Feb. 1, 1927. 1,616,402

J. WICKS

AUTOMATIC TELEPHONE SYSTEM

Original Filed March 8, 1920 4 Sheets-Sheet 1

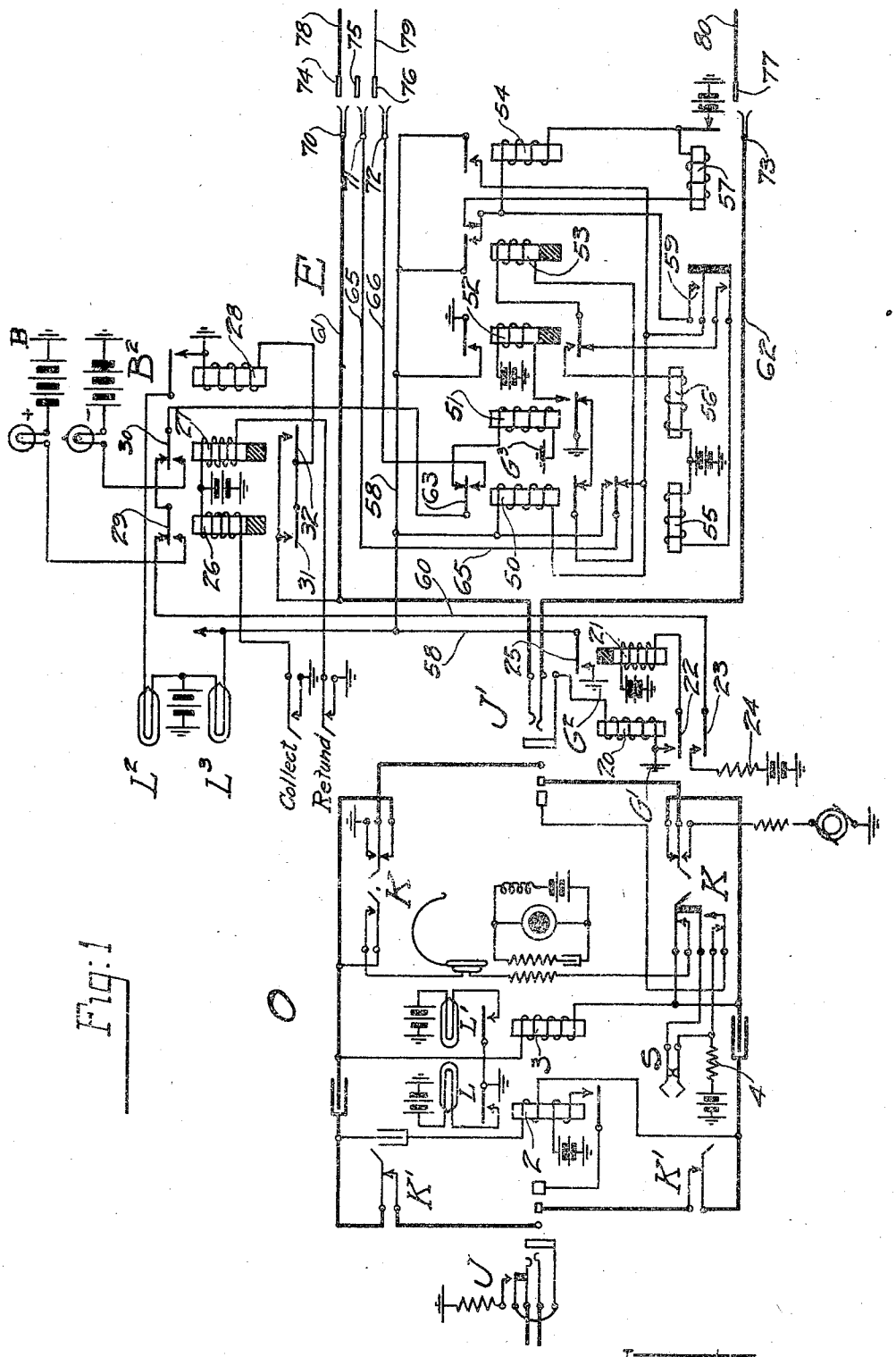


Fig: 1

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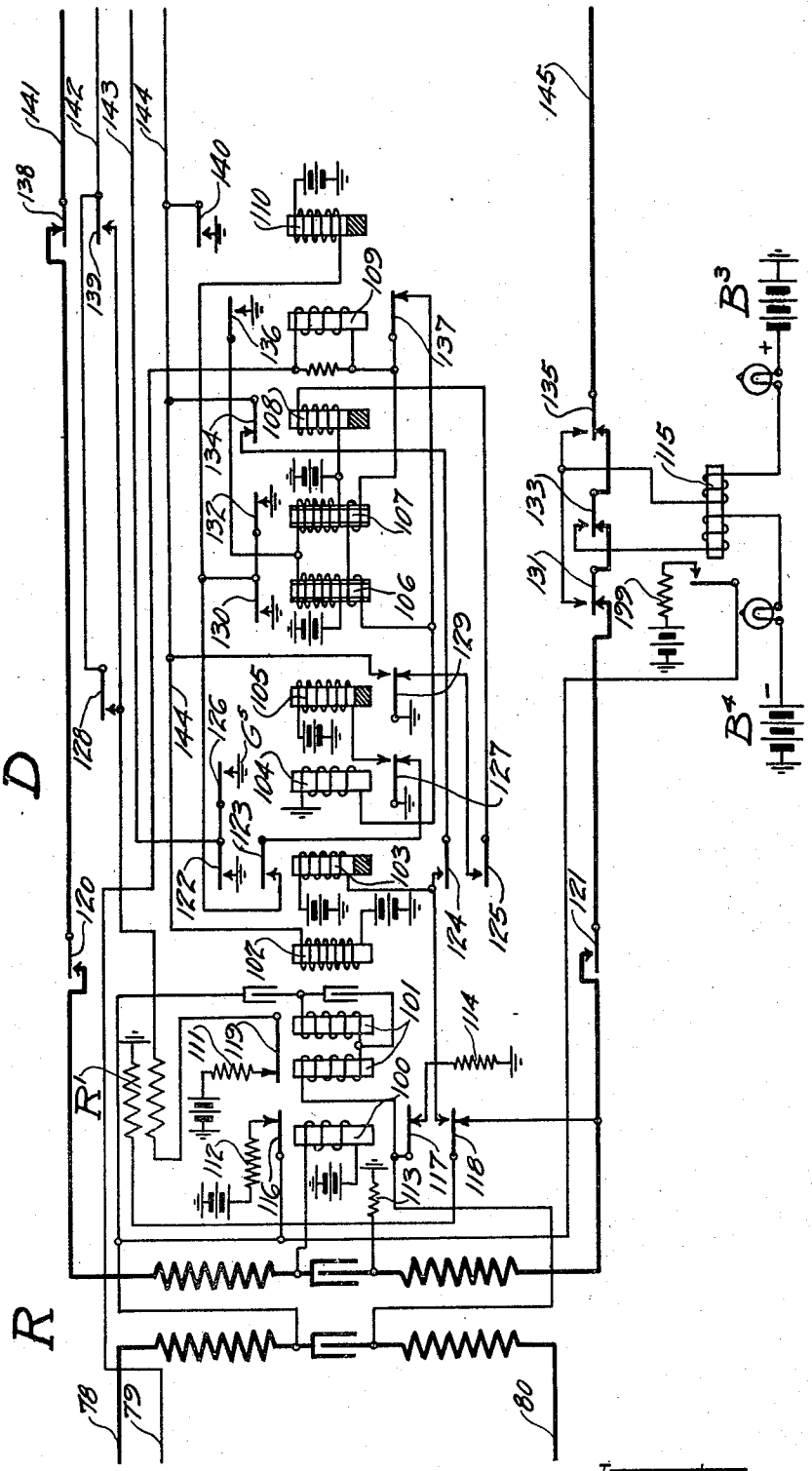
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Original Filed March 8, 1920 4 Sheets-Sheet 2

Fig. 2



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AUTOMATIC TELEPHONE SYSTEM

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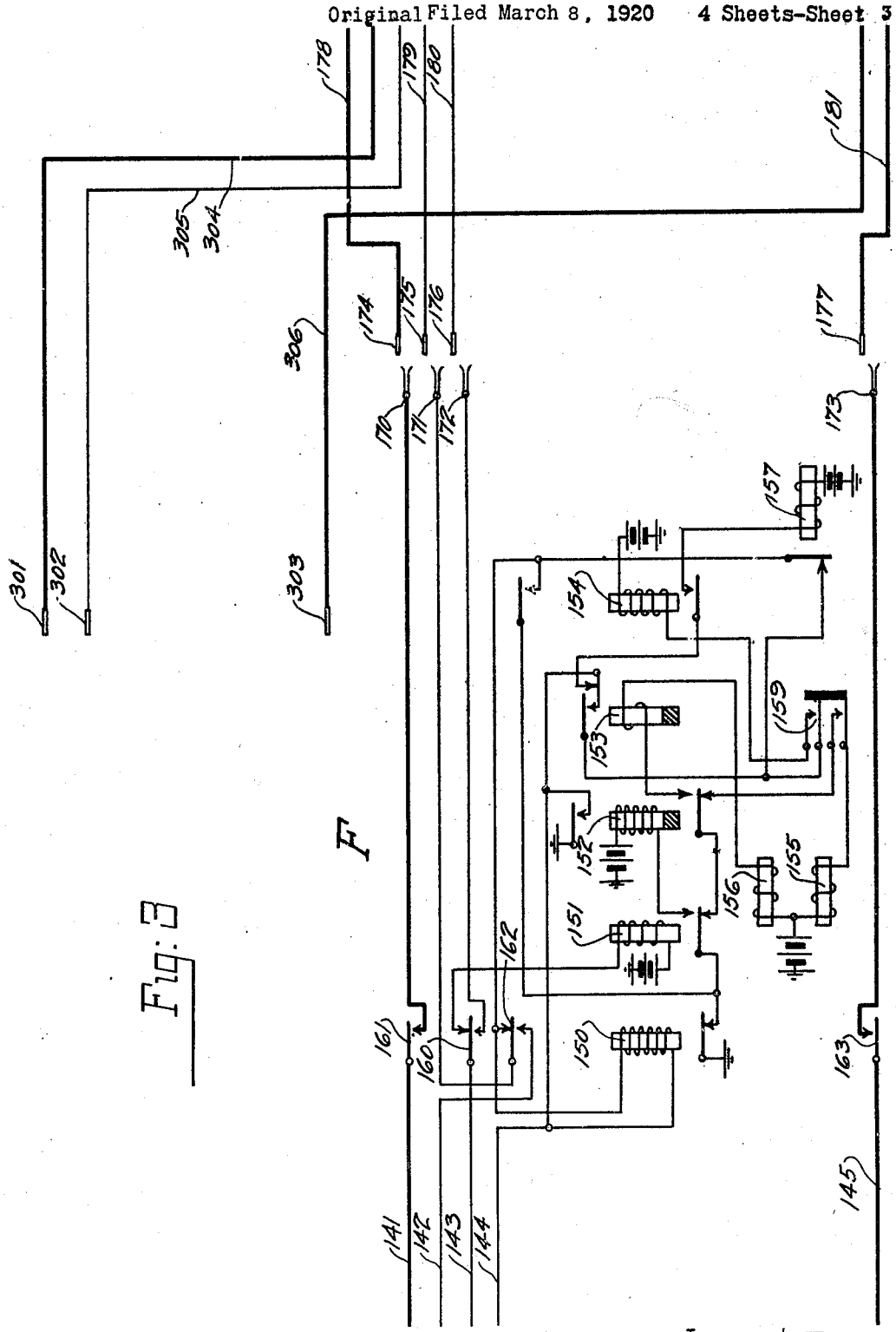


Fig. 3

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AUTOMATIC TELEPHONE SYSTEM

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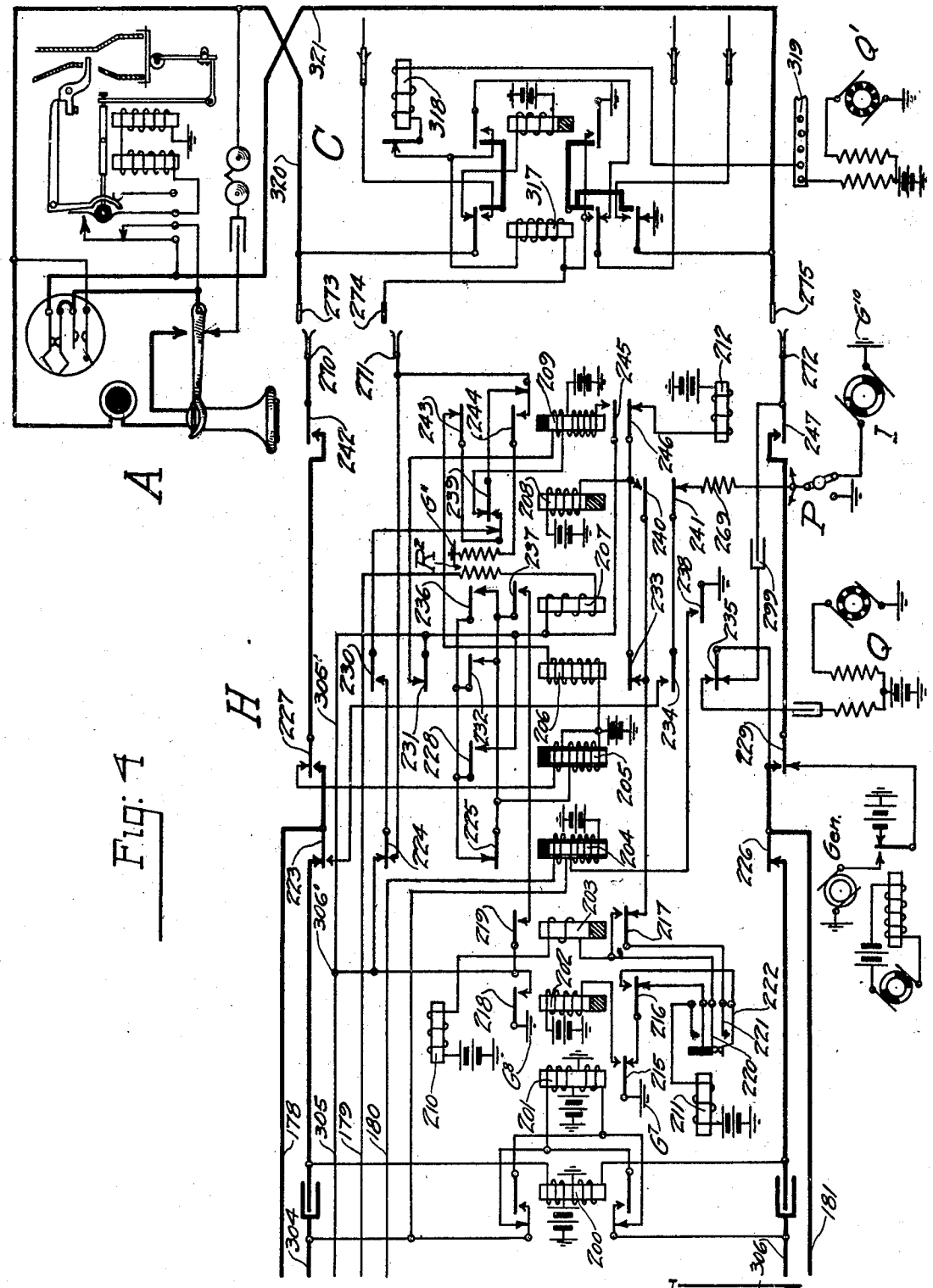


Fig. 4

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UNITED STATES PATENT OFFICE.

JOHN WICKS, OF OAK PARK, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

AUTOMATIC-TELEPHONE SYSTEM.

Application filed March 8, 1920, Serial No. 364,069. Renewed July 17, 1926.

My invention relates in general to automatic telephone systems but is concerned more particularly with methods of handling long distance calls in such systems, and the object of the invention, in general, is to provide a new and improved toll service trunking system for connecting local subscribers in automatic exchanges with long distance lines, either as calling or called subscribers.

Toll service trunking systems of the above character have been known before, and I wish to refer to U. S. Patent #1,315,444, issued to me on Sept. 9, 1919, which shows and fully describes a modern system of toll service trunks, and also to my pending applications, Serial Numbers 155,640 and 346,323, filed March 19, 1917, and December 20, 1919, respectively, which show various improvements in such systems. The present application is directed to the same general objects, and includes a number of improvements, one of which lies in the provision of circuit arrangements in a toll service trunking system, whereby a toll operator can successfully handle calls from subscribers' stations which are equipped with the well known coin collecting devices which are commonly known as Gray paystations, shown and described in the U. S. patent to Forsberg, #1,043,219, granted November 5, 1912. I have devised complete circuits which enable the toll operator to collect or refund deposited coins as desired, and which at the same time give the operator lamp supervision over the collecting and refunding operations according to standard practice.

In addition to the above I have found it advisable to make many circuit changes, and have made numerous other improvements not especially connected with the paystation feature, all of which will be pointed out and fully described in the detailed specification which follows. reference being had to the accompanying drawings forming a part thereof.

The subject matter claimed in the instant application is confined to that part of the system having to do with the control and operation of paystation mechanism, while the other features of novelty disclosed are being claimed in a division of this application bearing Serial No. 531,076, filed January 23, 1922.

In the drawings, comprising Figs. 1, 2, 3, and 4, I have shown by means of the usual circuit diagrams the apparatus and circuit connections necessary to establish a complete connection in my improved toll service trunking system. In view of the well known character of the apparatus involved and of the descriptions thereof in the publications previously referred to, it will be unnecessary to describe such apparatus in detail in the present application, but such mention thereof as seems to be called for will be included along with the explanation of the circuit improvements in which the real invention lies, and which will now be proceeded with.

For this purpose it will be assumed that the subscriber at substation A, Fig. 4, has placed a long distance call with a toll recording operator and that the ticket containing the usual data concerning the desired connection has been forwarded to the toll operator having the cord circuit O, Fig. 1, for completion. Having extended a connection to the desired distant exchange over one of her toll lines, as for example the toll line which terminates in jack J, Fig. 1, and having ordered the proper local line to be connected up in that exchange, the toll operator will next proceed to call the subscriber at substation A by way of the toll service trunking system. Observing that the toll service trunk terminating in jack J′ is idle, as indicated by the unlighted condition of the busy lamp L^3, the operator will insert the calling plug of cord circuit O in the said jack J′, the combination ringing and listening key K being thrown to listening position. Upon the insertion of the plug in the jack J′ a circuit is completed for relay 20 as follows: ground at G′, winding of relay 20, sleeve of jack J′, sleeve of plug, contact springs of key K, the impulse springs of the call device S, and the resistance 4 to battery. Upon the closure of the above circuit relay 20 is energized and completes a circuit for the slow acting relay 21, which upon energizing in turn connects ground G^2 to the release trunk conductor 58 extending to the toll selector E. A branch of this conductor extends to the busy lamp L^3 and its multiples in other positions (not shown), and the lamps are lighted to indicate that the trunk line associated therewith is busy. When relay 20 energizes it also closes a control or

operating circuit for the toll selector E which may be traced as follows: ground at G^3, winding of the line relay 51, resting contact of armature 63 and the said armature, armature 30 and its resting contact, armature 29 and its resting contact, conductor 60, armature 23 and its working contact, and the resistance 24 to battery. Upon the closure of the above circuit the line relay 51 is energized and closes the circuit of the slow acting release relay 52. Upon energizing, the latter relay prepares the selector switch for operation in its vertical movement in the usual manner, and at its upper armature connects ground to the release trunk conductor 58, as it is desirable to have this conductor grounded locally while the switch is being operated.

The toll operator will now operate her calling device S in accordance with the telephone number of the subscriber at substation A. When the calling device dial is operated in accordance with the first digit of the number, a series of interruptions is produced in the circuit of the relay 20. Responsive to these interruptions in its circuit, relay 20 deenergizes momentarily a corresponding number of times, and produces a series of interruptions in the circuit of the line relay 51 of the toll selector E. The line relay 51 is therefore deenergized a plurality of times corresponding to the digit called, and at each deenergization sends a current impulse through the slow acting series relay 53 and the vertical magnet 56 to battery. By the operation of the vertical magnet the switch shaft is raised step by step until the wipers 70–73, inclusive, stand opposite the horizontal level of bank contacts which are terminals of trunk lines leading to the desired thousand group. The slow acting series relay 53 is energized in series with the vertical magnet, maintaining its armature continuously attached during the vertical operation of the switch, and closes a circuit for the stepping relay 54. The stepping relay 54 is therefore energized, and when the off normal springs are shifted at the first upward movement of the switch shaft, establishes a locking circuit for itself by way of the off normal springs 59. At the end of the vertical movement of the switch the slow acting relay 53 is deenergized and completes a circuit for the rotary magnet 57 which extends from the grounded conductor 58 by way of the armature of stepping relay 54 and its working contact, the off normal springs 59, and contact springs controlled by the armature of relay 53 to the said rotary magnet 57. The rotary magnet is accordingly energized and advances the wipers 70–73, inclusive, into engagement with the first set of bank contacts in the level opposite which they were raised. Near the end of its stroke the rotary magnet breaks its own circuit and also the circuit of the stepping relay 54, which is accordingly deenergized to open the circuit of the rotary magnet at another point. Both the rotary magnet 57 and the stepping relay 54 having deenergized, the operation now depends upon whether the test contact with which the test wiper 71 is in engagement is busy or is not busy. If this test contact is busy, it will have a ground potential upon it and a circuit will be established which extends by way of the said test wiper, conductor 65, lower armature of relay 50 and its resting contact, off normal springs 59, and the winding of the stepping relay 54 to battery. By current flow over the above circuit the stepping relay 54 is again energized and again closes the circuit of the rotary magnet 57 which in turn operates to advance the switch wipers into engagement with the next set of bank contacts. This operation continues as long as the test wiper 71 continues to engage grounded test contacts. As soon as the first non-grounded test contact is reached, which we will assume to be the test contact 75 associated with the trunk line comprising conductors 78, 79, and 80, the stepping relay 54 will not again be energized, and the rotary movement of the switch will cease. The switching relay 50, which heretofore has been short circuited, is now energized over the following circuit: grounded conductor 58, winding of the switching relay 50, off normal springs 59 and the winding of the stepping relay 54 to battery. Relay 50 is of such high resistance that the stepping relay 54 is not energized. Upon energizing, relay 50 connects the grounded conductor 58 to the test wiper 71 in order to make the multiples of test contact 75 busy to other switches, opens another point in the circuit of the release magnet 55, and at its armature 63, disconnects the control or operating circuit from the line relay 51 and extends it by way of the working contact of the said armature 63, conductor 66, wiper 72, bank contact 76, conductor 79, winding of the marginal relay 109 of the repeater D, Fig. 2, armature 137 and its resting contact, and the winding of the line relay 104 to ground. Upon the extension of the control circuit as above described, the line relay 104 is energized and completes a circuit for the slow acting release relay 105. Upon energizing, relay 105 connects ground at its armature 129 to the release trunk conductor 144 thereby closing a circuit for relay 102 which upon attracting its armatures 120 and 121 closes the upper and lower talking circuit conductors through the repeater. It should be mentioned that the relay 109, which is included in the circuit of the line relay 104, is shunted by a non-inductive resistance and is marginally adjusted so that it will not energize at the present time.

The talking strands of the operator's cord

circuit have now been extended by way of the springs of jack J', the conductors 61 and 62, wipers 70 and 73, bank contacts 74 and 77, conductors 78 and 80, left hand windings of the repeating coil R, armatures 116 and 117 of relay 100 and their respective resting contacts, and resistances 112 and 114 to battery and ground, respectively. It follows that the bridged supervisory relay 3 at the cord circuit O will be energized to light the supervisory lamp L'. It may be mentioned at this time that after the relays 51 and 52 of the toll selector E have deenergized, the switching relay 50 is maintained energized over the release trunk conductor 58 coming from the armature 25 of the slow acting relay 21, which relay is associated with the jack J'. This method of establishing a holding circuit by extending the ground forward instead of backward is contrary to the usual practice, but is adopted here because in certain circumstances the selector E and repeater D may be located in different exchanges, in which case it is desirable to eliminate the release trunk conductor extending from the repeater back to the selector.

When the line relay 104 of the repeater D was energized as previously explained, a control or operating circuit extending to the line relay 151 of the toll second selector F, Fig. 3, was completed as follows: ground at G^5, working contact of armature 126 and the said armature, conductor 143, armature 160 and its resting contact, and the winding of the line relay 151 to battery. Upon the closure of the above circuit the line relay 151 is energized, and completes a circuit for the slow acting release relay 152 in the usual manner. Upon energizing, relay 152 grounds the release trunk conductor 144 locally at its upper armature, and at its lower armature prepares the circuits of the selector for the vertical operation thereof. The toll operator may now operate the dial of her calling device S in accordance with the second digit in the number of the subscriber at substation A. The interruptions produced by this operation are repeated by relay 20 and by the line relay 104 of the repeater D, and cause a series of deenergizations of the line relay 151 of the selector F. The toll second selector F is very similar to the selector E and its operation therefore will not be described in detail. It will be sufficient to say that the deenergizations of the line relay 151 bring about the operation of the vertical magnet 156 through the medium of which the switch shaft is raised step by step until the wipers 170–173, inclusive, stand opposite the horizontal level of bank contacts which are terminals of trunk lines leading to the desired group of connector switches. The slow acting relay 153 is energized in series with the vertical magnet and at the first upward step of the shaft closes the initial energizing circuit of the stepping relay 154 by way of the off normal contact springs 159. The stepping relay 154 locks itself as usual and prepares a circuit for the rotary magnet 157. At the end of the vertical movement of the switch, the slow acting relay 153 is deenergized and the switch wipers are rotated in search of an idle trunk line by means of the rotary magnet 157, which is controlled by the stepping relay 154 and the test wiper 171. When an idle trunk line is reached, which we will assume to be the trunk line comprising conductors 178–181, inclusive, the rotation of the switch will cease, leaving the wipers 170–173, inclusive, in engagement with bank contacts 174–177, inclusive. The switching relay 150 is now energized and at its armatures 161 and 163 connects the talking conductors 141 and 145 with the line wipers 170 and 173, respectively. Relay 150 also extends conductors 142 and 143 by way of its armatures 162 and 160, wipers 171 and 172, and bank contacts 175 and 176 to conductors 179 and 180. The conductor 143 is included in the control circuit of the toll selector F, and when it is extended as above mentioned, the line relay 151 and the release relay 152 of the selector are of course deenergized, the selector being maintained in operated position by the continued energization of the switching relay 150, which is supplied with ground over the conductor 144 coming from the repeater D.

The switch control circuit having been extended, as above stated, to the conductor 180, it may be further traced by way of the said conductor 180, the upper winding of the relay 204 of the combination connector H, Fig. 4, contact springs controlled by the back bridge relay 200, and the upper winding of the line relay 201 to battery. Upon the extension of the control circuit over the above path, the line relay 201 is energized and completes a circuit for the slow acting release relay 202, which at its armature 216 prepares the connector for vertical operation in the usual manner. At its upper armature 218, relay 202 connects ground G^8 with the release trunk conductor 305, which conductor extends to and is multipled in the banks of the second selectors of the regular exchange trunking system which have access to the combination toll and regular connector H. Conductor 305 is the release trunk conductor of the trunk line comprising conductors 304, 305, and 306, which terminate in bank contacts 301, 302, and 303 respectively, Fig. 3. These bank contacts are assumed to be located in the banks of one of the regular selectors referred to, and the ground potential upon conductor 305, and the test contact 302 and its multiples, renders the connector H busy.

A branch of conductor 305 may be traced

from junction point 306′ by way of conductor 305′, winding of relay 207, left hand winding of the induction coil R^2, conductor 179, bank contact 175, wiper 171, armature 162 and its working contact, conductor 142, armature 128 and its working contact, lower winding of the induction coil R^1, armature 119 and its resting contact, and the resistance 111 to battery. By current flow over the above circuit the relay 207 is energized and at its armatures 236 and 237 prepares circuits for the ring cut off relay 205 which will be explained later. Relay 207 also closes a circuit for the switching relay 204 by means of its armature 238, and the latter relay upon energizing produces a number of circuit changes in the connector which are brought about for the purpose of enabling it to function as a toll connector rather than as a regular connector. These circuit changes include the opening of the permanent locking circuit of the ring cut off relay 205 at armature 225, the shifting of the locking circuit of the busy test relay 206 at armature 224, the disconnection of the regular truck line conductors 304 and 306 at armatures 223 and 226, and the preparation of a busy signalling circuit for the toll operator at armature 223. These circuit changes and the results effected thereby will be mentioned more in detail hereinafter. Before proceeding further with the explanation a few more details concerning relays 207 and 204 may be inserted with benefit. Relay 207 is of relatively low resistance, and the circuit traced through its winding from the grounded conductor 305 to the conductor 179 and test contact 175, places a potential upon the said test contact 175 and its multiples which is sufficiently near to ground potential to render the connector H busy to the toll second selectors. With regard to relay 204, the upper winding of this relay, which is included in the circuit of line relay 201, is of low resistance and is not necessarily strong enough to energize the relay by itself, but is strong enough to hold the said relay in operated position after it has been completely operated by the closure of the circuit through its lower winding. In order to reduce the impedance of the upper winding so as not to interfere with operating impulses transmitted to the line relay 201, the relay 204 is provided with a copper slug as indicated in the drawing.

The connector H is now ready to be operated under the control of the calling device S, when the dial is actuated in accordance with the next digit in the number of the subscriber at the substation A. A series of interruptions is produced as before, which are repeated by the relays 20 and 104 to bring about a series of deenergizations of the line relay 201. At each deenergization the line relay transmits a current impulse through the vertical magnet 210 over the following circuit: ground at G^7, armature 215 and its resting contact, armature 216 and its working contact, off normal springs 222 and 220, winding of the slow acting series relay 203, and winding of the vertical magnet 210 to battery. This is the circuit over which the first impulse is transmitted. At the first upward step of the switch shaft, however, the off normal springs are shifted, and the circuit extends from the working contact of armature 216 by way of off normal springs 222 and 221, armature 217 and its working contact, (relay 203 being now energized), winding of the relay 203, and the winding of the vertical magnet 210 to battery. By the operation of the vertical magnet the switch shaft is raised step by step until the wipers 270–272, inclusive, stand opposite the level of bank contacts in which the line of substation A is terminated. The slow acting relay 203 which is energized in series with the vertical magnet, maintains its armature attracted throughout the vertical operation of the switch. When this relay energizes at the beginning of the vertical movement it closes the following circuit for the ring cut-off relay 205: ground at G^8, armature 218 and its working contact, armature 219 and its working contact, working contact of armature 237 and the said armature, and the lower winding of the ring cut off relay 205 to battery. Upon energizing, relay 205 opens contacts included in a later established signalling circuit at its armatures 227 and 229, and at its armature 228 establishes a locking circuit for itself as follows: grounded conductor 305′, working contact of armature 228 and the said armature, armature 236 and its working contact, and the lower winding of relay 205 to battery. At the end of the vertical movement of the switch, the slow acting relay 203 deenergizes and prepares the connector for operation in its rotary movement.

The toll operator may now operate the dial of the calling device S in accordance with the final digit in the number of the subscriber at substation A. The interruptions produced are repeated as before through the medium of relays 20 and 104, and cause another series of deenergizations of the line relay 201 of the connector H. At each deenergization the line relay now sends a current impulse through the rotary magent 212 over the following path: ground at G^7, armature 215 and its resting contact, armature 216 and its working contact, off normal springs 222 and 221, armature 217 and its resting contact, resting contact of armature 233 and the said armature, armature 246 and its resting contact, and the winding of the rotary magnet 212 to battery. In

response to these impulses the rotary magnet operates to rotate the wipers 270–272, inclusive, into engagement with the particular set of bank contacts in which the line of substation A terminates, these bank contacts being the contacts indicated in the drawing by the reference characters 273, 274, and 275. The slow acting relay 208 is energized in parallel with the rotary magnet and retains its armatures attracted throughout the rotary movement of the switch. At its armature 239, relay 208 connects the test wiper 271 to the winding of the busy test relay 206, and at its armature 240 relay 208 closes a shunt around armature 233 of relay 206 and its resting contact to guard against the possibility of the said relay being momentarily energized while the test wiper 271 is passing over busy test contacts. In order to afford an opportunity to explain the operation of the busy test circuits it will be assumed that when the line of substation A is called at this time it is busy. In such case the test contact 274 will be grounded and when the test wiper 271 makes connection with the said test contact, the test relay 206 will be energized, the circuit being traceable as follows: grounded test contact 274; test-wiper 271, contact springs controlled by armature 244, of relay 209, armature 239 and its working contact, armature 243 and its resting contact, and the winding of the test relay 206 to battery. The test relay is energized over the above circuit and when the slow acting relay 208 deenergizes at the end of the rotary movement of the switch, the test relay becomes locked up by means of the following circuit: grounded test contact 274, test wiper 271, working contact of armature 224 and the said armature, working contact of armature 230 and the said armature, contact springs controlled by armature 239 of relay 208, armature 243 and its resting contact, and the winding of the test relay 206 to battery. The various circuit changes effected by the operation of the test relay will now be briefly pointed out. Its locking circuit which is closed at armature 230 has just been explained. At armature 231 the circuit of the switching relay 209 is opened, at armature 232 a shunt is connected around the armature 236 of relay 207 and its working contact in order to prevent accidental deenergization of the ring cut off relay 205 (by movement of ringing key at the operator's cord circuit) at armature 233 the circuit of the rotary magnet 212 is opened in order to prevent the switch wipers from being rotated off the contacts of the called line, and at armature 235 a lead from the busy signalling machine Q is connected to the lower line conductor 181. The conductor 181 extends back through the selector F, to the lower right hand winding of the repeating coil R, and it follows that the toll operator will be given an audible busy signal indicating to her that the called line is busy. This busy signalling operation is similar to methods in common use, and will be understood without further explanation. The operator is also given a visual flash busy signal in the following manner: When the test relay 206 is energized a circuit is completed which extends from ground by way of the interrupter I, switch P, resistance 269, resting contact of armature 241 and the said armature, armature 234 and its working contact, and the working contact of armature 223 and the said armature to the upper line conductor 178, whence the circuit may be traced over the upper conductor of the talking circuit back to the upper right hand winding of the repeating coil R, and through this winding and the winding of the battery feed relay 100 to battery. The circuit above traced is intermittently opened and closed by means of the interrupter I, and it follows that the relay 100 will be intermittently energized and deenergized. By this operation of the relay 100, battery and ground are intermittently disconnected from the trunk conductors 78 and 80, causing an intermittent operation of the supervisory relay 3 at the operator's cord circuit. This gives the operator a visual busy signal. If it is desired to depend solely on the audible busy signal, the switch P may be set so that the interrupter I is cut out of the circuit, thereby providing for the permanent extinguishing of the supervisory lamp when a busy line is called, and in the case of the cord circuit O, shown herein, this might well be done because the calling device key and the listening key are combined in one structure, and when the operator finishes dialling a number her head set is necessarily cut across the trunk circuit in readiness to receive an audible busy signal. However, certain types of cord circuits have separate calling device keys so that the operators can dial numbers and set up connections while talking on other circuits and in such cases the busy flash signal is of great utility; and it is of considerable value even in the present system, because it is a constant reminder to the operator that she has a connection up on a busy line, and thus removes the possibility of her confusing the connection with an answered call.

To proceed with the explanation, the toll operator will now restore her listening key K and may proceed to work on other connections while waiting for the line of substation A to become idle, first, however, operating the cut off key K′ in her cord circuit in order to prevent the busy tone from passing out over the toll line. Or she may withdraw the plug from the jack J if she prefers. As soon as the line of substation A becomes idle, ground potential is removed

from the test contact 274 and the locking circuit of the test relay 206 is broken. The test relay therefore deenergizes, disconnects the busy signalling machine Q, opens the busy flash signalling circuit, and establishes a circuit for the switching relay 209 which may be traced as follows: grounded conductor 305′, armature 231 and its resting contact, upper winding of the switching relay 209, resting contact of armature 239 and the said armature, contact springs controlled by armature 244, test wiper 271, test contact 274, winding of the switching relay 317 of the individual line switch C; and the winding of the stepping magnet 318 to the common bus-bar 319, whence it extends by way of the low resistance secondary winding of the tone test signalling machine Q′ to battery. Upon the closure of the above circuit relays 209 and 317 are energized in series, and the latter relay is operated to disconnect the line conductors 320 and 321 from their normal connections in the line switch. Relay 317 is not completely operated because of the fact that the line relay of the line switch has not been energized and does not connect the line conductors with the wipers of the line switch. In the connector H, the relay 209, upon energizing, opens the circuit of the rotary magnet 212 at armature 246, establishes a locking circuit for itself at armature 245, connects ground G^{11} to the test wiper 271 at armature 244, thus closing the circuit of the switching relay 317 of the line switch over a new path excluding the upper winding of relay 209 which was formerly included in the circuit, and at armatures 242 and 247 closes the talking circuit through to the line wipers 270 and 272.

The connection has now been established with the line of substation A. When the busy test relay 206 is deenergized and the connector cuts through on to the called line as described in the preceding paragraph, the supervisory lamp L′ at the operator's cord circuit stops flashing and is lighted continuously, thus indicating to the operator that the busy line with which that particular cord circuit is connected has become idle and that the connection thereto has been completed. The operator will now go in on the line with her listening key in order to listen for the tone test which is associated with the paystation lines. The stepping magnets in the individual line switches of the paystation lines are supplied with battery through the low resistance secondary winding of the tone test transformer, indicated in Fig. 4, by the reference character Q′. Apparatus of this kind is well known and has been used before to indicate to an operator the character of a calling line, a system of this character being shown in the U. S. patent to Bernard D. Willis, No. 1,281,112, granted October 8, 1918. I believe, however, that this is the first time a circuit arrangement has been provided for giving the toll operator a distinctive tone test through a toll service trunking system to indicate the character of a called line. As disclosed herein, the tone is transmitted to the operator by means of induction coil R^2, induction coil R′, and repeating coil R. The circuits are not especially difficult, and need not be traced out in detail. To proceed, the operator is advised by the distinctive tone in her receiver that the subscriber whom she has called over her toll service trunks and who desired a toll connection is a paystation subscriber and she will know therefore that the call will have to be paid for in cash and will not be charged.

The next operation is to ring the subscriber at substation A. For this purpose the operator throws the key K momentarily to ringing position, thereby projecting ringing current out over the trunk line with which the cord circuit O is connected, to operate the alternating current relay 101 at repeater D. Upon attracting its armature 119, relay 101 breaks the previously described circuit of the relay 207 at the connector H. Relay 207 accordingly deenergizes and at its armature 236 breaks the locking circuit of the ring cut-off relay 205. Relay 205 then deenergizes and at its armatures 227 and 229 opens the talking conductors and establishes the usual signalling circuit which includes the ringing current generator Gen. and its own upper winding. There is no especial novelty in the signalling circuit itself, and the bell at substation A will be rung automatically as long as the receiver remains on the hook. During the ringing operation the operator is given the well known "ringing current induction," provided of course that she is listening on the line, to notify her that the ringing is proceeding satisfactorily. This is accomplished by means of the inductive path which extends from armature 247 of relay 209 by way of the low capacity condenser 299 to the resting contact of armature 235 of relay 206. Condenser 299 is of very low capacity, perferably about .005 micro farads, and permits just enough ringing current to leak back in the direction of the operator to give her an easily distinguished signal.

When the subscriber at substation A removes his receiver in response to the ringing of his bell the ring cut off relay 205 will be operated by current from the exchange battery in series with the ringing current generator Gen. or by current from the exchange battery in series with booster battery associated with the generator, and upon attracting its armature 228 will re-establish its former locking circuit, the operator having restored her key by this time to permit the

energization of relay 207. The ring cut off relay also disconnects its own upper winding and the ringing apparatus at its armatures 227 and 229, respectively, and closes the talking conductors at these same armatures. The transmitter at substation A is now supplied with talking battery through the winding of the battery feed relay 100 at the repeater D. This circuit will not be traced in detail but it will be observed that the lower line conductor extends uninterruptedly back through the connector H and the selector F, to the lower right hand winding of the repeating coil R, whence it extends through the resistance 113 to ground, while the upper line conductor 320 extends back through the connector H and the selector F to the upper right hand winding of the repeating coil R, from which point it may be traced through the said winding and through the winding of the relay 100 to battery. Relay 100 is energized by current flow through the transmitter at substation A, and upon operating its armatures 116 and 117 breaks the circuit of the supervisory relay 3 at the cord circuit, and causes this relay to deenergize to extinguish the supervisory lamp L'.

The operator will now come in on the line again by throwing her key K to listening position, and after ascertaining that the proper person is at the telephone will request such person to deposit the correct coin or coins to pay for his connection. When the coins are deposited the operator is given an audible signal over the telephone circuit in the usual manner so that she will know that the right coins have been deposited, and also the polarized magnet of the paystation is connected to the line in order that the operator may thereafter either collect or refund the coins.

Everything is now in readiness for conversation to begin, at least so far as the connection to the party at substation A is concerned. Assuming that the desired party has been obtained in the distant exchange, the operator will now complete the connection at her cord circuit and the connected parties can converse as desired.

It will be assumed now that the conversation has been successfully completed, and it therefore becomes the duty of the operator to collect the coin or coins which have been deposited in the paystation mechanism by the subscriber at substation A. In order to collect the coins, the operator actuates the collect key which is associated with outgoing toll service trunk in use. By this operation a circuit is completed for the relay 26, which upon energizing disconnects the exchange battery from the control circuit extending on conductors 66 and 79 to the line relay 104 of the repeater D, and substitutes therefor the high voltage battery B^1. It is noted that this battery has its negative pole grounded. When the battery B^1 is inserted in the control circuit the flow of current therein is considerably augmented, and the marginal relay 109 at the repeater D, which heretofore has remained inoperative, is now energized. Upon attracting its armature 136, relay 109 completes circuits for the polarizing windings of the electropolarized relays 106 and 107, and at the same time, at its armature 137, removes the short circuit around the lower windings of these two relays, with the result that the said lower windings are inserted in the control circuit in series with relays 109 and 104. The upper polarizing windings of relays 106 and 107, and the lower windings of these relays, are so wound as regards their relative directions that with battery B^1 connected in the circuit, relay 106 will be operated while relay 107 will not be operated. Upon attracting its armature 130, relay 106 closes a circuit for the slow acting relay 110, which upon energizing opens the upper conductor of the talking circuit at its armature 138, and at armatures 139 and 140 closes connections which are the same as the connections closed by armatures 128 and 129 of relay 105. Since relay 105 is not deenergized at this time these latter operations are of no importance just now. Returning to the electropolarized relay 106, in its operated position this relay breaks the lower conductor of the talking circuit at its armature 131 and at the working contact of this armature connects the high voltage battery B^3 with the lower line conductor 145. Battery B^3 is similar to battery B^1, and in case the repeater and toll board are in the same exchange, it may be the same battery. Current now flows from the battery B^3 through the right hand winding of relay 115, to the lower line conductor 145, whence the circuit may be traced by way of armature 163 and its working contact, wiper 173, bank contact 177, line conductor 181, working contact of armature 229 and the said armature, working contact of armature 247 and the said armature, wiper 272, bank contact 275, conductor 321 of the line of substation A, and the winding of the polarized magnet of the paystation mechanism to ground. Responsive to the flow of current in the above circuit, the polarized magnet is operated in the proper direction to collect whatever coins may have been deposited, at the same time disconnecting itself from the line circuit. At repeater D the relay 115, whose right hand winding is in series with the battery B^3, is energized and connects the low resistance 199 in multiple with resistance 112. Whenever relay 26 or relay 27, Fig. 1, is energized the upper talking circuit con-

ductor is connected by way of the marginal relay 28 to ground. A circuit may now be traced for this relay 28 which extends from its grounded terminal through its winding and by way of armature 31 and its working contact, conductor 61, wiper 70, bank contact 74, conductor 78, upper left hand winding of repeating coil R, and the resistances 112 and 199 in parallel to battery. The current flow over the above circuit is sufficient to energize relay 28, which thereupon closes the circuit of the collect and refund supervisory lamp L^2. The lighting of lamp L^2 at this time indicates to the operator that one or more coins were actually deposited and are being collected. If no coins had been deposited, when the operator actuated her key and connected battery B^3 to the line of substation A, there would have been no circuit closed for the said battery by way of the polarized magnet at substation A, no flow of current would have taken place, relays 115 and 28 would not have energized, and the lamp L^2 would not have been lighted. The lighting of the lamp, therefore, notifies the operator that she is actually collecting a coin. Having noticed the lighting of lamp L^2, the operator will now restore her collect key momentarily, thus permitting all the circuits having to do with the collection of the coin to restore to their normal position. The operator will now operate her collect key once more momentarily in order to make sure that the coin has been collected. If so, the lamp L^2 will not be lighted this time, and being sure by this that the deposited coins have been properly collected, the operator will then pull down the connection.

When the plug is removed from jack J' all the automatic switching apparatus involved in the connection is released. There is nothing especially new in the releasing operations, so they will only be very briefly described. Upon the removal of the plug from the jack J' relays 20 and 21 are deenergized. Relay 21 breaks the holding circuit extending to the toll selector E which is restored to normal through the medium of release magnet 55 upon the deenergization of the switching relay 50. Relay 20, upon deenergizing, breaks the control circuit extending to the line relay 104 of the repeater D, whereupon relays 104 and 105 are deenergized. Relay 105 breaks the holding circuit extending to the toll second selector F which is restored to normal position by its release magnet 155 following the deenergization of switching relay 150. The line relay 104 breaks the control circuit extending to the line relay 201 of the connector H and the said relay 201 and relay 202 are therefore deenergized. The latter relay closes the circuit of release magnet 211 which operates in the usual manner to restore the connector H to normal, whereupon all the automatic equipment will have been released and made ready for use in subsequent calls.

It will not be necessary to describe in full detail the manner in which the toll operator can refund deposited coins instead of collect them, as the refunding operation is similar to the collecting operation throughout, except that high voltage batteries having their positive poles grounded are used. Thus, assuming that the previously described connection is set up, and the operator desires to refund the deposited coin, she will operate her refund key. Relay 27 is therefore energized and connects battery B^2 in the control circuit extending to the repeater D. The operations at the repeater are the same as before described except that since a battery of opposite polarity is now included in the circuit, the electro-polarized relay 107 will be operated instead of relay 106. As a result, battery B^4 is connected to the subscriber's line rather than battery B^3, and the polarized magnet at the substation is operated in the proper direction to refund the deposited coin. The lamp L^2 operates during the refunding operation in the same manner as it does when the coins are being collected.

There remains one other feature which will now be considered, when it is believed the explanation will have been completed. This feature has to do with an auxiliary coin collecting arrangement which has the function of collecting any deposited coins in case the operator should forget or neglect to collect them. As has been explained before, the operator is supposed to either collect or refund whatever coins have been deposited before she releases the connection but she may forget to do so some times. In order to take care of this contingency, means is provided in the repeater D which is effective during the release of a successful connection to connect the battery B^3 with the connected subscriber's line and thereby collect any coins which remain undisposed of. This automatic collecting operation only takes place in case a connection has been established which has been answered; in other words, if the local subscriber connected with over the toll service trunks does not answer his telephone, the automatic collect mechanism is not required and is not operated. Let it be assumed that the previously described connection is in the process of being released and that the operator has not collected the deposited coins. Since the subscriber at substation A has answered his telephone relay 103 will have been energized when the battery feed relay 100 was operated, being locked to the grounded conductor 144 by way of armature 134 of relay

108. Now when the relays 104 and 105 of the repeater D are deenergized during the releasing operation circuits are completed by way of armatures 123 and 125 of relay 103 for the relays 110 and 108 respectively. Relay 110 maintains ground on conductor 144 to prevent the release of the toll second selector F at its armature 140, and at its armature 139 holds the circuit of relay 207 of the connector closed in order to prevent the deenergization of the ring cut off relay 205 for the time being; while relay 103 maintains the operating circuit of the connector closed at its armature 122 in order to prevent the connector from releasing. Relays 103 and 110 together therefore serve to maintain the connection intact while the relay 108 is operating to perform the collecting operation. This is done at its armature 135 which serves to connect battery B^3 to conductor 145 the same as in the case where the electro-polarized relay 106 was energized. Relay 108 also breaks the locking circuit of relay 103 at its armature 134. Upon deenergizing, relay 103 breaks the circuit of relays 108 and 110. When relays 103 and 110 deenergize the release of the connection, which has been suspended, is continued and the remaining apparatus is restored to normal as previously described.

Having described my invention what I consider to be new and desire to have protected by Letters Patent will be pointed out in the appended claims.

What I claim as my invention is:

1. In a telephone system, a toll line, a toll operator's switchboard, a subscriber's telephone line, means whereby a toll operator can establish a talking circuit between said lines, said means comprising serially related automatic switches, a trunk conductor separate from the talking circuit for controlling the setting of said switches, paystation mechanism at the subscriber's station, and means controlled by the toll operator over said conductor for collecting or refunding deposited coins.

2. In a telephone system, a toll line, a toll operator's switchboard, a subscriber's telephone line, means whereby a toll operator can establish a talking circuit between said lines, said means comprising serially related automatic switches, an inductive connection included in said talking circuit, paystation mechanism at the subscriber's station, and means controlled by the toll operator over a non-talking conductor on one side of said inductive connection for collecting or refunding deposited coins over a talking conductor on the other side of said inductive connection.

3. In a telephone system, a toll line, a toll operator's switchboard, a subscriber's telephone line, means whereby a toll operator can establish a talking circuit between said lines, said means comprising serially related automatic switches, a repeating coil dividing said talking circuit into two inductively connected sections, one section comprising continuous metallic talking conductors extending from said coil to said telephone line, paystation mechanism at the subscriber's station, and means in said repeater for controlling said mechanism to collect or refund deposited coins.

4. In a telephone system, a toll line, a toll operator's switchboard, a subscriber's telephone line, means whereby a toll operator can establish a talking circuit between said lines, said means comprising serially related automatic switches, a repeating coil dividing said talking circuit into two inductively connected sections, one section comprising continuous metallic talking conductors extending from said coil to said telephone line, paystation mechanism at the subscriber's station, devices in said repeater, for controlling said mechanism to collect or refund deposited coins, and means whereby the operator can control said devices.

5. In a telephone system, a toll line and a subscriber's telephone line, means comprising an operator's cord circuit and a system of toll service trunks for connecting said lines, a selector and a connector switch included in said trunking system, paystation mechanism at the station on said telephone line, and a continuous metallic circuit extending through said connector switch to said telephone line over which the operator can collect or refund coins deposited in said mechanism to pay for the connection.

6. In a telephone system, a toll line and a subscriber's telephone line, means comprising an operator's cord circuit and a system of toll service trunks for connecting said lines, a repeater, a selector switch, and a connector switch, all included in said trunking system, paystation mechanism at the station on said telephone line, and means whereby the operator can collect or refund coins deposited in said mechanism to pay for the connection.

7. In a telephone system, a toll line and a subscriber's telephone line, means comprising an operator's cord circuit and a system of toll service trunks for connecting said lines, a repeater, a selector switch, and a connector switch, all included in said trunking system, paystation mechanism at the station on said telephone line, devices in said repeater for controlling said mechanism to collect or refund deposited coins, and means whereby the operator can control said devices.

8. In a telephone system, a subscriber's telephone line, a trunk line terminating in

a repeater, means including a selector and connector switch for connecting said trunk line through the said repeater to the said telephone line, means in said repeater for supplying talking current to the telephone on said line, paystation equipment at said telephone, and means in said repeater for controlling said paystation equipment to collect or refund deposited coins.

9. In a telephone system, a subscriber's line, a toll operator's switchboard, a toll service trunking system comprising selector and connector switches, means for establishing a complete metallic talking circuit extending through serially related selector and connector switches in said system to the station on said line, paystation mechanism at the said station and means controlled by an operator for collecting and refunding coins deposited in said mechanism.

10. In a telephone system, a subscriber's line, a toll service trunking system comprising a trunk line and selector and connector switches, means for operating certain of said switches over a conductor of said trunk line separate from the talking conductors to extend a connection to said line, and means operated over said conductor to collect or refund deposited coins.

11. In a telephone system, a subscriber's line, a toll service trunking system comprising repeaters and selector and connector switches, an operator's switchboard, a calling device at said board for operating certain of said switches to establish a complete metallic talking circuit extending from one of said repeaters through the operated selector and connector switches to the said line, paystation mechanism at the station on said line, and means controlled by an operator for collecting or refunding deposited coins.

12. In a telephone system, a called subscriber's line, a toll service trunking system comprising repeaters and selector and connector switches, means for operating certain of said switches to establish a complete metallic talking circuit extending from one of said repeaters through the operated selector and connector switches to the said line, pay station mechanism at the station on said line, and means in the connected repeater for controlling said mechanism to collect or refund deposited coins.

13. In a telephone system, a subscriber's line, a toll service trunking system comprising repeaters and selector and connector switches, means for operating certain of said switches to establish a complete metallic talking circuit extending from one of said repeaters through the operated selector and connector switches to the said line, paystation mechanism at the station on said line, sources of high voltage current of opposite polarities, and means in the connected repeater for applying either of said sources to a conductor of said talking circuit to control said mechanism.

14. In a telephone system, a subscriber's line, a toll service trunking system comprising repeaters and selector and connector switches, means for operating certain of said switches to establish a complete metallic talking circuit extending from one of said repeaters through the operated selector and connector switches to the said line, paystation mechanism at the station on said line, sources of high voltage current of opposite polarities, means in the connected repeater for applying either of said sources to a conductor of said talking circuit to control said mechanism, an operator's switchboard, and a circuit extending from said board to said repeater over which the said last means is controlled by an operator.

15. In a telephone system, a toll operator's position, a subscriber's line, means including serially related automatic switches whereby the toll operator can extend a connection to the said line, paystation mechanism at the subscriber's station, means controlled by the operator for collecting or refunding deposited coins, and a signal at the operator's position for giving the operator supervision over the collecting and refunding operations.

16. In a telephone system, a toll line and a subscriber's telephone line, means comprising an operator's cord circuit and a system of toll service trunks for connecting said lines, a selector and a connector switch included in said trunking system, paystation mechanism at the station on said telephone line, means whereby the operator can collect or refund coins deposited in said mechanism to pay for the connection, and a signal at the operator's position for giving the operator supervision over the collecting and refunding operations.

17. In a telephone system, a toll line and a subscriber's telephone line, means comprising an operator's cord circuit and a system of toll service trunks for connecting said lines, a repeater, a selector switch, and a connector switch, all included in said trunking system, paystation mechanism at the station on said telephone line, means whereby the operator can collect or refund coins deposited in said mechanism to pay for the connection, and a signal at the operator's position for giving the operator supervision over the collecting and refunding operations.

18. In a telephone system, a toll line, a subscriber's telephone line, a toll operator's switchboard, means whereby a toll operator can establish a talking circuit between said lines, said means comprising serially related automatic switches, paystation mechanism at the subscriber's station, means controlled by

the toll operator for collecting or refunding deposited coins, and automatic means for collecting deposited coins in case the operator forgets to do so.

19. In a telephone system, a toll line, a subscriber's telephone line, a toll operator's switch board, means whereby a toll operator can establish a talking circuit between said lines, said means comprising serially related automatic switches, an inductive connection included in said talking circuit, paystation mechanism at the subscriber's station, means controlled by the toll operator for collecting or refunding deposited coins, and automatic means for collecting deposited coins in case the operator forgets to do so.

20. In a telephone system, a toll line and a subscriber's telephone line, an operator's switchboard, means comprising an operator's cord circuit and a system of toll service trunks for connecting said lines, a selector and a connector switch included in said trunking system, paystation mechanism at the station on said telephone line, means whereby the operator can collect or refund coins deposited in said mechanism to pay for the connection, means for releasing the connection at the end of the conversation, and automatic means for collecting deposited coins in case the operator has neglected to collect them.

21. In a telephone system, a toll line and a subscriber's telephone line, an operator's switchboard, means comprising an operator's cord circuit and a system of toll service trunks for connecting said lines, a repeater, a selector switch, and a connector switch, all included in said trunking system, paystation mechanism at the station on said telephone line, means whereby the operator can collect or refund coins deposited in said mechanism to pay for the connection, means for releasing the connection at the end of the conversation, and automatic means for collecting deposited coins in case the operator has neglected to collect them.

22. In a telephone system, a subscriber's line, a toll operator's switchboard, a toll service trunking system comprising selector and connector switches, means for establishing a talking circuit including continuous metallic conductors extending through serially related selector and connector switches in said system to the station on said line, paystation mechanism at the said station, means controlled by an operator for collecting and refunding coins deposited in said mechanism, and automatic means for collecting deposited coins in case the operator forgets to do so.

23. In a telephone system, a subscriber's telephone line, a repeater, a trunk line terminating in said repeater, means including a selector and connector switch for connecting said trunk line through the said repeater to the said telephone line, means in said repeater for supplying talking current to the telephone on said line, paystation equipment at said telephone, means in said repeater for controlling said paystation equipment to collect or refund deposited coins, means for releasing said switches, and means operated automatically when the release is initated to actuate the said coin collection controlling means in said repeater.

24. In a telephone system, a toll line, a subscriber's line, means for completing a talking connection between said lines, said means including a final connector switch having access to said subscriber's line, pay-station mechanism at the station on said subscriber's line, means for releasing said connection, and means operated automatically when the release is initiated for collecting coins deposited in said mechanism to pay for the said connection.

25. In a telephone system, a toll line, a subscriber's line, an operator's switchboard, means whereby a toll operator can establish a talking connection between said lines, said means including a first selector, a repeater, a second selector and a connector in serial relation, a repeating coil dividing said talking connection into two inductively related sections, pay-station mechanism at the subscriber's station, and means in said repeater for controlling said mechanism to collect or refund deposited coins.

26. In a toll service trunking system, an operator's position, a plurality of serially related automatic switches controllable from said operator's position to extend a connection to a subscriber's line, a coin collecting mechanism associated with said subscriber's line, means controllable from said operator's position for controlling the operation of said mechanism, and means independent of said operator controlled means for causing the operation of said mechanism.

27. In a telephone system, a toll line, a subscriber's line, means for setting up a talking connection from said toll line to said subscriber's line, said means including a final connector switch having access to said subscriber's line, pay-station mechanism at the station on said subscriber's line, a plurality of means for releasing said connection, and means operated automatically when the release is initiated for collecting deposited coins in said mechanism to pay for the said connection.

28. In a toll service trunking system, an operator's switchboard, operator controlled serially related automatic switches for extending a connection from said switchboard to a paystation line, a combination switch control and paystation control conductor separate from the talking conductors, a relay in series with said conductor for controlling said switches, and other relays in series with

said first relay for controlling the collection or refunding of coins deposited in the paystation on said line.

29. In a toll service trunking system, an operator's switchboard, operator controlled serially related automatic switches for extending a connection from said switchboard to a paystation line, a combination switch control and paystation control conductor separate from the talking conductors, a line relay controlled over said conductor for controlling said switches, and two polarized relays also controlled over said conductor for collecting or refunding coins deposited in the paystation on said line.

30. In a toll service trunking system, an operator's switchboard, operator controlled serially related automatic switches for extending a connection from said switchboard to a paystation line, a combination switch control and paystation control conductor separate from the talking conductors, a line relay controlled over said conductor for controlling said switches, two polarized relays also controlled over said conductor for collecting or refunding coins deposited in the paystation on said line, a short circuit maintained around said polarized relays while the line relay is in use, and a third relay in series with said line relay and said polarized relays for opening said short circuit.

31. In a toll service trunking system, an operator's switchboard, operator controlled serially related automatic switches for extending a connection from said switchboard to a paystation line, a combination switch control and paystation control conductor separate from the talking conductors, a line relay in series with said conductor, two polarized relays in series with said line relay, means for short circuiting said polarized relays while said line relay is being used to control said switches, and means for removing the short circuit to permit the operation of one or the other of said polarized relays to collect or refund a coin deposited in the paystation on said line.

32. In a toll service trunking system, an operator's switchboard, operator controlled serially related automatic switches for extending a connection from said switchboard to a paystation line, a combination switch control and paystation control conductor separate from the talking conductors, a battery in series with said conductor at one end, a line relay at the other end of said conductor responsive to current from said battery for controlling said switches, a marginal relay and a normally short circuited polarized relay in series with said line relay, said marginal relay non-responsive to current from said battery, a high voltage current source and means for substituting it for said battery, to cause said marginal relay to respond, and means controlled by said marginal relay for opening the shunt around said polar relay to permit the latter relay to control the disposal of a coin deposited in the paystation on said line.

33. In a toll service trunking system, an operator's switchboard, a train of automatic switches for extending a talking connection from said switchboard to a paystation telephone line, a conductor separate from the talking circuit over which said switches are controlled by the operator, a high voltage source of current, a relay controlled by the operator for connecting said source to said conductor at one end thereof, a second high voltage current source, and a relay at the other end of said conductor energized by current from said first source to connect said second source with said telephone line to dispose of a coin deposited in the paystation.

34. In a toll service trunking system, an operator's switchboard, a plurality of trunk lines, means including automatic switches for connecting said trunk lines together in serial relation to extend a connection from said switchboard to a paystation line, relay mechanism for controlling the disposition of a coin deposited in the paystation on said line over a talking conductor of one of said trunk lines, and a circuit including a non-talking conductor of another of said trunk lines for controlling said relay mechanism from the operator's switchboard.

35. In a toll service trunking system, an operator's switchboard, a plurality of trunk lines, means including automatic switches for connecting said trunk lines together in serial relation to extend a connection from said switchboard to a paystation line, sources of high voltage collect and refund currents, relay mechanism for connecting one or the other of said sources to a talking conductor of one of said trunk lines to dispose of a coin deposited in the paystation on said line, other sources of high voltage currents for controlling said relay mechanism, and a circuit including a non-talking conductor of another one of said trunk lines for supplying current from said other sources to effect the operation of said relay mechanism.

36. In a toll service trunking system, an operator's switchboard, a plurality of trunk lines, means including automatic switches for connecting said trunk lines together in serial relation to extend a connection from said switchboard to a pay-station line, relay mechanism for controlling the disposition of a coin deposited in the paystation on said line over a talking conductor of one of said trunk lines, a circuit including a non-talking conductor of another of said trunk lines for controlling said relay mechanism from the operator's switchboard, a paystation super-

visory signal at said switchboard, and a circuit including a talking conductor of said last mentioned trunk line for controlling said signal.

37. In a toll service trunking system, a toll operator's switchboard, a train of automatic switches and interconnecting trunk lines for extending a connection from said switchboard to a paystation telephone line, switching devices at an intermediate switching point in said connection for controlling the disposal of coins deposited in the paystation on said line, a signal at the switchboard for supervising the coin disposing operations, and separate circuits connecting said switchboard and switching point over which the switching devices are controlled from the switchboard and the signal is controlled from the switching point.

38. In a toll service trunking system, a toll operator's switchboard, a train of automatic switches and interconnecting trunk lines for extending a connection from said switchboard to a paystation telephone line, switching devices at an intermediate switching point in said connection for controlling the disposal of coins deposited in the paystation on said line, a signal at the switchboard for supervising the coin disposing operations, a circuit including a non-talking conductor of one of said trunk lines over which said switching devices are controlled from said switchboard, and a second circuit including a talking conductor of the same trunk line over which the said signal is controlled from said switching point.

39. In a toll service trunking system, a toll operator's switchboard, a train of automatic switches and interconnecting trunk lines for extending a connection from said switchboard to a paystation telephone line, switching devices at an intermediate switching point in said connection for controlling the disposal of coins deposited in the paystation on said line, a signal at the switchboard for supervising the coin disposing operations, separate circuits connecting said switchboard and switching point over which the switching devices are controlled from the switchboard and the signal is controlled from the switching point, a relay at said switching point for controlling the signal circuit, and a common circuit extending between said switching point and the paystation over which the said relay and paystation are controlled simultaneously.

40. In a telephone exchange system, the combination with a telephone line, automatic switches including a toll transmission selector, an operator's position, a sender thereat for controlling said switches to build up a connection to the called line over said automatic switches, including said toll selector, a coin collector associated with said line having a magnet to collect or refund deposited coins, and means controlled by the operator for selectively operating said magnet.

41. In a telephone exchange system, the combination with a telephone line, automatic selector circuits including a toll selector circuit, the talking conductors of which are conductively separated by a repeating coil, a source of current bridged across said conductors between the windings on one side of the coil for energizing the transmitter of said line, an operator's position, a sender thereat for controlling said switches to build up a connection to said line over said automatic switches including said toll selector, a coin collector associated with said line having a magnet to collect or refund deposited coins, and means controlled by the operator for selectively operating said magnet.

42. In a telephone exchange system, the combination with a telephone line, automatic switches including a toll selector having a repeating coil and talking battery for energizing the transmitter of the line, and also including a combination toll and local connector, an operator's position, a sender thereat for controlling said switches to build up a connection to the line, a local bridge at said connector for feeding talking current to the line, means for maintaining said bridge open when the connector is seized from said position, a coin collector at the station of the line having a magnet, and means controlled by the operator for causing said magnet to collect or refund deposited coins.

43. In a telephone exchange system, the combination with a telephone line, automatic switches including a toll selector having a repeating coil and a source of talking battery for energizing the transmitter of the line, an operator's position, a sender thereat for controlling said switches to build up a connection to the said line, a coin collector at the station of said line, a polarized relay at said toll selector beyond said repeating coil, coin current sources at said selector of opposite polarity, and means at said operator's position for operating said polarized relay to apply current from one or the other of said sources to the magnet of the coin collector to collect or refund deposited coins.

44. In a telephone exchange system, the combination with a telephone line, automatic switches including a toll selector having a repeating coil and a source of talking current for energizing the transmitter of the line, an operator's position, a sender thereat for controlling said switches to build up a connection to the line, means for causing the connector to remain on the line if busy and signal the operator of this condition, means controlled by the line becoming idle for

again signalling the operator, a coin collector at the station of the line having a magnet and means controlled by the operator for causing said magnet to collect or refund the deposited coins.

45. In a telephone exchange system, the combination with a telephone line, automatic switches, an operator's position, a head set thereat, a sender for controlling said switches to build up a connection to said line, a coin collector at the station of the line, means individual to the line for transmitting a tone back to the operator's head set, a coin collector at the called station including a magnet and means controlled by the operator for controlling said magnet to collect or refund deposited coins.

46. In a telephone exchange system, the combination with a telephone line, automatic switches including a toll selector having a repeating coil and source of talking current for energizing the transmitter of the line, an operator's position, a head set thereat, a sender thereat controlling said automatic switches to build up a connection to the line, means individual to said line for transmitting tone back to the operator's head set, a coin collector at the station having a magnet, and means controlled by the operator for causing said magnet to collect or refund deposited coins.

47. In a telephone exchange system, the combination with a telephone line, automatic switches including a toll selector having a repeating coil and a source of talking current for energizing the transmitter of the line, and including a combination toll and local connector, an operator's position, a head set thereat, a sender thereat for controlling said switches to build up a connection to said line, a local bridge at the connector for feeding current to the line, said bridge being cut off when said connector is seized from said position, means for transmitting tone from the line to the operator's head set, a coin collector at the station of the line having a magnet and means controlled by the operator for operating said magnet to collect or refund deposited coins.

48. In a telephone exchange system, the combination with telephone lines, automatic switches including a toll selector having a repeating coil and a source of talking current for energizing the transmitter of the line, an operator's position, a head set thereat, a sender thereat for controlling said switches to build up a connection to the line, means for transmitting a tone from the line to the operator's head set, sources of current of different polarity at said toll selector, a polarized relay thereat, a coin box at the station of said line having a polarized magnet, and means controlled by the operator for operating said polarized relay to connect one or the other of said sources to the line to operate said coin collector magnet to collect or refund deposited coins.

49. In a telephone exchange system, the combination with a telephone line, automatic switches including a toll selector having a repeating coil and a source of talking current to energize the transmitter of the line and including a connector, an operator's position, a signal thereat, a head set thereat, a sender thereat for controlling said switches to build up a connection to the line, said connector, if the line is busy, remaining in connection therewith, means actuated by the busy condition of the line for operating said signal, means actuated by the line becoming idle for again operating said signal, means individual to said line for transmitting tone to the operator's head set, a coin box at the station of the line having a magnet, and means controlled by the operator for causing said magnet to collect or refund deposited coins.

50. In a telephone exchange system, the combination with a telephone line, an operator's position, a head set thereat, means including automatic switches for extending said line to said position, means controlled by the operator, including automatic switches, for building up a connection to said line, means individual to said line for transmitting a tone to the operator's head set, a coin collector at the substation of the line having a magnet therein, and means controlled by the operator for causing said magnet to collect or refund deposited coins.

51. In a telephone system, a calling station and a line therefor extending to a central exchange, pay station equipment at said station including a polarized relay adapted to be connected to the line for controlling the collection and refunding of deposited coins, automatic switches at the exchange controllable from said station for extending a connection to an operator's position, means whereby the operator may complete the connection to a called station, current sources of opposite polarity, and means whereby the operator can connect either of said sources to the calling line to control said relay as desired.

52. In a telephone system, a substation and a line therefor extending to a central exchange, a toll device including a polarized relay connected to the line when calling, sources of current of opposite polarity at the exchange for controlling the operation and disconnection of said device, automatic switches controlled by the subscriber at said station, and operator's equipment cooperating therewith to extend a connection to a called line, and means whereby the operator can connect either of said sources to the calling line to control said toll device as desired.

53. In a telephone system, a substation and a line therefor extending to a central

exchange, a toll device including a polarized relay connected to the line when calling, sources of current of opposite polarity at the exchange for controlling the operation and disconnection of said mechanism, automatic switches controlled by the subscriber at said station, operator's equipment cooperating therewith to extend a connection to a called line, means whereby the operator can connect either of said sources to the calling line to control said device as desired, the connection of either source being effective to disconnect said device from the line, and the connection of either of said sources being effective to operate the device before it is disconnected.

Signed by me at Chicago, Cook County, Illinois, this 3d day of March, 1920.

JOHN WICKS.