

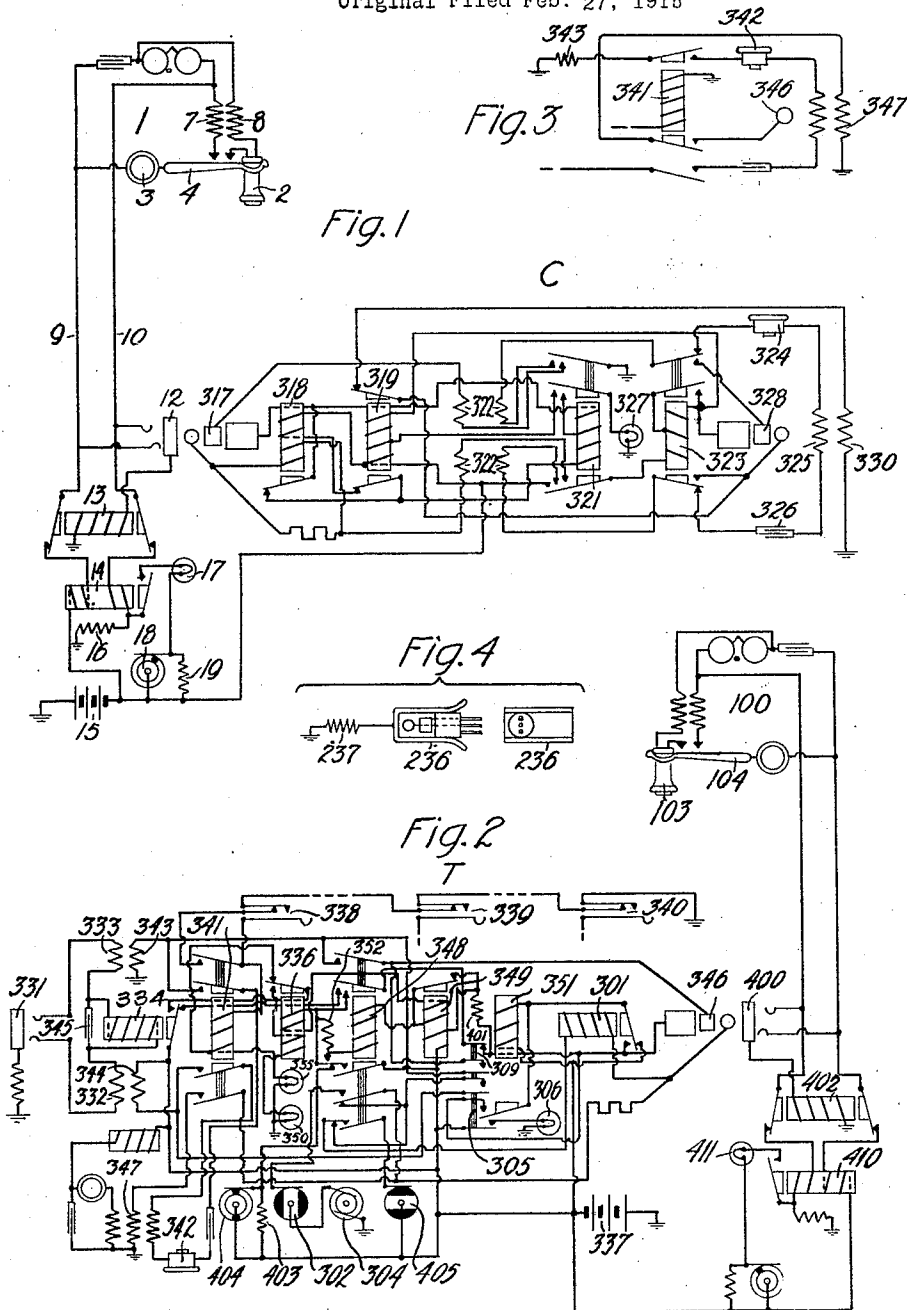
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TELEPHONE SYSTEM

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Inventor:
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TELEPHONE SYSTEM.

Original application filed February 27, 1915, Serial No. 11,046, now Patent No. 1,451,896, dated April 17, 1923. Divided and this application filed February 10, 1923. Serial No. 618,192.

To all whom it may concern:

Be it known that I, HUBERT S. TURNER, a citizen of the United States of America, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and more particularly to trunking systems or systems in which calls are extended from one operator's position to another operator's position and the connection completed through by a so-called B operator. This application is a division of application, Serial No. 11,046, filed February 27, 1915, Patent No. 1,451,896, April 17, 1923.

Heretofore, in extending a call over a trunk circuit, it has been the practice for an A operator to communicate the details of the call over an order wire to a B operator who then assigns a trunk to the A operator. The A operator then connects the calling subscriber to the assigned trunk by means of a link or cord circuit and the B operator connects the trunk to the line of the called subscriber. Such a procedure requires call-wire apparatus that is not actually in use during the conversation between calling and called subscribers.

It is therefore an object of this invention to minimize the time and apparatus employed in establishing connections by eliminating the use of call or order wire circuits.

In accordance with the present invention, the A operator, upon answering a call, plugs into the jack of an idle trunk, leading to a B operator's position. Means are provided at the B operator's position for connecting her telephone set to the trunk circuit taken for use by the A operator. The B operator then communicates over the trunk itself and ascertains the number of the line desired. The B operator thereupon associates the trunk with the line of the called subscriber whereupon her telephone set is automatically disconnected from the trunk circuit and ringing current is automatically applied to the called line to signal the called subscriber. The removal of the receiver from the switchhook at the called subscriber's station in response to the signal, automatically disconnects the ringing current source from the trunk circuit.

The invention will be readily understood

from the accompanying drawing in which Fig. 1 shows a calling subscriber's line and an A operator's cord circuit. Fig. 2 shows a trunk circuit adapted to function with the cord circuit shown in Fig. 1 and a called subscriber's line. Fig. 3 shows an alternative arrangement for connecting the operator's relay to effect the automatic connection of the operator's receiver to the trunk. Fig. 4 shows apparatus for disconnecting the operator's telephone set from a calling line previous to the connection being completed through to the called line.

In order that the invention will be more readily understood, a call will be traced over the cord circuit C and trunk circuit T from a calling subscriber's substation 1 to a called subscriber's substation 100.

The subscriber at substation 1 on initiating a call removes the receiver 2 from the switchhook 4 and in so doing establishes a circuit for line relay 14 which may be traced from grounded battery 15, left-hand winding of line relay 14, back contact and left-hand armature of cut-off relay 13, conductor 9, transmitter 3, switchhook 4, primary 7, conductor 10, right-hand armature and back contact of relay 13, right-hand winding of relay 14 to ground through the resistance element 16. The actuation of line relay 14 in this circuit effects the illumination of line lamp 17 in a circuit extending from grounded battery 15, brush and live segment of interrupter 18, filament of line lamp 17 front contact and armature of relay 14 to ground through the resistance element 16.

The interrupter 18 consists of a rotating metallic member with one or more insulating segments. In order that the current passing through resistance 16 from the line lamp 17, may be variable and not intermittent, a shunt circuit including resistance 19 is provided around the interrupter 18. By means of this shunt circuit, the current from grounded battery 15, which passes through the resistance 16 over the line circuit including the primary 7, is variable and sets up an alternating current in the secondary 8 which effects an audible signal in the telephone receiver 2 which is in circuit with the secondary 8. Upon hearing this signal, the calling subscriber is assured that the line signal associated with the substation 1 and located at the central office has functioned properly and that the line wires intercon-

necting the station and the central office are in proper working condition.

Having observed the displayed line signal 17, the A operator inserts answering plug 5 317 of the cord circuit C into jack 12 associated with the calling substation. The insertion of answering plug 317 in the answering jack 12 closes a circuit which may be traced as follows: from ground through the 10 cut-off relay 13, through the sleeve contacts of answering jack 12 and answering plug 317, armature and back contact of answering supervisory relay 318, lower armature and back contact of controlling relay 319, upper 15 winding of answering supervisory relay 318 to ground, through the battery 15. The current flowing in this circuit actuates the cut-off relay 13 and the answering supervisory relay 318. The cut-off relay 13 in operating 20 disconnects the line relay 14 from the line conductors of substation 1, whereupon this relay becomes deenergized and line lamp 17 extinguished. The deenergization of line relay 14 also stops the audible signal from 25 sounding in the calling subscriber's receiver 2 so that the subscriber knows that the A operator has received the signal and has connected a cord circuit with the terminals of the substation line. Relay 318 in operating 30 opens the circuit previously traced through its armature and back contact and allows the current to flow through the winding of connecting relay 321 which had heretofore been short-circuited by the engagement 35 of the armature of answering relay 318 with its normal contact. Connecting relay 321 is actuated by this current and the engagement of the uppermost armature with its front contacts connects the upper windings of repeating coil 322 to ground, whereas 40 the lower windings are connected to the live pole of grounded battery 15 by the connection of the left-hand contact of the bottom armature of relay 321 to the other two contacts thereof. The lowermost one of the 45 two top armatures of relay 321 first engages its right-hand contact and then its left-hand contact, this engagement taking place after the other two armatures have engaged their respective contacts. By this engagement, 50 a shunt circuit is closed around the lower part of the winding of connecting relay 321 which may be traced from the central terminal of this winding through the connected contacts of the lowermost one of the two top armatures of said relay and the 55 lower part of the winding of controlling relay 319 to the live pole of battery 15. The controlling relay 319 is actuated by the current so allowed to pass through the lower 60 part of its winding and the disengagement of its bottom armature from its normal contact opens the circuit through the upper winding of answering supervisory relay 318 65 and the lower part of the winding of con-

necting relay 321. The answering supervisory relay 318 is not deenergized since current is now flowing through its lower winding over a circuit which may be traced 70 from ground, through the uppermost armature and right-hand front contact of connecting relay 321, left-hand winding of repeating coil 322, ring contacts of answering plug 317 and jack 12 through the calling 75 substation loop and apparatus, tip contact of jack 12 and plug 317, lower winding of answering supervisory relay 318, lower left-hand winding of repeating coil 322, right and left-hand contacts of the bottom armature of connecting relay 321 to ground 80 through battery 15. The connecting relay 321 also remains energized owing to the current passing through the upper part of its winding.

The A operator and the calling party can 85 now converse as the operator's telephone receiver 324 is connected to the right-hand windings of repeating coil 322. A talking circuit for the receiver 324 may be traced as follows: from ground, through the up- 90 permost armature and left-hand front contact of connecting relay 321, upper right-hand winding of repeating coil 322, uppermost armature and back contact of operator's relay 323, receiver 324, secondary of 95 the operator's induction coil 325, condenser 326, back contact and lower armature of operator's relay 323, lower right-hand winding of repeating coil 322, middle and left-hand front contacts and lower armature 100 of connecting relay 321 to ground through battery 15. The primary of the operator's induction coil and the operator's transmitter are not shown since their relation to the secondary 325 is well known in 105 the art.

Relay 321, in attracting its lowermost top armature, closes a circuit which may be traced from ground, through supervisory 110 lamp 327, lowermost top armature and left-hand front contact of relay 321, lower part of the winding of controlling relay 319 to ground through battery 15. The super- 115 visory lamp or signal 327 is energized by the current flowing in this circuit and indicates that the calling party has not replaced the telephone substation receiver upon the switchhook and is still awaiting the estab- 120 lishment of the connection.

The A operator then converses with the 125 calling subscriber to ascertain the nature of the call. Upon learning that the subscriber at substation 100 is desired, the A operator inserts plug 328 of her cord circuit C into 130 jack 331 of an idle trunk circuit which terminates at a B operator's position from which the line of the called party is directly accessible.

When the operator inserts calling plug 328 into jack 331, a circuit is closed which 135

may be traced from ground, sleeve contact of jack 331 through the sleeve contact of calling plug 328, winding of operator's relay 323, bottom armature and left-hand front contact of connecting relay 321 to ground through battery 15. The operator's relay 323 is actuated by the current flowing in this circuit and the disengagement from its normal contacts and engagement with its alternate contacts of the uppermost one of the two top and bottom armatures disconnect the operator's telephone receiver from the right-hand windings of repeating coil 322 and connect the latter to the tip and ring contacts of calling plug 328. If desired the operator's relay 321 may be made slow-to-release so as to delay the disconnection of the A operator's telephone set. Therefore, when the proper connection has been completed at the B operator's position, the calling and called subscribers will be telephonically connected.

Engagement with its contact of the lowermost one of the two top armatures of the operator's relay 323 short-circuits the upper portion of the winding of this relay, the purpose of which is to prevent an accidental or deliberate connection to a busy trunk line as no connection is made to the tip and ring contacts of calling plug 328 until the operator's relay 323 has been fully actuated. When the calling plug 328 was inserted into the trunk jack 331 if another calling plug was connected to a multiple trunk jack of the same trunk line and connecting relay 321 associated with the second mentioned calling plug had not been de-energized, then the current from the grounded resistance connected to the sleeve contacts of the multiple trunk jacks would have two paths, one through the operator's relay 323, associated with the second-mentioned calling plug, which would have the upper portion of its winding short-circuited, as described, and the other through the same relay associated with the first-mentioned calling plug. As the latter path would be of a higher resistance than the former, it would not receive sufficient current to operate, as the operator's relay 323 needs all the current that can flow from the sleeves of the trunk jacks in order to fully actuate it. The same result may be obtained without providing for the short-circuited portion of the winding but it is found in practice that the control of the actuation of the relay is made more reliable by using the short-circuited winding. The same thing applies to the control of all other relays described in this specification, the windings of which need all the current that can flow through the sleeves of the respective jacks in order to accomplish their complete actuation.

If this automatic prevention of a connec-

tion to a busy trunk line is not desired then the lowermost of the two top armatures of operator's relay 323 and its associated contact can be eliminated as can the alternate contacts of the other two armatures, the tip and ring contacts of calling plug 328 being connected directly to the top and bottom armatures.

The connection of a busy line to the operator's telephone set or to the left-hand windings of repeating coil 322 is prevented by similar means associated with the connecting relay 321. When the answering plug is inserted in a jack if there is a divided path for the current flowing through the cut-off relay, the complete winding of connecting relay 321 does not receive sufficient current to cause any of its armatures to engage their respective contacts due to the low resistance path offered by the upper portion of the winding of the relay which is connected to battery at the link connector already engaged with the busy line.

The insertion of plug 328 into jack 331 causes relay 334 to energize in a circuit traced from grounded battery 15, lowermost armature and left-hand front contact of relay 321, middle lower front contact of relay 321, lower right-hand winding of repeating coil 322, lower armature and front contact of relay 323, tip contacts of plug 328 and jack 331, lower left-hand winding 332 of the repeating coil, winding of relay 334, upper left-hand winding 333, ring contacts of jack 331 and plug 328, front contact and uppermost armature of relay 323, upper right-hand winding of repeating coil 322 to ground over the right-hand front contact and uppermost armature of relay 321. Relay 334 in operating establishes a circuit which may be traced from grounded battery 337, armature and front contact of relay 334, armature and back contact of relay 336, lamp 335 to ground. The lamp 335 located at the B operator's position is energized in this circuit.

On noting the illumination of lamp 335, the B operator realizes that there is a call awaiting her attention and actuates the connecting key 338 which is individual to the trunk circuit with which the lamp 335 is associated. Each trunk at the B operator's position has a connecting key similar to the key 338, the keys 339 and 340 being associated with other trunk circuits, not shown. The keys 338, 339, and 340 are connected up in series as shown, the spring contact of the last key 340 being connected to ground. By the use of this key arrangement, it is impossible for an operator's telephone set to be connected with more than one trunk circuit at a time, the trunk circuit in use always being represented by the depressed key.

When the connecting key 338 is actuated, a circuit is closed which may be traced as

follows: from ground, through the top springs and normal contacts of connecting keys 340 and 339, top spring and alternate contact of key 338, winding of operator's relay 341, back contact and armature of release relay 336, front contact and armature of relay 334 to ground through battery 337. Relay 341 operates in this circuit and at its uppermost armature and front contact establishes a locking circuit for itself which becomes effective upon the release of the connecting key 338. In this manner, the operation of relay 341 is made independent of the actuated condition of the key 338 so that when the operator releases this key, the relay 341 remains energized. At its inner, upper and lower armatures and front contacts, relay 341 connects the operator's telephone set 342 to the windings 343 and 344 of the repeating coil. The B operator is now in a position to converse with the calling party. The condenser 345 bridges the winding of relay 334 in order to permit the passage of voice currents.

Where more than one connection at a time is not made to any B operator the connecting keys 338, 339, etc., can be eliminated and the upper terminal of the winding of the operator's relay 341 connected direct to ground as shown in Fig. 3. In this case, the operator's telephone set 342 would be automatically connected to the calling line whenever a calling plug such as 328 was inserted in the trunk jack 331. If a second call needed to be answered before completing through a first call, trunk plug 346 would be inserted in a device shown in Fig. 4. The disconnecter or spring clip 236 is so arranged that it engages only the sleeve contact of the inserted plug so that when the ringing relay of the associated link connector is actuated due to current allowed to pass therethrough over the grounded spring clip 236 and resistance 237, there is no circuit for ringing current from the tip and ring contacts of the calling plug. As the actuation of the ringing relay causes the actuation of the controlling relay and the operation of the latter effects the deenergization of the operator's relay which disconnects the operator's telephone set from the associated link connector as long as the calling plug remains engaged with the spring clip 236, the operator is free to connect another answering plug to a calling line. When a call over the first line can be completed, the calling plug is removed from the spring clip 236 and inserted in a multiple jack in the usual manner.

The engagement with its contact of the lowermost one of the two bottom armatures of operator's relay 341 connects the tip contact of trunk plug 346 to the special primary 347 of the operator's induction coil, thereby furnishing a means for making the necessary

busy tests. This connection can be made to winding 343 of the repeating coil instead of primary 347, if desired.

The B operator learns from the calling subscriber that the subscriber at station 100 is desired and she proceeds to test the called line.

In testing the line the tip of plug 346 is applied to the sleeve of jack 400 and if there is no calling plug connected to a multiple jack associated with the line, then the sleeve of the tested jack would be at the potential of the earth and primary 347 of the operator's induction coil would not be energized. Consequently no audible signal would be produced in the operator's receiver 342. If a calling plug was so connected to the tested line, both relays 348 and 351 would be deenergized as will hereinafter be pointed out so that the sleeve of the tested jack would be at a potential higher than that of the earth, due to current flowing from grounded battery 337, lower winding of relay 349, resistance 401, to the sleeve of the jack already connected to the line, which current passes through primary 347 and produces a distinctive sound in the operator's receiver 342, notifying her of the busy condition of the line.

Having tested and found the line idle the B operator proceeds to complete the connection by inserting plug 346 into jack 400, whereupon a circuit is established which may be traced from ground, winding of cut-off relay 402, sleeve contacts of jack 400 and plug 346, resistance 401, back contact and armature of relay 349, winding of trunk ringing relay 348, resistance 352, uppermost lower normal contact of relay 348, interrupter 404, to ground through battery 337. It is to be noted that a branch circuit in bridge of part of the circuit just traced extends from the upper terminal of the resistance element 401 through the upper windings of controlling relay 349 and release relay 336 as soon as relay 348 operates. Release relay 336 being energized by the current flowing through this circuit opens the circuit through the operator's relay 341 which thereupon breaks the connection of the operator's telephone set with the repeating coil and that of the tip contact of trunk plug 346 with the special primary 347. If it is desirable to delay the disconnection of the B operator's telephone set from the trunk circuit this may be effected by making relays 348 and 336 slow operating and operator's relay 341 slow to release, though it may be more practical to omit the slow acting feature from relay 348 since on its operation depends the application of ringing current to the called line. The trunk line lamp or signal 335 is also deenergized. Relay 336 in attracting its armature closes a circuit which may be

traced as follows: from ground through the trunk supervisory lamp 350, lower winding of release relay 336, front contact and armature of relay 336, front contact and armature of trunk relay 334 to ground through battery 337. The trunk supervisory lamp 350 is energized by the current flowing in this circuit and is a substitute for the supervisory lamp 335 and indicates that the calling party has not replaced the substation telephone receiver upon its switchhook and is still awaiting the completion of the connection. The release relay 336 remains energized when the circuit through its upper winding is broken owing to the fact that sufficient current flows through its lower winding. It is, therefore, evident that the operator's telephone set cannot be connected to the repeating coil nor can a trunk line lamp be energized until the trunk relay 334 has been deenergized which does not take place until the calling party replaces the substation telephone receiver upon its switchhook.

The operation of relay 348 in the circuit previously traced establishes a circuit which may be traced from ground through the ringing generator 304, interrupter 302, lower middle front contact and armature of relay 348, tip contact of plug 346 and jack 400, ringing apparatus at substation 100, ring contacts of jack 400 and plug 346, uppermost armature and front contact of relay 348 to ground through the winding 343 of the repeating coil. Intermittent battery is also impressed on the line through the winding of trunk supervisory relay 301 from battery interrupter 405.

The return path for the ringing current just traced traverses the winding 343 of the trunk repeating coil so that the inductive effect of this winding causes an audible signal in the receiver of the calling party's telephone receiver to notify the subscriber thereof that the called party is being signaled.

When the called party responds to the calling signal by removing the receiver 103 from the switchhook 104, a circuit is established so that the rapid intermittent direct current sent through the calling supervisory relay 301 by the interrupter 405 is sufficient to cause the energization of this relay and an engagement of its armature with its alternate contact closes a circuit which may be traced as follows: from ground through the winding of cut-off relay 402, sleeve contacts of jack 400 and plug 346, front contact and armature of calling supervisory relay 301, winding of calling relay 351 to ground through battery 337.

Relay 351 energizes in the circuit just traced and in attracting its armature causes the movement of spring switch 305 which in turn causes the lowermost one of the vari-

ous spring switches to close a circuit from grounded battery 337, through the supervisory lamp or signal 306, the illumination of which indicates to the operator that the trunk link connector is being used for conversational purposes.

The energization of trunk calling relay 351 causes the opening of the circuit through the upper winding of trunk controlling relay 349 and trunk ringing relay 348, the former remaining energized due to the current flowing in its lower winding and the latter being deenergized. The return to normal condition of the two bottom armatures of relay 348 disconnects the ringing current from the tip contact of trunk plug 346 and connects said contact to winding 344 of the repeating coil through the spring contact already made by the actuation of trunk calling relay 351. As the winding of trunk relay 334 is bridged by condenser 345 and as the tip and ring contacts of trunk jack 331 are connected to windings 332 and 333 of the repeating coil and the tip and ring contacts of trunk plug 346 are connected to windings 344 and 343 of the same repeating coil, conversation can take place between the calling and called substations.

When the called substation telephone receiver is replaced upon its switchhook at the conclusion of the conversation, the winding of trunk calling relay 351 is short-circuited by the engagement of the armature of trunk supervisory relay 301 with its normal contact due to the deenergization of this relay. The consequent deenergization of the trunk calling relay 351 interrupts the energizing circuit for the trunk supervisory lamp 306, whereupon this lamp is extinguished notifying the B operator that the conversation has ceased and she proceeds to take down the connection by removing plug 346 from jack 400. All the apparatus depending upon the connection of plug 346 with jack 400 is thereupon released. It should be noted that when the called subscriber replaces the receiver on the switchhook, relay 351 becomes deenergized and opens the circuit to ground from windings 343 and 344 of the repeating coil, therefore the tip and ring contacts of calling plug 346 are disconnected from any source of current and cannot be again connected thereto until plug 346 has first been removed from jack 400. However, the circuit hereinbefore traced through cut off relay 402 and the lower winding of controlling relay 349 is still maintained. As the lower winding of controlling relay 349 is of an extremely low resistance the current allowed to pass through it is not sufficient to maintain cut-off relay 402 energized, whereupon this relay releases its armature, restoring the line relay 410 and the line lamp 411 to normal and the busy condition of the line is removed

independent of the removal of plug 346 from jack 400.

As trunk calling relay 349 remains actuated, the continued disengagement of its lower armature from its normal contact prevents the connection of the tip contact of trunk plug 346 to the busy test primary 347 of the operator's induction coil and the same disengagement of its top armature prevents the trunk ringing relay 348 from again being actuated.

When the calling party at substation 1 replaces the receiver 2 on the switchhook 4, the circuit is opened through the lower winding of answering supervisory relay 318 and its armature engages its normal contact, the current from the live pole battery 15, flowing through the lower part of the winding of the controlling relay 319 and the two engaged contacts of the lowermost one of the two top armatures of connecting relay 321, now has two paths offered to it one through the upper portion of the winding of the relay 321 and one through the lower portion thereof. Both paths lead to ground through the sleeve contact of the answering plug 317. As these two windings are in opposition to each other, connecting relay 321 is deenergized, whereupon the circuit for the lamp 327 is opened. The lamp 327 becomes extinguished notifying the A operator that conversation has ceased and she proceeds to take down the connection set up by her by removing the plug 317 from the jack 12. The removal 317 from jack 12 restores the remaining apparatus to normal.

If, for any reason the calling subscriber should desire that the B operator re-ring the called party and flashes the receiver hook the first opening of the line circuit restores the line lamp 17 to normal and upon the subsequent closure of the line loop caused by the release of the switchhook, the line lamp 17 would relight, notifying the A operator that her attention is desired by the calling subscriber. On learning of the calling subscriber's desire, the A operator removes plug 328 from jack 331, and then reinserts it. This operation by the A operator causes the release of relay 334 which effects a subsequent release of relay 336. Relay 336, in releasing, prepares a circuit for relay 341 which is completed upon the reinsertion by the A operator of plug 328 into jack 331 so that relay 341 operates and reconnects the B operator's telephone set and the ringing current supply to the called line. It is obvious from the foregoing description that the A operator alone is capable of reconnecting the B

operator's telephone set to the trunk circuit. What is claimed is:

1. In a telephone system, subscribers' lines, a first and second link circuit for interconnecting said lines, an operator's telephone set associated with each of said link circuits, means responsive to the connection of said first link circuit with one of said lines for automatically connecting the operator's telephone set associated therewith with the first link circuit, means associated with said second link circuit for connecting therewith the associated operator's telephone set, a source of signaling current, and means responsive to the connection of said second link circuit with another of said lines for disconnecting the operator's telephone set from said second link circuit and connecting said current source thereto.

2. In a telephone system, subscribers' lines, an A operator's position, a B operator's position, a first and second link circuit for interconnecting said positions and said lines, an operator's telephone set for each link circuit located at each of said positions, means responsive to the connection of said first link circuit with one of said lines for automatically connecting the A operator's telephone set with the first link circuit, means associated with the second link circuit for connecting the B operator's telephone set with the second link circuit, means responsive to the connection of said second link circuit with another of said lines for disconnecting the B operator's telephone set from said second link circuit, and means controlled from the A operator's position for reconnecting the B operator's telephone set to said second link circuit.

3. In a telephone system, a calling line, called lines, a cord circuit, a trunk circuit, an operator's telephone set for said trunk circuit, means for automatically connecting the telephone set to the trunk circuit controlled by the connection of the cord circuit to the trunk circuit, means for automatically disconnecting the telephone set from the trunk circuit controlled by the connection of the trunk circuit to a called line, means for reconnecting the telephone set to the trunk circuit controlled by the disconnection and reconnection of the cord circuit to the trunk circuit while the trunk circuit is still connected to the said called line.

In witness whereof, I hereunto subscribe my name this 31st day of January A. D., 1923.

HUBERT S. TURNER.