Jan. 10, 1928.

1,655,602

J. E. GARDNER

AUTOMATIC TELEPHONE SYSTEM

Filed May 25, 1921

2 Sheets-Sheet 1

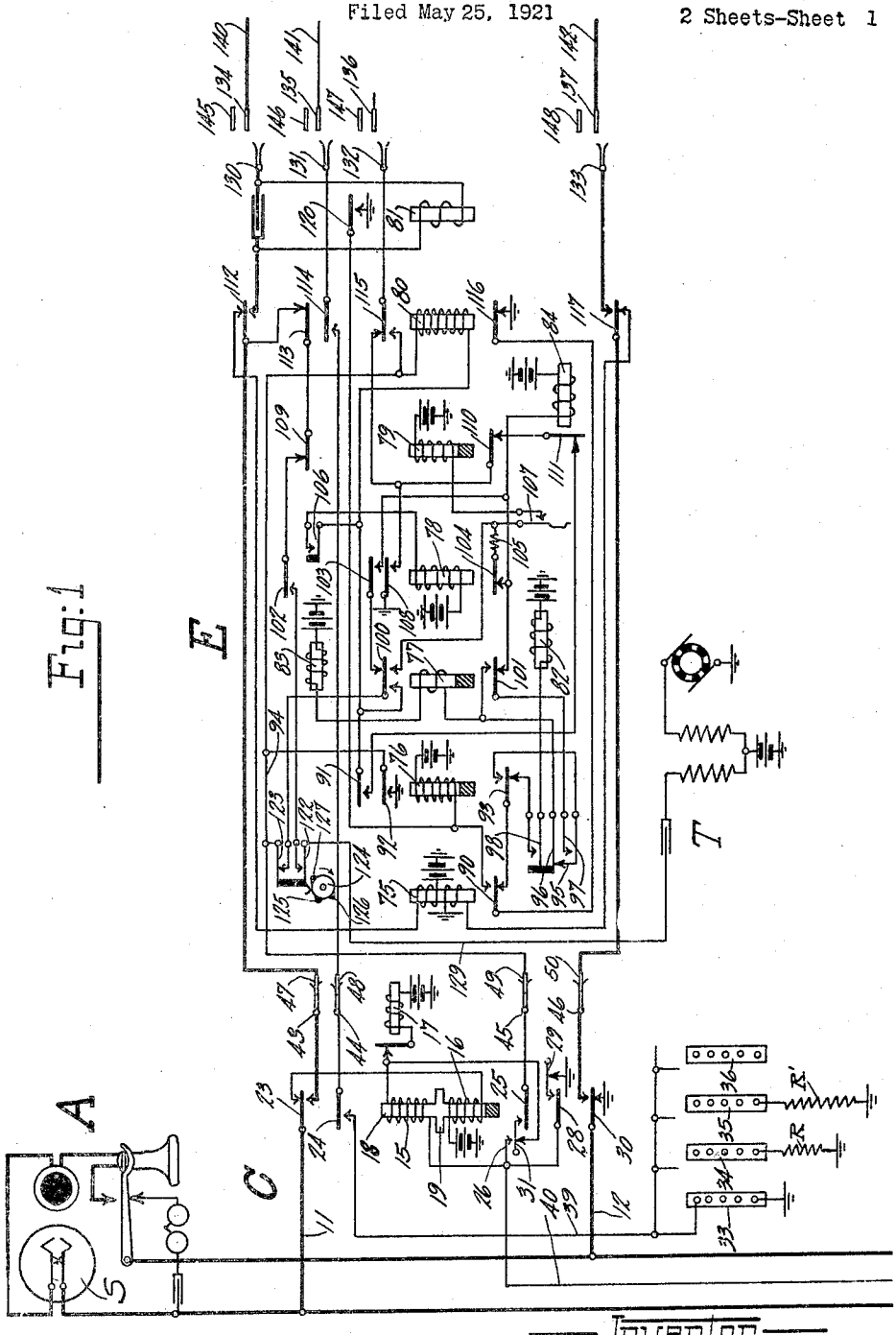


Fig. 1

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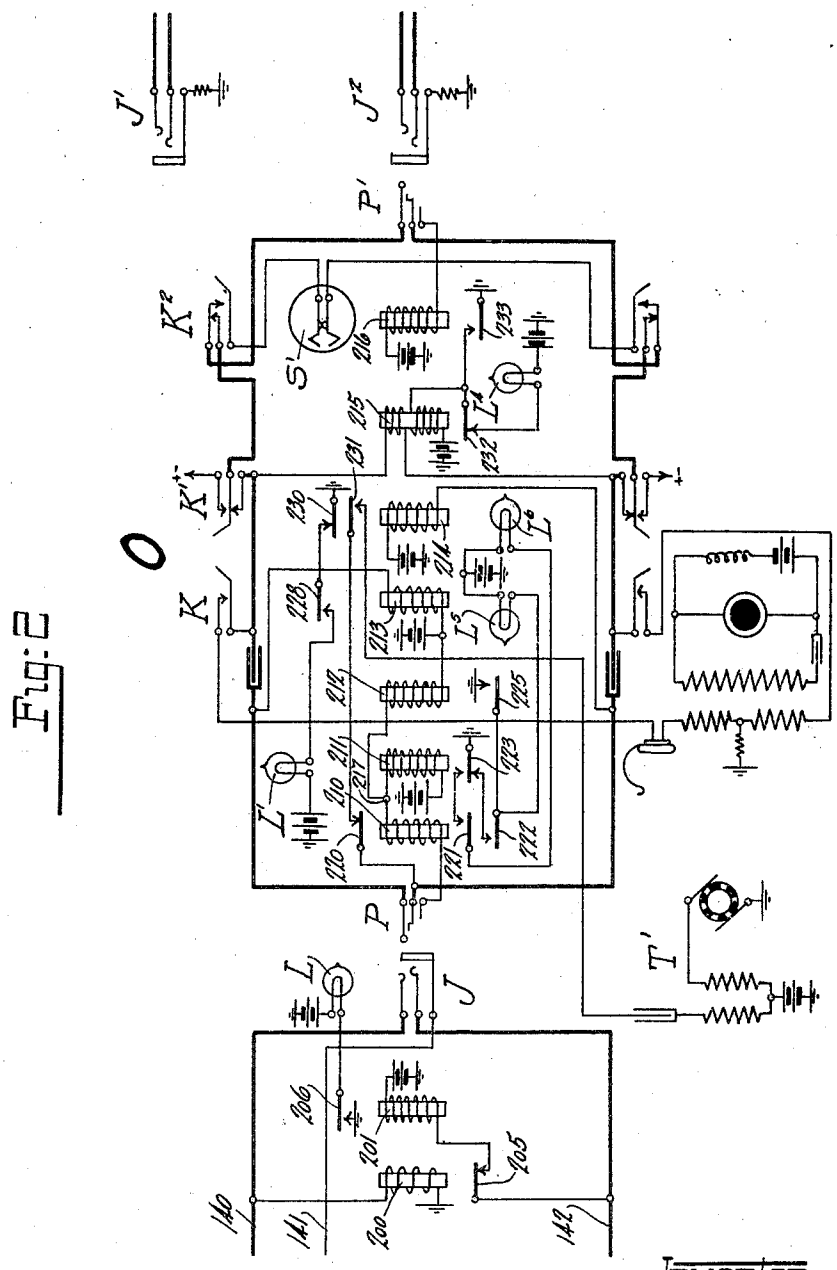


Fig: 2

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Patented Jan. 10, 1928. 1,655,602

UNITED STATES PATENT OFFICE.

JOHN E. GARDNER, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

AUTOMATIC TELEPHONE SYSTEM.

Application filed May 25, 1921. Serial No. 472,536.

The present invention relates in general to automatic telephone systems, but is more especially concerned with systems of the type which are installed in small automatic exchanges, and which are well known commercially as private automatic exchanges. In such systems it is usual to provide certain special features which are unnecessary in larger exchanges, among which is an arrangement known as discriminating service. According to this feature the subscribers in the exchange are divided into groups or classes, the number of these being dependent upon the number of classes of service it is necessary to give, and the subscribers entitled to the various classes of service are put in their respective groups.

One of the objects of the present invention is to provide a new and improved discriminating service arrangement in a private automatic exchange, wherein an operator is employed to extend all connections outgoing from the exchange to other exchanges. In the present case the subscribers are divided into four classes in accordance with the different classes of service to which they are entitled and means are provided for notifying the operator whenever an outgoing call is made just what other exchanges the calling subscriber is entitled to be connected with.

A second object of the invention is to provide a novel and improved type of rotary line switch which is individual to a subscriber's line.

A further object of the invention relates to the provision of a new and improved selector circuit whereby a selector switch may have a directively controlled movement on certain levels, this being necessary in case it is necessary to call any one of the operators.

There are other objects of the invention not now specifically mentioned which together with the foregoing, will be described hereinafter, reference being had to the accompanying drawings, in which Fig. 1 shows an automatic substation A, the individual line switch C, and the selector E, while Fig. 2 shows an incoming trunk line terminating in jack J at the attendant operator's switchboard, a cord circuit O, and portions of two outgoing trunk lines terminating in jacks J' and J^2, over which calls may be extended to other exchanges.

Referring now to the drawings, in Fig. 1 is shown an automatic substation A of the usual type, the associated line of which terminates in the exchange in an individual line or trunk selecting switch C. This line switch is of the usual rotary type whose wipers have no normal position and whose function it is to extend the associated line, when calling, to an idle first selector switch such as the one shown at E. The circuits of the line switch C are somewhat different from those usually employed in accordance with the present invention and will be described fully hereinafter.

The selector E to which the line switch C in common with a plurality of other line switches have access is of the usual Strowger vertical and rotary type, the circuits of which have been designed to operate in the improved system. These first selectors, such as E, have access from the first nine levels of their bank contacts to local connector switches of the usual Strowger type. These connector switches have not been shown in the drawings, but have the usual functions and are the last in a series of switches used in extending connections to local called lines. On the tenth level the selector E has access to trunk lines leading to operators' positions, one of these being shown in the drawings comprising conductors 140–142, inclusive, and terminating at an operator's position in jack J, Fig. 2.

Calls coming in over the trunk line terminating in jack J are adapted to be extended by the operator through the medium of a cord circuit such as O, or similar cord circuits, to a trunk line going to any desired exchange, two of these outgoing trunk lines being shown in the drawings. The one terminating in jack J' extends to a manual exchange while the one terminating in the jack J^2 extends to an automatic exchange.

Having briefly described the apparatus shown in the drawings, a detailed description of its operation will now be given. For this purpose, it will be assumed that the subscriber at substation A desires to obtain a connection with the subscriber in the distant automatic exchange. In order to ob-

tain this connection, the subscriber at substation A must call the operator at the position shown in Fig. 2, and he will therefore remove his receiver and operate his calling device in accordance with the number of the operator, which we will assume is the number 01. When the receiver is removed at substation A a circuit is completed over the two line conductors 11 and 12 in series for the line winding 16 of the relay 18. The line winding 16, upon energizing, partially attracts the armatures 25 and 28. That is, the armature 25 engages its working contact but it does not break the springs 31, while the armature 28 engages its working contact but it does not break the springs 29. As a result of the operation of the line winding 16, a circuit is completed at armature 28, for the switching winding 15 of the relay 18 in series with the motor magnet 17, while at armature 25 the test wiper 45 is connected to the above circuit at a point midway between the switching winding and the motor magnet. The operation of the line switch C now depends upon whether or not the trunk line with which the switch wipers 43–46, inclusive, are in engagement is busy. If the trunk line is busy, there will be a ground potential present upon the test contact engaged by the test wiper 45, the switching winding 15 will be short circuited, and the motor magnet 17, being supplied with direct ground by way of the said test wiper, will operate to advance the switch wipers step by step in search of an idle trunk line. However, it will be assumed in the present case that the trunk line with which the switch wipers 43–46, inclusive, is associated when the receiver is removed at substation A is idle. It will be assumed further that this trunk line is the one shown in the drawings extending to the selector E and terminating in bank contacts 47–50, inclusive. Under these conditions, immediately following the energization of the line winding 16, the switching winding 15 will be energized in series with the motor magnet 17. Upon energizing, the switching winding attracts the armatures 23 and 30 thereby extending the line of the calling substation by way of wipers 43 and 46, bank contacts 47 and 50, armatures 112 and 117 and their back contacts, to the upper and lower windings of the line relay 75 of the selector E.

The line relay 75 of the selector E is energized over two sides of the calling line in series and, upon operating, completes the circuit of the slow acting relay 76. The latter relay, upon energizing, prepares the operating circuits of the selector E at armature 93 and at armature 92 places ground upon the release trunk conductor 94 thereby establishing a holding circuit for line switch C, which may be traced from ground on release trunk conductor 94, bank contact 49, test wiper 45, armature 25 and its working contacts, which includes the spring 26, switching winding 15 of the relay 18, and thence through the winding of the motor magnet 17 to battery. A branch of this holding circuit also extends by way of the private normal conductor 40 to multipled test contacts in the banks of connector switches which have access to the line of the substation A whereby the said line is protected from intrusion in the usual manner.

At this point it will be well to explain the operation of the line switch C a little more in detail. It will be understood that, when the switching winding 15 energized, it attracted the armatures 23, 24 and 30, and besides this completely attracted the armatures 25 and 28, it being, of course, assisted in this operation by the line winding 16, which, though its circuit is opened a armatures 23 and 30, is slow acting and thus assists the switching winding 15 in attracting the armatures. The switching winding 15, it will be seen, is in a different magnet circuit than is the line winding 16, on account of the soft iron shield 19. However, the switching winding is adapted once the armatures have been completely attracted, to hold them in this position, this being accomplished by so constructing the shield 19 that it does not completely separate the magnetic circuits of the windings 15 and 16. In order to provide for proper operation of the line switch, armatures 23 and 30 are adjusted to engage their working contacts a short interval before the springs 29 operated by armature 28 break contact. This provision is made so that the circuit of the switching winding 15 will not be opened until the above traced holding circuit has been established.

The calling subscriber at substation A may now operate his calling device in accordance with the first digit 0 of the desired operator's number. By this operation ten interruptions are produced in the circuit of the line relay 75 which retracts its armature a corresponding number of times in response thereto, each time, sending an impulse of current over the following circuit: from ground, by way of back contact and armature 116, armature 90 and its back contact, armature 93 and its front contact, off normal springs 95 and 96, winding of the slow acting relay 77, and thence through the winding of the vertical magnet 83 to battery. The above is the circuit over which the first impulse to the vertical magnet is sent. Upon the first vertical step of the shaft, the off normal springs are shifted and the remaining impulses to the vertical magnet traverse a different circuit, which is the same as the one previously traced except that it includes the off normal springs 95 and 97, and armature 101 and its front contact, relay 77 being now in an operated po-

sition. The vertical magnet 83 operates to raise the switch wipers 130–133, inclusive, step by step until they are placed opposite the tenth level of bank contacts. The slow acting relay 77 is energized in series with the vertical magnet and maintains its armature attracted throughout the vertical movement of the switch. Upon the first vertical step of the shaft, the off normal spring 106 is operated and a circuit may now be traced extending from ground on release trunk conductor 94, by way of spring 123 and its resting contact, armature 100 and its front contact, off normal spring 106 and its working contact, and through the winding of the stepping relay 78 to battery. Relay 78, upon energizing, prepares the circuit of the rotary magnet 84 at its armature 103, and at its armature 108 establishes a locking circuit for itself, which extends from ground, by way of armature 108 and its front contact, armature 110 and its back contact, armature 111 and its back contact, front contact and armature 91, off normal spring 106 and its working contact, and thence through the winding of relay 78 to battery. It will be noted that the slow acting relay 77, upon attracting its armature, completed a circuit in multiple with the one of the stepping relay 78 which extends from ground on release trunk conductor 94 by way of spring 123 and its resting contact, armature 100 and its working contact, resistance 105, armature 104 and its back contact, through the winding of the rotary magnet 84 to battery. The above circuit is completed only for a short interval, that is, until the relay 78 is energized, and as it includes the resistance 105, the rotary magnet 84 is not operated. The spring 107 is adapted to be brought into engagement with its working contact by the switch shaft when it is brought opposite the tenth level of bank contacts. This may be accomplished by any suitable cam arrangement. When the spring 107 engages its working contact, a circuit is completed extending from ground on release trunk conductor 94, by way of spring 123 and its resting contact, armature 100 and its front contact, spring 107 and its working contact, and through the winding of slow acting relay 79 to battery. Slow acting relay 79 is energized over this circuit and, upon operating, opens the previously traced locking circuit of the stepping relay 78 and causes this relay to deenergize thereby opening a point in the circuit of the rotary magnet. Shortly after the termination of the vertical movement of the switch, the slow acting relay 77 is deenergized and retracts its armature 100, but, as the relay 78 is now deenergized, no circuit is completed for the rotary magnet 84.

The calling subscriber at substation A may now operate his calling device S in accordance with the next and final digit 1 of the operator's number. By this operation one interruption is produced in the circuit of the line relay 75 and an impulse of current is sent over a circuit extending from ground, by way of back contact and armature 116, armature 90 and its back contact, armature 93 and its front contact, off normal springs 95 and 97, armature 101 and its back contact, and thence through the winding of the rotary magnet 84 to battery. The rotary magnet 84 operates to rotate the switch wipers 130–133, inclusive, into engagement with the first set of bank contacts in the tenth level. The slow acting relay 79 is energized in multiple with the rotary magnet and operates its armature 110 to open the connection of the test wiper 132 with the stepping relay 78.

The further operation of the selector E depends upon whether the trunk line with which the switch wipers are now in engagement is busy or not. Assuming the trunk line to be busy, there will be a ground potential present upon the test contact engaged by the test wiper 132. Then, following the deenergization of the slow acting relay 79, a circuit may be traced extending from said grounded test contact, by way of the test wiper 132, armature 115 and its back contact, armature 110 and its back contact, armature 111 and its back contact, front contact and armature 91, off normal spring 106 and its working contact, and thence through the winding of the stepping relay 78 to battery. The stepping relay 78 is energized over this circuit and, upon operating, establishes a locking circuit for itself at its armature 108 and at its armature 103 completes the circuit of the rotary magnet 84. Magnet 84 operates to rotate the switch wipers into engagement with the set of bank contacts associated with the next trunk line in the tenth level and at its armature 111 breaks the locking circuit of the stepping relay 78 which deenergizes opening the circuit of the rotary magnet 84 which deenergizes also. The alternate operation of the stepping relay 78 and the rotary magnet 84 will continue until an idle trunk is found or until the switch wipers are rotated into engagement with the last trunk line of the group extending to the desired operator's position. The trunk lines in the tenth level are divided into groups by means of a cam arrangement such as 124. The cam 124 has certain projections on it such as 125, 126, and 127 which are adapted to operate the springs 122 and 123 when the switch wipers are rotated into engagement with the last trunk line in each group on the tenth level. The projections on the cam 124 are so constructed that the switch wipers may be readily rotated into engagement with any trunk line in any group and

released without any interference in their restoration to normal. It will be seen that by the operation of the springs 122 and 123 the release trunk ground is removed from armature 100 of the slow acting relay 77 so that the operation of the relay 78 will not cause the operation of the rotary magnet 84 and therefore no further rotation of the switch will occur. As the switch wipers 130–133, inclusive, are in engagement with a busy trunk line the switching relay 80 will not be energized. A circuit may now be traced extending from the busy tone machine T, conductor 129, spring 122 and its working contact, front contact and armature 102, back contact and armature 109, armature 113 and its back contact, to the upper heavy talking conductor. This tone is audible to the subscriber at substation A and he will know that all trunk lines extending to the desired operator's position are busy and he will therefore replace his receiver upon the switchhook thereby initiating the release of the operated switches in the usual manner.

It will now be assumed that the switch wipers 130–133, inclusive, are rotated into engagement with an idle trunk line extending to the desired operator's position, and it will be assumed further that the selected trunk line is the one terminating in bank contacts 134–137, inclusive. When the switch wipers are rotated into engagement with this trunk line there will be no ground potential present upon the test contact 136 engaged by the test wiper 132 and there will be no circuit completed for the stepping relay 78. The switching relay 80, being no longer short circuited, immediately energizes in series with the said stepping relay. As a result of the energization of relay 80, the line of the said substation A is disconnected from the windings of the line relay 75 and is extended by way of armatures 112 and 117, wipers 130 and 133, bank contacts 134 and 137, trunk conductors 140 and 142, through the winding of relay 200 and through the winding of relay 201, to ground and battery, respectively. The relay 200 is of such low resistance that it is not energized in series with the high resistance relay 201 though the latter relay is operated. Relay 201, upon energizing, at its armature 206 completes the circuit of the line lamp L whereby the trunking operator is notified that a connection is desired with one of the outgoing trunk lines. It will be noted that low resistance relay 81 in the selector E is included in the energizing circuit of the relay 201. This relay is operated and serves to maintain the slow acting relay 76 energized so as to prevent the release of the selector E. It will be seen that by the provision of relay 81 only a three conductor trunk is necessary between the trunking operator's position and the first selectors, the release trunk conductor not being extended to the position.

The trunking operator, upon perceiving the lighted condition of the line lamp L, will insert the answering plug of an idle cord circuit into the jack J which, we will assume, is the plug P of the cord circuit O. When the plug P is inserted into the jack J, the relay 213 is energized in series with the cut off relay 200. The latter relay is energized over this circuit and operates at its armature 205 to open the circuit of the line relay 201. Relay 201, upon deenergizing, extinguishes line lamp L. Relay 213, upon energizing, closes the circuit of the supervisory lamp L′ at armature 228 but this lamp is not lighted at this time as the supervisory control relay 214 is energized over the calling subscriber's line loop. Another circuit completed when the plug P is inserted into the jack J may be traced from ground at the calling subscriber's line switch, by way of the bus-bar 33, conductor 39, front contact and armature 24, wiper 44, bank contact 48, front contact and armature 114, wiper 131, bank contact 135, conductor 141, sleeve of the jack J, sleeve of the plug P, through the winding of the relay 210 to the junction point 217, where the circuit divides, one path extending through the winding of relay 211 to battery the other extending through the winding of relay 212 to battery. As there is direct ground on the discriminating trunk conductor 141 all the relays 210, 211 and 212 will be energized. A circuit may now be traced extending from ground by way of armature 223 and its front contact, front contact and armature 221, and thence through the lamp L^6 to battery. Another circuit may be traced from ground by way of front contact and armature 225, through the lamp L^5 to battery. The lamps L^5 and L^6 are of different colors and, as both are operated, serve to inform the trunking operator that the calling subscriber is entitled to unrestricted service. If only the lamp L^6 were lighted, as would be the case were only the relays 210 and 211 energized over the discriminating trunk, the operator would know that the calling subscriber would be entitled only to service over the trunk lines going to the manual exchange, such as the trunk line terminating in the jack J′. If the lamp L^5 was the one operated, as would be the case if only the relay 210 was energized, the operator would know that the calling subscriber would only be entitled to connections over the trunk lines extending to the automatic exchange such as the trunk line terminating in the jack J^2.

Upon perceiving the class of service which the calling subscriber is entitled to, the operator will actuate her listening key K there-

by associating her head set with the cord circuit in order to ascertain what exchange the calling subscriber desires. Assuming that the calling party desires a connection with a subscriber in the manual exchange the operator will test the various trunk lines extending thereto by means of the tip of the plug P′ in the usual manner, and, upon finding an idle trunk line, insert the plug P′ into its associated jack. It will be assumed that the trunk line terminating in jack J′ is the one selected for use by the operator. When the plug P′ is inserted into the jack J′, the relay 216 is energized over the sleeve of the jack. This relay upon operating, at its armature 233 completes the circuit of the supervisory lamp L^4. The operator will now actuate her ringing key in order to operate the ring down signal bridged across the trunk at the manual exchange. The trunk lines extending to the manual exchange may terminate there in the usual equipment the only special provision being that the operator at the manual exchange, upon answering, will place battery upon the trunk line in such a direction as to operate the electropolarized relay 215 in the cord circuit O in order to inform the operator at the private branch exchange of her response. The subsequent operations by which a connection is extended to the desired called line in the manual exchange will take place in a well known manner and need not be described herein.

It will now be assumed that the calling subscriber at substation A desires a connection with a subscriber in the automatic exchange. After ascertaining this fact, the trunking operator will insert the plug P′ into the jack of the first idle trunk line extending to this exchange, which we will assume is the jack J^2. By this operation the relay 216 is energized as before, and the supervisory lamp L^4 is lit. The operator will now throw her calling device key K^2, thereby placing the impulse springs of the calling device S′ in bridge of the conductors of the outgoing trunk line, and operate the calling device S′ for the digits of the called subscriber's number, after which she will restore the key K^2 to normal. The connection to the subscriber in the automatic exchange will be completed in the well known manner and the subscriber automatically signalled. When the called party answers battery is reversed over the outgoing trunk line and the electropolarized relay 215 in the cord circuit O operated to extinguish the supervisory lamp L^4. By the effacement of this signal the operator in the private automatic exchange is notified of the response of the called party.

When the conversation is terminated, both subscribers will replace their receivers upon the switchhook. When the receiver is replaced at substation A the circuit of the relay 214 in the cord circuit O is opened and this relay deenergizes to complete the circuit of the supervisory lamp L′. Another result of the replacement of the receiver at substation A is that the circuit of relay 81 in the selector E is opened. This relay then deenergizes opening the circuit of the slow acting relay 76. Upon the deenergization of the latter relay, the holding circuit of the switching relay 80 and the switching winding 15 of the line switch C is opened and these relays then deenergize. Relay 80, upon deenergizing, completes the circuit of the release magnet 82 of the selector E whereby the switch is restored to normal position. It will be noted that during the release of the selector E, test wiper 132 is not connected to the stepping relay 78 as the slow acting relay 76 is now deenergized. This provision is made so that should the wipers of the selector E engage any busy trunk lines during this restoration to normal the stepping relay 78 will not be energized to interfere with the release of the selector. In the line switch C, the switching winding 15, upon deenergizing, allows all its armatures to restore to normal. In this manner the release of the connection takes place.

When the receiver is replaced at the called substation in the distant automatic exchange the normal battery flow over the incoming trunk line is restored to normal and the polarized relay in the cord circuit O is deenergized to light the supervisory lamp L^4. By the operation of the supervisory signals L′ and L^4 the operator is informed of the disconnection and she will withdraw the plugs of the cord circuit from the associated jack. When the plug P′ is withdrawn from the jack J, the bridge across the conductors of the outgoing trunk line is broken and the automatic switches in the distant exchange are released. When the plug P is withdrawn from the jack J the cut off relay 200 in the trunk circuit is deenergized, and the connection is thus released.

From the foregoing it will be apparent as to how the subscribers in the private automatic exchange are divided into different groups according to the class of service to which they are entitled. That is, a subscriber that is entitled to unrestricted service has his discriminating trunk conductor such as 39 connected to the bus-bar 33, which has direct ground upon it. A subscriber entitled only to connections to the manual exchange has his conductor similar to 39 connected to the bus-bar 34 which has ground through the resistance R connected to it. In this case, when a connection is extended through to the trunking operator's position and is answered by means of a cord circuit such as O, only the relays 210 and 211 are energized, the relay 212 being marginal and not receiving

sufficient current to energize it in series with the resistance R. Only the lamp L^6 is operated and the operator is thereby informed the class of service which the calling subscriber is entitled to. Should the calling subscriber only be entitled to extend connections over the trunk lines going to the automatic exchange the conductor similar to conductor 39 will be connected to the bus-bar 35 which has ground through the resistance R'. This resistance is somewhat higher than the resistance R and only allows enough current to flow over the discriminating trunk to energize the relay similar to relay 210, the relays 211 and 212 remaining in an inoperative position. Thus the lamp L^5 is the only one operated and in this manner the operator is informed that the calling subscriber is entitled only to connections over the trunk lines extending to the automatic exchange. The subscribers who are not entitled to any outside connections at all have their conductor, such as 39, connected to the bus-bar 36 which is ungrounded. Should one of these subscribers attempt to obtain a connection on one of the outgoing trunk lines, a line lamp, such as L, at the operator's position would be lighted and the operator would answer in the usual manner by means of a cord circuit, such as O. As there is no ground present upon the discriminating trunk conductor neither of the relays 210, 211 or 212 is energized though the supervisory control relay 214 will be energized over the calling subscriber's line loop. A distinctive tone is now given to the calling subscriber over a circuit extending from the tone machine T' by way of front contact and armature 231, back contact and armature 220, ring of the plug P, and thence to the lower talking conductor of the associated trunk circuit. This tone will serve to inform the calling subscriber that he is not entitled to any service whatsoever over the outgoing trunk lines. As neither of the lamps L^5 or L^6 is lighted the operator will know that the subscriber calling is not entitled to outgoing service and she will not operate her listening key in order to answer the call. When the calling subscriber hangs up the relay 214 will be deenergized and the lamp L' lighted. This signal will serve to inform the operator that the calling subscriber has replaced his receiver and she will withdraw the plug of the cord circuit O from its associated jack.

At this point it is convenient to briefly describe the operation of the line switch C when the line of the substation A is called. Immediately upon the connector engaging the bank contacts associated with the line of the substation A, ground is placed upon the private normal conductor 40 by way of the test or private wiper of the connector. This closes a circuit through the switching winding 15 of the relay 18 and thence through the winding of the motor magnet 17 to battery. The winding 15 is energized over this circuit but only partially attracts the armatures 23 and 30, that is enough to disconnect the line of the substation A from its normal battery and ground connections in the line switch C. On account of the soft iron shield 19 it has no operative effect on the other armatures. The armatures 23 and 30 are prevented from being completely attracted by a mechanical interlocking device controlled by the armature of the line winding 16 of the relay 18.

In order to describe the operation of the selector E when it is used in an ordinary connection, it will be assumed that the subscriber at substation A desires to obtain a connection with a local subscriber in the private automatic exchange. In order to do this he will remove his receiver and operate his calling device in accordance with the digits of the desired subscriber's number. When the receiver is removed at substation A, the line switch C operates, as before described, to extend the calling line to an idle first selector switch which, we will assume, is the selector E.

Immediately upon the calling line being extended to the selector E, the line relay 75 is energized over two sides of the calling line in series and operates to close the circuit of the slow acting release relay 76. The latter relay operates in the usual manner to prepare the operating circuits of the selector and to establish a holding circuit for the line switch C.

The calling subscriber may now operate his calling device in accordance with the first digit of his desired number. By this operation a series of interruptions is produced in the circuit of the line relay 75 which retracts its armature a plurality of times in response thereto. At each retraction of armature 90, an impulse of current is sent to the vertical magnet 83 in series with the slow acting relay 77. The vertical magnet operates in the usual manner to raise the switch wipers 130–133, inclusive, step by step until they are placed opposite the level of bank contacts which is allocated to trunk lines extending to the desired group of connector switches which have access to the line of the called substation. The slow acting relay 77 is energized in series with the vertical magnet and, upon the first off normal step of the switch, completes a circuit for the stepping relay 78. The latter relay upon energizing, establishes a locking circuit for itself at its armature 108 and at its armature 103 prepares the rotary magnet circuit. At the termination of the vertical movement of the switch, the slow acting relay 77 deenergizes and completes the circuit of the rotary magnet 84. The rotary magnet 84 operates to rotate the switch

wipers into engagement with the first set of bank contacts in the selected level and at its armature 111 breaks the locking circuit of the stepping relay 78. The latter relay deenergizes opening the circuit of the rotary magnet which deenergizes also.

If the trunk line with which the switch wipers are now associated is busy there will be a ground potential present upon the test contact engaged by the test wiper 132 and the stepping relay will be again energized. Relay 78 operates in the usual manner to establish a locking circuit for itself and to complete the rotary magnet circuit. Rotary magnet 84 operates to rotate the switch wipers into engagement with the next trunk line in the selected level and to break the locking circuit of the stepping relay which deenergizes opening the circuit of the rotary magnet which deenergizes also. The alternate operation of the stepping relay 78 and the rotary magnet 84 will continue until an idle trunk is found. When this occurs there will be no ground potential present upon the test contact engaged by the test wiper 132, the switching relay 80, being no longer short circuited, will be energized in series with the stepping relay 78. Relay 80, upon energizing, extends the line of the calling subscriber to the line relay of the selected connector switch.

The subsequent operations by which the connection is finally completed and the called subscriber signalled will take place in the usual manner. When the conversation is terminated the operated switches will be released upon the subscriber at the calling substation A replacing his receiver upon the switchhook in the same manner as was described hereinbefore.

Having fully described and ascertained the features of the invention, what is considered to be new and desired to have protected by Letters Patent will be pointed out in the appended claims.

What I claim is:

1. In a telephone system, calling lines divided into groups, an operator's position, a trunk line terminating in a jack at the said position, subscriber-controlled means for automatically connecting one of said calling lines with said trunk line, called lines, a cord circuit for extending the connected trunk line in the direction of one of said called lines, said cord circuit being common to said trunk line and other similar trunk lines, and means in said cord circuit independent of the operator's headset and responsive to the connection of said cord circuit with said trunk line for notifying the operator to which group the calling line belongs.

2. In a telephone system, calling lines, an operator's position, a trunk line terminating in a jack at said position, means controlled over the calling line for connecting one of said calling lines with said trunk line, other trunk lines terminating at said position leading to different exchanges, a cord circuit for connecting the first mentioned trunk line to one of said other trunk lines, means for notifying the operator at said position if the calling subscriber is entitled to be connected to any one of said other trunk lines, and means in said cord circuit responsive to its connection with said trunk line for selectively operating said notifying means.

3. In a telephone system, calling lines, an operator's position, a trunk line terminating in a jack at said position, means for connecting one of said calling lines with said trunk line, other trunk lines terminating at said position leading to different exchanges, a cord circuit for connecting the first mentioned trunk line to one of said other trunk lines, means for marking said lines differently, and relays in said cord circuit responsive to the connection of said cord circuit with said first mentioned trunk line and operated from said marking means for notifying the operator at said position if the calling subscriber is entitled to be connected to certain of said other trunk lines.

4. In a telephone system, calling lines divided into groups, an operator's position, trunk lines terminating in jacks at said position, other lines, a cord circuit for extending connections from said trunk lines to said other lines, means for connecting a calling line in one group with one of said trunk lines, means in said cord circuit responsive to its connection with the connected trunk line and operative over a circuit closed by means individual to the calling line for giving the operator at said position a signal, means for connecting a calling line in another group with another of said trunk lines, and means in said cord circuit responsive to its connection with the said other connected trunk line for giving the operator a different signal.

5. In a telephone system, calling lines, trunk lines, an operator's position, a cord circuit at said position for connecting one of said calling lines with an idle one of said trunk lines, a pair of relays individual to said cord circuit, one of said relays energized when connection is made with one of said calling lines, both of said relays energized simultaneously when connection is made with another of said calling lines, and means controlled by each of said relays for giving a different signal to the operator at the said position the signal given depending on the line with which the connection is made.

6. In a telephone system, calling lines divided into groups, trunk lines, an operator's position, an automatic switch for extending said calling lines to said position, a double plug cord circuit at said position for con-

necting one of said calling lines with one of said trunk lines, a pair of relays in said cord circuit, one of said relays energized when connection is made with a calling line of one group, the other of said relays energized when connection is made with a calling line of another group, and means controlled by said relays for giving a signal of one kind to the operator in said first connection and a different signal in said second connection.

7. In a telephone system, calling lines divided into classes, trunk lines, an operator's position, means including an automatic switch for extending said calling lines to said position, a cord circuit at said position for connecting one of said calling lines with one of said trunk lines, relays in the said cord circuit one less in number than the number of classes of calling lines, class signaling circuits controlled by said relays, means for operating varying numbers of said relays when connection is made with the calling lines of different classes, and a circuit for said relays extending through said switch.

8. In a telephone system, calling lines divided into classes, trunk lines, an operator's position, a cord circuit at said position for connecting one of said calling lines with one of said trunk lines, a relay in said cord circuit energized when connection is made with the calling line of one class, another relay in said cord circuit energized when connection is made with a calling line of another class, said first relay remaining inoperative in the second connection to prepare a circuit which is controlled by said second relay for placing a distinctive tone on said calling line.

9. In a telephone system, calling lines divided into classes, trunk lines, an operator's position, a cord circuit at said position for connecting one of said calling lines with one of said trunk lines, a relay in said cord circuit energized when connection is made with a calling line in one class, and means controlled by said relay for placing a tone on the calling line.

10. In a telephone system, subscribers' lines of different classes, an operator's switchboard, a trunk line, automatic switching mechanism controlled over a calling one of said lines to extend such line to said switchboard via said trunk line, manual equipment for answering the call, and visual signalling apparatus controlled solely over said trunk line and automatically responsive to the answering of the call for notifying the operator of the class to which the calling line belongs.

11. In a telephone system, subscribers' lines of different classes, an operator's switchboard, automatic switching mechanism controlled over a calling one of said lines to extend such line to said switchboard, a cord circuit adapted to be connected with said line at said switchboard to answer the call, a plug and a jack by means of which the connection is effected, and visual signalling apparatus automatically responsive to the insertion of the plug in the jack for notifying the operator of the class to which the calling line belongs.

12. In a telephone system, subscribers' lines of different classes, an operator's switchboard, automatic switching mechanism controlled over a calling one of said lines to extend such line to said switchboard, a signalling circuit including a conductor individual to the calling line and a conductor common to said lines, the resistance of said circuit depending on the class of the calling line, and visual signalling apparatus selectively controlled over said circuit in accordance with the resistance thereof to notify the operator of the class to which the calling line belongs.

13. In a telephone system, subscribers' lines of different classes, an operator's switchboard, automatic switch mechanism for extending said lines to said switchboard when calling, a signalling circuit established when a line is so extended, means for establishing a predetermined steady flow of current in said circuit, the value of the current flow depending on the class to which the calling line belongs, and class signalling apparatus selectively controlled over said circuit in accordance with the value of the current flowing therein.

14. In a telephone system, subscribers' lines of different classes, an operator's switchboard, automatic switching mechanism for extending said lines to said switchboard when calling, resistances of different values, one for each class, a signalling circuit established when any one of said lines is extended to said switchboard, such circuit including the particular resistance which corresponds to the class to which the calling line belongs, and class signalling apparatus controlled over said circuit.

In witness whereof, I hereunto subscribe my name this 17th day of May, A. D. 1921.

JOHN E. GARDNER.