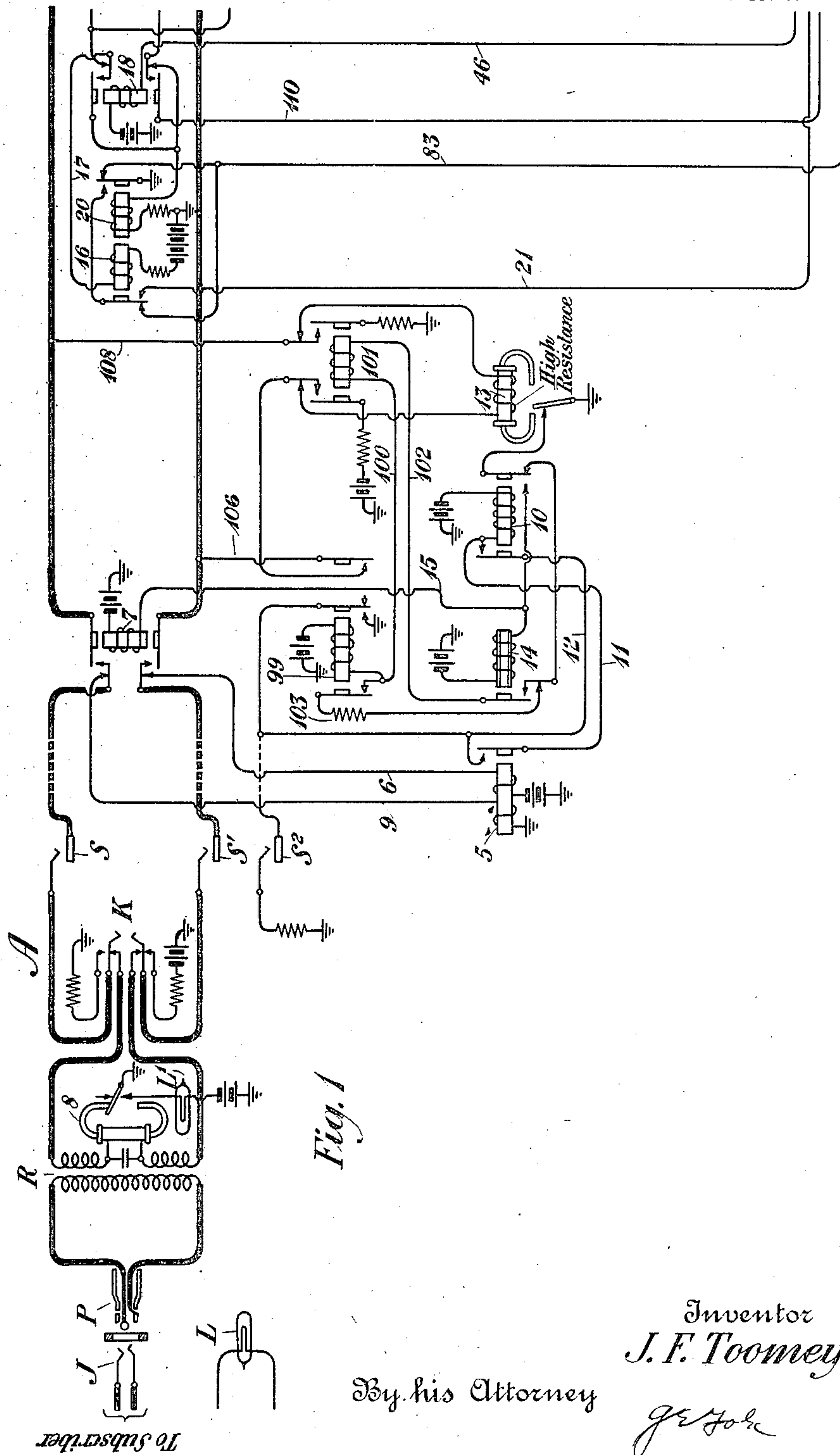


1,431,195.

J. F. TOOMEY.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED MAY 26, 1921.

Patented Oct. 10, 1922.

3 SHEETS-SHEET 1.



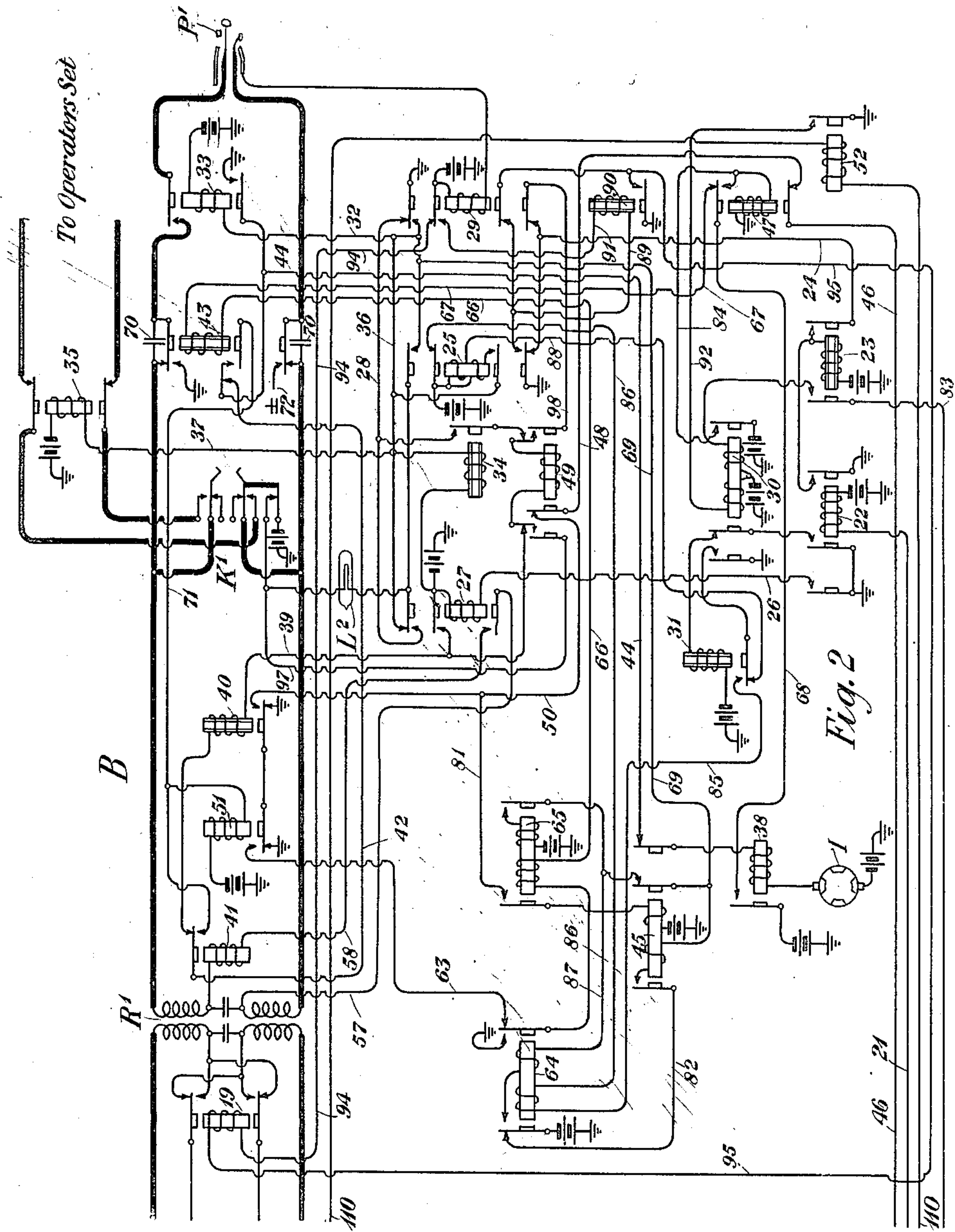
Inventor
J. F. Toomey

By his Attorney

J. F. Toomey

1,431,195.

Patented Oct. 10, 1922.
 3 SHEETS—SHEET 2.



Inventor
 J. F. Toomey

By his Attorney

g. e. h. o. l. e.

1,431,195.

Patented Oct. 10, 1922.

3 SHEETS—SHEET 3.

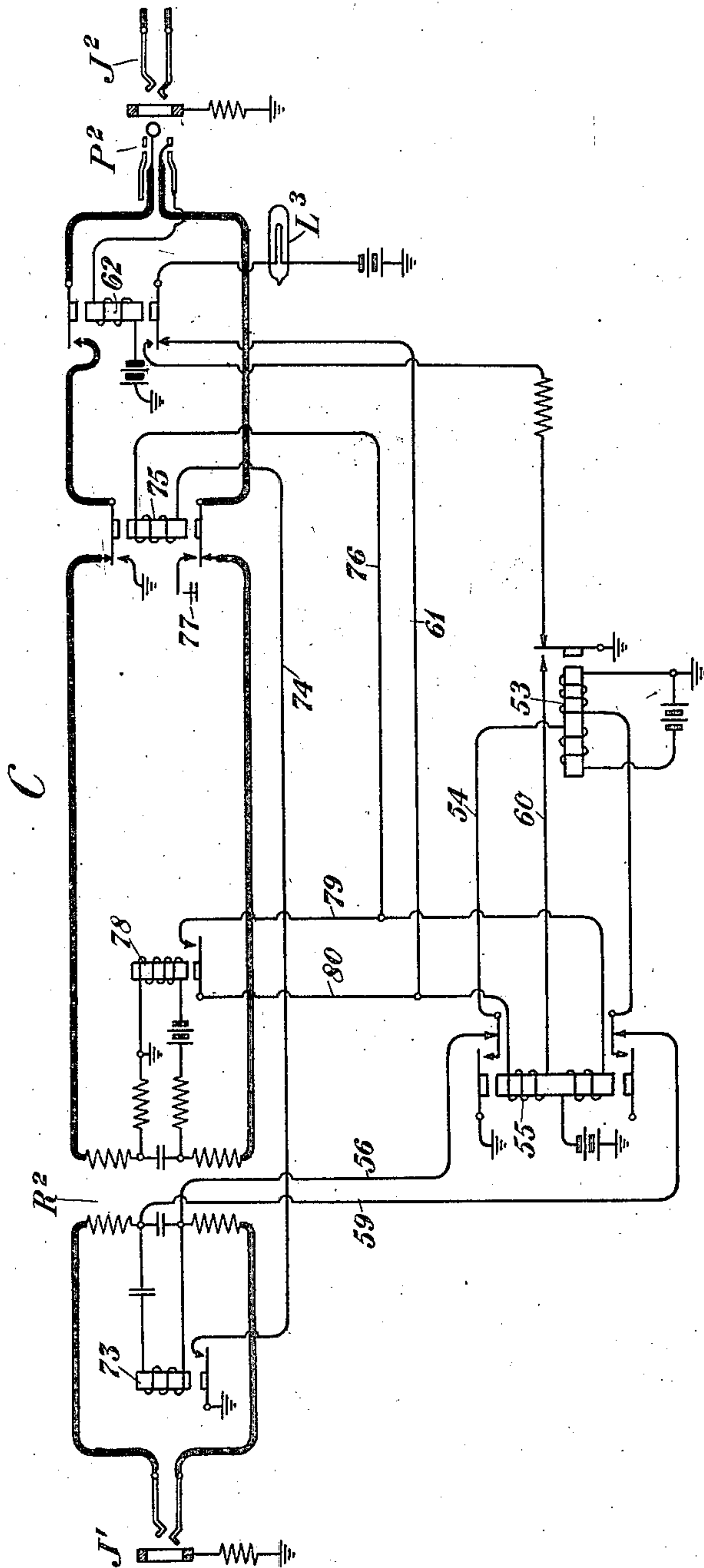


Fig. 3

Inventor
J. F. Toomey

By his Attorney

g r y o l e

Patented Oct. 10, 1922.

1,431,195

UNITED STATES PATENT OFFICE.

JOHN F. TOOMEY, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

Application filed May 26, 1921. Serial No. 472,723.

To all whom it may concern:

Be it known that I, JOHN F. TOOMEY, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Telephone-Exchange Systems, of which the following is a specification.

This invention relates to telephone systems, and more particularly to the establishment of connections in such systems between subscribers whose lines terminate at different offices.

One of the objects of the invention is to provide an arrangement for signaling a called subscriber as soon as a connection is completed with the subscriber's line.

Another object is to provide an arrangement for dissociating a telephone set of an operator from an interconnecting trunk when that trunk is connected with a line in the course of the establishment of a call, thus preventing the operator from cutting in on a working connection and thereby eliminating resulting transmission losses.

A further object is to provide a circuit arrangement whereby the originating end of a connection is maintained in a "busy" condition until the apparatus of the entire connection has been restored to normal.

These objects, as well as other objects of the invention, may be attained by means of the apparatus set forth in the attached drawings, in Figures 1, 2 and 3, of which are illustrated circuit diagrams of one embodiment of the invention.

Referring to drawing, A represents a cord or link circuit of the automatic switching type, terminating at one end in plug P, which is adapted to be connected through intermediate apparatus with a jack J leading to a subscriber's station. The other end of the cord terminates in the usual automatic switching arrangement illustrated by terminals S, S¹ and S² which are connected with an interconnecting trunk B. The trunk B terminates in plug P¹ which is adapted to be associated with jack J¹ of a switching trunk or other link circuit C, and this latter trunk terminates in plug P² which is adapted to be connected with J², which leads to a subscriber's station. Cord A, and trunks B and C are provided with the ordinary type of repeating coils R, R¹ and R², respectively. Key K is provided in cord A for the purpose of flashing the operator at trunk B. At

trunk B is provided a listening key K¹ and also apparatus I for intermittently operating electromechanisms whereby signaling current is transmitted to trunk C from which it is relayed to a called subscriber's station.

Further details of the circuits and apparatus will now be apparent from the following description of their operation.

In response to a call from a subscriber whose line terminates in jack J, as will be indicated by the lighting of lamp L, plug P of cord A will be inserted in said jack and lamp L extinguished in the customary manner. The operator at A upon ascertaining the wanted number, will operate the apparatus controlling the terminals S, S¹ and S² to the desired points in a well understood manner, thereby closing the following circuit: from battery, right hand winding of relay 5, conductor 6, lower normal contact of relay 7, ring contact of terminal S¹, lower normal contact of key K, through repeating coil R, including winding of polar relay 8, upper normal contact of key K, tip contact of terminal S, upper normal contact of relay 7, conductor 9, left hand winding of relay 5 to ground. This circuit causes the operation of relay 5, which closes a circuit through its contact from battery, winding of relay 10, conductor 11, sleeve contact of terminal S² to ground. This circuit energizes relay 10, which upon operating closes a locking circuit through its winding and left hand contact from battery, conductor 12, sleeve contact of terminal S² to ground. The operation of relay 10 also closes a circuit from ground, normal contact of polar relay 13, right hand front contact of relay 10, winding of slow release relay 14 to battery, thereby energizing the latter relay. The operation of relay 10 also closes a circuit from ground, normal contact of relay 13, right hand front contact of relay 10, conductor 15, winding of relay 7 to battery. This circuit causes the operation of relay 7, which connects the tip and ring conductors of the trunk B to like conductors of cord A. The operation of relay 7 breaks the circuit previously described whereby relay 5 was energized and said relay releases. Relay 10, however, is maintained energized by the locking circuit above outlined, and relay 14 which is controlled by relay 10 is also kept energized. The previously

mentioned relays however, perform no useful function at this time. The operation of relay 7 closes the following circuit: from battery, winding of relay 16, conductor 17, upper normal contact of relay 18, upper back contact of relay 19, lower left hand winding of repeating coil R^1 , ring conductor of trunk B, lower closed contact of relay 7, ring contact of terminal S^1 , lower normal contact of key K, lower right hand winding of repeating coil R, winding of polar relay 8, upper right hand winding of repeating coil R, upper normal contact of key K, tip contact of terminal S, upper closed contact of relay 7, tip conductor of trunk B, upper left hand winding of repeating coil R^1 , lower back contact of relays 19 and 18, respectively, winding of relay 20 to ground. This circuit operates relays 16 and 20 and also polar relay 8. The operation of polar relay 8 causes lamp L^1 to light. The operation of the relay 20 closes a circuit through its front contact from ground, closed contact of relay 16, conductor 21, winding of relay 22, to battery, thereby energizing the latter relay. The operation of relay 22 will close a circuit through its right hand contact from ground, winding of relay 23 to battery. This circuit will cause relay 23 to operate and close a locking circuit through its winding and contact from battery, conductor 24, lower back contact of relay 25 to ground. The operation of relay 22 will also close a circuit through its outer left hand contact from ground, conductor 26, winding of relay 27 to battery, thereby operating the latter relay and causing the lighting of guard lamp L^2 by a circuit from battery, lower closed contact of key K^1 , through the filament of said lamp, upper closed contact of relay 27, conductor 28, uppermost normal contact of relay 29 to ground. The operation of relay 22 will also close a circuit through its middle make contact from ground, left hand inner contact of relay 30, winding of relay 31 to battery, thereby operating the latter relay.

In response to the lighting of lamp L^2 , the operator at B will operate key K^1 , thereby temporarily extinguishing said lamp in an obvious manner. The operation of key K^1 will connect the operator's set with the tip and ring or talking conductors of trunk B and cord A in the usual way and allow the operator at B to receive the number of the wanted subscriber from the operator at A. The operator at B, after operating key K^1 and ascertaining that the call is for a subscriber whose line terminates at an office switchboard, as, for instance, in jack J^2 , goes in on a call circuit in the customary manner and receives a trunk assignment such as C, which terminates in jack J^1 , and thereupon inserts plug P^1 in said jack, which closes the following circuit:

from battery, winding of relay 29, sleeve contacts of plug P^1 and jack J^1 to ground. The closing of this circuit causes relay 29 to operate, which breaks the circuit through its uppermost contact, previously described in connection with the lighting of lamp L^2 and permanently extinguishes said lamp. The operation of relay 29 also closes a circuit from ground through its upper make contact, conductor 32, winding of relay 33, to battery. This circuit causes relay 33 to operate and connect the tip conductor of trunk B with the tip conductor of trunk C. The operation of relay 29 also causes relays 34 and 35 to operate, relay 34 being energized by a circuit from ground, upper make contact of relay 29, conductor 36, winding of relay 34 to battery, while relay 35 is energized by a circuit from ground, upper make contact of relay 29, conductors 36 and 37, winding of relay 35 to battery. Relay 34 upon operating performs no useful function at this time. The operation of relay 35 cuts off the operator's telephone set from the talking conductors, so that she is unable to cut in on the connection. Relay 38 is now operated intermittently over the following circuit: from battery, interrupter I, winding of relay 38, right hand outer contact of relay 45, conductor 44 to ground, through the lower closed armature of relay 33. Relay 40 is also operated at this time by a circuit from battery, upper inner contact of relay 27, conductor 39, winding of relay 40, back contact of relay 41, conductor 42, lower inner contact of relay 43, lower make contact of relay 33 to ground. The operation of relay 40 closes the following circuit by which relay 18 is energized: from battery, winding of relay 18, conductor 46, lower back contact of relay 47, conductor 48, inner left hand contact of relay 49, conductor 50, closed contact of relay 40, normal contact of relay 51 to ground. The operation of relay 18 breaks the circuit previously described over the tip and ring conductors of trunk B and cord A, thereby deenergizing polar relay 8 of said cord and extinguishing lamp L^1 . Relays 16 and 20, however, are maintained operated by a circuit from battery, winding of relay 16, conductor 17, upper make contact of relay 18, winding of relay 20 to ground. The energization of relay 18 bridges relay 52 across the line, but this relay does not operate at this time.

The insertion of plug P^1 in jack J^1 closes the following circuit: from battery, left hand winding of relay 53 of trunk C, conductor 54, upper normal contact of relay 55, conductor 56, ring contacts of jack J^1 and plug P^1 , lower normal contact of relay 43, ring conductor of trunk B, lower right hand winding of repeating coil R^1 , conductor 57, lower closed contact of relay 27, conductor 58, winding of relay 41, upper right hand

winding of repeating coil R^1 , tip conductor of trunk B, upper contact of relay 43, tip contacts of plug P^1 and jack J^1 , conductor 59, right hand winding of relay 53 to ground. This circuit causes the energization of relay 53 in trunk C. The operation of relay 53 closes a circuit through its make contact from ground, conductor 60, upper winding of relay 55, conductor 61, lower contact of relay 62, filament of lamp L^3 to battery. The closing of this circuit causes the operation of relay 55 and the lighting of lamp L^3 . The operation of relay 55 breaks the circuit just described whereby relay 53 was operated, but this relay is maintained energized by a circuit through the upper contact of relay 55, from ground, conductor 54, left hand winding of relay 53 to battery. The operator at C now inserts plug P^2 in jack J^2 , to which the subscriber's line is connected, and closes the following circuit: from ground, over the sleeve contacts of said plug and jack, winding of relay 62, to battery, thereby energizing relay 62, which upon operating connects through its upper contact the tip conductors of trunk C and through its lower contact breaks the lamp circuit just referred to, thereby releasing relay 55 and extinguishing lamp L^3 .

The release of relay 55 re-establishes the circuit for operating relay 53 in series with relay 41 of trunk B. The operation of relay 41 of trunk B causes the energization of relay 51 by closing the following circuit: from battery, winding of relay 51, make contact of relay 41, conductor 42, inner normal contact of relay 43, closed contact of relay 33 to ground. The operation of relay 41 also breaks the circuit through its back contact, formerly described in connection with the operation of relay 40, which causes the latter relay to release, and relay 18 also releases, owing to the opening of its circuit upon the deenergization of relay 40. Battery and ground are now connected to trunk B and cord A through the windings of relays 16 and 20 and including winding of polar relay 8 of said cord, causing said polar relay to operate and light lamp L^1 as a ringing signal for the operator at cord A. The operation of relay 51 closes a circuit from ground, normal contact of relay 40, make contact of relay 51, conductor 63, right hand normal contact of relay 64, left hand winding of relay 65, conductor 66, winding of relay 43, conductor 67, upper back contact of relay 47, conductor 68, closed contact of relay 38 to battery. The closing of this circuit operates relays 65 and 43. The operation of relay 65 closes a locking circuit through its winding and right hand contact from battery, inner right hand contact of relay 45, conductor 69, upper closed contact of relay 29 to ground.

Relay 43 will be operated intermittently under control of relay 38 and will ring the called subscriber as will later appear and at the same time an audible signal will be sent to the operator at A, through condensers 70, 70 over the tip and ring conductors of trunk B. Relay 51 will be maintained energized during the intermittent action of relay 43, over the circuit through the inner normal contact of relay 43, previously outlined, or over a circuit from battery through winding of relay 51, conductor 71, inner make contact of relay 43, lower closed contact of relay 33 to ground. The intermittent operation of relay 43 will intermittently transmit ringing current from source 72 over the tip and ring conductors of trunks B and C in a well-known manner, thereby intermittently operating relay 73 of trunk C. The operation and release of relay 73 will intermittently close a circuit through its contact from ground, conductor 74, winding of relay 75, conductor 76, lower winding of relay 55 to battery. This circuit will cause the intermittent energization of relays 75 and 55. The operation of relay 75 will transmit ringing current from source 77 over the tip and ring conductors in trunk C and signal the subscriber, who is connected with jack J^2 , in the customary manner. The operation of relay 55 disconnects relay 53 from the tip and ring of the line and holds it operated. The subscriber, in response to the signal, will remove the receiver from its hook and thereby close the following circuit: from battery and ground, through winding of relay 78, tip and ring conductors of trunk C, tip and ring contacts of plug P^2 and jack J^2 over the subscriber's line in a well-understood manner. The closing of this circuit will energize relay 78 which, upon operating will also close a circuit from battery, lower winding of relay 55, conductors 79 and 80, including contact of relay 78, upper winding of relay 55, conductor 60, front contact of relay 53 to ground. Relay 55 will again be operated upon the closing of this circuit and open the circuit formerly described in connection with the energization of relay 41 of trunk B causing it to release. The release of relay 41 breaks by way of its front contact the circuits whereby relay 51 was energized, causing it to release. The release of relay 51 opens the circuit whereby relay 43 was energized and causes this relay to release and in turn cause the release of relays 73 and 75 and permanently cut off ringing current. The release of relay 41 causes relay 40 to again operate over the circuit previously traced. The operation of relay 40 closes a circuit from ground, back contact of relay 51, closed contact of relay 40, conductors 50 and 81, left hand closed contact of relay 65, right hand winding of relay 45 to battery. The

closing of this circuit energizes relay 45 which, upon operating, closes a locking circuit from battery, left hand back contact of relay 64, conductor 82, left hand contact and winding of relay 45, conductor 69, upper closed contact of relay 29 to ground. The operation of relay 45 breaks at its inner right hand contact the locking circuit previously described whereby relay 65 was maintained energized, and causes this relay to release, and it also breaks at its outer right hand contact the circuit whereby relay 38 was intermittently energized under control of interrupter I. The operation of relay 40 also causes relay 18 to again operate over the previously traced circuit and cut off battery from the trunk, as formerly indicated, and extinguish lamp L^1 of cord A. A through connection is now established between the calling and called subscriber.

Should the called subscriber at this time move the receiver hook up and down, the circuit described for energizing relay 78 of trunk C will be opened and closed intermittently, causing said relay to operate intermittently, and it, in turn, will operate and release relay 55 of trunk C. The operation and release of relay 55 will cause relay 41 of trunk B to operate intermittently. Relay 51, which is controlled by relay 41, will be also operated and released, as well as relay 18, and this latter relay will cause the intermittent energization of polar relay 8 and the flashing of lamp L^1 of cord A over a circuit previously outlined. The operator at A in response to the flashing of said lamp will connect her telephone set (not shown) with the cord and communicate with the called subscriber.

If the originating operator at A desires to re-ring the called subscriber, flashing key K will be operated and a circuit will be established from battery and ground over the upper and lower make contacts of key K, respectively, tip and ring conductors of trunk B, normal contacts of relays 19 and 18, windings of relays 16 and 20 to ground. The flashing of key K will intermittently open and close this circuit, thereby intermittently releasing and operating relays 16 and 20, and these relays in turn, will intermittently operate relay 22 over the circuit previously traced. The operation of relay 22 will cause the same sequence of relay operations as heretofore described and which included the operation of relay 27, relay 23 having already operated and locked as previously described. The intermittent operation of relay 27 causes guard lamp L^2 to flash. In its intermittent operation relay 20 also closes a circuit through its normal contact from ground, conductor 83, left hand closed contact of relay 23, right hand winding of relay 30 to battery. The closing of this circuit

energizes relay 30, which, in operating, closes a circuit through its right hand make contact from battery, conductor 84, winding of slow release relay 47 to ground, thereby energizing relay 47, the operation of which prevents the application of ringing current to the line at this time. The operation of relay 30 through its outer left hand contact closes a circuit from ground, make contact of relay 31, this relay being of the slow release type does not release during the flashing interval, conductor 85, left hand winding of relay 64, conductor 86, inner upper contact of relay 25 to battery. This circuit causes the energization of relay 64 which, in operating, opens through its left hand normal contact the locking circuit of relay 45, causing this relay to release and the circuit formerly outlined through relay 38 and interrupter I is again established. The operation of relay 64 closes a locking circuit through its left hand make contact and right hand winding from battery, conductor 87, inner right hand normal contact of relay 45, conductor 69, upper make contact of relay 29 to ground. When the operator at A restores key K to normal, relay 30 will release and in turn cause the release of relay 47. The operation of relay 64 will also close a circuit through its right hand make contact from ground, left hand winding of relay 65, conductor 66, winding of relay 43, conductor 67, upper back contact of relay 47, conductor 68, make contact of relay 38, to battery. The closing of this circuit will cause the operation and release of relay 43 under control of the intermittent operation of relay 38, so that the called subscriber will be signaled by means of ringing current transmitted from source 72 of trunk B to trunk C, and thence to the called subscriber's station in a manner previously described. When the subscriber answers the ringing will cease and the circuits and apparatus will function in the same way as mentioned before.

When the called subscriber whose line terminates at jack J^2 restores the receiver to its hook, relay 78 of trunk C is released, opening the circuit through its contact by which relay 55 was operated and causing the latter relay to release. The release of relay 55 will again establish over its upper back contact a circuit through the winding of relay 41 of trunk B, from battery and ground through the windings of relay 53 of trunk C, as formerly outlined, thereby energizing these relays. The operation of relay 41 causes the operation of relay 51 and the latter relay in turn causes the sequence of operations which result in the release of relay 18 as previously described, and this relay upon operating closes a circuit over the cord A, through polar relay 8 which operates and causes the lamp L^1 to light as a disconnect signal.

The originating operator at A, in response to the lighting of disconnect signal L^1 , will remove plug P from jack J, and the switching equipment represented by the terminals S, S^1 , and S^2 will be returned to normal in a well understood manner, thereby opening the locking circuit previously referred to whereby relay 10 was maintained operated, causing this relay to release. The release of relay 10 will cause the release of relay 7 and 14. The latter relay, however, being of the slow release type will remain operated momentarily, and before it releases the following circuit will be closed: from battery, winding of relay 99, conductor 100, winding of relay 101, conductor 102, make contact of relay 14, right hand back contact of polar relay 13 to ground. The closing of this circuit operates relays 99 and 101, and the former relay, upon operating, closes a locking circuit through its winding and left hand contact from battery, resistance 103, normal contact of relay 14, which relay has released by this time, back contact of relay 10, contact of polar relay 13 to ground. When relay 14 releases, it breaks the circuit just traced through its contact whereby relay 101 was energized and the latter relay releases. The operation of relay 99 through its inner right hand contact connects ground to the sleeve terminal S^2 and thereby maintains the multiple terminals of the trunk "busy" until the remainder of the connection has been restored to normal. The return of the switch to normal, and the release of relay 7 will open the circuit of relays 16 and 20, and while a circuit will be closed through relays 16 and 20 in series with polar relay 13, through the back contacts of relay 101 and outer right hand closed contact of relay 99, owing to the high resistance of polar relay 13, relays 16 and 20 release. The deenergization of relays 16 and 20 opens the circuit of relay 22, causing it to release, and the latter relay will cause the deenergization of relays 27 and 31. The release of relay 27 will cause lamp L^2 to light by closing the circuit previously outlined and will also cause the deenergization of relay 41, which in turn will cause relay 51 to release. Relay 23, which remains energized through its locking circuit, closes a circuit through its left hand contact from grounded contact of relay 20, conductor 83, right hand winding of relay 30 to battery, thus energizing the latter relay. The operation of relay 30 causes the operation of relay 47 over the circuit traced before, and the operation of this relay prevents ringing current from being started again. Slow releasing relay 31 becomes deenergized at this time due to the operation of relay 30, and a circuit is closed from battery, upper winding of relay 25, con-

ductor 88, lower normal contact of relay 31, outer left hand make contact of relay 30 to ground. The closing of this circuit causes the operation of relay 25, which establishes a locking circuit through its lower winding and contact from battery, conductor 36, upper closed contact of relay 29 to ground. The operation of relay 25 maintains the disconnect signal L^2 lighted by a circuit from ground, upper closed contacts of relays 29 and 25, filament of lamp L^2 to battery. The operation of relay 25 also opens the locking circuit through its lower contact, whereby relay 23 was maintained operated and causes this relay to release, which in turn releases relays 30 and 47. The energization of relay 25 also closes a circuit through its lower contact from ground, conductor 89, winding of relay 90, conductor 91, upper inner make contact of relay 29 to battery. The closing of this circuit energizes relay 90 which upon operating removes the "busy" condition at the outgoing end of this connection in the following manner:—

In response to the lighting of the disconnect signal L^2 , the operator at B will remove plug P^1 from jack J^1 , thereby deenergizing relay 29, and this relay, upon releasing, will open at its contacts the energizing or the locking circuits previously traced for relays 25, 33, 34, 35 and 45 and these relays release, and the disconnect signal L^2 , due to the release of relay 29, will be extinguished. The release of relay 29 will close a circuit through its upper inner back contact from battery, conductor 94, winding of relay 19, conductor 95, contact of slow release relay 90, to ground. The closing of this circuit will cause relay 19 to operate and send out battery of reversed polarity to the outgoing end A and will remove the "busy" condition thereat in the following manner: The operation of relay 19 will close the following circuit: from battery, winding of relay 16, conductor 17, upper normal contact of relay 18, upper left hand winding or repeating coil R^1 , tip conductor of trunk B, conductor 108, right hand normal contact of relay 101, winding of polar relay 13, left hand normal contact of relay 101, outer right hand contact of relay 99, conductor 106, ring conductor of trunk B, lower left hand winding of repeating coil R^1 , lower closed contact of relay 19, lower normal contact of relay 18, to ground through winding of relay 20. The closure of this circuit will cause the operation of polar relay 13, which will break its ground contact and open the locking circuit previously referred to whereby relay 99 was maintained operated, thereby deenergizing this relay and removing the ground from the sleeve contact of terminal S^2 . The release of relay 99 will open the

circuit just traced whereby relay 13 was operated and the entire circuit will now be returned to normal.

In case the operator at A disconnects prematurely as, for instance, before the disconnect signal L' is lighted, the circuit will function as just described in connection with the normal disconnect, except when relay 101 operates it momentarily closes the following circuit: from battery left hand make contact of relay 101, outer right hand contact of relay 99, conductor 106, ring conductor of trunk B, lower left hand winding of repeating coil R^1 , upper normal contact of relay 19, through the winding of relay 52 by way of conductor 110, lower make contact of relay 18, this relay being held operated under this condition, lower normal contact of relay 19, upper left hand winding of repeating coil R^1 , tip conductor of trunk B, conductor 108, right hand make contact of relay 101 to ground. The closing of this circuit causes relay 52 to operate momentarily and in turn to operate relay 30 by a circuit battery through its left hand winding, conductor 92 over the grounded contact of relay 52. The energization of relay 30 will operate relay 47 by a circuit from battery, right hand contact of relay 30, conductor 84, winding of relay 47 to ground. The closing of this circuit will open the energizing circuit whereby relay 18 was operated, causing it to release and open at its lower contact the circuit just described for operating relay 52 thereby deenergizing this relay. The deenergization of relay 52 will close the circuit formerly described and cause the operation of relays 16 and 20 in place of relay 52 whereupon the disconnect signal L^2 of trunk B will be brought about by the same sequence of operation that was described in the preceding paragraphs in connection with the normal disconnect.

In case the operator at B disconnects by mistake, and removes plug P^1 from jack J^1 before the operator at A disconnects, relay 29 will be deenergized. Relay 27 will be maintained in operated condition over the circuit previously outlined, and disconnect signal L^2 will be lighted by a circuit from ground, upper outer normal contact of relay 29, conductor 28, upper closed contact of relay 27 filament of said lamp and lower normal contact of key K^1 to battery. The release of relay 29 will cause the deenergization of relays 33, 34, 35 and 45. Relay 34, however, is of the slow release type and remains energized momentarily, during which time the following circuit is closed: from battery, middle make contact of relay 27, outer left hand contact, winding and right contact of relay 49, right hand closed contact of relay 34, conductor 28, uppermost back contact of relay 29 to ground. This circuit causes the operation of relay 49, which

closes a locking circuit from battery, normal contact of key K^1 , conductor 97, outer left make contact, winding and right hand make contact of relay 49, conductor 98, lower normal contacts of relays 29 and 25, to ground. The operation of relay 49 breaks the circuit previously traced through its inner left hand contact, whereby relay 18 was operated and this relay releases, causing the operation of polar relay 8 over the circuit previously outlined and the lighting of disconnect lamp L^1 of cord A. Should the operator at B note the error made and re-establish the connection by again inserting plug P^1 in jack J^1 , relay 29 will again operate and cause the operation of relays 33, 34, and 35, thereby deenergizing relay 49 and extinguishing lamp L^2 , and a through connection is again established.

If the operator at A discovers that the connection has been broken down, she can operate the flashing key K and cause the flashing of lamp L^2 at trunk B, as previously described, in order to get the operator thereat back on the circuit.

Although trunk B is shown and described as being connected with a toll switching trunk such as indicated at C, it will be understood that said trunk is also adapted for use with other intermediate trunks, as for instance, a call circuit toll trunk, or the like.

While the circuit arrangements of this invention are herein shown and described as embodied in a specific arrangement, it will be understood they are capable of embodiment in many and widely varied forms, without departing from the spirit of the invention, as defined in the appended claims.

What is claimed is:

1. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, subscribers' lines connected with each of said switchboards, a link circuit at the first switchboard, signaling means associated with said trunk circuit responsive to the connection of said link circuit therewith, an operator's set connected with said trunk circuit, a link circuit at the second switchboard, means associated with said trunk circuit responsive to the connection therewith of the link circuit at said second switchboard for extinguishing said signaling means and disconnecting said operator's set, and means associated with the said trunk circuit and said second link circuit for signaling a subscriber connected with said second switchboard.

2. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, subscribers' lines connected with each of said switchboards, a link circuit at the first switchboard, an operator's set connected with said trunk circuit, a link circuit at the second

switchboard, means associated with said trunk circuit for disconnecting said operator's set, means associated with said trunk circuit and said second link circuit for signaling a subscriber connected with said second switchboard, a disconnect signal at said first switchboard operable upon the disconnection of said subscriber, means responsive to the disconnection of said first link circuit from said trunk circuit for maintaining said trunk circuit in a busy condition, and means in said trunk circuit responsive to the disconnection of said second link circuit therefrom for removing the busy condition and restoring said trunk circuit to normal.

3. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, subscribers' lines connected with each of said switchboards, link circuits at each of said switchboards, signaling means in said trunk circuit responsive to the connection of said first switchboard link circuit therewith, means associated with said trunk circuit and said second link circuit for signaling a subscriber connected with said second switchboard, a signal at the first link circuit operable upon the disconnection of said subscriber, means including a relay associated with the sleeve of the trunk circuit for maintaining said trunk circuit busy upon the disconnection of the first link circuit therefrom, and means including a polar relay in bridge of the trunk circuit for removing said busy condition and restoring said trunk circuit to normal upon the disconnection of the second switchboard link circuit therefrom.

4. A telephone exchange system comprising a trunk circuit extending from a first to a second switchboard, link circuits at each of said switchboards, signaling means associated with said trunk circuit responsive to the connection of the link circuit at said first switchboard therewith, an operator's set associated with said trunk circuit in talking connection with the link circuit of said first switchboard, a relay for disconnecting the operator's set from talking connection, and a second relay connected with the sleeve of said trunk circuit responsive to the connection with the link circuit of said second switchboard for extinguishing said signaling means and for actuating said first mentioned relay whereby said operator's set is rendered inoperative during the connection of the trunk circuit and the link circuit at said second switchboard.

5. In a telephone exchange system comprising a local office and a distant office, link circuits for each of said offices, subscribers' lines connected with said offices, a trunk circuit for interconnecting the link circuits of

said local office and said distant office, signaling means associated with said trunk circuit, relay means in said trunk circuit responsive to the connection of the link circuit of said local office therewith for operating said signaling means, means for connecting an operator's set with said trunk circuit, a relay connected with the sleeve of said trunk circuit responsive to the connection thereof with the link circuit at said distant office for disconnecting said operator's set from said trunk circuit and extinguishing said signaling means, means associated with said trunk circuit and said distant office link circuit for automatically signaling a subscriber connected with the latter office, means associated with the local office link circuit responsive to the disconnection of the subscriber at said distant office for operating a disconnect signal at said local office, and means associated with said trunk circuit whereby it is maintained in busy condition upon the disconnection of said local link circuit until the remainder of the circuit has been restored to normal.

6. In a telephone exchange system comprising a trunk circuit extending from a first switchboard to a second switchboard, subscribers' lines connected with each of said switchboards, a link circuit for each switchboard, signaling means associated with said trunk circuit responsive to the connection of said first switchboard link circuit therewith, a source of ringing current, means associated with said trunk circuit and a second switchboard link circuit for applying ringing current to a subscriber's line connected with the latter switchboard, means responsive to the closing of the subscriber's line for causing the disconnection of said ringing current, means including a polar relay at said first switchboard link circuit responsive to the disconnection of the subscriber at said second switchboard link circuit for operating a disconnect signal at said first switchboard link circuit, means associated with said trunk circuit for maintaining it in busy condition upon the disconnection of said first switchboard link circuit therefrom until the remainder of the circuit has been restored to normal, and means including a second polar relay bridged across said trunk circuit for restoring said circuit to normal.

7. In a telephone exchange system comprising a local office and a distant office, subscribers' lines connected with each of said offices, link circuits for each of said offices, a trunk circuit for interconnecting the link circuits of said local office and said distant office, signaling means associated with said trunk circuit responsive to the connection of said local office therewith, means associated with said trunk circuit and said distant office for automatically signaling a subscriber connected with the latter office,

means including a polar relay associated with the link circuit at said local office responsive to the disconnection of the subscriber at said distant office for operating a
5 disconnect signal at said local office, means associated with said trunk circuit whereby it is maintained in busy condition upon the disconnection of the link circuit at said local office therefrom until the remainder of
10 the circuit has been restored to normal, and means including a second polar relay bridged across said trunk circuit for restoring said circuit to normal.

8. In a telephone exchange system comprising a local office and a distant office, subscribers' lines connected with each of said offices, a trunk circuit for interconnecting said local office and said distant office, signaling means associated with said trunk circuit responsive to the connection of said local office therewith, an operator's set associated with said trunk circuit in talking connection with said local office upon its association with said trunk circuit, means as-

sociated with said trunk circuit responsive 25 to its connection with said distant office for disassociating said operator's set from talking connection and for extinguishing said signaling means, means associated with said trunk and said distant office for automati- 30 cally signaling a subscriber connected with the latter office, means including a polar relay at said local office responsive to the disconnection of the subscriber at said distant office for operating a disconnect signal at 35 said local office, means associated with said trunk whereby it is maintained in busy condition upon the disconnection of said local office therefrom until the remainder of the circuit has been restored to normal, and 40 means including a second polar relay bridged across said trunk for restoring said circuit to normal.

In testimony whereof, I have signed my name to this specification this 24th day of 45 May, 1921.

JOHN F. TOOMEY.