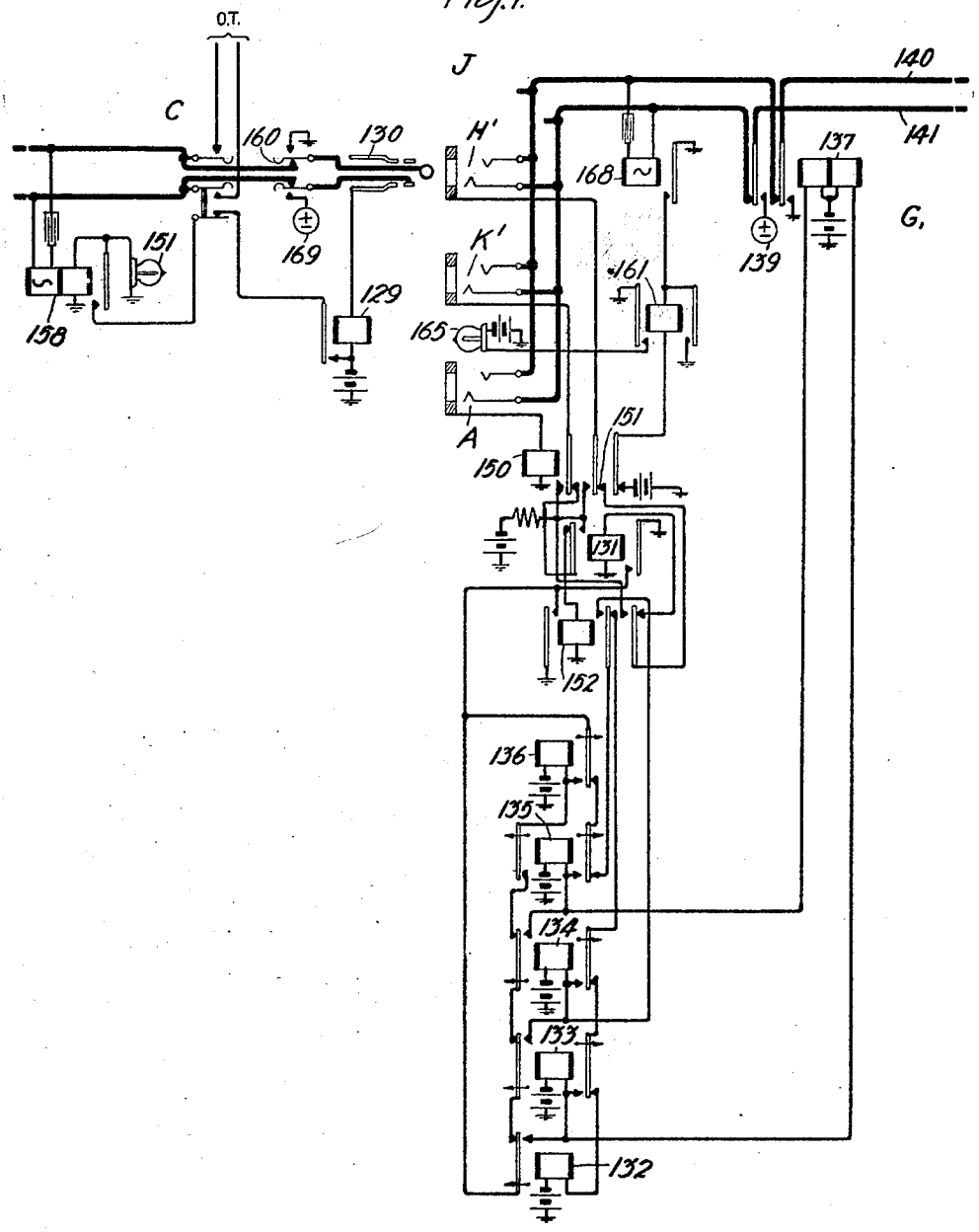
Dec. 29, 1925. 1,567,231

L. J. BOWNE

TELEPHONE EXCHANGE SYSTEM

Filed July 26, 1922 3 Sheets-Sheet 1

Fig. 1.



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by W. E. Beatty. Att'y.

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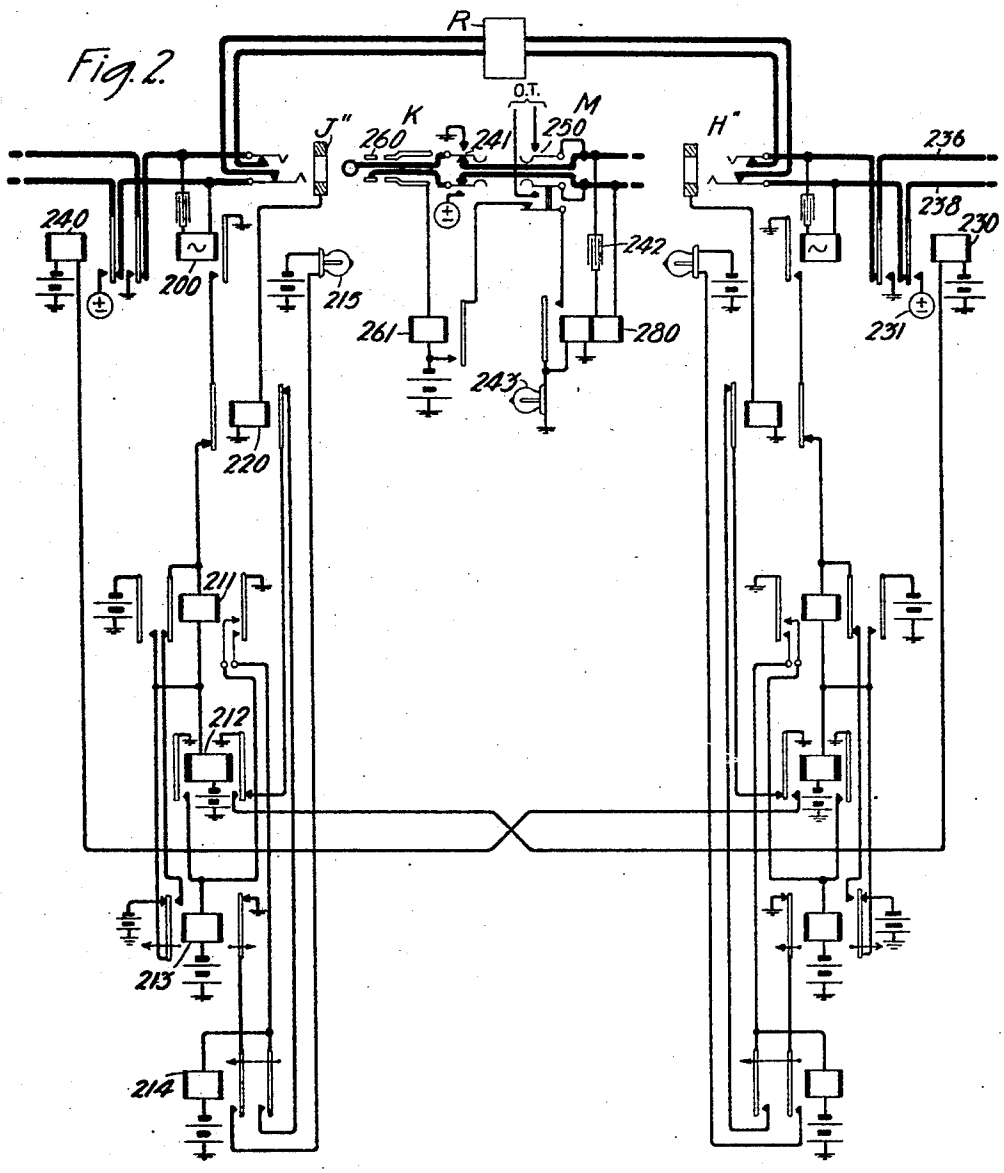
Fig. 2.



Inventor:
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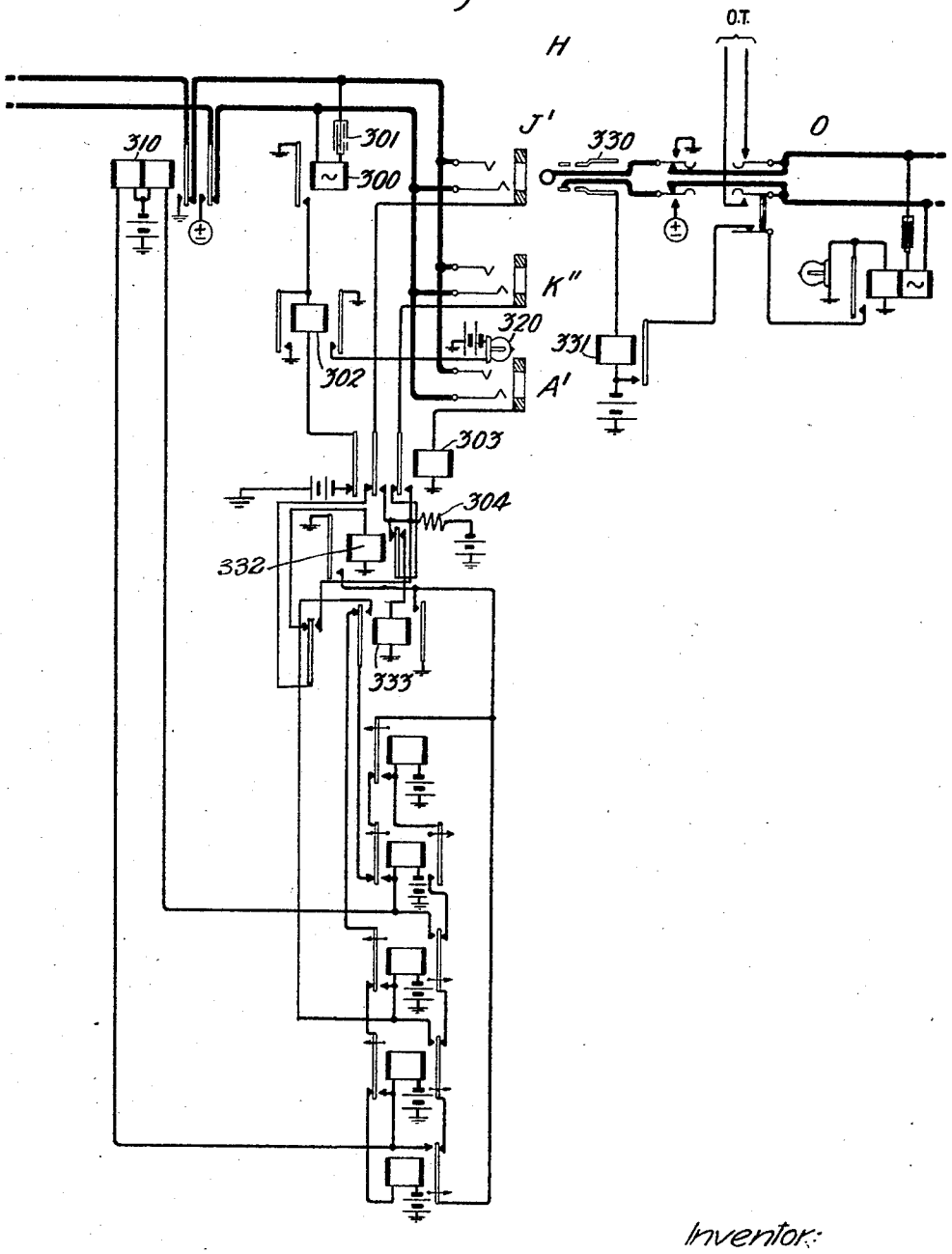
Fig. 3.



Inventor:
Langford J. Bowne.
by
W. E. Beatty. Atty.

Patented Dec. 29, 1925. 1,567,231

UNITED STATES PATENT OFFICE.

LANGFORD J. BOWNE, OF HOWARD BEACH, NEW YORK, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

Application filed July 26, 1922. Serial No. 577,501.

To all whom it may concern:

Be it known that I, LANGFORD J. BOWNE, a citizen of the United States, residing at Howard Beach, in the county of Queens, State of New York, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone exchange systems, and more particularly to circuit arrangements for signaling over toll lines.

One of the objects of the invention is to reduce the number of conductors between telephone exchanges widely separated.

Another object of the invention is to provide an improved circuit arrangement for selectively signalling any one of a plurality of exchanges having access to a toll line.

These objects are accomplished by the use of impulse transmitting means which responds to the seizure of the toll line at one of the exchanges to transmit current over the toll line to selectively signal another of the exchanges.

The invention may now be fully understood from the following description when read in connection with the accompanying drawings, Figs. 1 to 3, inclusive, which when taken together, constitute a circuit diagram of one embodiment of the invention. In order that the drawings may be more clearly read, the sheets should be arranged with Fig. 2 placed to the right of Fig. 1 and Fig. 3 to the right of Fig. 2.

Referring to the drawings, a toll line comprising two talking conductors is shown extending from a first exchange J, through jacks J'' and H'' at a second exchange K, to a third exchange H. Repeater equipment, represented by the rectangle R, of any well known type, as for example as that shown in Patent No. 1,216,136 to B. W. Kendall of February 13, 1917, may be connected in the toll line between the jacks J'' and H''. The toll line terminates at the J exchange in a plurality of jacks, such as H' and K', one jack for each exchange having access to the toll line, for completing outgoing calls over the toll line, and a jack A for answering incoming calls over the toll line. Associated with the jacks H', K' and A is a train of relays which operate to send a number of impulses over the toll line for signaling the succeeding exchanges, the number of impulses being determined by the jack selected by the operator. The train of relays is set in operation by the insertion of an operator's cord circuit C (a portion only of which is shown in the drawing). At exchange H, equipment which is a duplicate of the equipment at exchange J is provided. At the second exchange K, a cord circuit M (a portion only of which is shown) is provided for enabling the operator to call and talk with the operator at either of the exchanges J or H. Associated with the jack J'' is a lamp signal 215, for indicating the arrival of a call from exchange J, and a train of relays which either operate to light the signal 215 or to relay a call to the exchange H, depending upon the number of impulses transmitted from the first exchange. The equipment associated with the jack H' is a duplicate of the equipment associated with the jack J' and a further description of such equipment is deemed unnecessary.

Further details of the apparatus may be best understood from a description of the operation of the circuit, which is as follows:

Assuming that the operator at exchange J desires to communicate with the operator at exchange H, she will insert plug 130 of the cord circuit C into the jack H' of the toll line extending between the exchanges J and H, whereupon relays 129 and 131 are energized over a circuit extending from grounded battery, through the winding of relay 129, sleeves of plug 130 and jack H', contacts 151 of relay 150, outer right-hand normal contacts of relay 152, and winding of relay 131 to ground. The energization of relay 129 is without effect at this time. Relay 131, in operating, causes the energization of relay 132 over a path extending from grounded battery, through the winding of relay 132, right-hand normal contacts of relays 133 and 134, inner right-hand normal contacts of relay 152, right-hand normal contacts of relays 135 and 136, and right-hand armature and front contact of relay 131 to ground. Relay 132, in operating, causes the operation of relays 137 and 133 over a path extending from ground, right-hand armature and front contact of relay 131, armature and front contact of relay 132 and thence in parallel, one path extending through the wind-

ing of slow-to-release relay 133 to grounded battery and the other path extending through the right-hand winding of relay 137 to grounded battery. Relay 137 in operating applies signaling current to the toll line as long as relay 133 is operated as will be described hereafter. Relay 133, in operating, locks up over a path extending from grounded battery, winding and right-hand alternate contacts of relay 133, right-hand normal contacts of relay 134, inner right-hand normal contacts of relay 152, right-hand normal contacts of relays 135 and 136, and right-hand armature and front contact of relay 131 to ground. An obvious path for maintaining relay 137 energized is provided through the alternate contacts of relay 133. Relay 133, in attracting its right-hand armature, opens the energizing circuit for slow-to-release relay 132, which relay, after an interval, retracts its armature. When relay 132 retracts its armature, a circuit for the energization of relay 134 is completed, over a path extending from grounded battery, through the winding of relay 134, left-hand alternate contacts of relay 133, normal contacts of relay 132, and the right-hand armature and front contact of relay 131 to ground. Relay 134, in operating, locks up over a path extending from grounded battery, through the winding and right-hand alternate contacts of relay 134, right-hand normal contacts of relay 152, and the right-hand normal contacts of relays 135 and 136 to ground at the right-hand armature and front contact of relay 131. Relay 134, in attracting its right-hand armature, opens the holding and locking circuits for relays 137 and 133, whereupon said relays 137 and 133 release. Relay 137, in releasing, disconnects signaling current from the toll line.

The release of relay 133 causes the energization of relays 137 and 135 over a path extending from ground, through the front contact and right-hand armature of relay 131, left-hand normal contacts of relays 132 and 133, left-hand alternate contacts of relay 134 and thence in parallel, one path extending through the winding of relay 135 to grounded battery, and the other path extending through the left-hand winding of relay 137 to grounded battery. Relay 137, in operating, applies signaling current to the toll line a second time. Relay 135, in operating, locks up over a path including grounded battery, winding and right-hand alternate contacts of relay 135, normal contacts of relay 136 and right contacts of relay 131 to ground. Relay 137 is held operated as long as relay 135 is operated by ground at the right-hand alternate contacts of relay 135. When relay 135 operated, it opened at its right-hand normal contacts the locking circuit for slow-to-release relay 134 which relay, after an interval, releases and completes a circuit for the energization of relay 136. The circuit for the energization of relay 136 may be traced as follows: grounded battery winding of relay 136, left-hand contacts of relay 135, left-hand normal contacts of relays 134, 133 and 132, and right-hand armature and front contact of relay 131 to ground. Relay 136, in attracting its right-hand armature, opens the circuit for relays 135 and 137, whereupon said relays release. Relay 137 in releasing disconnects signaling current from the toll line conductors 140 and 141.

At the intermediate station K, relay 200, operates in response to each impulse of signaling current applied to the toll line conductors 149 and 141. In response to the first impulse of signal current, relay 200 operates and completes a circuit for energizing relay 211, said circuit including ground at the contacts of relay 200, contacts of relay 220, winding of relay 211, and grounded battery at the left-hand normal contacts of relay 213. Relay 211 in attracting its right-hand armature completes obvious circuits for operating relays 213 and 214. Relay 211 in attracting its outer left-hand armature short circuits relay 212. Relay 214 is of the slow to operate type and its inner contacts are not closed until the right-hand contacts of relay 213 are opened thereby preventing the lighting of the lamp 215 at the intermediate station, on a through call. Upon disconnection of the signaling current from the toll line at the end of the first impulse, line relay 200 releases, releasing in turn relay 211. Relay 211 in retracting its right-hand armature, opens the energizing circuits for relays 214 and 213. Relay 214 does not release at this time, however, because it locks over a path extending from grounded battery, through the winding and outer contacts of relay 214, right-hand contacts of relay 220, and normal contacts of relay 212 to ground. Relay 213, being of the slow-to-release type, remains operated for the interval between impulses of signaling current so as to prevent the lighting of lamp 215 when the next impulse is transmitted over the line. When the next impulse of signaling current is supplied to the toll line, conductors 140 and 141, relays 200 and 212 operate. The circuit for operating relay 212 includes ground at the contacts of relay 200, left-hand contacts of relay 220, inner left-hand contacts of relay 211, left-hand alternate contacts of relay 213, and winding of relay 212 to grounded battery. Relay 211 is short-circuited at this time by the inner left-hand contacts of relay 211 and the left-hand alternate contacts of relay 213. The closing of the left-hand contacts of relay 212 completes a circuit for relay 213 and prevents its release. Relay 212 in operating also opens the locking circuit for and causes the release of relay 214 and completes a cir-

cuit for the energization of relay 230 over a path extending from ground, through the alternate contacts of relay 212 and the winding of relay 230 to grounded battery. Relay 230, in operating, connects signaling current from the source 231 to the conductors 236 and 238 of the toll line circuit. Relay 300 at the terminating end of the toll line operates over a path extending from ground, through the outer alternate contacts of relay 230, conductor 236, inner normal contacts of relay 310, condenser 301, winding of relay 300, outer normal contacts of relay 310 and inner alternate contacts of relay 230 to the source of signaling current 231. Relay 300, in operating, completes a circuit for relay 302 over a path extending from ground, through the contacts of relay 300, winding of relay 302 and outer armature and back contact of relay 303 to grounded battery. Relay 302, in operating, locks through its left-hand contacts and through its right-hand contacts completes an obvious circuit for the lamp 320 causing said lamp to light, indicating to the operator at the terminating station H that a call has arrived.

The operator at the terminating exchange H, noting the lamp signal 320, may insert the plug 330 of the cord circuit O into the jack A′ whereupon relays 303 and 331 are energized over a path extending from grounded battery, through the winding of relay 331, sleeves of plug 330 and jack A′ and winding of relay 303 to ground. Relay 303 upon energizing connects grounded battery through the resistance 304 and through the inner and intermediate alternate contacts of relay 303 to the sleeves of jacks J′ and K″ for the purpose of placing a busy test on these jacks. Relay 303 in operating, also disconnects battery from the relay 302 and disconnects the relays 332 and 333 from the outgoing jacks J′ and K″, respectively, thereby rendering the signaling circuit ineffective during the time that the plug 330 is inserted in the jack A′. Relay 303 in operating also opens the locking circuit for relay 302 causing the release of said relay 302 and the extinguishing of the lamp 320.

A talking circuit between the originating exchange J and the terminating exchange H now exists over a path including the tips of plug 130 and jack H′, inner normal contacts of relay 137, conductor 140, outer normal contacts of relay 240, tip contacts of jack J″ through the repeater R, tip contacts of jack H″, outer normal contacts of relay 230, conductor 236, inner normal contacts of relay 310, tip contacts of jack A′ and plug 330, ring contacts of plug 330 and jack A′, outer normal contacts of relay 310, conductor 238, inner normal contacts of relay 230, ring contacts of jack H″, through the repeater R, ring contacts of jack J″, inner normal contacts of relay 240, conductor 141, outer normal contacts of relay 137, and ring contacts of jack H′, and plug 130.

It will next be assumed that the operator at the originating exchange J desires to signal the operator at the intermediate exchange K. The operator will thereupon insert the plug 130 of the cord circuit C into the jack K′ corresponding to the intermediate station K, whereupon relay 152 will be energized over a path extending from grounded battery, through the winding of relay 129, sleeves of plug 130 and jack K′, inner normal contacts of relay 150, left-hand normal contacts of relay 131, and winding of relay 152 to ground. Relay 152, in operating, completes a circuit for the energization of relay 134 over a path extending from ground, through the left-hand contacts of relay 152, right-hand normal contacts of relays 136 and 135, inner right-hand alternate contacts of relay 152, and winding of relay 134 to grounded battery.

Relay 134 in attracting its left-hand armature, completes a circuit for the energization of relays 135 and 137 over a path extending from ground, through the left-hand contacts of relay 152, left-hand normal contacts of relays 132 and 133, left-hand alternate contacts of relay 134 and thence in parallel, one path extending through the winding of relay 135 to grounded battery, and the other path extending through the left-hand winding of relay 137 to grounded battery. Relay 135, in operating, locks to ground at the contacts of relay 152 and opens the energizing circuit for relay 134 whereupon said relay 134 releases. Relay 136 then operates over a path extending from grounded battery, through the winding of relay 136, left-hand contacts of relay 135 and left-hand normal contacts of relays 134, 133 and 132, to ground at the left-hand contacts of relay 152. Relay 136, in operating, locks through its right-hand alternate contacts to ground at the left-hand contacts of relay 152, and opens the locking circuit for relay 135 whereupon said relay 135 releases.

Relay 137, in operating, connects signaling current from the source 139 to the conductors 140 and 141 of the toll line circuit, causing the energization of relay 200 at the intermediate office K. Relay 200, in operating, completes a circuit for the energization of relay 211 as previously described. Relay 212, being short circuited, does not operate. Relay 211, in attracting its right-hand armature, completes circuits for relays 213 and 214. Relay 214 locks over a path including grounded battery, winding and outer contacts of relay 214, contacts of relay 220, and contacts of relay 212. When the signaling current is disconnected from the conductors 140 and 141, relay 200 releases, releasing in turn relays 211 and 213. Relay 213 in re-

leasing completes a circuit of the lighting of lamp 215 over a path extending from grounded battery, through the lamp 215, inner contacts of relay 214, and right-hand contacts 213 to ground.

The operator at the intermediate station K noting the lighting of lamp 215 inserts the answering plug 260 of the cord circuit M into the jack J'' whereupon relays 220 and 261 operate over a path extending from ground, through the winding of relay 220, sleeves of jack J'', and plug 260, and the winding of relay 261 to grounded battery. Relay 220 in attracting its left-hand armature disconnects the signaling circuit from the toll line circuit, and in attracting its right-hand armature opens the locking circuit for relay 214 whereupon said relay 214 releases and opens the circuit for lamp 215, causing the extinguishment of said lamp 215. The operator at the originating exchange J may now converse with the operator at the intermediate exchange K. During this time the toll line circuit extending from the intermediate exchange K to the terminating exchange H is in condition for signaling and the operator at exchange K may either signal the operator at the terminating exchange H or the operator at exchange H may signal the operator at exchange K.

Upon termination of conversation the operator at the exchange J may apply signaling current to the toll line conductors 140 and 141 by actuating the key 160 whereupon relay 280 of the cord circuit M will be energized over a path extending from ground, through the upper alternate contacts of key 160, tips of plug 130 and jack K', inner normal contacts of relay 137, conductor 140, outer normal contacts of relay 240, tips of jack J'' and plug K, upper normal contacts of key 241, condenser 242, right-hand winding of relay 280, lower normal contacts of key 241, rings of plug K and jack J'', inner normal contacts of relay 240, outer normal contacts of relay 137, rings of jack K' and plug 130, and lower alternate contacts of key 160 to the source of signaling current 169. Relay 280, in operating locks and causes the lighting of lamp 243 over a path extending from ground, through lamp 243, and the left-hand winding of relay 280 in parallel, contacts of relay 280, lowermost contacts of key 250 and contacts of relay 261 to grounded battery. The lighting of lamp 243 indicates to the operator at the intermediate exchange K that conversation has ceased whereupon she may remove plug K from the jack J'' causing the restoration of all apparatus at the intermediate exchange to normal. If the operator at the exchange K applies signaling current to the toll line, relay 158 of the cord circuit at the originating operator's position will be energized and locked over an obvious circuit causing thereby the lighting of lamp 151 which indicates to the operator that conversation has ceased. The operator at the originating exchange will then remove the plug 130 from jack K' whereupon all apparatus associated with the cord circuit C and the toll line circuit will be restored to normal position.

It will next be assumed that the operator at the intermediate exchange desires to communicate with the operator at one of the terminating exchanges. The equipment associated with jacks J'' and H'' is identical and the equipment associated with the toll line at the terminating exchanges J and H is also identical, so that it is immaterial in which direction the call is traced. Assuming, however, that the operator at the intermediate station K desires to communicate with the operator at the terminating exchange J, she will insert the plug 260 into the jack J'' whereupon relays 261 and 220 are energized over a circuit previously traced. Relay 220 in operating, renders the signaling current for receiving incoming signals, ineffective. The operator will thereupon actuate ringing key 241 to apply signaling current to the toll line conductors 140 and 141. Relay 168 is then energized over an obvious circuit causing in turn the energization of relay 161 over a path extending from ground, through the contacts of relay 168, winding of relay 161, and outer right-hand contacts of relay 150 to grounded battery. Relay 161 in operating locks up over a path extending from grounded battery, through the outer right-hand contacts of relay 150, winding and right-hand contacts of relay 161 to ground. Relay 161 in attracting its left-hand armature completes an obvious circuit for lighting lamp 165.

The operator at exchange J, noting the lighting of the lamp 165, will insert the plug 130 of the cord circuit C into the jack A whereupon relays 150 and 129 are energized over a path previously traced. Relay 150 in operating, opens the locking circuit for relay 161 causing the extinguishment of lamp 165. Relay 150 in attracting its inner and intermediate armatures, disconnects the signaling circuit from the toll line circuit. Conversation may now proceed between the two operators and upon completion of conversation either of the operators may signal the other in the manner previously described.

Upon the conclusion of conversation and removal of the plugs 130 and 260, all apparatus on the cord circuits and on the toll line circuit is restored to normal position. During the time that the operator at the intermediate exchange K is using the toll line extending between her position and the exchange J, a signaling circuit exists between the intermediate exchange and the terminal

exchange and is ready for use in either direction.

The characteristics of the repeating circuit R are such that when the signaling current is applied to the toll line, it will not affect the apparatus of the repeating circuit.

What is claimed is:

1. In a telephone exchange system, a plurality of exchanges, a continuous line circuit connecting said exchanges, a switching means whereby said line may be seized, impulse transmitting means associated with the line and responsive solely to the seizure of the line at one of said exchanges by said switching means for transmitting current over the line to selectively signal another of said exchanges, and a signal responsive means at each of said exchanges.

2. In a telephone system, a first exchange, a plurality of other exchanges, a continuous line circuit connecting the plurality of other exchanges with said first exchange, and a train of relays associated with the line and responsive to the seizure of the line at the first exchange for transmitting a number of impulses over the line to selectively signal any desired one of said other exchanges.

3. In a telephone system, a first exchange, a plurality of other exchanges, a continuous two-conductor line circuit connecting the plurality of other exchanges with said first exchange, a switching means whereby said line may be seized, and means associated with said lines and responsive solely to the seizure of the line at the first exchange by said switching means for transmitting a number of impulses over the two conductors of said line circuit to selectively signal any desired one of said other exchanges.

4. In a telephone exchange system, a first exchange, a plurality of other exchanges, a continuous line circuit normally connecting all of said exchanges, a switching means whereby said line may be seized, means associated with said line and responsive solely to the seizure of the line at the first exchange by said switching means for transmitting a number of impulses over the line to the exchange desired to signal said exchange.

5. In a telephone exchange system, a line circuit extending between an originating and a terminating office and terminating at each end in a plurality of connecting terminals, a signaling device associated with the connecting terminals at each office, an intermediate office into which said line is led, a signal at said intermediate office, a signal operating and signal repeating device at said intermediate office, and means operative over said line in response to the seizure of the line at the originating office for operating at will the device at the intermediate office to cause this signal at said office to operate or to cause a signal to be repeated to the terminating office.

6. In a telephone exchange system, a two-conductor line circuit extending between an originating and a terminating office, and terminating at each end in a plurality of connecting terminals, a switching means whereby said terminals may be seized, a signaling device associated with the connecting terminals at each office, an intermediate office into which said line is led, a signaling device at said intermediate office, and means operating over the two conductors of said line in series solely in response to the seizure of the connected terminals of the line at the originating office by said switching means for operating at will the signaling device at the intermediate or at the terminating office.

7. In a telephone exchange system, a line circuit terminating at each end in a plurality of jacks, a signaling device at each end of the line circuit, an operator's position intermediate the ends of said line to which said line is carried, signal operating devices thereat responsive to a call from either end of the line, a cord circuit at each end of the line, and means operating in response to the connection of the cord circuit with a jack at either end for operating one of said devices at the intermediate station to cause the operation of a signal at the opposite end or for operating said device to cause a signal at the intermediate position to operate determined by the jack to which the cord circuit is connected.

8. In a telephone exchange system, a line circuit terminating at each end in a plurality of jacks, a signaling device at each end of the toll line, an operator's position intermediate the ends of said toll line to which said line is carried, signaling devices thereat for indicating the arrival of a call from either end of the toll line, a cord circuit at each end of the toll line, and means operating upon connection of the cord with one of the jacks at either end for sending a number of impulses over the line circuit to operate the signal at the opposite end or a signal at the intermediate position determined by the jack to which the cord is connected.

9. In a telephone system, a toll line normally connecting more than two offices, said toll line having a plurality of connecting terminals at each of said offices, an operator's signal at each of said offices, a signal operating and signal repeating device at an intermediate office, a cord circuit at one of said offices, and means operating in response to the connection of the cord with the toll line for actuating said device to cause the signal at the intermediate office to operate or for actuating said device to repeat a signal through said intermediate office to another office, the action of said device depending upon the connecting terminal to which the cord circuit is connected.

10. In a telephone exchange system, a plu-

rality of exchanges, a continuous line circuit connected to all of said exchanges, an impulse transmitting means at one of said exchanges associated with said line and responsive to the seizure of the line at said exchange for transmitting current over the line to signal an exchange, and means at said second exchange associated with said line to repeat a signal intended for another exchange over that portion of the line connecting said other exchange and the second exchange.

In witness whereof, I hereunto subscribe my name this 24th day of July A. D., 1922.

LANGFORD J. BOWNE.