battery, contact and brush of bank 5 of the line-finder LF, contacts of relay 111, contacts of relay 112, the first contact and brush of bank 1 of switch 104, left-hand armature and front contact of relay 606, inner right-hand armature and front contact of relay 610, to ground at the outer left-hand armature and back contact of relay 613. As relay 106 now releases the tone to the calling subscriber's line will be removed. The operation of relay 603 prepares a circuit for the subsequent operation of relays 111 and 112 in the link circuit and causes the release of relay 602. Relay 603 also prepares a transmission circuit by closing a circuit at its third outer left-hand armature and front contact for the left-hand windings of repeating coil 721. The tip and ring conductors from the calling line are now connected through the tip and ring conductors of the trunk 102 to the distant operator over a circuit as follows, from the tip and ring conductors of the calling line at 100, contacts of banks 3 and 4 of the line-finder LF, armatures and contacts of relay 114, first contacts and brushes of banks 5 and 6 of switch 104, contacts of relay 724, left-hand windings of repeating coil 721, and through the above-mentioned contacts closed by relay 603, the transmission circuit for the trunk being closed through the right-hand windings of repeating coil 721, through contacts of relay 701, condensers 725 and 726, contacts of relay 718, left-hand windings of repeating coil 727, while the right-hand windings of this repeating coil are closed through the jack 715 and plug 714 to the cord circuit of the operator at D.

The operator may now talk to the calling subscriber at 100 and if the subscriber should desire to extend a connection to another line in the same office A, the operator will dial back over the trunk to obtain the number desired. The operations of these circuits are as follows: To dial the desired number, the operator inserts plug 730 into jack 712 to connect dial 731 to the trunk for dialing. He then operates his dial and as the dial moves from normal, relay 718 is operated from the battery, off-normal contact of dial 730, sleeve contacts of jack 712 and plug 730, winding of relay 718 to ground. Relay 718 in operating opens a connection from the trunk to the operator at its outer upper and lower armatures and back contacts. Relay 718 also opens the connection to battery at its upper inner armature and back contact for the control circuit over the ring conductor, but battery for this circuit is substituted through the dial contacts of the dial 731 and tip contacts of jack 712, plug 730, left-hand winding of coil 732, lower inner armature and front contact of relay 718, outer left-hand armature and front contact of relay 709, contacts of ringing key 719 to the ring conductor of the trunk 102 to maintain relay 716 operated. As the dial returns to normal the dial contacts open this circuit and relay 716 responds to the pulses. At the first pulse relay 716 releases and opens the circuit for relay 606 and closes a circuit for the stepping magnet 116 for the connector C as follows: from battery through the winding of this magnet 116, winding of relay 117, upper middle armature and back contact of relay 111, first contact and brush of bank 4 of switch 104, middle right-hand armature and front contact of relay 606, upper outer armature and back contact of relay 735, upper armature and back contact of relay 716, to ground at the upper outer armature and back contact of relay 722. Relay 117 operates and remains operated with relay 606 during the pulsing as both are slow to release. The operation of relay 117 closes a circuit for the operation of relay 114, from battery, inner left-hand armature and front contact of relay 603, inner left-hand armature and front contact of relay 117, upper winding of relay 114 to ground. Relay 114 provides a locking circuit for itself from the battery at relay 603, upper middle armature and front contact of relay 114, resistance 119, upper winding of this relay to ground. The operation of relay 114 removes the calling subscriber's line from the talking connection at its upper and lower outer armatures and back contacts. The connector C is now advanced in accordance with the dialing to the desired subscriber's line. At the end of the dialing relay 716 remains operated while relay 117 releases.

If the called line is busy the wipers of connector C will encounter ground on the brush of bank 5 and relay 120 will not operate when the relay 117 is released, as the circuit closed through the right-hand winding of this relay is also connected to ground. A circuit will therefore be closed for the operation of relay 615 from battery through the lower armature and back contact of relay 735, left-hand winding of relay 615, middle left-hand armature and back contact of relay 613, outer left-hand armature of back contact of relay 117, outer right-hand armature and back contact of relay 120, second lower armature and front contact of relay 114, the brush and a corresponding contact of bank 2 of the connector C to ground. Relay 615 in operating closes an obvious circuit for the operation of relay 616 and this relay in turn closes an obvious circuit for the operation of relay 613. Relay 613 in operating opens the circuit for relay 615 which now releases and this relay in turn releases relays 616 and 613. These operations are then repeated causing an intermittent busy tone to be placed on the ring conductor of trunk 102. As relay 615 operates it closes an obvious circuit for relay 601 each time it operates causing this relay to transmit the tone over the ring conductor through the condenser 617 and the lower right-hand winding of the repeating coil 721.

Under this condition the operator may report to the calling subscriber that the called line is busy. This is done by operating the control key 713 which in operating shunts out the resistance of a winding of relay 717 from a circuit for the marginal relay 723. The circuit for relay 723 normally, after relay 716 has operated, extends

from battery contacts of relay 718 through the left-hand winding of relay 717, contacts of relay 709, normal contacts of release key 710, over the tip conductor, contacts of relay 701, upper right-hand winding of the repeating coil 721, make-before-break contacts of relay 611, winding of relay 723 to ground at the lower armature and front contact of relay 716. The circuit for relay 723 now extends through contacts of key 713, terminal of jack 715 to battery through coil 732. Relay 723 operates in this circuit and closes an obvious circuit for relay 722 and this relay in turn closes an obvious circuit for the operation of relay 735. The operation of relay 722 places a holding ground for maintaining relay 606 operated at its lower inner armature and front contact and opens the circuit for relay 716 at its lower outer armature and back contact; while relay 716 now releases a circuit for relay 723 is maintained at the ground placed at the lower armature and front contact of relay 722. Relay 735 in operating opens a circuit for the step-by-step magnet 116 of connector C, which would have been closed when relay 716 was released. Relay 735 removes the battery at its lower armature and back contact for the circuit for relay 615 which therefore releases so that the busy tone will now be stopped. Relay 735 closes a circuit for the operation of relay 111 from battery through the lower armature and front contact of relay 735, lower winding of relay 111 to ground. Relay 111 in operating enables the operator to monitor and challenge on the called line by closing a circuit from the called line through contacts and brushes of banks 3 and 4, upper and lower outer armatures and front contacts of relay 111, first contacts and brushes of banks 5 and 6 of switch 104, contacts of relay 724, the left-hand windings of repeating coil 721, contacts of relay 603, while the connection to the operator is closed through the right-hand windings of this repeating coil 721, contacts of relay 701, contacts of release key 710, condensers 725 and 726, windings of repeating coil 727, terminals of jack 715 and plug 714 to the operator at D. The operator may now ascertain the condition of the line and if it is busy the operator will release the control key 713, and operate the release key 710. This releases relay 723 which, in turn, releases relays 722 and 735. As relay 735 is slow in releasing a momentary circuit is closed for the release of relay 114. This circuit extends from battery through the lower winding of relay 114, lower inner armature and front contact of this relay, upper inner armature and back contact of relay 722 and upper inner armature and front contact of relay 735, outer left-hand armature and back contact of relay 117, outer right-hand armature and back contact of relay 120, second lower armature and front contact of relay 114 to ground at the brush and the corresponding contact of bank 2 of the connector C. Relay 114 now releases as it is differentially wound. The operator will now be able to talk to the calling subscriber over the calling loop again closed at the outer upper and lower armatures and back contacts of relay 114.

If the line is busy and engaged in a revertive call, that is, between subscribers on the same line the line relay of that busy line will not be operated. Consequently, when relay 117 releases after dialing relay 120 will operate from the battery at the line relay of this busy line through the corresponding contact and brush of magnet 5 of the connector C, the second lower armature and back contact of relay 111, inner right-hand armature and back contact of relay 117, right-hand winding of relay 120 to ground. The operator will then proceed as usual by operating the control key 713 to connect her line to the called line for monitoring. The operation of the control key 713 operates relays 723, 722 and 735 and relay 111 as hereinbefore described. As relay 120 is operated the circuit for relay 616 will not be completed and hence there will be no busy tone in this case. As the operator is now connected to the called line she will hear conversation and know thereby that the line is busy in a revertive call. She will then release the control key 713 and operate the release key 710. This causes the release of relays 723, 722 and 735 and causes the operation of relay 716. It should be noted that in this case between the release of relays 722 and 735, relay 114 will not be released through the circuit over its lower winding which was momentarily closed between the release of relay 722 and the release of relay 735 as this circuit is opened at the outer right-hand armature and back contact of relay 120. Hence, in this case the operator will have to release the connection by first dialing a number, for example, the digit 3. On the first release of relay 716 in response to the dialing, a shunting circuit is closed for releasing relay 114. This shunting circuit extends from ground at the outer armature and back contact of relay 722, upper armature and back contact of relay 716, upper outer armature and back contact of relay 735, middle right-hand armature and front contact of relay 606, first terminal of bank 4 of switch 104, second upper armature and front contact of relay 111, resistance 119, upper winding of relay 114 thus causing the release of relay 114. Relay 114 in releasing closes the circuit for the operation of relay 112 from battery, outer left-hand armature and front contact of relay 120, third lower armature and back contact of relay 114, winding of relay 112 to ground. Relay 112 in operating connects the calling subscriber's line with the called subscriber's line at the upper and lower outer armatures and front contacts and thus the calling subscriber will hear the conversation over the called line as engaged in a revertive call connection. The operator will then immediately again operate her control key 713 to close the circuit for relay 723 as hereinbefore described. This relay closes the circuit for the ringing relay 736 and the operator will then operate her ringing key 719 momentarily to operate relay 736 and transmit, as before, a ringing signal to release the connection by the operation of relay 123 over a circuit from the tip and ring conductors of the connection between the line finder and the connector, the inner left-hand armature and back contact and left-hand winding of relay 123. Relay 123 in operating is locked through its right-hand winding from battery through its inner right-hand armature and front contact, the right-hand winding to ground at brush of bank 2 of connector C. The operation of relay 123 causes the release of relay 112 by closing a connection to ground at its outer right-hand armature and front contact. This armature is of the vibrating type and will not close the circuit until it comes to rest and hence there will be sufficient delay in the release of relay 112 to permit the calling subscriber to listen to the conversation as above mentioned. The operator then will restore the control key 713 and withdraw from the connection, as will hereinafter be

described in connection with the regular ring-off.

If, however, the called line is idle the release of relay 117 will complete a circuit for the operation of relay 120. This circuit may be traced from battery at the called subscriber's line relay corresponding to relay 106, brush and corresponding contact of bank 5 of the connector C, second lower armature and back contact of relay 111, inner right-hand armature and back contact of relay 117, right-hand winding of relay 120 to ground. The operation of relay 120 in turn completes a circuit for relay 111 from battery, inner left-hand armature and front contact of relay 603, inner right-hand armature and front contact of relay 120, upper winding of relay 111 to ground. Relay 111 in operating completes a locking circuit for relay 120 from battery, left-hand winding and inner left-hand armature and front contact of this relay, upper inner armature and front contact of relay 111 to ground at the brush and the corresponding contact of bank 2 of the connector C. Relay 111 in operating grounds the test terminal, the called line at its second lower armature and front contact, the ground being supplied at the upper outer armature and back contact of relay 724. Relay 111 in operating completes the connection to the called line over banks 3 and 4 of the connector C to the trunk 102 as hereinbefore traced.

The operator may now ring the called subscriber. Before the ringing key 719 is operated, the operator must operate the control key 713. The operation of this key causes a marginal relay 723 to operate as hereinbefore described and this relay in turn operates relay 722 which prepares a path for the alternating current responsive relay 736. Relay 722 when operated maintains the ground connection for the relay 723 and opens the circuit for relay 716 which releases, and places a holding ground for relay 606 to prevent this relay from releasing. Relay 722 also operates relay 735. The operator now operates the ringing key 719 and ringing current extends out over the ring conductor of the trunk 102, over contacts of relay 701, lower right-hand winding of repeating coil 721, upper armature and front contact of relay 723, condenser and winding of relay 736 to ground. Relay 736 operates and closes an obvious circuit for relay 724 and this relay closes a path from the ring conductor of the trunk contacts of relay 724 over the called subscriber's loop and back to ground at contacts of relay 724. When the relay 724 operates the shunt ground for the lower winding of the line relay of the called subscriber corresponding to line relay 106 is removed allowing this line relay to fully operate each time the operator rings down on the line. Each time relay 724 releases the called subscriber's line relay will be shunted down again. This circuit may be traced from ground, upper outer armature and back contact of relay 724, outer right-hand armature and back contact of relay 117, middle lower armature of relay 111, brush and corresponding terminal of bank 5 of connector C, to battery at the line relay of the called subscriber corresponding to relay 106 of the calling subscriber.

When the called subscriber answers the operator either withdraws from the bank and completes the connection between the subscribers or remains on the connection to monitor the call. If the operator wishes to remain she will release the control key 713 and operate the release key 710 causing relay 723 to release which, in turn, releases relays 722 and 735 and allows relay 716 to reoperate. She will then dial for example digit 3. This allows a ground impulse to momentarily shunt the holding winding for relay 114 as hereinbefore described causing this relay to release and this, in turn, causes the operation of relay 112 as hereinbefore described in connection with a busy connection engaged in a revertive call. This connects the calling subscriber's line to the called subscriber's line and the operator is also connected to the link through contacts of relay 111. If the operator desires to leave the line she will release the control key to release relays 723, 722 and 735 and operate relay 716. She will then withdraw her plug 714 from jack 715. This causes the release of relay 716. This causes a momentary impulse to release relay 114 as hereinbefore described. In this case, however, relay 716 in releasing causes the release of relays 606 and 603. Relay 603 in turn releases relay 111. The release of relay 114 allows relay 112 to operate and connect the calling and called together as hereinbefore described and also completes a holding circuit for relay 120. The ground circuit for the called subscriber's line relay as hereinbefore traced to the upper armature and back contact of relay 724 is now transferred due to the release of relay 111 through the right-hand winding of relay 120 to ground. This shunt circuit may be traced from ground to the right-hand winding of relay 120, contacts of relays 117 and 111 to the brush and the corresponding contact of bank 5 of connector C through the lower winding of the called subscriber's line relay to battery. This shunting, of course, prevents the full operation of the called subscriber's line relay should a subscriber attempt to ring in before releasing the link by the regular ring off. The release of relay 606 will of course allow relay 700 to release thereby completing a circuit for operating relays 708 and 711 for charging of battery 706. Relays in the trunk such as 709 and 716 will release in the regular order and the operator should in the meantime withdraw the dial with its plug 730 from jack 712 to completely restore the control circuits to normal.

When relay 112 operated to complete the connection between the calling subscriber's line and the called subscriber's line through the link the switch 104 will be operated to select another idle link for subsequent calls. It will be noted that a circuit will then be completed for the stepping magnet 607 of the switch 104 from battery through its winding and self-interrupting contacts, left-hand armature and back contact of relay 606 which is now released, through the brush and the first terminal of bank 1 of switch 104 to ground at the second lower armature and front contact of relay 112. The magnet 607 will operate and advance the brushes of switch 104 to the next link. If ground is encountered on this terminal on bank 1 the magnet 607 will take another step and continue to step until an idle link is found, an idle link being identified by the absence of ground on the corresponding terminal of bank 1. Consequently the brushes of this switch will come to rest on terminals of the first free link.

When the subscribers decide to release the connection, either subscriber may operate her handset to send an alternating current impulse over the line to release the connection. This causes the operation of relay 123 over a circuit from the ring conductor, the left-hand inner armature and back contact of relay 123 and its left-hand winding, upper inner armature and front contact of

relay 112 back to the tip conductor. Relay 123 provides a locking circuit for itself from battery through its inner right-hand armature and front contact and right-hand winding to ground at the corresponding contact of bank 2 of connector C. The operation of relay 123 causes its weighted armature 124 to vibrate and when it finally operates relay 112 will be shunted out by the ground applied by armature 124. Relay 123 together with relay 112 complete a release circuit for the connector C. This circuit may be traced from battery through the winding of the stepping magnet 116 of connector C, winding of relay 117, vibrating contacts of the stepping magnet 116, the corresponding terminal of the called line in bank 1 and brush of this bank through the second upper armature and back contact of relay 112, middle left-hand armature and front contact of relay 123 to ground at 620. Stepping magnet 116 will step the connector forward until it reaches a normal position which is at terminal 125 of bank 1. When the connector reaches this position the above-mentioned stepping circuit is opened and the holding circuit for relay 123 is opened at this position by the brush in bank 2 causing relay 123 to release which in turn removes the ground from the bank 1 and releases relay 111 which, it will be noted, was operated when relay 123 was operated. The purpose of having relay 111 operated during the release of the connector switch was to shunt down the line relay of the called subscriber's line and to clear the connector test wiper during release. This link is now available for other connections.

If the calling subscriber is on a party line and desires to call another subscriber on the same line two methods of establishing this so-called revertive call may be used. In one case the subscriber originates a call for another party on his own line by ringing the code of the other party. With this arrangement revertive calls cause no operation at office A.

If, however, a central office selective ring is available, the subscriber originates a revertive call in the same manner as a call to another line. The operator will answer the call and upon finding that it is for another party on the same line can either ring the party for the calling subscriber, or he can wait on the connection until the subscriber has finished ringing. As previously explained it would be necessary to operate the control key 713 if the operator wishes to speak to the calling subscriber. After either the operator or the subscriber has finished ringing the control key 713 should be restored and the connection can then be completely pulled down. At the end of the conversation the subscribers should hang up without ringing off as a ring-off signal would bring in a calling signal at the operator's position.

A call will now be described from the coin box subscriber at 130 to another subscriber in the same exchange. In the present system the first, second and third lines may be arranged for pay station operation. The line to the subscriber at 130 is shown as the first line. With this type of call the link and control circuits function as for a regular call until the wipers of the line-finders have come to rest on the called line. In this position and before the slow acting relay 610 is operated a circuit is closed from battery through the stepping magnet 110 and its interrupting contacts, the corresponding terminal and brush of bank 3 of switch 104, the inner right-hand armature and front contact of relay 606, outer right-hand armature and back contact of relay 610 brush and corresponding terminal of bank 2 of switch 104, the brush and corresponding terminal of bank 2 of line-finder LF, upper inner armature and front contact of relay 105, middle right-hand armature and back contact of relay 603, right-hand winding of relay 611 to ground. Relay 611 operates and closes a locking circuit for itself through its left-hand armature and front contact, outer right-hand armature and back contact of relay 613, lower armature and back contact of relay 735 to battery. The stepping magnet 110 does not operate under these conditions. Relay 611 in operating opens the tip conductor of the trunk at its make-before-break contacts to again light the lamp 704 which was extinguished when the operator answered. The circuit over the tip conductor normally extends through the left-hand winding of relay 717 and as it is now opened the differential relay operates and the lamp 704 by the closure of a circuit for the lamp at its armature and front contact. When the vibrating armature 621 or of relay 611 comes to rest, a circuit is closed for the operation of relay 616 over an obvious circuit. This relay in turn closes a circuit for the operation of relay 613 over an obvious circuit. Relay 613 in operating opens the locking circuit at its outer right-hand armature and back contact for relay 611 causing this relay to release which in turn allows relays 616 and 613 to release. The release of relay 611 closes the tip conductor thereby releasing relay 717 to extinguish the lamp 704. The operator is thereby given a lamp signal after the plug has been inserted to indicate that a pay station is calling. The normal operating circuit for relay 611 is opened as soon as relay 610 operates. This takes place soon after relay 611 is operated as relay 610 is slow to operate. The operations of selecting another subscriber from this point on are the same as in the call heretofore described. The operator will attend in the usual manner to the collection of coins.

In case a call is made from a subscriber in exchange A while the control trunk 102 is busy, the operator will receive a flashing signal as soon as she starts to dial when the call is in progress, or if dialing is completed or in progress a flashing signal will be received as relay 611 will, under these conditions, open and close the tip conductor of the trunk. In this case when a second line relay such as 106 operates a circuit is closed from ground at the lower outer armature and front contact of this relay, inner right-hand armature and front contact of relay 603 which is operated at this time, to the normally open connection at the upper inner armature and front contact of relay 114. If dialing has commenced on the previous call in progress or is completed, relay 114 will be operated and the above-mentioned circuit will therefore be completed at this time through the inner upper armature and front contact of relay 114 through the inner right-hand armature and back contact of relay 613, the left-hand winding of relay 611, lower armature and back contact of relay 735 to battery. Relay 611 will therefore operate and open the tip conductor of the trunk 102 and when the vibrating armature 621 comes to rest a circuit will be closed for the operation of relay 616. This relay will in turn operate relay 613 which releases relay 611 and this relay releases in turn relays 616 and 613. This cycle of operation of relays 611, 613 and 616 will then be repeated to alternately open and close the tip conductor

until the operator operates her control key 713 in the progress of completing the first call. Therefore, the lamp 704 will be alternately lighted and extinguished due to the alternate operation and release of relay 717 to indicate to the operator that a second calling subscriber is waiting. When the operator disconnects on the first call lamp 704 will be lighted steadily as hereinbefore described as an indication to the operator to attend to the waiting call.

In case all of the links, as shown in Fig. 5, are busy when a call is originated, the calling subscriber receives the regular tone and the operator is signaled in the usual manner. When the operator answers the signal relay 716 will be operated and then relay 606, as hereinbefore described, to close a circuit for the operation of relay 610 from ground, winding of relay 610, inner right-hand armature and front contact of relay 606, brush and the sixth contact 622, of bank 3 of switch 104 to battery. It will be noted that in this case the switch 104 has been advanced to the sixth position as soon as the last, that is, the fifth link became busy in the same manner as the switch is operated to engage a next idle link as hereinbefore described. Relay 610 now closes an obvious circuit for the operation of relay 603 and a circuit is thereby closed for the operation of relay 615 from battery, right-hand winding of relay 615, inner left-hand armature and back contact of relay 613, second left-hand armature and front contact of relay 603 through the sixth contact 623 and brush of bank 1 of switch 104, left-hand armature and front contact of relay 606, inner right-hand armature and front contact of relay 610 to ground at the outer left-hand armature and back contact of relay 613. Relay 615 in operating closes a circuit for the operation of relay 601 as hereinbefore described and this causes a tone to be transmitted to the operator through condenser 617 as hereinbefore described. Relay 616 is also operated over an obvious circuit by the operation of relay 615. This relay in turn operates relay 613. Relay 613 now opens the circuit for relay 615 and the relays 615, 616 and 613 are released in turn. Relay 615 is then reoperated and the cycle of operation and release of relays 615, 616 and 613 are repeated. An intermittent tone is therefore sent to the operator to indicate that a call is waiting and that all links are busy. It should be understood that this interrupted tone is also transmitted to the calling subscriber under these conditions through the induction coil 600 and the line relay 106 when the operator answered the call to indicate to the calling subscriber that he will have to wait for an interval before he can receive attention.

Under these conditions the stepping magnet 607 of the switch 104 comes directly under control of the operator who may now test each link to ascertain whether it is actually busy. In order for the operator to test these links he will have to dial 1 under these conditions, the switch 104 will thereby be operated to advance its brushes to the seventh position. The circuit for the stepping magnet 607 when relay 716 releases in response to this impulse may be traced from battery through the winding of this magnet, the sixth terminal 624 and brush of bank 4, middle right-hand armature and front contact of relay 606, upper outer armature and back contact of relay 735, upper armature and back contact of relay 716 to ground at the upper outer armature and back contact of relay 722. The bank terminals 7 to 11 on banks 5 and 6 of the switch 104 are multipled back to terminals 1 to 5, respectively, thereby enabling the operator to monitor and ascertain if the first link is busy, that is, in this case the tip and ring conductors are extended through terminals of banks 5 and 6 to the first link. The operator then dials 1 again, for the next succeeding link and to test this link, and will dial 1 for each succeeding link to test it.

When a call is originated by the operator at D, she inserts plug 714 into jack 715, causing the operation of relay 709 as usual. Relay 708 is thereby disconnected from the line and causes the release of relays 708 and 711. The release of relay 711 closes a circuit for the operation of relay 701 from battery, winding of this relay, upper armature and front contact of relay 711, outer right-hand armature and back contact of relay 603. Relay 701 closes the tip and ring conductors through to relay 716, causing this relay to operate as usual. Relay 716 in operating causes the operation of relay 606 and relay 606 closes a holding circuit for relay 701. As a ground is supplied by all the line relays such as 106 through terminals of bank 1 in the line-finder LF, the stepping magnet 110 for the line-finder will step the line-finder over the terminals of all the lines until the twenty-fifth position terminal is reached in lever 1 which terminal is allotted to mark the operator's finding position. In this position there is no ground connection and relay 610 will operate as usual and open the stepping magnet circuit. Relay 603 is now operated over an obvious circuit. The finder having found this position and with relays operated as mentioned the operator may now proceed to dial the digit of the desired number in the exchange A. The link circuit functions in response to dial pulses as before in selecting any subscriber's line. However, after conversation is completed and before removing a cord, the operator will dial a special digit. This allows relay 114 to release by being short-circuited and thus closing a circuit for the operation of relay 112 as relay 120 is operated as usual. The purpose of operating relay 112 is so that the operator may then operate her control key 710 and her ringing key 719 to send out a short pulse of ringing current. This ringing current will energize relay 123 as heretofore described, allowing the link circuit to restore as in a regular ring-off signal as previously described. The operator then restores the control key 710 and operates the release key 710 and then disconnects by removing her plug from the jack 715 and the dial cord from jack 712 as usual. The operator may test succeeding links in this manner by dialing 1 as hereinbefore described. The dialing of 1 will step the switch 107 from one link to another as described. Under these circumstances if a link is found held busy and there is no conversation taking place over the link, the operator may release the link by sending a short ringing impulse over the trunk to operate relay 123 and release the link as described.

In cases where the switch 104 has stepped to the sixth position, due to all links being busy, and no call originates, and then a link becomes idle, the switch 104 will step to the idle link. When one of the links becomes idle the brushes of the associated connector C, as hereinbefore described, will be restored to the twenty-fifth terminal 125. In this case, therefore, a circuit will be closed for the stepping magnet 607 of the switch 104 as follows: From battery through the winding of the stepping magnet 607, its pulsing

contacts, left-hand armature and back contact of relay 606, the sixth terminal 623, and brush of bank 1, terminal 125 of the released connector bank 1 and brush thereof, upper middle armature and back contact of relay 112, the associated back contact and armature of relay 610 to ground at 620. This circuit steps the switch 104 to the seventh position where the ground over the sixth contact 623 will be replaced by a ground on the remaining terminals of bank 1 of switch 104 so that the switch will continue to step until an idle unguarded terminal is found corresponding to an idle link. That is, when switch 104 returns to a normal position, brush of bank 1 of switch 104 will rest on the terminal of the first link. If this link is busy there will be a ground on this terminal from the second lower armature and front contact of relay 112 in that link and the switch will continue to operate until an idle link is found.

In case a toll call is incoming for a subscriber at the exchange A, the remote control operator at D inserts the plug 714 of her cord into the jack 132 of the talking or toll trunk 103 of Fig. 1. This toll trunk terminates at the office A in exactly the same manner as an ordinary subscriber's line, that is, it terminates with the tip and ring conductors the same as subscriber at 100 in line-finders and connectors and in a line relay such as 106 shown in Fig. 5 by box 134 and in the common control circuit shown in Fig. 6. The operator will then ring with her cord circuit ringing key in the usual manner and this brings in the calling signal 704 over the remote control trunk 102 in the same manner as if a call originated from a subscriber's line in the exchange A. She answers this signal with a cord and challenges so as to make sure that the control trunk is actually connected to the toll trunk 103 as there is the possibility that a subscriber in exchange A might have originated a call at the same moment and obtain connection to the control trunk. If the toll trunk 103 has secured the connection over the control trunk 102, the operator will follow the regular operating procedure for a call from one subscriber to another in the exchange A. When the called subscriber answers, the operator completes the connection from the jack, such as 135, on which the incoming toll call is waiting to the jack 132 of the toll trunk 103 by means of an ordinary cord circuit 133, thereby completing the toll connection to a subscriber in an exchange A. At the end of conversation a ring-off signal from either subscriber will release the link and will also indicate to the operator that the connection has been taken down as is well known in the art.

If a toll call connection is desired by a subscriber in the exchange A, and such toll call is likely to require some time to complete, the operator should request the calling subscriber to hang up and await a call. The operator then obtains the connection to the distant subscriber over jack 135 and completes the connection to the calling subscriber at exchange A in the same manner as in the case of an incoming toll call. On the other hand if a toll call from the subscriber at exchange A is one that can be completed without delay, the operator may complete a connection from the calling subscriber to the toll trunk 103 by dialing the number of the toll trunk and ringing in the same manner as on the regular call from one subscriber to another in the exchange A. She will then answer the signal on the toll trunk 103 and complete the connection to the desired subscriber, as usual. The operation when the subscriber rings off is the same as on an incoming toll call.

If reference is now made to Figs. 6, 8 and 9 arranged in accordance with Fig. 3, descriptions will be made of calls between the step-by-step office F and exchange A. When the subscriber, for example at 101, in the step-by-step office F desires a connection to a subscriber in exchange A, a connection is established in the usual manner from this subscriber through the usual switches such as a line-finder 106, a selector 107 and a connector 108 to a trunk line 109, leading through the manual office B to the exchange A. As shown in Fig. 1, the trunk 109 also terminates in office B in a multiple jack 136 at the control operator's position at D. When the wipers of connector 108 land on the terminals TR, EC and C of the trunk 109, as shown in Fig. 8, a circuit for lead C is completed to cause the operation of relay 137. This relay disconnects relay 138 from the terminals of the right-hand windings of repeating coil 139, and closes a circuit for the lamp 140 in the manual office B to light this lamp thereby busying the multiple jack 805 at the manual office. As soon as ringing current is placed on the tip and ring conductors from the connector 108, a relay in the connector circuit, not shown, operates to complete a circuit for relay 142 from battery through the upper winding of this relay over terminal EC to the connector. Relay 142 operates and closes at its upper armatures and front contacts, direct connections through the left-hand and right-hand windings of repeating coil 139 permitting ringing current to be transmitted through the coil over the trunk 109 to exchange A. During the ringing period the line relay 806 is operated by the induced ringing current through the repeating coil 143, tip and ring conductors, the right-hand armatures and back contacts of relay 807, outer right-hand armature and back contact, and left-hand winding of relay 806. Relay 806 closes a circuit for the operation of relay 601, 602 and the relay 900 in a control trunk 902 modified to provide for alternating current dialing but otherwise similar to trunk 102. A tone is transmitted through the operation of relay 601 to the calling subscriber as induced through the lower winding of relay 806 over the tip and ring conductors over coils 143 and 139 in the same manner as hereinbefore described in connection with calls from a local subscriber in connection with Figs. 5, 6 and 7. In general in the following circuit descriptions only such circuits that differ from the circuits described in connection with Figs. 5, 6 and 7 will be traced in detail. Relay 900 closes a circuit for relay 901, which opens the circuit for relays 911 and 908 to cut off the charging battery. Relay 908 in releasing closes a circuit for the line lamp 904 from battery at dial jack 912, right-hand contacts of relay 908, inner left-hand armature and back contact of relay 909, lamp 904, contacts of the control key 913 to ground.

The operator in answering inserts plug 714 into jack 915 thereby causing the operation of relay 909 from battery through the winding of this relay and contacts of jack 915. Relay 909 in operating opens the lamp circuit and closes a circuit for relay 916 which is responsive both to direct current and alternating current. The circuit in this case extends from battery at the upper inner armature and back contact of relay 918, right-hand winding of relay 917, contacts of relay 909, ring conductors of brush 902, contacts

of relay 901, lower right-hand winding of repeating coil 921, contacts of relay 922, upper winding of relay 916 to ground at contacts of relay 922. It also closes a circuit over the left-hand winding of relay 917, contacts of relay 909, contacts of the release key 910, the tip conductor, contacts of relay 901, upper right-hand winding of repeating coil 921, make-before-break contacts of relay 611, winding of relay 923 to ground. Relay 923 is marginal and does not operate in this circuit. Relay 916 in operating closes a circuit for the operation of the relay 606 from battery, winding of the stepping magnet 607 and its vibrating contacts, winding of relay 606, armature and front contact of relay 916, lower outer armature and back contact of relay 922, to ground. Stepping magnet 607 does not operate in this circuit. Relay 606 in operating closes a circuit for the stepping magnet 810 of line-finder LF—8 from battery through the winding of this magnet and interrupting contacts, first terminal and brush of bank 3 of switch 104, inner right-hand armature and front contact of relay 606, outer right-hand armature and back contact of relay 610, brush and first contact of bank 2 of switch 104, brush and a terminal of bank 1 of line-finder LF—8 to ground at the corresponding line relay such as 806. As hereinbefore described, the stepping magnet 810 will now operate until the line-finder LF—8 finds the calling line terminals. When this takes place relay 610 operates over a circuit as hereinbefore described, as the shunt circuit for relay 610 is removed by the operated condition of relay 806 of a calling line, ground having been removed from the sleeve terminal to the brush of bank 1 of line-finder LF—8. The operation of relay 610 closes a circuit for relay 603. As the holding circuit for relay 806 is now shunted as hereinbefore described this relay releases and removes tone from the calling subscriber's line.

The operator now obtains the number of the desired subscriber and inserts plug 930 into jack 912 and operates the dial key 932. This changes the direct current connection through the pulsing contact of dial 731 to the alternating current source 933 to prepare the alternating current dialing circuits for the pulsing relay 916. When the operator dials the number of the desired subscriber the off-normal contacts of the dial close an obvious circuit for the operation of relay 918 which closes the alternating current dialing circuit for relay 916. This circuit may be traced from the alternating current source 933, operated left-hand contacts of dialing key 932, pulsing contacts of dial 731, tip contacts of plug 930 and jack 912, right-hand operated contacts of key 932, lower inner armature and front contact of relay 918, outer left-hand armature and front contact of relay 909, ring conductor of trunk 102, lower armature and front contact of relay 901, lower right-hand winding of repeating coil 921, contacts of relay 922, the condenser and lower winding of relay 916 to ground at contacts of relay 922. Relay 916 responds to alternating current dial pulses over the trunk and the stepping circuit is completed on each release of relay 916 for the stepping magnet 816 as follows: from battery through the winding of this magnet 816, winding of relay 817, contacts of relay 811, first terminal on brush of bank 4 of switch 104, middle right-hand armature and front contact of relay 606, contact of relay 935, armature and back contact of relay 916, to ground at contacts of relay 922. Relay 817 is operated during the dialing and closes a circuit for relay 814 from battery, inner left-hand armature and front contact of relay 603, inner left-hand armature and front contact of relay 817, upper winding of relay 814 and ground. Relay 814 locks through its upper winding from this battery at relay 603 through its upper middle armature and front contact. The operation of relay 814 removes the calling subscribers from the connection. On completing the dialing the wipers of the connection switch C—8 rest on the terminals of the called line. The pulsing relay 916 remains operated and the relay 817 is released.

If the called line is busy the circuits operate as hereinbefore described. If the called line is idle when relay 817 releases, relays 811 and 820 operate as hereinbefore described and the operator is connected through trunk 902 to the called subscriber's line. The operator will then ring the called subscriber by first operating the control key 913. This will now operate relay 923 over a circuit from battery to the repeating coil 940, contacts of jack 915, contacts of control key 913, contacts of release key 910, tip conductor of trunk 902, upper armature and front contact of relay 901, upper right-hand winding of repeating coil 921, make-before-break contacts of relay 611, winding of relay 923 to ground. Relay 923 in operating closes a circuit for the operation of relay 922 and relay 916 releases. Relay 922 operates relay 935. The operator then actuates the ringing key 919 to cause the operation of the alternating current responsive relay 936 from the alternating current source, contacts of ringing key 919, the ring conductor, lower armature and front contact of relay 901, lower right-hand winding of repeating coil 921, contacts of relay 923, the condenser and the winding of the relay 936 to ground. Relay 936 closes an obvious circuit for the operation of relay 924, and places a holding ground on the locking circuit for relay 606 to maintain this relay operated and closes an obvious circuit for the operation of relay 935. The operation of relay 924 closes a circuit from the ring conductor of the trunk 902 over the called subscriber's loop to ground at the upper armature and front contact of relay 924, to the upper inner armature and front contact and the lower armature and front contact of this relay. Relay 924 in operating removes the shunt to ground across the operating winding of the called subscriber's line relay allowing this line relay to fully operate each time the operator rings out of the line. Each time relay 924 releases the called subscriber's line relay will be shunted down again. This circuit may be traced from ground, lower inner armature and back contact of relay 924, outer right-hand armature and back contact of relay 817, middle lower armature and front contact of relay 811, brush and corresponding terminal of bank 5 of the connector C—8 to battery at the lower winding of the relay of the called subscriber corresponding to line relay 806 of the trunk 109. Should the operator desire to remain on the connection for monitoring the operation of the circuits are as hereinbefore described. If the operator, however, pulls down the cord by removing plug 714 from jack 915, the connection between the subscribers is established as before through the link and the control circuit is released. The ring-off takes place as hereinbefore described in connection with calls between sub-

scribers in exchange A by the operation of relay 823.

If the subscriber at 100 in the exchange A desires to establish a connection with the subscriber at 101 in the step-by-step office F, the following operations take place: The subscriber at 100 rings in the usual manner and causes the lamp 904 to light before the operator at D as hereinbefore described. After the operator has inserted her plug 714 into jack 915 to answer the call and receives the desired subscriber's number from the calling subscriber, the operator will connect the dial 931 and operate the dial key 932 and thereby changing the circuit for alternating current control of the impulse responsive relay 916. The operator then dials the first digit of the desired number, which digit is the step-by-step office digit, causing relay 916 to respond in the usual manner and cause the connector C—8 to step to the terminals of the trunk 109, leading to the step-by-step office F. When this trunk has been found the relay 807 in the trunk circuit will operate from battery through its upper winding, the corresponding contact and brush of bank 5 of the connector C—8 second lower armature and front contact of relay 811, outer right-hand armature and back contact of relay 817, lower inner armature and back contact of relay 924 to ground. The operation of relay 807 closes the trunk circuit from the connector C—8 to repeating coil 143, the operator then restores her dialing key 931 and operates the control key 913. The operation of this key causes as hereinbefore described the operation of relay 923 which in turn causes the operation of relays 922 and 935 and release relay 916, a path is thereby prepared for the ringing current responsive relay 936. The operator now operates her ringing key 919 and thereby causes alternating current ringing signals to be transmitted out over the trunk 109. The relay 936 operates as usual to cause the establishing of the connection by the operation of relay 924 for the ringing current over the trunk 109 through repeating coil 143. In response to this ringing current at the step-by-step office, the impulse relay 138 is operated over the lower winding of relay 138 and normal contacts of relay 137. The operation of relay 138 closes a circuit at its armature and front contact for the establishing of the usual line-finder, such as 106, over conductors R—2 and T—2 to a first selector, such as 107, to prepare the circuit for dialing as is well known in the art. After the operator has received the usual dial tone she will proceed with the dialing of the remainder of the number of the desired subscriber's line in the step-by-step exchange F. This is done in the usual manner by the operation of the dialing key 932 and the operation of the dial 931. The dial pulses extend in this instance over the ring conductor through the right-hand winding of repeating coil 143, back to ground over the tip conductor at the upper armature and front contact of relay 924. These pulses will be repeated through the repeating coil 143, trunk 109, through the lower winding of relay 138 which will respond accordingly. This relay in responding will set the proper switches at the step-by-step office to the terminals of the called subscriber's line over the line-finder 106, first selector 107 and connector such as 108. On completion of the dialing the switches at the step-by-step office will establish a ground connection to the lead CT to cause the operation of relay 142 from battery through the upper winding of this relay to ground over lead CT. Relay 142 in operating closes a holding circuit for impulsing relay 138 from battery, lower outer armature and back contact of relay 137, lower inner armature and front contact of relay 142, lower inner armature and back contact of relay 137, upper winding of relay 138, lower outer armature and front contact of relay 142, upper outer armature and back contact of relay 137 to ground. This is to maintain relay 138 operated after the operator has restored her dial key 932. After the dial key is restored relay 936 releases which in turn releases relay 924 and the operator can then ascertain the condition of the called subscriber's line whether it is busy or idle. If the called line is busy the regular busy tone is received by the operator and on receipt of the busy tone the operator will operate key 145 to release relay 142 by a circuit through its lower winding. The windings of relay 142 are differential. Relay 142 in releasing opens the holding circuit for relay 138 permitting the step-by-step office circuits to release. The operator will then establish a connection back to the calling subscriber in exchange A as hereinbefore described and advise that the line is busy and take down the connection as usual. If the called line is idle the control operator will receive a ring back tone from the step-by-step office F. On receipt of this tone the control operator will disconnect from the trunk and permit the calling subscriber to be connected through the engaged link to the step-by-step office as usual. When the step-by-step office subscriber answers conversation may be conducted. After conversation the step-by-step subscriber restores the receiver permitting the operation of relay 137 and causes the release of relay 138 and thereby releasing the circuit equipment at the step-by-step office which in turn will release relay 142. The calling subscriber in office A will then release the circuit in her office by the usual ring-off signal.

If a toll connection is desired for a subscriber in exchange A a toll operator at the manual exchange B will insert her plug 714 into jack 136 which is multipled to her position from the trunk 109. This causes the operation of relay 137 over the sleeve connection through the jack 136. Relay 142 also operates from battery, upper winding of relay 142, contacts closed by jack 136 to ground. The operator will then ring from her cord which causes the operation of the line relay 806 at the exchange A. Relay 142 closes connections across the condensers 146 and 147 through repeating coil 139. The control operator at B will be called in the usual manner, that is in the same manner as this operator was called when a subscriber at the step-by-step office was calling. The connection to a desired subscriber in exchange A is then completed by the control operator in the usual manner and when the connection is completed between the subscriber in exchange A and the trunk 103 the operator will extend the toll connection through jack 136.

With the Figs. 5, 6 and 10 arranged as shown in Fig. 4, descriptions will be made of the operations of these circuits when instead of the remote control trunk 102 a phantom circuit is used as a remote control trunk. Two ordinary telephone circuits 1000 and 1001 may extend from the exchange A to the manual exchange B and the phantom circuit derived from these two telephone circuits may be used as a remote con-

trol trunk, by tapping off at the mid-points of the repeating coils at each end as shown in Fig. 10. The circuits at both ends of the phantom trunk are but slightly different from the equipment at both ends of trunk 102 shown in Fig. 7. While the operations of the link shown in Fig. 5 and the control circuit of Fig. 6 are the same as when they are used with the remote control trunk 102, there are slight differences in the circuit arrangements for the phantom trunk. The following descriptions of calls using the phantom trunk will therefore omit in general, circuit details already described. In a call from a subscriber at 100 to another subscriber in the same exchange, the subscriber calls up as usual and causes the operation of relay 106. This causes the operation of relay 601 to send the tone to the calling subscriber, and the operation of relays 602 and 1002. Relay 1002 is operated over a circuit from battery through the upper winding of relay 1002, contacts of relay 603 to the ground at relay 106. It should be noted that relay 1002 is only momentarily operated as relay 602 operates at the same time and being slow in operating it closes a circuit through the lower winding of relay 1002 from battery lower winding, right-hand armature and front contact of relay 602 to the ground at relay 106. The windings of relay 1002 are differential. This relay will therefore release and be maintained in non-operated condition. The momentary operation of the relay 1002 opens the circuits for the normally operated relay 1003 to cause this relay to release. The circuit for relay 1003 may be traced from battery at the terminals of jack 1004, contacts of release key 1005 and control key 1006, contacts of relay 1007, armature and front contact of relay 1003, winding of this relay, the left-hand windings of repeating coil 1008, the tip and ring conductors, the left-hand windings of the repeating coil 1009, tip and ring conductors of the telephone circuits 1000 and 1001, right-hand windings of the repeating coil 1010, the tip and ring conductors, right-hand windings of repeating coil 1011, armature and back contact of relay 1002, make-before-break contact of relay 1012 make-before-break contact of relay 611, windings of relays 1013 and 1014 to ground. This circuit normally holds relay 1003 operated but due to the resistance of the winding of this relay, relays 1013 and 1014 do not operate normally. The release of relay 1014 closes a circuit for the lamp 1015 from battery at the terminals of jack 1004, contact of release key 1005 and control key 1006, contacts of relay 1007, armature and back contact of relay 1003, lamp 1015 to ground. The operator answers this call by inserting a plug into jack 1016 and this operation closes an obvious circuit for relay 1007 which opens the lamp circuit causing it to be extinguished. Relay 1007 in operating also closes a circuit for relays 1017 and 1014. The circuit is the same for relay 1014 as previously traced to the repeating coil 1008, then through the winding of relay 1017, contacts of relay 1018, contact of ringing key 1019, resistance 1020, contacts of relay 1007 to battery at the terminals of jack 1004. Relay 1013 does not operate in this circuit due to the resistance 1020. Relay 1014 in operating closes a circuit for the operation of relay 606, the circuit extending from battery through the stepping magnet 607 of switch 104 and its interrupting contacts, winding of relay 606, armature and front contact of relay 1014, lower outer armature and back contact of relay 1012 to ground. The operation of relay 606 causes as hereinbefore described the line-finder LF to find the calling line and when the calling line has been found the tone is removed and the tip and ring conductors completed to the operator at the remote control office. The circuit extending through repeating coils 1011, 1010 over trunks 1000 and 1001 serving as tip and ring conductors, respectively, repeating coils 1009 and 1008 to the operator over the jack 1016.

The operator now obtains information as to the number of the desired subscriber's line and the operator then connects her dial 1022 to jack 1004 and thus transfers the control of the relay 1014 to the pulsing contacts of the dial. Then by operating the dial she will select the desired scriber's line over the connector C in the usual manner, the pulsing relay 1014 responding to the pulses and closing and opening the pulsing circuit that extends to the lower armature and back contact of relay 1023, the armature and back contact of the pulsing relay 1014 and the lower outer armature and back contact of relay 1012 to ground.

Should the called line be busy, the connector brush of bank 5 will encounter ground and relay 120 will not operate as usual under these circumstances. Therefore, when relay 117 releases a circuit will be completed from ground corresponding terminal and brush of bank 2 of connector C to contacts of relays 114, 120, 117 and 613, left-hand winding of relay 615, upper inner armature and back contact of relay 1023 to battery. Relay 615 operates and this relay in conjunction with relays 616 and 613 causes a tone to be produced as hereinbefore described and conducted through condenser 617 through the upper outer armature and back contact of relay 1023, upper winding of relay 1025, upper left-hand winding of the repeating coil 1011, contacts of relay 603, lower left-hand winding of repeating coil 1011, lower armature and back contact of relay 1026 through the lower windings of the retardation coil 1025 to ground. This tone is transformed through the right-hand windings of the repeating coils 1011 over the telephone circuits 1000 and 1001 to the operator. Under these conditions the operator will now determine whether the line is actually busy. The operation of the control key 1006 closes a circuit from battery through winding of relay 1028 to ground at contacts of relay 1018. Relay 1028 shunts out the resistance 1020 from the trunk circuit by connecting battery from the control key 1006 through the right-hand armatures and front contacts of relay 1028 through contacts of the ringing key 1019, contacts of relay 1018, winding of relay 1017 to the trunk. This causes the operation of relay 1013 in series with the pulsing relay 1014. Relay 1013 closes an obvious circuit for the operation of relay 1012. Relay 1012 transfers the control circuit to relay 1029 to cause it to operate. This circuit may be traced through the upper inner armature and front contact of relay 1012, contacts of relay 1026, upper winding of relay 1029 to ground. Relays 1013 and 1014 are released and relay 1012 is held operated by relay 1029 over an obvious circuit. The operation of relay 1012 also places a holding ground for maintaining relay 606 operated in place of the ground supplied through the contacts of relays 1014 and 1012. Relay 1012 closes an obvious circuit for the operation of relay 1023. This opens the cir-

cuit for relay 613 and the busy tone is stopped. Relay 111 is now operated by a circuit closed from battery, upper inner armature and front contact of relay 1023, lower winding of relay 111 to ground. This enables the operator to challenge on the called line by the closing of the tip and ring conductors through contacts of relay 111, from the connector to the operator. The operator may now ascertain the condition of the line and if it is idle may ring down in the usual manner by operating the relay 1031 over a circuit from the alternating current source through the operated contacts of the ringing key 1019, contacts of relay 1018, contacts of the ringing key 1019 over the trunk circuit, lower right-hand armature of contacts of relay 1002, upper inner armature and front contact of relay 1012, condenser 1032, alternating current responsive relay 1031 to ground. This relay in operating closes a circuit for the operation of relay 1026 which closes a connection from ground, upper outer armature and front contact of relay 1026 over the tip conductor to the called subscriber, back over the ring conductor, the lower outer armature and front contact of relay 1026, over the trunk circuit to the alternating current source at the operator's ringing key 1019. The operator may then disconnect by removing the plug from jack 1016 and permitting the connection between the calling subscriber and the called subscriber to be established as hereinbefore described. If the line is busy the operator will release the control key 1006 and operate the release key 1005. The operation of the release key momentarily opens the trunk circuit and releases relay 1029 which then releases relays 1012 and 1023. Relay 1023 is slow in releasing so a momentary circuit is therefore closed for the release of relay 114. The momentary circuit extends from battery, lower winding of relay 114 and its lower inner armature and front contact, upper outer armature and back contact of relay 1012, lower inner armature and front contact of relay 1023, contacts of relays 117 and 120, lower inner armature and front contact of relay 114 to ground at the corresponding terminals and brush of bank 2 of the connector C. The operator will thereby be able to talk to the calling subscriber over the calling loop and the normal contacts of relay 114 as hereinbefore described.

On the other hand, if the called line is idle a circuit will be completed for relay 120 when relay 117 is released. This relay in turn closes a circuit for relay 111. Relay 111 in operating completes a locking circuit for relay 120. Relay 111 also grounds the called line test terminal at the lower middle armature and front contact to prepare a circuit for relay 114 if the operator wishes to monitor on the completed connection. Relay 111 connects the tip and ring of the called line to the trunk circuit.

The operator may now ring the called party but before the ringing key is operated, the operator must first operate the control key 1006. The operation of this key causes the operation of relay 1013 as hereinbefore described and this relay in turn operates relay 1012. Relay 1012 prepares a path for the ring relay 1031 and opens the circuit for relays 1014 and 1013 which release and cause the operation of relay 1023. The operator now operates the ringing key 1019 to operate relay 1031 and ring the called subscriber as hereinbefore described by first operating relay 1026.

If the operator wishes to monitor on the connection she will release the control key 1006 and operate the release key 1005. This releases relay 1029 which in turn releases relays 1012 and 1013 allowing relay 1014 to operate. She will then dial the digit three, for example, and thus allow a ground impulse to momentarily shunt out relay 114 and this relay in turn causes the operation of relay 112 which connects the calling subscriber's line to the called subscriber's line. The operator may release the trunk by withdrawing the cord as in ordinary connections. When the operator removes her cord from jack 1016, relay 1007 releases but as this relay is slow to release a circuit is completed for the reoperation of relay 1003 from battery through the inner right-hand armature and front contact of relay 1007, terminals of jack 1007, winding of relay 1003 over the trunk. This releases relay 1017 while relay 1003 remains operated from the battery and the dialing jack 1004. Relay 1014 releases and opens the circuit for relay 606 and this relay in turn releases relays 610 and 603, which in turn release relay 111. This in turn causes the operation of relay 112 to connect the calling and called lines together. When relay 112 operates the switch 104 will select another idle link.

On pay station calls the operations of the circuits shown in Figs. 5 and 6 are the same as hereinbefore described and when relay 611 operates and the operator is given special signal to indicate a pay station call after the plug is inserted and the lamp 1015 is extinguished when calling line is found by line-finder F in a regular call.

On calls originated by the operator, the operator inserts her plug into jack 1016 and the circuits will function in the same manner as when the operator answers a local call, except that in this case provision is made whereby the twenty-fifth terminal in bank 1 of line-finder F is allotted to mark the operator's finding position. When the finder finds this position the operator may proceed to dial the wanted number. The link circuit functions as before after conversation is completed and before removing her cord, the operator will dial a digit allowing the relay 112 to operate. The operator will then actuate the control key 1006 and send out a short impulse of ringing current which energizes relay 123 allowing the link circuit to restore as in a regular ring-off signal hereinbefore described. After sending out this short impulse of ringing current the operator restores the control key 1006 and operates the release key 1005 and then disconnects by removing her regular and dial cords.

What is claimed is:

1. In a telephone system, subscribers' lines, a trunk, links for connecting a calling line with a called line, means for associating one end of said trunk with an idle link, means for associating a calling line with said idle link, a signal at the other end of said trunk, and means operated in response to the seizure of a calling subscriber's line for operating said signal without associating the calling line with said idle link.

2. In a telephone system, subscribers' lines, a trunk, links, means responsive to a subscriber initiating a call for signaling over the trunk, and means responsive to the answering of said signal by the seizure of the trunk for connecting the calling line to a link.

3. In a telephone system, subscribers' lines, a trunk, an operator's position at one end of said trunk, links for connecting calling lines to called lines, means operative over a calling subscriber's

line for seizing said trunk, means operative over said trunk when the operator answers the call by connecting to the trunk for connecting said calling line to one end of an idle link, and means operative when the operator dials a desired subscriber's number for connecting the other end of said link to the called subscriber's line.

4. In a telephone system, exchanges, subscribers' lines terminating at a first exchange, a trunk extending from said first exchange to a second exchange, an operator's position at said second exchange, links in said first exchange for connecting calling lines to called lines, each link comprising a line-finder and a connector switch, means for normally connecting an idle one of said links with said trunk, means responsive to a calling subscriber operating his hand generator for seizing said trunk and signaling the operator at said other exchange, means responsive to the operator answering said signal for actuating the line-finder of the associated link to connect the calling subscriber's line to said link, means responsive to the transmission of impulses over said trunk from said operator's position for controlling the connector switch of said link to connect said link to a called subscriber's line, and means for disconnecting said trunk from said link and connecting said trunk to another idle link.

5. In a telephone system, subscribers' lines, a trunk, links for connecting calling lines to called lines, means operative over a calling subscriber's line for seizing said trunk and signaling over said trunk, a control circuit, a relay in said control circuit, means in said control circuit for normally associating an idle link with said trunk, means operative over said trunk for actuating said relay, means in said control circuit and said link responsive to the operation of said relay for connecting said calling subscriber's line to the link associated with said trunk, means in said control circuit and said link operating over said trunk for connecting said link to a called subscriber's line, and means operative over said trunk for releasing it from said link and connecting it to another idle link through said control circuit.

6. In a telephone system, subscribers' lines, a trunk, normally open links for connecting calling lines to called lines, means for normally connecting said trunk to one end of an idle one of said links, means operative over a calling line for signaling over said trunk, means operative over said trunk for connecting said calling line to said one end of said link, means operative over said trunk for disconnecting said trunk from said one end of said link, for connecting the other end of said link to a called subscriber's line and for connecting said trunk to the other end of said link, and means operative over said trunk for disconnecting said trunk from said other end of said link, for connecting the calling subscriber's line to the called subscriber's line through said link, and for connecting said trunk to the first-mentioned end of another idle link.

7. In a telephone system, subscribers' lines, a trunk, normally open links for connecting calling lines to called lines, means for normally connecting said trunk to one end of an idle one of said links, means operative over a calling line for signaling over said trunk, means operative over said trunk for connecting said calling line to said one end of said link, means operative over said trunk for disconnecting said trunk from said one end of said link, for connecting the other end of said link to a called subscriber's line and for connecting said trunk to the other end of said link, and means operative over said trunk for connecting the calling line to the called line through said link.

8. In a telephone system, subscribers' lines, a trunk, normally open links for connecting calling lines to called lines, means for normally connecting said trunk to one end of an idle one of said links, means operative over a calling line for signaling over said trunk, means operative over said trunk for connecting said calling line to said one end of said link, means operative over said trunk for disconnecting said trunk from said one end of said link, for connecting the other end of said link to a called subscriber's line and for connecting said trunk to the other end of said link, and means operative over said trunk for reconnecting said trunk to said one end of said link and for connecting the calling line to the called line through said link.

9. In a telephone system, subscribers' lines, a trunk, normally open links for connecting calling lines to called lines, means for normally connecting said trunk to one end of an idle one of said links, means operative over a calling line for signaling over said trunk, means operative over said trunk for connecting said calling line to said one end of said link, means operative over said trunk for disconnecting said trunk from said one end of said link, for connecting the other end of said link to a called subscriber's line and for connecting said trunk to the other end of said link, means operative over said trunk for signaling over the called line, and means operative over said trunk for disconnecting said trunk from said other end of said link, for connecting the calling subscriber's line to the called subscriber's line through said link, and for connecting said trunk to the first-mentioned end of another idle link.

10. In a telephone system, subscribers' lines, a trunk, normally open links for connecting calling lines to called lines, means for normally connecting said trunk to one end of an idle one of said links, means operative over a calling line for signaling over said trunk, means operative over said trunk for connecting said calling line to said one end of said link, means operative over said trunk for disconnecting said trunk from said one end of said link, for connecting the other end of said link to a called subscriber's line and for connecting said trunk to the other end of said link, means operative over said trunk for signaling over the called line, and means operative over said trunk for reconnecting said trunk to said one end of said link and for connecting the calling line to the called line through said link.

11. In a telephone system, subscribers' lines, a trunk, an operator's position at one end of said trunk, links for connecting calling lines to called lines, means for associating the other end of said trunk with an idle link, a signal associated with said first end of said trunk, means operative in response to the seizure of a calling line by a subscriber for operating said signal, means responsive to the seizure of said trunk at the other end thereof by the operator at said position for connecting the calling line to one end of said idle link, means responsive to the operator dialing over said trunk for associating the other end of said link with a called subscriber's line, means responsive to the operator releasing said trunk for connecting the calling line to the called line through said idle link and for disconnecting said

trunk from said link and for connecting said trunk to a succeeding idle link.

12. In a telephone system, subscribers' lines, a trunk, links for connecting calling lines to called lines, means for connecting said trunk to an idle link for controlling the establishing of a connection over said link between a calling line and a called line, and means operative if all links are busy for connecting said trunk to said links in succession for testing.

13. In a telephone system, subscribers' lines, a trunk, links for connecting calling lines to called lines, a control switch, means for operating said control switch to connect the trunk with an idle link for controlling the establishing of a connection between a calling line and a called line over said link, for disconnecting said trunk from said link when engaged and for connecting said trunk to a succeeding idle link, and means for operating said control switch if all links are engaged for connecting said trunk to said links in succession for testing.

14. In a telephone system, subscribers' lines, a trunk, an operator's position at one end of said trunk, links for connecting a calling line or the trunk with a called line, each link including a line-finder switch and a connector switch, means for normally connecting the other end of said trunk to an idle link, means responsive to the seizure of said trunk at the operator's position for actuating the line-finder switch of said idle link to a certain position to mark the trunk call on the line-finder, means operative over said trunk for actuating the connector switch of said idle link to connect said link to a called subscriber's line to establish a connection between the trunk and said called subscriber's line.

15. In a telephone system, subscribers' lines, a trunk, an operator's position at one end of said trunk, links for connecting a calling line or the trunk with a called line, each link including a line-finder switch and a connector switch, means for normally connecting the other end of said trunk to an idle link, means responsive to the seizure of said trunk at the operator's position for actuating the line-finder switch of said idle link to a certain position to mark the branch call on the line-finder, means operative over said trunk for actuating the connector switch of said idle link to connect said link to a called subscriber's line to establish a connection between the trunk and said called subscriber's line, and means operative over said trunk for releasing said line-finder and connector switches.

16. In a telephone system, subscribers' lines, a trunk, an operator's position at one end of said trunk, links for connecting a calling line or the trunk with a called line, each link including a line-finder switch and a connector switch, means for normally connecting the other end of said trunk to an idle link, means responsive to the seizure of said trunk at the operator's position for actuating the line-finder switch of said idle link to a certain position to mark the trunk call on the line-finder, means operative over said trunk for actuating the connector switch of said idle link to connect said link to a called subscriber's line to establish a connection between the trunk and said called subscriber's line, means operative over said trunk for releasing said line-finder and connector switches, and means operative over said trunk for connecting said trunk to a succeeding idle link.

17. In a telephone system, subscribers' lines, a trunk, an operator's position at one end of said trunk, links for connecting calling lines to called lines, means for normally connecting the other end of said trunk to an idle link, a signal associated with said trunk at the operator's position, means operative in response to the seizure of a calling line for continuously actuating said signal, means operative over the trunk from the operator's position for disabling said signal and connecting the calling line to a called line through the associated link, means for intermittently operating said signal during the establishing of said connection between a calling line and a called line operative in response to the seizure of another calling subscriber's line.

18. In a telephone system, subscribers' lines, a trunk, an operator's position at one end of said trunk, links for connecting calling lines to called lines, means for normally connecting the other end of said trunk to an idle link, a signal associated with said trunk at the operator's position, means operative in response to the seizure of a calling line for continuously actuating said signal, means operative in response to the seizure of the trunk at the operator's position for disabling said signal and connecting the calling line to the associated link, means responsive to the sending of dial pulses over said trunk from the operator's position for connecting said calling line to a called line through said link, and means for flashing said signal during the sending of dial pulses should another calling line be seized during this period.

19. In a telephone system, pay station and non-pay station subscribers' lines, a trunk, an operator's position at one end of said trunk, links for connecting a calling line with a called line, means for normally connecting the other end of said trunk to an idle link, a signal associated with said trunk at the operator's position, means operative in response to the seizure of a calling line for actuating said signal, means operative over the trunk from the operator's position for disabling said signal and connecting the calling line to the associated link, means thereafter responsive if the calling line is a pay station line for again actuating said signal for a short interval, and means operative over the trunk from the operator's position for connecting the calling line through the connected link to the called line.

20. In a telephone system, pay station and non-pay station subscribers' lines, a trunk, an operator's position at one end of said trunk, links for connecting a calling line with a called line, means for normally connecting the other end of said trunk to an idle link, a signal associated with said trunk at the operator's position, means operative in response to the seizure of a calling line for actuating said signal, means operative over the trunk from the operator's position for disabling said signal and connecting the calling line to the associated link, means thereafter responsive if the calling line is the pay station line for again actuating said signal for a short interval and for applying a tone over the calling pay station line.

21. In a telephone system, single and party subscribers' lines, links for establishing connections between subscribers' lines, a trunk, an operator's position at one end of said trunk, means for normally connecting the other end of said trunk to an idle link, means controlled over said trunk from the operator's position for establishing a connection between a calling line and a called line over said idle link, operative if said called line is idle, means for transmitting a

busy tone to the operator's position when a connection is attempted to a called line over said link, if the called line is a single line and busy or if the called line is a party line and busy in a connection to another line, means operative when a connection is attempted to a party line and said party line is busy in a revertive call connection for preventing a busy tone to the operator's position and for connecting the trunk to said called party line so that the operator at said position will know by listening to the conversation that the party line is engaged in a revertive call, and means thereafter controlled over said trunk from the operator's position for momentarily connecting the calling subscriber's line to the called party line so that the calling subscriber will know that the called party line is engaged in a revertive call and for releasing the established connection to said party line.

22. In a telephone system, single and party subscribers' lines, links for establishing connections between subscribers' lines, a trunk, an operator's position at one end of said trunk, means for normally connecting the other end of said trunk to an idle link, a relay in said idle link, means controlled over said trunk from the operator's position for establishing a connection between a calling line and a called line if said called line is idle, said means including the operation of said relay, means controlled over said trunk from the operator's position for preventing the operation of said relay if the call is attempted to a busy single line or a busy party line if said busy party line is connected to another line, means responsive to the operation of said relay for transmitting a tone over the trunk to the operator's position, means controlled over said trunk from the operator's position for establishing a connection from the trunk to a called line over said idle link, if the called line is a party line and busy in a revertive call connection, said last means including the operation of said relay to prevent the transmission of a busy tone to the operator's position and so that the operator at said position will know by listening to the conversation that the party line is engaged in a revertive call, and means thereafter controlled over said trunk from the operator's position for momentarily connecting the calling subscriber's line to the called party's line so that the calling subscriber will know that the called party is engaged in a revertive call and for releasing the established connection to said party line.

23. In a telephone system, subscribers' lines, a remote control trunk, talking trunks, a first exchange in which said lines and one end of said trunks terminate, a second exchange in which the other ends of all of said trunks terminate, an operator's position at said second exchange, means responsive to the seizure of a talking trunk by the operator at said position for signaling said operator from said first exchange over said remote control trunk, means at said first exchange responsive to the seizure of said remote control trunk at said second exchange by said operator and responsive to dialing of a desired subscriber's number over said remote control trunk for connecting said seized talking trunk to the called subscriber's line, and means for disconnecting said remote control trunk from said subscriber's connection.

24. In a telephone system, subscribers' lines, a remote control trunk, talking trunks, a first exchange in which said lines and one end of said trunks terminate, a second exchange in which the other ends of all of said trunks terminate, an operator's position at said second exchange, links for connecting a calling line or a talking trunk to a called line in said first exchange, means for associating the remote control trunk with an idle link, means responsive to the seizure of a talking trunk by the operator at said second exchange for signaling said operator from said first exchange over said remote control trunk, means operative in response to the seizure of said remote control trunk by the operator at said second exchange for connecting said talking trunk to one end of the link associated with the remote control trunk, and means operative in response to dialing over said remote control trunk from said second exchange for connecting a called subscriber's line to the other end of said link, and means responsive to the operator releasing the remote control trunk for disconnecting it from said link and for connecting the called line to said talking trunk through to said link.

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