

April 29, 1924.

G. W. KUHN

1,491,867

ELECTRICAL SWITCHING DEVICE

Filed July 24, 1920

2 Sheets-Sheet 1

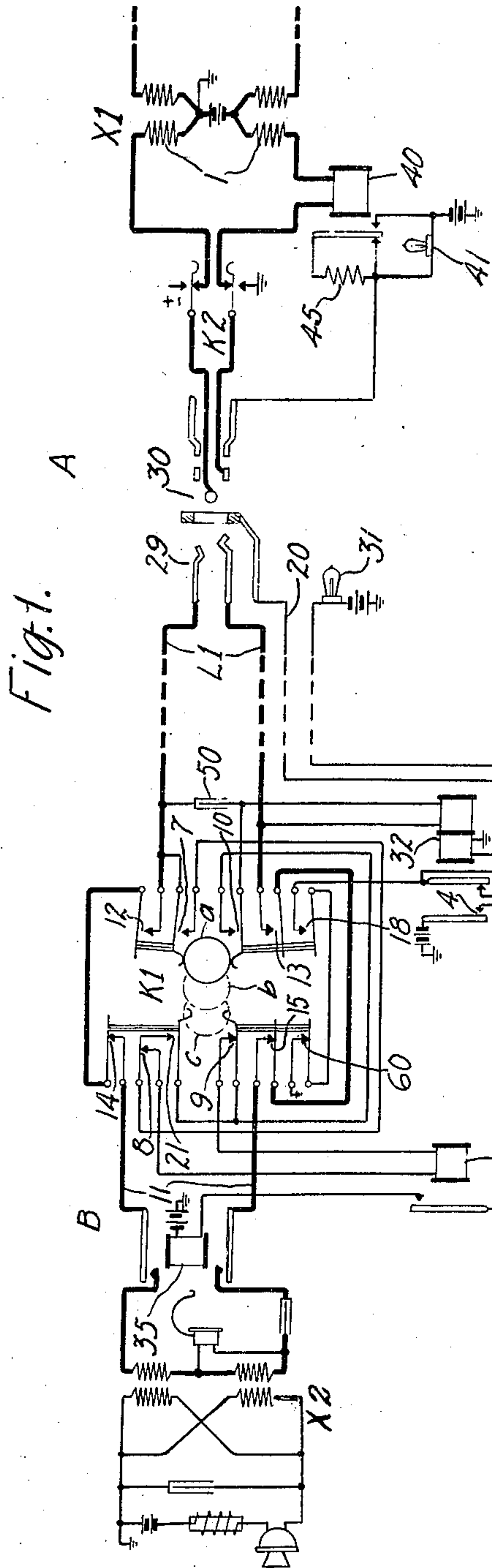
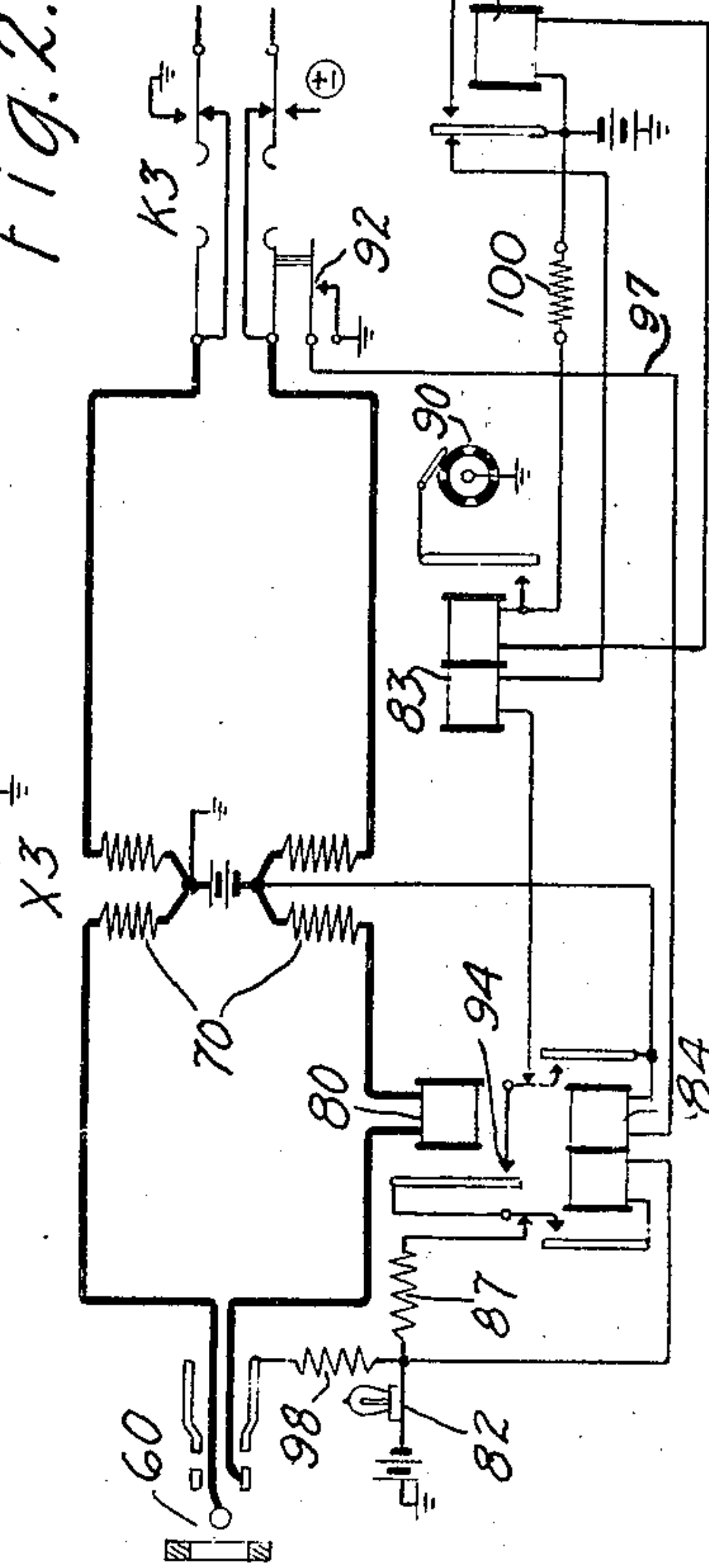


Fig. 2.



by

Inventor:
G. W. KUHN.
J. E. Tolson
Att'y.

April 29, 1924.

G. W. KUHN

1,491,867

ELECTRICAL SWITCHING DEVICE

Filed July 24, 1920

2 Sheets-Sheet 2

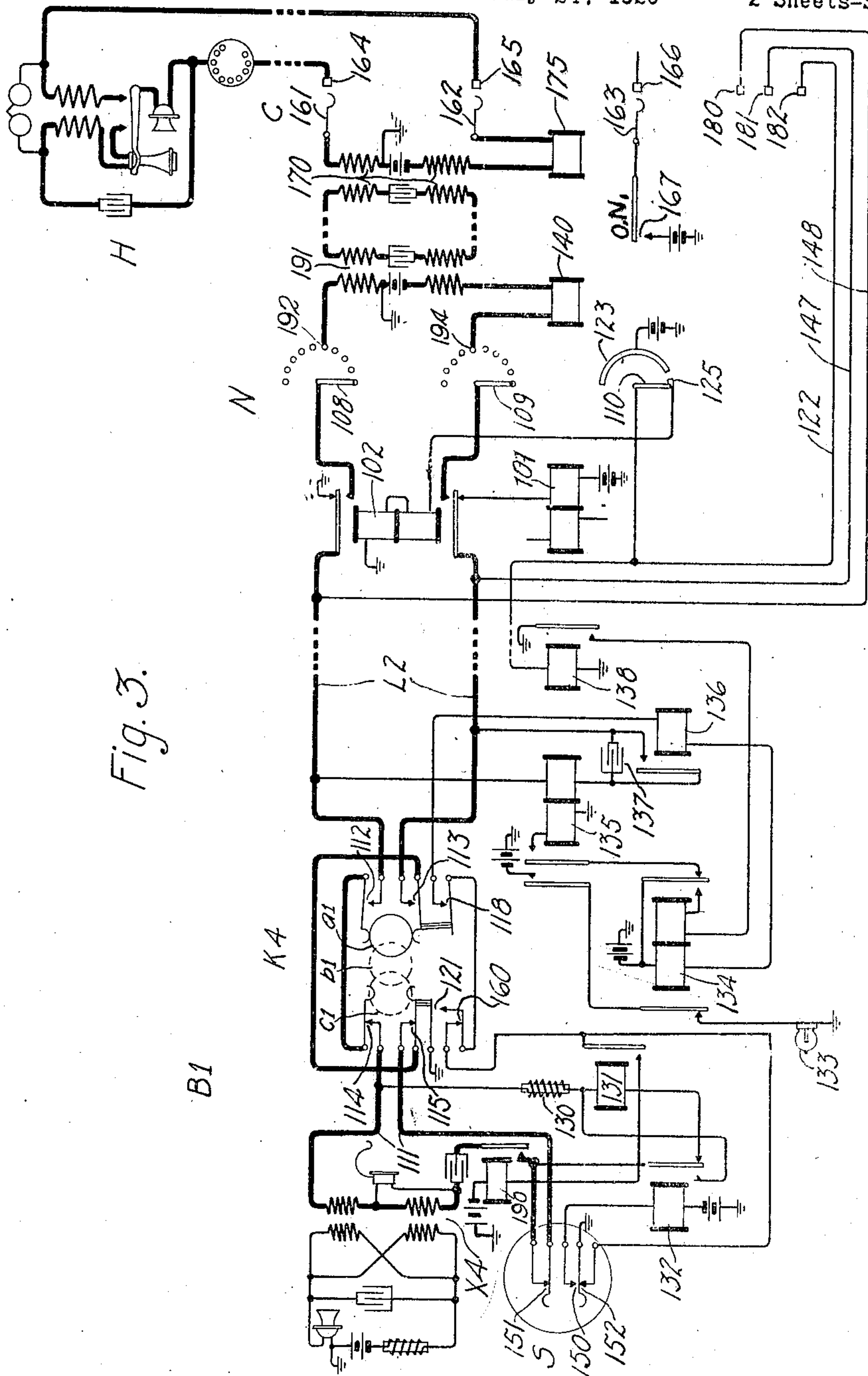


Fig. 3.

Inventor:
G. W. Kuhn

by

J. F. Ford
Att'y.

UNITED STATES PATENT OFFICE.

GEORGE W. KUHN, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

ELECTRICAL SWITCHING DEVICE.

Application filed July 24, 1920. Serial No. 398,698.

To all whom it may concern:

Be it known that I, GEORGE W. KUHN, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Electrical Switching Devices, of which the following is a specification.

This invention relates to electrical switching devices, and more particularly to a switching device adapted for insertion in a telephone circuit and designed to effect successively a plurality of different electrical connections without rendering discontinuous the connection between the tip and ring sides of the said circuit.

Devices of this nature heretofore used belonging to that class designed to connect a telephone circuit, such as a trunk circuit with an operator's telephone circuit, or to bridge across the said trunk circuit a holding coil whose function was to maintain in its operated condition certain apparatus associated with the trunk circuit, consisted usually of a key having two groups of contacts, which, for the purpose of description, may be referred to as the right-hand and left-hand groups, although in practice these groups may occupy other relative positions. The trunk circuit terminated upon certain springs of one of these groups and was looped back or strapped through to the springs of the other group of contacts when the springs of both groups were in their normal non-operated position. The telephone set circuit was connected with certain springs of the said first group and the holding coil circuit was connected with certain springs of the other of the said groups of springs.

Associated with each group of springs were certain master springs adapted to be engaged by the cam of the key and when so engaged, designed to operate the other contacts of the same group with which the operated master springs were associated. Thus, if the cam of the key were moved so as to operate the master springs associated with the right-hand group, contacts necessary to connect the operator's telephone set with the line would be made. If the cam were moved so as to operate the master springs of the left-hand group, the incoming circuit would be connected with the circuit of the holding coil. If the cam were left in its normal position, which opera-

tively would be midway between the talking and the holding positions of the said key, the master springs of neither group would be operated, in consequence of which neither the telephone set nor the holding coil would be connected to the incoming line circuit, and, furthermore, the circuit between the tip and ring sides of the incoming line would be maintained opened. If the incoming line has associated with it a supervisory relay, the operation of which is dependent upon the maintenance of a closed circuit between the tip and ring sides of the line, such relay would be released when the cam was in its normal neutral position resulting in the release of switches, where the key is used in a system employing automatic switches, and in the actuation of a supervisory signal where the key is used in a manual telephone system.

Thus, if the operator at the incoming position, after answering the call, finds it necessary to disconnect her telephone set from the incoming trunk circuit, but desires to hold the latter, she will move the cam of the key from its right to its left-hand position, which necessitates passing through the normal neutral position of the key, during which time the circuit between the tip and ring sides will be opened. If the key is operated relatively slowly, the supervisory relay may be released, thus releasing switches in an automatic telephone system, or causing the actuation of a supervisory signal in a manual system, thus giving to the operator a disconnect signal. This inadvertent opening of the line circuit thus results in a disconnection of the parties in an automatic system, or the giving of a disconnect signal to the operator in a manual system, and leads to confusion of operation.

It is the object of the present invention to provide a switching device by means of which the tip and ring sides of the incoming circuit will not be opened when the operator moves the cam of the key from the talking to the holding position, or vice versa.

This invention will be better understood from the following description when read in connection with the attached drawings, represented by Figs. 1 and 2, which show an application of the invention to a manual telephone system, and Fig. 3 which shows an application of the invention to an automatic telephone system.

In Fig. 1 of the drawings L^1 represents a trunk line which, for the purpose of description, will be assumed to be of that type extending from a switchboard A to a repair clerk's desk B. The line L^1 terminates at the switchboard A in a jack 29 with which is associated the lamp 31 by means of which the repair clerk may signal the operator at A. X^1 represents a portion of a cord circuit which may be of the usual subscriber's type located at the switchboard A having associated therewith a plug 30 which is adapted to be inserted in a jack 29. The cord circuit X^1 , of which approximately one end is shown, comprises, in part, a repeating coil 1 to which battery is connected in order to furnish energy to the line with which the cord circuit may be connected. Connected with the ring side of the cord circuit is a supervisory relay 40, having associated therewith a lamp 41, which serves as the supervisory signal of the cord circuit. At the repair clerk's desk B there may be located a telephone circuit X^2 , which is adapted to be connected with the springs of the key K^1 . Associated with the trunk circuit L^1 , and located at the repair clerk's end of the said circuit, are the relays 32 and 33, and the key K^1 . The key K^1 is so designed that the cam thereof is adapted to occupy normally the position represented by the circle *a*. It will be seen that when the cam is in this position the master springs and the other springs controlled thereby, included within the right-hand group of springs, are spread apart and all of the contacts of said springs are opened. If the cam be moved to its middle position *b*, the master springs of the right-hand group and the associated springs will be released, and in returning to their natural position, they will close the contacts of the various adjacent springs of this group. This, as will be seen more clearly, later serves to connect the trunk line L^1 with the telephone circuit X^2 . If it is desired to disconnect the telephone set circuit from the trunk line but to maintain operated the supervisory relay of the cord circuit X^1 , the cam may be moved into the position designated *c*. When the cam is thus operated, the master springs of the left-hand group and the springs associated therewith will be moved so as to disconnect the telephone set from and to bridge the holding circuit across the trunk circuit.

Having in mind the foregoing description of the parts shown in the drawings, this invention will be more fully understood from the following description of its mode of operation.

Let it be assumed that the operator at A desires to obtain from the repair clerk at the position B certain information. The operator at A will insert the plug 30 of the cord circuit X^1 into the jack 29, and will

then apply ringing current by means of the key K^2 to the line L^1 which, flowing through the condenser 50 and the right-hand winding of relay 32 will cause the operation of said relay. Relay 32 is locked up over a path extending from ground, the left-hand winding of relay 32, contacts 16 of relay 33 and contacts 4 of relay 32 to grounded battery. By the closing of the contacts 4 of relay 32, current will flow through the outer armature of relay 32 and contacts 4 through contacts 6 of relay 33 and through lamp 43 to ground, causing the lighting of this lamp. The clerk at the desk B, noting the lighting of the lamp 43, will operate the key K^1 by moving the cam into the position *b*. Relay 34 will then be energized over a path extending from ground, through the upper left-hand winding of repeating coil 1, through the upper normal contacts of key K^2 , tips of plug 30 and jack 29, contacts 7 and contacts 8 of key K^1 , winding of relay 34, contacts 9 and contacts 10 of key K^1 , right-hand winding of relay 32, rings of jack 29 and plug 30, lower normal contacts of key K^2 , winding of relay 40, and lower left-hand winding of repeating coil 1 to grounded battery. Relay 34, in operating, completes a circuit at its armature and front contact for relay 35. Relay 35, in operating, connects the operator's telephone circuit X^2 with the talking conductors 11. The tip and ring sides of the line L^1 are also connected through contacts 12, 14, and 13 and 15 respectively with the talking conductors 11, and, therefore, with the telephone circuit X^2 . By the operation of key K^1 , contact 18 is also closed, thereby causing the operation of relay 33 over a path traceable from grounded battery, left-hand winding of relay 33, contacts 18 and 60 of key K^1 to ground. Relay 33, in operating, locks up over a path extending from ground, right-hand winding, front contact, and right-hand armature of relay 33, sleeves of jack 29 and plug 30 and thence through lamp 41, resistance 45, armature and front contact of relay 40 in parallel to grounded battery. Since the supervisory relay 40 has already been operated by a flow of current there-through when key K^1 was moved to position *b*, a shunt path was established around the lamp 41, said shunt path including the front contact and armature of relay 40 and resistance 45, so that lamp 41 will no longer glow. Relay 33, in operating, opens the circuit for lamp 43 at contact 6, thereby extinguishing lamp 43. The locking circuit for relay 32 is also opened at contact 16 but relay 32 remains energized due to current flowing through its right-hand winding from the battery at repeating coil 1, through the winding of relay 34. If the clerk at the desk B desires to disconnect his telephone set from the incoming

line circuit L^1 , but does not desire to give to the operator at A a disconnect signal, the said clerk will move the cam of the key K^1 into position c . By the operation of the master springs of the left-hand group of springs, the contacts 14 and 15 are opened, whereby the conductors 11 are disconnected from the telephone set X^2 , thereby permitting the telephone set to be used with other trunk circuits. Contacts 8 and 9 of this group are also opened, but contact 21 is closed. It will be seen, therefore, that the movement of the cam to position c serves to release relay 34, which in turn releases relay 35. The tip and ring sides of the line L^1 , however, remain connected together through contacts 7, 21 and 10 of the key K^1 and the right-hand winding of relay 32. The supervisory relay 40, therefore, remains energized, and the lamp 41, associated therewith, remains extinguished so that the operator at A does not receive a disconnect signal as a result of the movement of the cam key K^1 from its talking to its holding position.

When the clerk at B desires to communicate with the operator at A, he will move the cam back again to the position b , thereby connecting the telephone set circuit X^2 with the line L^1 . Upon the completion of the conversation and when the connection is no longer desired, the cam of key K^1 will be moved into position a . This serves to open all of the contacts of said key and thereby breaks the connection between the tip and ring side of the line L^1 , which results in the releasing of the relay 40. The lamp 41, therefore, will be lighted due to the removal of the shunt around it, and the operator at A will accordingly remove the plug 40 from the jack 29 and restore the circuit to normal condition.

Fig. 2 shows a cord circuit X^3 equipped to give a flashing recall signal and is adapted for use in connection with the trunk circuit L^1 . The cord circuit X^3 , a portion only of which is shown, has a plug 60 which is adapted for insertion in the jack 29. This cord circuit comprises a repeating coil 70 to which a battery for talking and signaling purposes is connected. Connected to the ring side of the answering cord is a supervisory relay 80. A similar relay is inserted in the same conductor of the calling cord but is not shown since it is not necessary for describing the invention. Associated with the sleeve conductor is a lamp 82 and connected therewith is a relay 84, the function of which will be hereinafter made clear. Associated with the relay 84 is a flashing interrupter circuit comprising an interrupter 90, relays 83 and 85, a buzzer 91, which may be of any well-known type and a current limiting resistance 100. Connected with the calling cord of the circuit

X^3 is a key K^3 , which is adapted to bridge the operator's telephone set (not shown) across the circuit or to apply ringing current to the line, depending upon the direction in which the key is operated.

Having in mind the foregoing description of the parts of the circuit and the function performed by each part, this invention will be better understood by the following description of its mode of operation.

Let it be assumed that the operator or clerk at B desires to obtain a certain subscriber, the clerk will signal the operator at A by moving the key K^1 to position b , which serves to light the lamp 31. The operator at A will insert plug 60 into jack 29 and operate the listening key K^3 , which serves to connect her telephone set with her cord circuit X^3 . Upon insertion of the plug 60 into jack 29, the lamp 82 would tend to light by a flow of current from grounded battery through lamp 82, resistance 98, sleeves of plug 60 and jack 29, right-hand armature and back contact of relay 33, and resistance 99 to ground. The lamp is, however, prevented from lighting by the operation of relays 80 and 84, which establish a short-circuit around the lamp in the following manner. It will be recalled from the description of Fig. 1 that when the key K^1 was moved to position b , the connection was established between the tip and ring sides of the line L^1 , and consequently across the conductors of the cord circuit X^3 . This results in a flow of current from the battery connected to the winding of repeating coil 70, through the winding of supervisory relay 80, causing the operation of supervisory relay 80, whereupon contacts 94 of supervisory relay 80 are closed. When the operator inserted the plug 60 into the jack 29 in order to take up the call, she operated the key K^3 in a left-hand direction in order to connect her telephone set with the circuit which connected conductor 97 through contact 92 to ground. This established a circuit from grounded battery, right-hand winding of relay 84, conductor 97, and contacts 92 of key K^3 to ground, thereby causing the operation of relay 84. Relay 84, in operating, locks up over a path extending from grounded battery, right-hand armature and front contact of relay 84, contacts 94 of the relay 80, front contact and left-hand armature of relay 84, left-hand winding of relay 84, through resistance 98, sleeves of plug 60 and jack 29, right-hand armature and front contact of relay 33, and right hand winding of relay 33 to ground. This establishes a shunt path around the lamp 82 so that it remains extinguished.

Let us assume that after the desired connection has been established and communi-

cation thereover has been completed, that the clerk at B restores the key K^1 to the position a momentarily and then moves to position b in order to again signal the operator at A.

5 When the key K^1 was moved to position a , the connection between the tip and ring sides of the circuit was opened and the supervisory relay 80 is deenergized which permits the opening of the contact 94. This results in the deenergization of relay 84 and causes the lighting of the lamp 82. This will indicate to the operator that the parties have disconnected, and unless some different signal is given to her as when the key K^1 is

10 moved to the position b , the operator would take down the cords of the circuit. This is prevented, however, when the key is moved into position b by the inauguration of what is known as the flashing recall signal. Thus,

15 when the key K^1 is in position b , relay 80 will be operated which, when relays 33, 84 and 85 are not energized, establishes a circuit from grounded battery, armature and back contact of relay 85, left-hand winding of relay 83, normal right-hand contacts of relay 84, contact 94, normal left-hand contacts of relay 84, resistances 87 and 98, sleeves of plug 60 and jack 29, right-hand armature and back contact of relay 33, and

20 resistance 99 to ground. This establishes a shunt path around lamp 82, which extinguishes the lamp. The flow of current through the left-hand winding of relay 83 energizes this relay, and if the contacts of the interrupter 90 are in a position to establish a connection to ground, current will flow from grounded battery, winding of relay 85, right-hand winding of relay 83, front contact and armature of relay 83, through interrupter 90 to ground. Relay 85 will be energized thereby, and at its armature and front contact, a circuit will be closed for buzzer 91, and, at the same time, the shunt path will be removed from the

25 lamp 82, thus permitting said lamp to light. It will be seen, therefore, that by means of this arrangement the interrupter 90 causes the intermittent energization of relay 85 and the intermittent lighting of lamp 82 whereby a flashing signal is given to the operator which indicates that the party whose line is connected with that cord desires to recall the operator.

30 In the arrangement of key switches heretofore used in which the cam passed through a neutral position between the talking position and the holding position whereby the connection between the tip and ring sides of the line was momentarily opened, there was presented the possibility of releasing the relay 84 during the passage of the cam through this neutral position, and thereby inaugurating the flashing recall signal when the clerk moves the key from the talking position to the holding position. It will be

seen, therefore, that by employing a key, such as K^1 , the inadvertent establishment of the flashing recall signal is prevented and thereby one of the difficulties incidental to the use of this circuit is eliminated.

It will also be seen that by means of the switching device of the type embodying the principle of this invention, it is possible to transfer the trunk circuit from the telephone set to a holding circuit and vice versa without opening the circuit of a supervisory cord relay and thereby causing an involuntary operation of the said supervisory relay which would produce a false disconnect signal.

In Fig. 3 of the drawings which represents an embodiment of the invention as applied to an automatic telephone exchange system, there is shown a trunk line L^2 extending from a repair clerk's desk or operator's position B^1 to an automatic telephone exchange. The trunk line L^2 terminates at the operator's position in the key K^4 and has associated therewith a lamp 133 by means of which the operator may be signaled on incoming calls from the automatic telephone exchange. An impulse sender S is provided for the operator at position B^1 for the purpose of controlling switches at the automatic exchange on outgoing calls to stations of said exchange. The trunk line L^2 terminates at the automatic exchange in a non-numerical switch N and is multiplied to contacts of a connector switch, such as C . The non-numerical switch N and the connector switch C are schematically represented only, since they form no part of the present invention, the inventive idea of the disclosure being capable of adaptation to any well-known automatic telephone exchange. Switches of the type herein indicated are fully disclosed and described in the patent of F. A. Stearn et al., No. 1,395,977, granted November 1, 1921.

Having in mind the foregoing description of the parts shown in Fig. 3 of the drawings, the invention will be more fully understood from the following description of a call from the operator's position to a station of the automatic exchange, and a call from a station of the automatic telephone exchange to the operator.

Assuming that the operator or clerk at position B^1 desires a connection with a station such as H , at the automatic telephone exchange, the operator at B^1 , by moving the key K^4 to position b^1 causes the energization of relays 136 and 134 of the trunk circuit over a path extending from grounded battery, left-hand winding of relay 134, winding of relay 136, contacts 118 and 160 of key K^4 and contacts 152 of sender S to ground. Relay 136 in operating short circuits condenser 137, and places a bridge across the trunk conductors L^2 , said bridge including the right hand winding of relay 135 and con-

tacts of relay 136 thereby causing the operation of line relay 101 of the non-numerical switch N over a path extending from ground, upper normal contacts of relay 102, right-hand winding of relay 135, contacts of relay 136, lower normal contacts of relay 102 and right-hand winding of relay 101 to grounded battery. Relay 131 of the operator's telephone set circuit is also energized over a path extending from ground, through the upper normal contacts of cut-off relay 102, contacts 112 and 114 of key K^4 , upper talking conductor 111, coil 130, winding of relay 131, back contact and armature of relay 132, contacts 151 of impulse sender S, lower talking conductor 111, contacts 115 and 113 of key K^4 , lower normal contacts of cut-off relay 102, and right-hand winding of relay 101 to grounded battery. Relay 101, of the non-numerical switch N, in energizing, closes a circuit for a stepping magnet (not shown) under the control of which the brushes 108, 109 and 110 of switch N are advanced. As soon as the brush 110 passes off of normal contact 125 and into engagement with segment 123, battery potential is connected to the multiple test terminal, such as 182, appearing in the banks of final selectors having access to the line, over conductor 122, brush 110 and segment 123 to grounded battery, and relay 138 of the trunk circuit L^2 is energized over a path extending from grounded battery, segment 123, brush 110, and the winding of relay 138 to ground. Under control of the stepping magnet (not shown) of the non-numerical switch N, the brushes 108, 109 and 110 are advanced until the terminals 192 and 194 of an idle switch, such as C, are reached, whereupon cut-off relay 102 is energized and the line L^2 is extended through to the switch C. It will be understood that there may be a number of selector switches interposed between the non-numerical switch N and the connector switch C.

When relay 131 of the operator's telephone set was energized, it completed a circuit through its contacts for relay 190, said circuit including contacts 152 of sender S. Relay 190 in energizing telephonically connects the operator's telephone set to the conductors 111.

The operator at position B^1 , may now actuate the impulse sender S to control the setting of the connector switch C upon the terminals of a desired station, such as H, in the well-known manner. Upon the initial movement of the impulse sender, contacts 150 are closed and remain closed during the movement of the sender. The closure of the contacts 150 completes a circuit for the energization of relay 132. Relay 132, in energizing, bridges coil 130 directly across the tip and ring conductors of the trunk circuit L^2 and opens the circuit for relay 131, which in

retracting its armature opens the circuit for relay 190. Relay 190 opens the operator's telephone circuit to prevent clicks during dialing.

During the actuation of the sender S, contacts 152 of the sender S are opened whereupon relay 136 of the trunk L^2 releases, thereby removing the direct current bridge from across the trunk conductors L^2 during dialing. As the impulse sender returns to normal, the bridge across the conductors 111, including coil 130, front contact and armature of relay 132 and contacts 151 of impulse sender S, is intermittently opened thereby conveying impulses to the connector switch C at the automatic telephone exchange in the well-known manner. At the end of each series of impulses, the contacts 150 of impulse sender S are opened, thereby permitting the deenergization of relay 132. The contacts 152 of impulse sender S are closed at the end of each series of impulses thereby connecting the bridge, consisting of the right-hand winding of relay 135, the armature and front contact of relay 136, across the trunk conductors L^2 . After sending a sufficient number of impulses to set the brushes 161, 162 and 163 of the connector switch C upon the terminals 164, 165 and 166 respectively, and if the line at such station has been found idle, off-normal contacts 167 will be closed thereby placing the busy test upon the terminal 166 of the desired station. Station H may then be signaled in the well-known manner and after the response of such station, the operator at position B^1 , and the party at station H may converse.

If the operator at the desk B desires to disconnect the telephone set from the trunk circuit L^2 and does not desire to release the connection, the said operator will now move the cam of the key K^4 into position c^1 . By the operation of the master springs in the left-hand group of springs, the contacts 114, 115 and 160 are opened and contacts 121 are closed. The opening of contacts 114 and 115 disconnects the tip and ring conductors from the telephone set X^4 thereby permitting the telephone set to be used with other trunk circuits. The closure of contacts 121 holds relay 136 energized when contacts 160 are opened, thereby maintaining the bridge across the tip and ring conductors of the trunk circuit L^2 . The switches at the automatic exchange are, therefore, not released when the key K^4 is moved from the talking to the holding position.

When the operator at position B^1 desires to again communicate with the station H, the operator will move the cam back again to the position b^1 , thereby connecting the telephone set circuit X^4 with the line L^2 . Upon completion of the conversation and when the connection is no longer desired,

the cam of key K^4 will be moved into position a^1 . This serves to open all the contacts of the right-hand group of the key K^4 , whereupon relay 136 is released and the
 5 bridge across the tip and ring conductors of the trunk L^2 is removed, resulting in the release of the switches at the automatic exchange in the well-known manner.

Let us now assume that a station of the
 10 automatic exchange desires to converse with the operator at position B^1 . The brushes of a connector switch, such as C, may be set upon the terminals 180, 181 and 182 in any desired manner. If the line is idle, off-
 15 normal contacts 167 of the connector switch, such as C, will be closed so that relay 138 of the trunk circuit and cut-off relay 102 of the non-numerical switch associated with the trunk circuit L^2 will be energized over
 20 a path extending from grounded battery, contacts 167, brush 163, terminal 182 conductor 122 and thence in parallel, one path extending through the winding of relay 138 to ground and the other path extending
 25 through brush 110, normal contacts 125, lower and upper windings of cut-off relay 102 to ground. Ringing current may be projected over the terminal 180, conductor 148, through the right-hand winding of re-
 30 lay 135 and condenser 137, which are normally bridged in series across the trunk conductors L^2 , and conductor 147 to terminal 181. Relay 135 is thereupon energized and locks up over a path extending from
 35 grounded battery, right-hand armature and back contact of relay 134, the inner armature, front contact and winding of relay 135 to ground. At the front contact and outer armature of relay 135, a circuit extending
 40 through the left-hand armature and back contact of relay 134 is completed for lamp signal 133.

The operator at position B^1 noting the signal 133, will actuate the key K^4 by mov-
 45 ing the cam into position b^1 , whereupon a circuit for relays 136 and 134 of the trunk circuit L^2 will be completed over a path extending from ground, contacts 152 of sender S, contacts 160 and 118 of key K^4 , and wind-
 50 ings of relays 136 and 134 to grounded battery. Relay 136 is energized, and in attracting its armature short circuits condenser 137 and bridges the right-hand winding of relay 135 directly across the tip and ring talk-
 55 ing conductors thereby causing the tripping of the machine ringing in the well known manner and the advancement of the connector into the talking position. Relay 134 is also energized and in attracting its left-
 60 hand armature, interrupts the circuit for lamp signal 133 thereby extinguishing said signal and at its right-hand armature and front contact completes a locking circuit for itself over a path extending from
 65 ground, armature and front contact of re-

lay 138, the right-hand winding, front contact and armature of relay 134 to grounded battery. Relay 134 in energizing also interrupts the locking circuit for relay 135, but
 70 this relay does not retract its armature since it is maintained energized over a path extending from ground, upper right-hand winding of repeating coil 170, brush 161, terminal 180, conductor 148, right-hand
 75 winding of relay 135, armature and front contact of relay 136, conductor 147, terminal 181, brush 162, winding of relay 175 and lower right-hand winding of repeating coil 170 to grounded battery. When the op-
 80 erator at position B^1 operated the key K^4 by moving the cam into the position b^1 , coil 130 and winding of relay 131 in series with the back contact and armature of relay 132 and contacts 151 of impulse sender S of the
 85 operator's telephone set circuit were also bridged across the talking conductors of the trunk circuit. Relay 131 associated with the operator's telephone set X^4 , is then energized over a path extending from grounded
 90 battery, upper right-hand winding of repeating coil 170 associated with the connector switch, brush 161, terminal 180, conductor 148, contacts 112 and 114 of key K^4 , coil 130, winding of relay 131, back contact and
 95 armature of relay 132, contacts 151 of impulse sender S, contacts 115 and 113 of key K^4 , conductor 147, terminal 181, brush 162, winding of relay 175 and the lower right-hand winding of repeating coil 170 to
 100 grounded battery. Relay 131, in energizing, completes a circuit for relay 190 of the operator's telephone circuit X^4 , over a path extending from ground, contacts 152 of impulse sender S, armature and front contact
 105 of relay 131 and winding of relay 190 to grounded battery. Relay 190 in attracting its armature telephonically connects the operator's telephone circuit to the conductors 111 and the operator at position B^1 may
 110 now converse with the calling station.

If, after conversation with the calling station, the operator at desk B^1 desires to disconnect the telephone set X^4 from the trunk circuit L^2 , but does not desire to re-
 115 lease the switches at the automatic exchange, the said operator will move the cam of the key K^4 into position c^1 . By the operation of the master springs in the left-hand group of springs, the contacts 114 and 115 are opened whereupon the tip and ring
 120 conductors of the trunk circuit L^2 are disconnected from the telephone set X^4 thereby permitting the telephone set to be used with other trunk circuits. Contacts 160 of the left-hand group are also opened, but
 125 contacts 121 are closed before contacts 160 are opened thereby maintaining relay 136 operated and consequently maintaining the bridge across the talking conductors of trunk circuit L^2 . The telephone set is thus
 130

disconnected and free for use but the switches at the automatic exchange are held by the bridge of relay 135 and contacts of relay 136. The switches are thus not released as a result of the movement of the cam K^4 from the talking to the holding switches.

When the operator at the position B^1 desires to converse with the calling station, the said operator will move the cam back into the position b^1 thereby connecting the telephone set circuit X^4 with the line trunk circuit.

Upon completion of conversation and when the connection is no longer desired, the cam of key K^4 will be moved into position a^1 . This serves to open all contacts of the right-hand group of key K^4 thereby removing the bridge from across the tip and ring conductors of the trunk circuit L^2 and causing the release of the switches at the automatic exchange in the well-known manner. The circuit is then ready for the next call.

What is claimed is:

1. In a signaling system, a circuit having associated therewith a supervisory relay, a holding circuit connected to said first circuit, a third circuit, and a single switch for transferring the connection of the said first circuit from the said holding circuit to the said third circuit and vice versa, without opening the circuit embracing the said relay.

2. In a signaling system, a circuit having associated therewith a relay, a supervisory signal controlled thereby, a holding circuit connected to said first circuit, a third circuit, and a single switch for transferring the connection of the said first circuit from the said holding circuit to the said third circuit and vice versa, without opening the circuit embracing the said relay and preventing the indication of a disconnect signal.

3. In a telephone system, a circuit having a supervisory relay, a holding circuit associated with said first circuit, a telephone circuit, and a single switch associated with said first mentioned circuit designed in its normal position to maintain open the circuit of said supervisory relay but arranged to close the circuit of said supervisory relay when the said circuit is connected to said telephone circuit, and to maintain the said supervisory relay circuit closed when the said circuit is transferred from said telephone to said holding circuit.

4. In a telephone system, a circuit having a supervisory relay, a holding circuit, a telephone circuit, and a single switch associated with said first mentioned circuit designed in its normal position to maintain open the circuit of said supervisory relay but arranged to close the circuit of said supervisory relay when the said circuit is con-

nected to said telephone circuit, and to maintain the said supervisory relay circuit closed when the said circuit is transferred from said telephone to said holding circuit and vice versa.

5. In a signaling system, the combination of a line circuit having associated therewith a supervisory signal adapted to indicate circuit conditions, a telephone circuit, a holding circuit, and a single switch designed normally to maintain open the circuit of said supervisory signal but adapted to close the supervisory signal circuit whenever the said line circuit is connected to the said telephone circuit, and to maintain the said supervisory signal circuit closed when the said line circuit is transferred from said telephone circuit to said holding circuit and vice versa.

6. In a signaling system, the combination with a first circuit of a cord circuit adapted for connection with the said first circuit, and having a supervisory relay associated therewith, a second circuit, a third circuit, and a single switch for connecting said first circuit with either said second or said third circuit without opening the connection between the sides of the said first circuit, whereby the said supervisory relay may be maintained in its operative position.

7. In a signaling system, the combination with a circuit having connected therewith, a cord circuit containing a supervisory relay, of a holding circuit connected to said first circuit, a third circuit, and a single switch for transferring the connection of the said line circuit from the said holding circuit to said third circuit without opening the connection between the two sides of the first mentioned circuit whereby the said supervisory relay may be maintained in its operative position.

8. In a signaling system, the combination with a circuit having connected therewith a cord circuit equipped with a supervisory relay, of a telephone circuit, a second circuit including a relay controlling said telephone circuit, a holding circuit and a multi-position switch adapted in one position to connect said supervisory relay in circuit with said second mentioned relay whereby said relays operate and said telephone circuit is connected to the cord circuit, and in another position to interchange said second circuit and said holding circuit to maintain said supervisory relay operated and to disconnect said telephone circuit from said cord circuit.

9. In a signaling system, the combination with a trunk circuit, a cord circuit equipped with a supervisory relay, a holding circuit for said relay, and a switching device having a normal and two successive operative positions, said device being adapted in its normal position to disconnect said trunk circuit from said cord circuit, in one of its operative

positions to connect said trunk circuit with said cord circuit, and in its other operative position to connect said cord circuit with said holding circuit.

- 5 10. In a signaling system, a first circuit having a supervisory device therein, a second circuit to be associated with said first circuit, a holding circuit to prevent the de-energization of said supervisory device, and
10 a switching device comprising a key having a normal and a plurality of successive operative positions whereby said first circuit and said second circuit will be normally disconnected, said first circuit and said second circuit will be connected when said switching
15 device is moved to one of its operative positions, and said first circuit and said holding circuit will be connected when said switching device is moved to another of its operative
20 positions.

11. An operator's telephone set, a circuit, an electroresponsive device in said circuit, a key having contacts for interrupting said circuit to connect or disconnect said opera-
25 tor's telephone set therefrom, and means associated with said key for substituting a second circuit for said operator's telephone set when the latter is disconnected from the circuit to prevent actuating said electrorespon-
30 sive device.

12. An operator's telephone set, a circuit having an electroresponsive device therein, a second circuit, and switching means between said set and said device and having succes-
35 sive movements in the same direction to connect said set to said circuit, to disconnect said set from said circuit, and to substitute said second circuit.

- 40 13. An operator's telephone set, a circuit, a second circuit, a switch having contacts in said first circuit, and connections for said switch whereby said operator's telephone set

and said second circuit may be interchangeably connected to said first circuit without thereby interrupting said first circuit. 45

14. In a signaling system, a plurality of operator's positions, a trunk circuit interconnecting said positions, a telephone circuit located at one of said positions, a supervisory circuit located at another of said positions 50 and a three position key adapted in one position to maintain said telephone circuit and said supervisory circuit disassociated when said trunk is seized at one of said positions, in another position to associate said tele- 55 phone circuit with said supervisory circuit, and in another position to disassociate said telephone circuit and said supervisory circuit and to substitute a holding circuit for said telephone circuit, thereby maintaining 60 said supervisory circuit closed.

15. In a signaling system, the combination with a trunk circuit, a cord circuit equipped with a supervisory relay, a telephone circuit, a relay for connecting said telephone circuit 65 with said trunk circuit, and a switching device having a normal and two successive operative positions, said device being adapted in its normal position to maintain said telephone circuit disassociated from said trunk 70 circuit, in one of its operative positions to establish a circuit for said relay whereby said telephone circuit is connected to said trunk circuit and said supervisory relay operated in series with said relay, and in its other 75 operative position to disconnect said relay and said telephone circuit from said trunk circuit and to substitute a holding circuit for said supervisory relay.

In testimony whereof, I have signed my 80 name to this specification this 22nd day of July 1920.

GEORGE W. KUHN.