

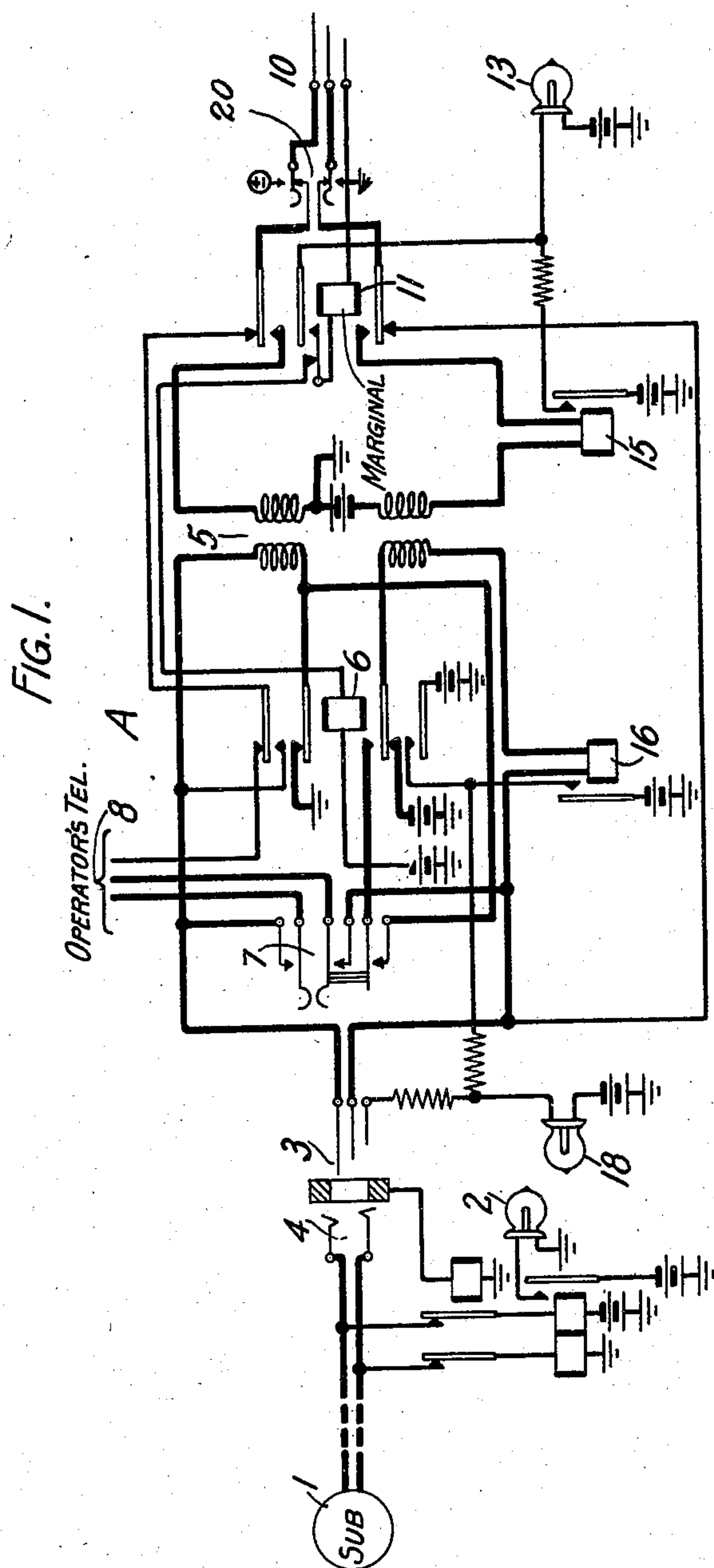
June 10, 1930.

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1,762,986

TELEPHONE SYSTEM

Original Filed March 30, 1927 2 Sheets-Sheet 1



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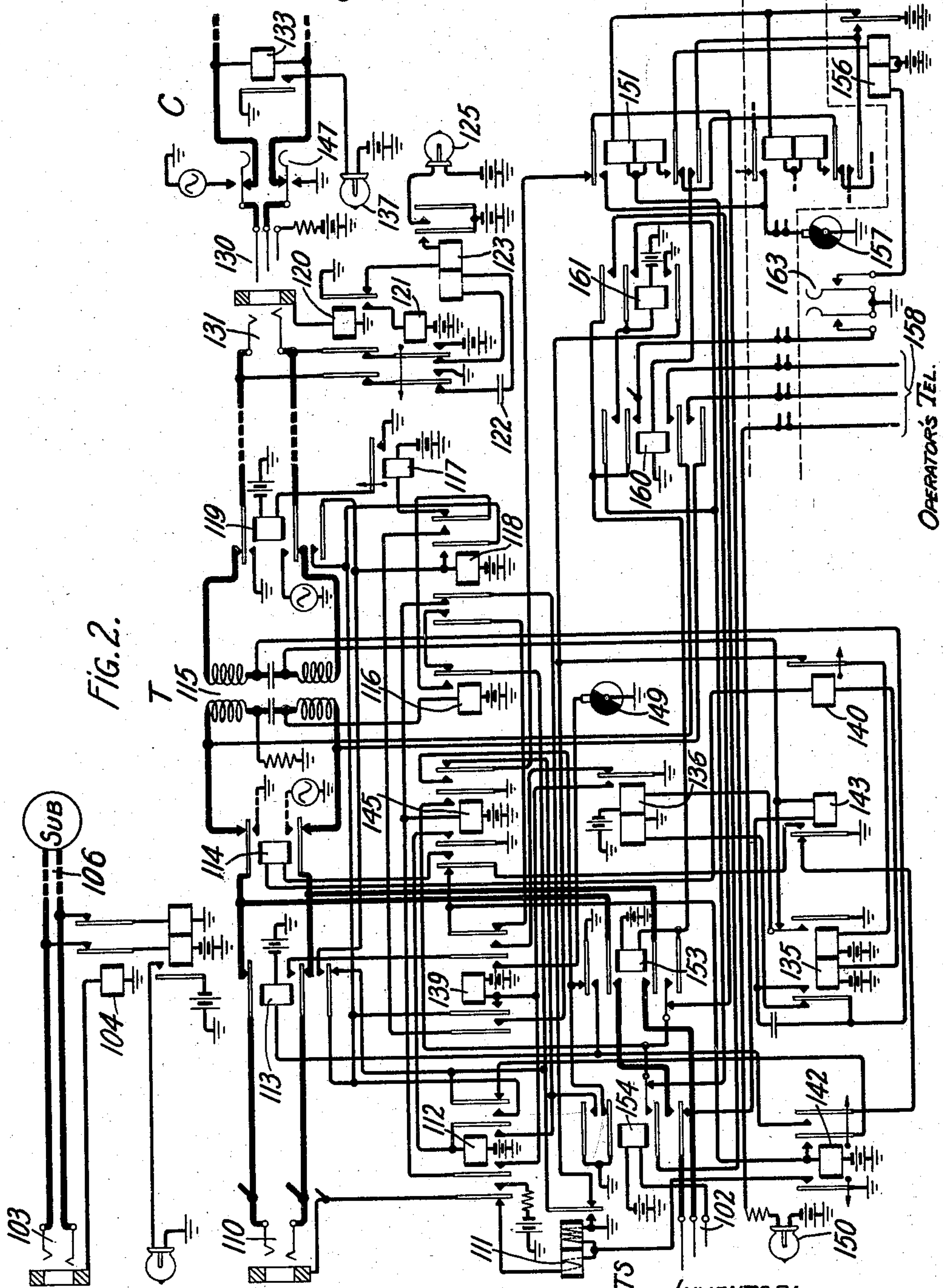
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2 Sheets-Sheet 2



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TELEPHONE SYSTEM

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This invention relates to telephone systems and more particularly to improvements in trunking systems.

In accordance with this invention there is provided a trunk circuit having a talking battery supply and a cord circuit which provides talking battery through a repeating coil when it is used for connecting ordinary subscribers' lines, but when the cord circuit is connected to the trunk, the repeating coil and talking battery in the cord are rendered ineffective.

The trunk and cord are further arranged so that when the cord is used for connecting ordinary subscribers' lines, the supervisory signaling arrangement in the cord circuit is controlled by the lines in the usual manner, while when the cord is connected to the trunk, the supervisory control of the connection is transferred to the operator's cord at the distant end of the trunk, that is, the signals in the first mentioned cord are then controlled by the distant operator who has connected to the distant end of the trunk with one of her cords.

The invention has been illustrated in the accompanying drawings, in which:—

Fig. 1 shows a cord circuit arranged in accordance with this invention and an ordinary common battery subscriber's line;

Fig. 2 shows a trunk circuit of the so-called recording and completing type arranged in accordance with this invention; and also a portion of a standard recording and completing or toll operator's cord circuit. This figure also shows an ordinary common battery subscriber's line.

The recording and completing trunk T shown in Fig. 2 is of the type whereby toll connections may be made between an ordinary subscriber's line, such as 1, to a toll operator's cord, such as C, through the A operator's cord at A, or connections from the toll operator's cord C to a toll switching operator's position TS where the trunk T terminates in a plug 102.

To clearly set forth the various features of the invention, a description will now be made of a call from the subscriber's line 1 to the subscriber's line 106, through the cord circuit A,

followed by a description of a call from the subscriber's line 1 to the toll operator at C through the cord circuit A and trunk T, and finally a description will be made of a call from the toll operator's cord C through the trunk T to an ordinary subscriber's line through the toll switching operator's position TS.

When the subscriber of line 1 takes his receiver off the hook, the signal 2 is actuated in the usual manner and the operator at cord A answers by connecting her plug 3 with jack 4 of line 1 and thereby causes the signal 2 to be extinguished as is well known in the art. A connection is now completed from the subscriber's loop through repeating coil 5 to ground and battery at the upper inner and lower inner armatures and back contacts of relay 6. To communicate with the calling subscriber, the operator at A now actuates her talking key 7 to connect her telephone set, not shown but connected to the leads marked 8, to the tip and ring conductors of the cord A.

The operator at A then receives from the calling subscriber the number desired. If the wanted line, for example line 106, can be reached through a multiple jack 103 at this operator's position, the operator will simply insert plug 10 into jack 103. This connection operates through the sleeve circuit, the marginal relay 11 and relay 6 due to the low resistance of the winding of cut-off relay 104. However, the operation of relay 11 opens at its make-before-break contacts the circuit for relay 6 which releases immediately, while the circuit for the marginal relay 11 now extended through the upper inner armature and front contact through signal 13 to battery. This causes the signal 13 to light for supervision. The operator at A now calls the subscriber of the line 106 by operating her usual ringing key 20, connected across the tip and ring conductors of cord A.

When the subscriber of line 106 answers the call, a circuit is completed through the subscriber's loop to the battery and ground through the winding of supervisory relay 15, the right hand windings of repeating coil 5 and the upper outer armature and front con-

tact and the lower armature and front contact of relay 11. The supervisory relay 15 operates to extinguish lamp 13 to indicate to the operator at A that the called subscriber has answered. A talking connection will now therefore be completed between the calling subscriber's line 1 and the called subscriber's line and conversation between the subscribers may begin. It should be noted that this connection is of the usual common battery type with the battery fed through the repeating coil 5. The battery for the calling subscriber's line is, as hereinbefore stated, supplied through the armatures of relay 6, while the battery for the called subscriber is supplied directly through the right hand windings of repeating coil 5. Supervision in this case is identical with the usual supervision in cord circuits of this type and need not be further described.

A connection from the subscriber's line 1 to a wanted subscriber's line through cord circuit A, trunk T and the toll operator's cord C will now be described. The subscriber of line 1 is connected with the operator at A in the manner above described and when the operator receives the information that a toll connection is desired, she will insert plug 10 into jack 110. A circuit is then completed through the sleeve circuit for the operation of relay 6 in the cord circuit and relay 111 in the trunk circuit. This circuit may be traced as follows: battery, winding of relay 6, make-before-break contacts and the winding of relay 11, sleeve terminals of plug 10 and jack 110, outer left hand armature and back contact of relay 112, both windings of relay 111 in series, to ground. Due to the high resistance of the right hand winding of relay 111 the marginal relay 11 will not operate in this circuit. The operation of relay 6 closes an unencumbered circuit between the tip and ring terminals of plug 10 and jack 110 as follows: The tip connection is made through the upper outer armature and front contact of relay 6 and the upper outer armature and back contact of relay 11, while the ring connection is completed through the lower armature and back contact of relay 11. The operation of relay 6 removes the battery and ground connection from the calling subscriber's line by the operation of its inner upper and lower armatures and the left hand windings of repeating coil 5 will be bridged across the tip and ring conductors as long as the talking key 7 is operated. This latter connection extends from the tip conductor to the upper left hand winding of repeating coil 5, lower contacts of talking key 7, lower inner armature and front contact of relay 6, lower left hand winding of repeating coil 5, through the winding of supervisory relay 16 to the ring conductor.

The above mentioned through connection

now extends from the loop of the subscriber's line 1 through the upper armature and the lower inner armature and back contacts of relay 113 and the armatures and back contacts of relay 114 to ground, through the upper left hand winding of repeating coil 115 for the tip conductor, and to battery through the lower left hand winding of repeating coil 115 and the winding of relay 116 for the ring conductor. Relay 116 operates in this circuit and closes a circuit for relay 117 as follows: battery, winding of relay 117, outer left hand armature and back contact of relay 118, armature and front contact of relay 116, armature and front contact of relay 111 to ground. Relay 117 in operating closes an obvious circuit for the operation of relay 119. The operation of this relay connects the alternating current source at its upper armature and lower inner armature and front contacts to the trunk conductors of trunk T, through the left hand armatures and back contacts of relays 120 and 121, through the condenser 122 and the left hand winding of relay 123. This impulse of ringing current is momentary only, as the operation of relay 119 closes a circuit for relay 118 as follows; battery, winding of relay 118, lower outer armature and front contact of relay 119, lower outer armature and back contact of relay 113, armature and front contact of relay 111 to ground. The operation of relay 118 opens the circuit for the relay 117 but as this relay is slow to release the opening of the circuit for relay 119 will be delayed a short interval sufficient to permit the operation of relay 123. Relay 118 in operating closes a locking circuit for itself through its inner right hand armature and front contact to the ground at the armature and front contact of relay 111. The operation of relay 123 closes an obvious circuit for signal 125 and also provides a locking circuit for itself through its inner left hand armature and left hand winding to the ground at the right hand armature and back contact of relay 120. Signal 125 in lighting indicates to the toll operator at C that a connection is desired over this trunk.

The toll operator in answering this call inserts plug 130 into jack 131 and thus closes an obvious circuit for the operation of relay 120. Relay 120 in operating causes the release of relay 123 so that lamp 125 is now extinguished. Relay 121 is operated over an obvious circuit by the operation of relay 120 but the battery and ground supplied at the armatures and front contacts of this relay have no effect on the circuits at this time, due to the operation of relay 120. The connection of plug 130 into jack 131 also closes a circuit loop through relay 133 to the tip and ring conductors through the upper armature and the lower inner armature and back contacts of relay 119, right hand windings of repeat-

ing coil 115, make-before-break contacts of relay 135, to battery through the right hand winding of relay 136 and to ground through the left hand armature and back contact of relay 135 and left hand winding of relay 136. This circuit causes the operation of relays 136 and 133. The operation of relay 133 closes an obvious circuit for the lighting of supervisory lamp 137, while the operation of relay 136 closes a circuit for the operation of relay 139 as follows; battery, winding of relay 139, armature and front contact of relay 136 to ground. Relay 139 in operating closes a locking circuit for itself through its inner left hand armature and front contact to the ground at the armature and front contact of relay 111. This relay also closes a circuit for the operation of relay 135 as follows; battery, right hand winding of relay 135, armature and back contact of relay 140, outer left hand armature and front contact of relay 139, outer left hand armature and front contact of relay 118, armature and front contact of relay 116 to the ground at the armature and front contact of relay 111. Relay 135 in operating opens the above mentioned circuit loop through relays 133 and 136. Relay 133 releases and causes lamp 137 to be extinguished to indicate to the toll operator at C that the connection to the calling subscriber has been completed through the trunk T. Relay 136, however, is maintained operated through its right hand winding by a circuit completed at the right hand armature and front contact of relay 135 to ground.

As a talking connection is now completed through repeating coil 115 from cord A to cord C the toll operator at cord C may connect her telephone set, not shown, across the tip and ring conductors of the cord and communicate with the operator at A and receive the number of the wanted subscriber. When this number is received the toll operator completes the connection to the wanted subscriber in the usual manner. The portion of the cord circuit C, whereby the connection to the wanted subscriber is completed, has not been shown as it is well known in the art and forms no part of this invention.

When the toll operator and the operator at A remove their telephone sets from their respective cords, conversation between the calling and called subscribers may begin and it will be noted that the circuit through the cord A for talking is a simple connection for the tip and ring conductors without any bridges or other connections attached thereto, and that the talking battery is supplied from the trunk T.

When conversation between the two subscribers is ended, either the calling subscriber or the toll operator may initiate the release of the connection. If the calling subscriber hangs up his receiver first, relay 116 will be released. The release of relay 116

causes the release of relay 135 and relay 135 in releasing completes the above mentioned connection to battery and ground through the windings of relay 136 for the operation of relay 133 in the cord C. This operation of relay 133 causes the lighting of lamp 137 to indicate to the toll operator that the calling subscriber has disconnected. The toll operator now removes plug 130 from jack 131, thus causing the release of relay 120. Relay 120 causes the release of relay 121 while the removal of plug 130 from jack 131 causes the release of relay 136. Relay 136 in releasing causes the operation of relay 142, over a circuit from battery, winding of relay 142, outer right hand armature and front contact of relay 139, armature and back contact of relay 136 to ground. Relay 142 in operating provides a locking circuit for itself through its inner right hand armature and front contact, to the ground at the armature and front contact of relay 111, and also short-circuits the right hand high resistance winding of relay 111. A circuit for relay 113 is also closed by the operation of relay 142 as follows; battery, winding of relay 113, outer right hand armature and front contact of relay 142, armature and back contact of relay 143 to ground. Relay 113 in operating opens the holding circuit at its lower outer armature and back contact for relays 139 and 118 which now release.

The short-circuiting of the right hand high resistance winding of relay 111 causes the operation of relay 11, and relay 11 in operating releases relay 6, and this relay in releasing causes battery to be removed from the sleeve circuit at the lower outer armature and front contact of relay 6 so that supervisory lamp 18 will now be lighted to indicate to the operator at cord A that the subscribers have disconnected. She will then remove plug 10 from jack 110 and plug 3 from jack 4. The removal of plug 10 from jack 110 causes the release of relay 111 and this relay in turn will release relays 142 and 113.

If the toll operator at C disconnects by removing her plug 130 from jack 131 before the subscriber of line 1 hangs up his receiver, the connection will be released in a somewhat different manner, that is, relay 120 will be released causing the release of relay 121, but as relay 121 is slow to release, battery and ground at the armatures and front contacts of this relay will be momentarily connected to the tip and ring conductors of trunk T. This connection provides a momentary energizing circuit for relay 143 which, as noted, is connected in a loop through the conductors of trunk T at the left hand armature and front contact of relay 135. This temporary operation of relay 143 closes a circuit for the operation of relay 142 as follows; battery, winding of relay 142, outer left hand armature and back contact of relay 145, armature and front contact of relay 143 to ground. Relay 142 in

operating closes a locking circuit for itself as hereinbefore mentioned, to the ground at the armature and front contact of relay 111 and short-circuits the high resistance winding of relay 111. It also causes the operation of relay 113 when relay 143 is released. The operation of relay 113 opens the circuit for relay 116. The release of relay 116 opens the circuit for relay 135 which causes the release of relay 136. Relay 136 causes the release of relay 139 which in turn releases relay 118 as relay 113 is operated. The short-circuiting of the high resistance winding of relay 111 causes lamp 18 to be lighted as hereinbefore described and the operator at cord A then removes the plugs of this cord from jacks 110 and 4, respectively, as hereinbefore mentioned to cause the circuits to be restored to normal condition.

If the toll operator at C should desire to recall the operator at line 1, she will operate her ringing key 147, thus connecting ringing current to the tip and ring of the trunk T, causing the operation of relay 143 which is also an alternating current responsive relay. This relay in operating closes the above mentioned circuit for the operation of relay 142. Relay 142 locks up, as hereinbefore mentioned, and on the release of relay 143 relay 113 is operated. Relay 136, however, remains operated even though relay 135 releases, so that relays 139 and 118 are not released on the operation of relay 113 and release of relay 116. As relays 139 and 113 are operated, the ring conductor of trunk T from the cord A is connected through the lower inner armature and front contact of relay 113 to the inner right hand armature and front contact of relay 139 through an interrupter 149 to ground, and as the high resistance winding of relay 111 is short-circuited by relay 142, relay 11 operates to connect the ground and battery through the right hand windings of repeating coil 5 to the tip and ring conductors. Hence the supervisory relay 15 is now alternately operated and released by the circuit completed from the ground at the interrupter 149 to battery at the lower right hand winding of the repeating coil 5, these operations of the supervisory relay 15 causing the alternate lighting and extinguishing of signal 13 to recall the operator at A. In answering this call signal from the operator at C, the operator at A removes plug 10 from jack 110 momentarily and thus causes the relays 11 and 111 to be released, relay 111 causing the release of relay 142 and relay 142 in releasing causing the release of relay 113. On the insertion of plug 10 into jack 110, relays 6 and 116 are again operated causing the reoperation of relay 135. The operator at A may now therefore operate her talking key 7 to communicate with the operator at cord C. As relays 139 and 118 are maintained operated, the in-

sertion of plug 10 into jack 110 will not cause the operation of relays 117 and 119 at this time.

If the toll operator at C desires to make a connection over trunk T to the toll switching operator's position at TS using the trunk T as a switching trunk, she will insert plug 130 in jack 131 to initiate the call. The operations of relays 120 and 121 are of no importance at this time. A circuit is established for the operation of relays 136 and 133. Relay 133 causes the lighting of signal 137 while relay 136 causes the relay 139 to be operated and as relays 111 and 118 are not operated, relay 145 is operated on the operation of relay 139 over a circuit as follows; battery, winding of relay 145, inner left hand armature and back contact of relay 118, armature and back contact of relay 111, lower outer armature and back contact of relay 113, inner left hand armature and front contact of relay 139 to the ground at the armature and front contact of relay 136. Relay 145 in operating closes an obvious circuit for the operation of relay 112, and this relay in operating disables the trunk for calls to the toll operator at C by opening the circuit for relay 111 at the outer left hand armature and back contact and by closing a busy circuit for the sleeve lead through a resistance to battery through the outer left hand armature and front contact. The operation of relay 145 closes a circuit for the lighting of the toll switching operator's guard lamp 150 as follows; battery, lamp 150, upper armature and back contact of relay 151, outer right hand armature and front contact of relay 145, upper outer armature and back contact of relay 153 to ground or to ground at the upper inner armature and back contact of relay 154. The lighting of this lamp indicates to the toll switching operator that a connection is desired.

Relay 145 also causes the operation of relay 151 over a circuit as follows; battery, armature and back contact of the relay 156, which is common to a plurality of trunks, through the upper winding of relay 151, make-before-break contacts of relay 153, inner right hand armature and front contact of relay 145 to ground. Relay 151 in operating closes a circuit for the operation of relay 156, that is, relay 156 operates from the ground at the inner right hand armature and front contact of relay 145 through a circuit from battery, right hand winding of relay 156 and inner lower armature and front contact and lower winding of relay 151. Relay 156 in operating removes the battery through the upper winding of relay 151 but the circuit for holding relay 151 operative now passes through the lower winding of this relay. The operation of relay 151 prevents the corresponding relay of any other trunk, in the group, from operating as the common battery normally supplied at the back contact and armature of relay 156 is

removed on the operation of relay 156. In other words, only one relay, such as 151, in the group of trunks at this position, can be operated at any one time. The operation of relay 151 changes the circuit for the toll switching operator's lamp 150 at the upper armature and connects the lamp through this armature and the corresponding front contact to a common interrupter 157 connected to ground. Lamp 150 will therefore now become alternately lighted and extinguished to indicate to the toll switching operator that her telephone set is connected to this particular circuit.

The manner in which the toll switching operator's telephone set, which is not shown but may be connected at the point 158, is associated with this particular trunk will now be described. On the operation of relay 156 and 151 a circuit is closed for the operation of relay 160 as follows; battery, armature and front contact of relay 156, lower outer armature and front contact of relay 151, winding of relay 160 to ground. Relay 160 in operating connects the tip and ring lead of the operator's telephone set connected at point 158 to the tip and ring conductors of trunk T through its lower armatures and front contacts. The operation of relay 160 also causes the operation of relay 161 over a circuit as follows; battery, winding of relay 161, upper outer armature and front contact of relay 160, to the above mentioned ground at the inner right hand armature and front contact of relay 145, and this relay 160 in operating closes an obvious circuit for the operation of relay 135. The operation of relay 135 opens the connection of the tip and ring conductors of trunk T through the cord C so that relay 133 now releases and lamp 137 is extinguished to indicate that the toll switching operator's telephone set has been connected to the line. It is noted, however, that relay 136 remains operated as hereinbefore described on the operation of relay 135. The toll operator at C may now connect her telephone set to the cord and thus get in communicative connection with the toll switching operator and pass the number of the wanted subscriber to said operator.

After this number is received, the toll switching operator may remove her telephone set manually from the circuit before she inserts plug 102 in the multiple jack of the wanted subscriber's line, not shown. However, the circuits are so energized that in case she does not remove her telephone set before she inserts the plug, the set will be automatically removed the moment the plug is inserted. To disconnect her telephone set before the connection is established to the wanted subscriber's line, the toll switching operator will actuate the common disconnect key 163. In operating this key a circuit is completed for the operation of relay 153 over a circuit as follows; battery, winding of

relay 153, inner upper armature and front contact of relay 160, key 163 to ground. Relay 153 provides a locking circuit for itself through its lower outer armature and front contact to the ground at the inner right hand armature and front contact of relay 145. This relay in operating also by opening its make-before-break contacts causes the release of relay 151 but it should be noted that relay 156 remains operated through a circuit established through its left hand winding by the operation of key 163. Relay 156 is maintained operated temporarily in order to prevent any other trunk from being connected with the toll switching operator's telephone set until this key has been released. The release of relay 151 opens the flashing circuit for lamp 150 and reestablishes the original circuit for lighting this lamp steadily. It should be noted in this connection that the ground for this lamp circuit at the armature and back contact of relay 153 is now removed while the other ground hereinbefore mentioned at the armature and back contact of relay 154 remains, so that this lamp circuit is now solely under control of relay 154. The release of relay 151 also opens the circuit for relay 160 which releases. Relay 161, however, remains operated as it established on its operation a locking circuit through its upper inner armature and front contact to the ground at the inner right hand armature and front contact of relay 145 independent of the original energizing circuit. Therefore, relay 135 is maintained operated while the toll switching operator's telephone set is disconnected on the release of relay 160. The operation of relay 153 also connects the tip and ring conductors from the plug 102 to the tip and ring conductors of the trunk T at the left hand side of the repeating coil 115. Another relay operated by relay 153 is relay 113. The circuit for this relay is obvious. Relay 113 disconnects the tip and ring conductors from the terminals of jack 110 to prevent connections being made to the trunk. The operation of relay 113 also closes a circuit for the operation of relay 118 as follows; battery, winding of relay 118, lower inner outer armature and front contact of relay 113, inner left hand armature and front contact of relay 139 to ground at the armature and front contact of relay 136. Relay 118 provides a locking circuit for itself, independent of the circuit through the lower outer armature and front contact of relay 113, through its inner right hand armature and front contact to the above mentioned ground at the armature and front contact of relay 136.

The circuit is now in condition for establishing a connection to the wanted subscriber's line and when the toll switching operator inserts plug 102 in the jack of the wanted line, relay 154 is operated through the sleeve lead in the usual manner. The op-

eration of relay 154 removes the busy test connection from the tip of plug 102 by opening the connection through the lower outer armature and back contact of relay 154 and connects the tip terminal of plug 102 to the tip conductor of trunk T at this armature and the corresponding front contact. The circuit for lamp 150 is opened through the operation of relay 154 so that this lamp will now be extinguished. The operation of relay 154 causes the operation of relay 153 if it has not already been operated by the key 163. The circuit for this relay is in this case as follows; battery, winding of relay 153, upper outer armature and front contact of relay 161, lower inner armature and front contact of relay 154 to ground at the inner right hand armature and front contact of relay 145. Relay 153 locks as hereinbefore described and closes a circuit for holding relay 113 operated when relay 143 operates as will hereinafter be described. The circuit for relay 161 is opened at the make-before-break contacts of relay 154 on the energization of this relay, and relay 161 in releasing opens the circuit for relay 135. Relay 135 in releasing closes the above mentioned circuit for the operation of relay 133 and the lighting of lamp 137 to indicate to the toll operator at C that the connection to the wanted subscriber has been established by the toll switching operator and that she may now ring the wanted subscriber. It should be understood, of course, that upon the operation of relay 153, in case key 163 has not been operated, relays 151 and 160 as well as relay 156 will release to disconnect the toll switching operator's telephone at this time.

The toll operator at C will now actuate her ringing key 147 and transmit ringing current to the trunk T to cause the operation of relay 143 over a circuit as hereinbefore mentioned. Relay 143 in operating closes a circuit for the operation of relays 114, 140 and 135. This circuit may be traced from battery, through the left hand winding of relay 135, winding of relay 140, winding of relay 114, outer left hand armature and front contact of relay 145 to ground at the armature and front contact of relay 143. All three relays will operate in this circuit. The operation of relay 140 performs no useful function at this time while the operation of relay 135 holds the relay 136 operated during the ringing period. The operation of relay 114 applies ringing current through its armatures and front contact over the tip and ring conductors to the wanted subscriber's bell.

When the subscriber answers the call by removing his receiver from the hook relay 116 will be operated through the subscriber's loop over the circuit established through the armatures of relays 153 and 154. Relay 116 in operating closes a circuit as hereinbefore traced for maintaining of relay 135 operated

when key 147 is released. Relay 133 is thereby maintained released to keep lamp 137 extinguished as an indication to the toll operator that the calling subscriber has answered the call. A connection is now completed from the called subscriber through to the toll switching operator's positions and the toll operator's position, the latter operator having previously established a connection to the calling subscriber's line. Conversation between the calling subscriber and the called subscriber may now begin.

In breaking down this connection, should the called subscriber hang up his receiver first, relays 116 and 135 would be released in succession and consequently lamp 137 lighted to indicate to the toll operator that the called subscriber has disconnected. The toll operator now removes her plug 130 from jack 131 and thus causes the release of relay 136 which in turn causes the release of relays 139, 145, 153, 113 and 118. The circuit for the toll switching operator's lamp 150 will now be completed over a circuit as follows; battery, lamp 150, upper armature and back contact of relay 151, outer right hand armature and back contact of relay 145, outer upper armature and front contact of relay 154 to ground. The lighting of this lamp indicates to the toll switching operator that the toll operator has released the connection and the toll switching operator thereupon removes plug 102 from the multiple jack of the called subscriber's line so that relay 154 now releases to extinguish lamp 150 and release relay 112, which, it will be noted, was held operated through a locking circuit established through its inner right hand armature and front contact to ground at the upper outer armature and front contact of relay 154. The purpose of maintaining relay 112 operated until this time is to maintain the busy condition on the jack 110 and maintain relay 145 operated after relay 118 operated as hereinbefore described.

If the toll operator at C disconnects before the called subscriber hangs up his receiver, relay 120 is released and eventually relay 121, but a momentary impulse from battery and ground at the armatures and front contacts of relay 121 will be transmitted over the trunk T to cause the operation of relay 143. This relay operates as relay 135 is maintained operated at this time due to the fact that relay 116 is operated. Relay 143 in operating closes a circuit for the operation of relays 114 and 140 and for holding relay 135 operative. The operation of relay 140, however, opens the original energizing circuit for relay 135 so that when relay 143 releases, relay 135 will release before it can be reenergized through the circuit later completed on the release of relay 140, relay 140 being slow to release. That is, the release of relay 135 causes the release of relay 136 and this relay

in turn releases relays 139, 145, 153, 113 and 118. Thus the original energizing circuit for relay 135 will be opened at relay 118 before relay 140 is fully released. The lamp 150 will therefore be lighted on the release of relay 145 and the lighting of this lamp indicates to the toll switching operator that the toll operator has released the connection and she will then return the circuit to normal by removing plug 102 from the calling subscriber's line as hereinbefore described.

It should be understood that the invention is not confined to the particular type of system disclosed and described, but that many modifications of the invention could readily be made without departing from the spirit thereof.

What is claimed is:

1. In a telephone exchange system, incoming lines, outgoing lines, a link circuit connecting an incoming line with an outgoing line, a repeating coil associated with said link circuit, means for establishing a low resistance non-inductive path around said repeating coil through said link circuit, and means associated with certain of said outgoing lines for actuating said last mentioned means to establish said path responsive to the establishing of a connection between the link circuit and one of said last mentioned outgoing lines.

2. In a telephone exchange system, incoming lines, outgoing lines, a link circuit for connecting an incoming line with an outgoing line, a repeating coil associated with said link circuit comprising a primary winding and a secondary winding, means for opening said primary winding, and means associated with certain of said outgoing lines for actuating said first mentioned means responsive to the establishing of a connection between the link circuit and one of said last mentioned outgoing lines.

3. In a telephone exchange system, incoming lines, outgoing lines, a manual link circuit for connecting an incoming line with an outgoing line, a repeating coil associated with said link circuit comprising a primary winding and a secondary winding, means for opening the primary winding and for establishing a low resistance non-inductive path around said repeating coil, and means associated with certain of said outgoing lines for actuating said first mentioned means in response to the establishing of a connection between said link circuit and one of said last mentioned outgoing lines.

4. In a telephone exchange system, incoming lines, outgoing lines, a link circuit for connecting an incoming line with an outgoing line, a repeating coil associated with said link circuit comprising a primary winding and a secondary winding, a source of current normally associated with said windings, means for disconnecting said source of cur-

rent from said primary winding, and means associated with certain of said outgoing lines for actuating said first mentioned means responsive to the establishing of a connection between said link circuit and one of said last mentioned outgoing lines.

5. In a telephone exchange system, in coming lines, outgoing lines, a link circuit for connecting an incoming line with an outgoing line, a repeating coil associated with said link circuit, a source of talking current normally connected with said repeating coil in such manner as to be supplied to an incoming line when said link circuit is connected therewith, and means associated with certain of said outgoing lines for causing said talking current to be disconnected from said incoming line when said link circuit is connected with one of said last mentioned outgoing lines.

6. In a telephone exchange system, incoming lines, outgoing lines of different characters, a link circuit for connecting the incoming line with the outgoing line, and having its talking conductors normally open, a source of talking current connected normally across the talking conductors, means for controlling the connection of said source of talking current to said link circuit, and means associated with said outgoing lines for controlling said first mentioned means to retain said source of talking current across the talking conductors of said link circuit and close connections through the talking conductors in response to the connection of an outgoing line of one character with the link circuit, and for disconnecting said source of talking current from across said talking conductors and close connections through said conductors in response to the connection of an outgoing line of the other character to said link circuit.

7. In a telephone exchange system, incoming lines, outgoing lines, a link circuit for connecting an incoming line with an outgoing line, a repeating coil comprising primary windings and secondary windings, a source of talking current associated with said primary windings and supervisory signals associated with said link circuit, means for establishing a low resistance non-inductive path around said repeating coil and source of talking current through said link circuit, means associated with certain of said outgoing lines for actuating said last mentioned means responsive to the establishing of a connection between said link circuit and one of said last mentioned outgoing lines, and means associated with said last mentioned outgoing line for controlling said signals.

8. In a telephone system, a link circuit at one exchange, a link circuit at another exchange, a trunk between said exchanges, a repeating coil comprising primary windings and secondary windings, a source of talking current associated with said primary windings and supervisory signals associated with

said first mentioned link circuit, means for establishing a low resistance non-inductive path around said repeating coil and source of talking current in said first mentioned link circuit responsive to the connection of said link circuit with said trunk circuit, means responsive to the connection and removal of said second mentioned link circuit from said trunk circuit for actuating said signals in one characteristic manner, a source of ringing current, and means responsive to the connection of said source of ringing current with the said second mentioned link circuit and the transmission of ringing current therefrom to said trunk circuit for controlling said signals in a characteristically different manner.

In witness whereof, I hereunto subscribe my name this 24th day of March, A. D. 1927.
EDWARD E. HINRICHSEN.