July 24, 1934. J. WICKS 1,967,848

AUTOMATIC TELEPHONE SYSTEM

Filed March 19, 1917 2 Sheets-Sheet 1

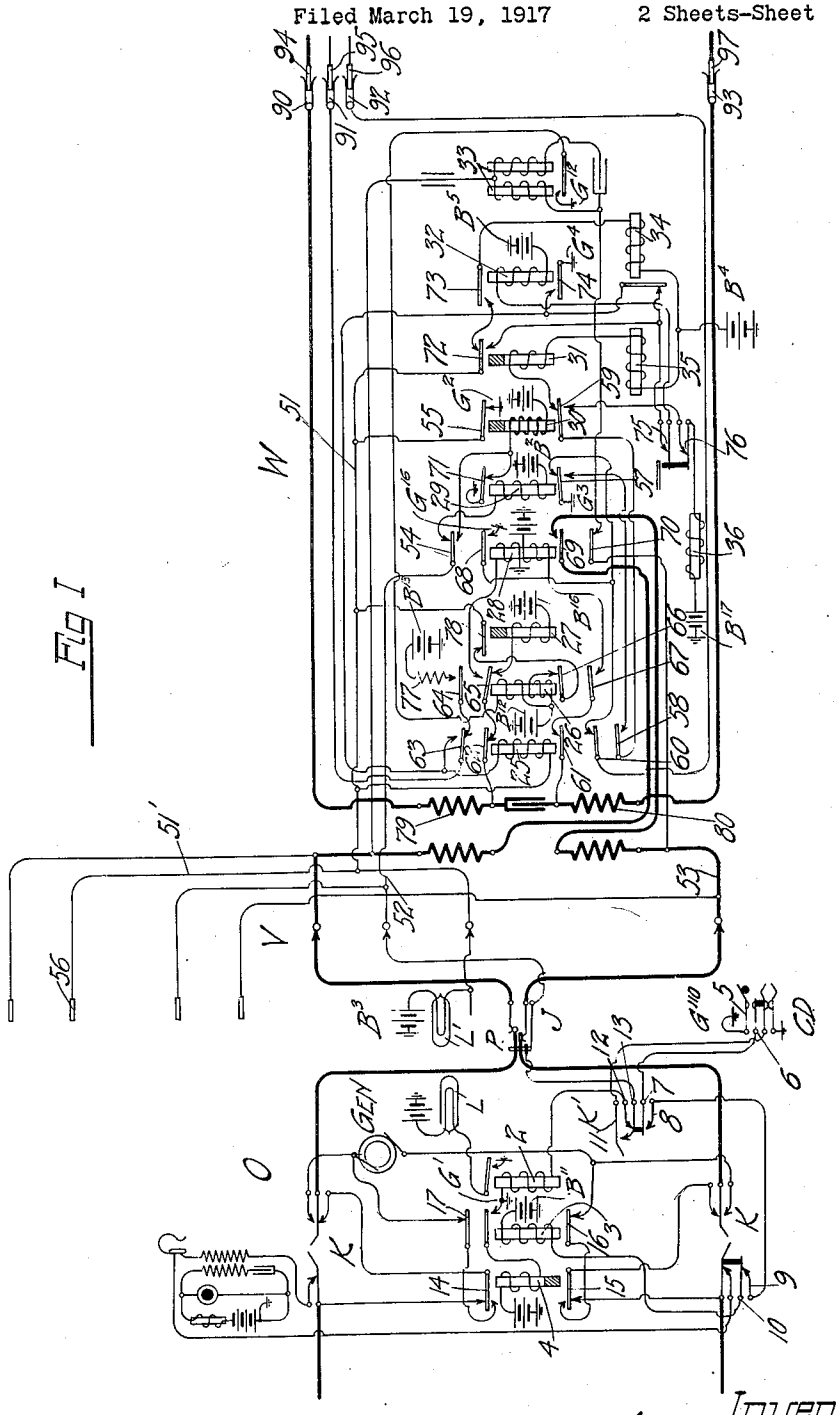

Fig 1

Inventor
John Wicks
By Hales
Attorney

July 24, 1934. J. WICKS 1,967,848

AUTOMATIC TELEPHONE SYSTEM

Filed March 19, 1917 2 Sheets-Sheet 2

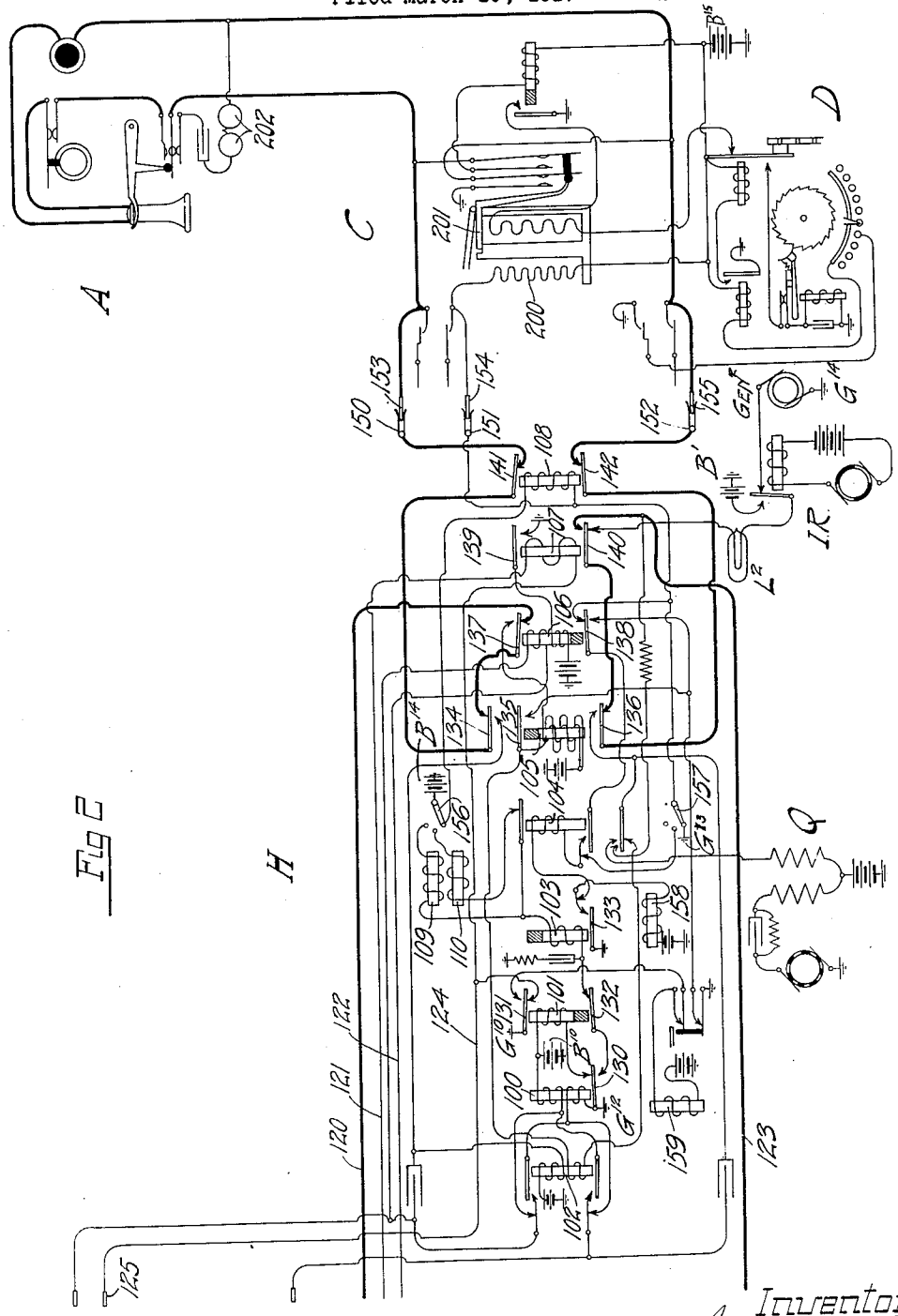


Fig 2

Inventor
John Wicks
By Hales
Attorney

Patented July 24, 1934 1,967,848

# UNITED STATES PATENT OFFICE

1,967,848

## AUTOMATIC TELEPHONE SYSTEM

John Wicks, Chicago, Ill., assignor, by mesne assignments, to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Application March 19, 1917, Serial No. 155,040

41 Claims. (Cl. 179—27)

My invention relates in general to automatic telephone systems, but is more particularly applicable to automatic toll service trunking systems, such for example as the one disclosed in my prior application, Serial No. 124,358, issued as Patent No. 1.315,444, Sept. 9, 1919; and the object of the invention is to provide an improved automatic ringing system of maximum convenience and efficiency.

The particular arrangement employed, its advantages, and its intended mode of operation will be fully described hereinafter, reference being had to the accompanying drawings, comprising Figs. 1 and 2, which show in diagrammatic form the essential circuits of a system embodying the principles of my invention.

For a clear understanding of the drawings they should be placed in order with the lines at the ends thereof in alignment, and when thus arranged there is shown a complete circuit connection extending from a toll operator's cord circuit to a local subscriber. The connection has been established through the medium of elements of a toll service trunking system comprising a toll first selector V (the circuits of which are not shown), a toll second selector W, and a combination toll and local connector H.

Inasmuch as a complete disclosure of the general purpose and utility of a toll service trunking system of the character shown in the drawings has been made in my prior application above referred to, it will be unnecessary to encumber this application with another. It may be mentioned briefly, however, that each toll operator is given access to a system of toll service trunks by means of which she is enabled to connect toll lines with the lines of local subscribers. For example, and referring to the drawings the operator who has the toll cord circuit O, has in front of her a plurality of jacks, one of which is the jack J, from which trunk lines extend to toll first selectors, one of which is the selector V. The toll first selectors have access to trunk lines terminating in toll second selectors, such as the selector W; and the toll second selectors in turn have access to trunk lines which terminate in connectors such as the connector H. If desired, and it is so illustrated in the drawings, the toll second selectors may also be accessible to incoming toll selector repeaters; while the connectors may be accessible in common to toll second selectors and the second selectors of the regular local trunking system.

The cord circuit O, of which only the local end is shown, may be of any approved long distance type, except for certain modifications which will be mentioned, and comprises the usual tip and ring talking strands terminating in the plug P, a combination ringing and listening key K, and a supervisory lamp L controlled by the supervisory relay 2. The key K' is a calling device key and when actuated serves to substitute the calling device CD for the supervisory relay 2 in the sleeve of the cord circuit. The calling device CD may be of any well known two-wire type, such for example as is shown in the British patent to Dicker, #29,654 of 1910; and in addition to the usual break impulse springs is provided with a pair of springs 5 and 6 which are allowed to make contact whenever the dial of the device is turned from its normal position. The function of the relays 3 and 4 is to start the automatic ringing of the called subscriber, as will be fully explained hereinafter.

The selector and connector switches in the system are of the well known Strowger vertical and rotory type, the mechanical construction of which is disclosed in the U. S. patents, to Keith, Erickson, and Erickson, Nos. 815,321, and 815,176, both granted March 13, 1906. In the selector switches, however, the side switches and private magnets have been omitted, and all circuits, including the connector circuits, have been revised in accordance with modern two-wire practice. Further circuit modifications, relating to the adaptation of the switches for use in a toll service trunking system, and to the incorporation in such a system of my improved automatic ringing arrangement, will be described in detail in the description of the operation.

The called substation A, the individual line switch C, and the master switch D are of the usual construction and are described and their functions explained in the U. S. patent to Newforth, No. 13,901, reissued April 13, 1915.

While I have shown throughout the drawings a plurality of batteries it is to be understood that there is preferably but one battery having its positive pole grounded. An exception to the above is the battery B' associated with the ringing interrupter IR, which is provided to insure the operation of the ring-cut-off relay in the connector when the called subscriber answers. The reference character Q indicates a busy signaling machine.

Having described briefly the apparatus involved, I will now proceed to explain the operation of the same, it being assumed for this purpose that the toll operator at whose position the cord circuit O is located desires to call the line

of substation A to complete a toll connection therewith. In the following explanation the operation of the toll first selector V will be neglected entirely and the operations will be considered as though the jack J was connected directly with the toll second selector W, as, in fact, it might well be.

Assuming that the cord circuit O is to be used in establishing the connection, the operator, after first observing that the toll service trunk with which the busy lamp L' is associated is idle, as indicated by the unlighted condition of the said lamp, will insert the plug P into the jack J of the service trunk. Upon the insertion of the plug in the jack a control circuit for the line relay 29 of the toll second selector W is completed over the following path: Ground at $G^1$, winding of supervisory relay 2, contact springs 12 and 13 of the calling device key K', sleeve of plug P, sleeve of jack J, conductor 52, armature 54 and its resting contact, and the winding of line relay 29 to battery $B^2$. Upon the completion of the above circuit, relays 2 and 29 are energized in series, the former relay closing a circuit for the supervisory lamp L in an obvious manner. Relay 29, upon energizing, completes a circuit for the slow-acting release relay 30, which relay, upon energizing in turn, prepares a circuit for the vertical magnet 35 in the usual manner, and also closes a circuit for the busy lamp L' and its multiples at other operators' positions over the following path: Ground at $G^2$, working contact of armature 55 and the said armature, conductor 51, and the lamp L' to battery $B^3$. By the illumination of the busy lamps, the other operators are warned that the service trunk terminating in the jack J has been taken for use. A branch of the above circuit extends over conductor 51', to the test contact 56 and its multiples in the banks of the toll selector repeaters having access to the toll second selector W, where by a ground potential on these test contacts, the said selector is made busy.

The foregoing operations have occurred in response to the insertion of the plug in the jack. The operator may now proceed to dial the number of the wanted subscriber, but before so doing, she is required first to operate the calling device key K', the actuation of which results in the substitution of the calling device CD for the supervisory relay 2 in the circuit of the relay 29 of the selector. When now the calling device is actuated in accordance with the first digit of the required number, a series of interruptions is produced in the circuit of the line relay 29. Responsive to these interruptions of its circuit, the line relay 29 deenergizes a corresponding number of times and at each deenergization sends an impulse to the vertical magnet 35 over the following path: Ground at $G^3$, armature 57 and its resting contact, resting contact of armature 58 and the said armature, armature 59 and its working contact, winding of low resistance relay 31, and winding of the vertical magnet 35 to battery $B^4$. In response to these impulses the vertical magnet is actuated to raise the switch shaft step by step until the wipers 90 to 93 inclusive, arrive at the horizontal level of bank contacts in which terminate trunk lines extending to a group of connectors which have access to the line of substation A. The relay 31 is energized in series with the vertical magnet, and being slow-acting retains its armature attracted during the series of impulses. At the first upward movement of the shaft, the off-normal springs 75 are permitted to close, thereby completing an initial energizing circuit for relay 32 as follows: Ground at $G^2$, working contact of armature 55 and the said armature, armature 72 and its working contact, off-normal springs 75, and the winding of relay 32 to battery $B^5$. Upon energizing, relay 32 closes a locking circuit for itself over the following path: Ground at $G^4$, interrupter contact of the rotary magnet 34, off-normal springs 75, and the winding of relay 32 to battery $B^5$. As a further result of its energization, relay 32 prepares at its armature 73 a circuit for the rotary magnet 34 which, however, is held open during the vertical movement of the switch by the slow-acting relay 31. At this point it should be mentioned that as soon as the off-normal springs 75 are closed, the line switching relay 25 is connected in series with the relay 32 over the following circuit: Grounded conductor 51, winding of the said relay 25, interrupter contact of the rotary magnet 34, off-normal springs 75, and the winding of relay 32 to battery $B^5$. It is noted however, that first ground $G^2$ and then ground $G^4$ have been connected to this circuit at points midway in the circuit connecting the two relays; whence it follows that the relay 25 is short-circuited and remains inoperative for the present.

At the end of the series of impulses the slow-acting relay 31 deenergizes and completes a circuit for the rotary magnet 34 as follows: Ground at $G^2$, working contact of armature 55 and the said armature, armature 72 and its resting contact, working contact of armature 73 and the said armature, and the winding of rotary magnet 34 to battery $B^4$. The rotary magnet 34 is energized over the above circuit and rotates the switch shaft one step, thereby bringing the wipers 90 to 93, inclusive, into engagement with the first set of contacts in the level opposite which they were raised. Near the end of its stroke the rotary magnet separates its interrupter contact, thereby breaking the circuit connecting relays 25 and 32 and opening the locking circuit of the latter relay. Relay 32, therefore is deenergized and breaks the circuit of the rotary magnet which deenergizes in turn and again closes its interrupter contact. The operation now depends upon whether or not the first trunk line is busy. If this trunk line is busy, the test contact with which the test wiper 91 is in engagement will have a ground potential upon it, and a circuit will be established via the test wiper which is effective to maintain the relay 25 short-circuited and to again energize the relay 32. This circuit extends as follows: Ground on busy test contact, test wiper 91, armature 63 and its resting contact, interrupter contact of rotary magnet 34, off-normal springs 75, and the relay 32 to the battery $B^5$. When the first trunk line is busy, then, the relay 32 will again attract its armatures to close the circuit of the rotary magnet 34, resulting in the advance of the switch wipers another step. It will be seen then that the relay 32 will operate as an impulse sender or stepping relay to advance the switch wipers through the medium of the rotary magnet as long as the test wiper 91 continues to engage grounded test contacts. As soon as the first ungrounded test contact is reached, assumed to be the test contact 95, and the rotary magnet 34 deenergizes to close its interrupter contact, the relay 25 will no longer be short-circuited but will instantly energize in series with the relay 32 over the circuit previously traced. Relay 25 is of such high resistance, that relay 32 remains inoperative. Upon

energizing, relay 25 opens the vertical magnet circuit at its armature 58; disconnects the test wiper 91 from its upper terminal at the resting contact of armature 63 and connects it instead to armature 64 of relay 26; at its armatures 61 and 62 prepares circuits including the right hand repeating coil windings which will later be explained in detail; and at its armature 60 completes a control circuit extending to the line relay 100 of the connector H (Fig. 2), which may be traced as follows: Ground at $G^3$, armature 57 and its working contact, working contact of armature 60 and the said armature, wiper 92, bank contact 96, conductor 122, upper winding of relay 106, upper contacts of the answering bridge or reversing relay 102, and the upper winding of line relay 100 to battery $B^{10}$. Relays 106 and 100 are energized in series upon the closure of the above circuit and the relay 100 completes in the usual way an energizing circuit for the slow acting release relay 101. Upon attracting its armatures, the relay 101 prepares a circuit for the vertical magnet 109 at its armature 132, and at its upper armature connects ground $G^{10}$ to the conductor 124, whereby a busy potential is established on the test contact 125 and its multiples in the banks of the local second selectors having access to the connector H. Same ground also extends by way of the winding of relay 107 and the conductor 121 to test contact 95 and its multiples in the banks of the toll second selectors, whereby the connector H is also made busy to remaining toll second selectors. The function of the relay 106, which it will be remembered was energized in series with the line relay 100, is to change the characteristics of the connector H from those of a local connector to those of a toll connector.

To explain this briefly, it has been mentioned before, that the connector H is accessible in common both to toll second selectors such as the selector W and to local second selectors comprising part of the regular exchange trunking system. The circuits of the connector H are normally in such condition that the connector will operate as a standard local connector, and when seized by a local second selector these circuits are not altered in any respect. When seized by a toll second selector however, certain of the circuits, as for example, those having to do with the signaling of the called subscriber and testing for a busy line are required to be altered and a relay is therefore inserted in series with the operating lead in the toll second selector trunk to perform these alterations or circuit changes. This relay is the relay 106, which is made slow acting so that it will not respond to impulses received over the operating circuit in which it is included. In its energized position, relay 106 disconnects at its armature 137 the ring cut-off relay 105, used on local connections, and substitutes therefore a ring cut-off relay in the toll second selector W over a circuit which will be subsequently traced; and at its lower armature 138, changes the characteristics of the connector from one which will "lock on busy" to one which will "cut thru" when the called line becomes idle.

The foregoing operations have occurred in response to the calling of the first digit of the required number (or the second digit, assuming that a first selector is included in the connection). Before proceeding with the calling of the remaining digits, it will be advisable to return to the cord circuit first and consider certain operations which take place in response to the actuation of the calling device dial in accordance with the digit of the called number which controls the operation of the toll second selector W. It has been assumed in the previous explanation that the toll operater desires to have the automatic ringing of the called subscriber begin immediately upon completion of the connection, and this being the case she will have her listening key K in operated position, as shown in the drawings. Now when the dial is turned to cause the actuation of the toll second selector as previously described, an energizing circuit is completed for the relay 3 in the cord circuit over the following path: Ground at $G^{110}$, contact springs 5 and 6 of the calling device, contact springs 7 and 8 of the calling device key K', contact springs 9 and 10 of the listening key K, and the winding of relay 3 to battery $B^{11}$. Upon energizing, relay 3 closes a circuit for the slow-acting relay 4, resulting in the energization of this relay also. When the calling device returns to normal position the contact springs 5 and 6 are separated again and the circuit of relay 3 is broken. Relay 3, upon deenergizing, breaks the circuit of relay 4, but this latter relay, being slow-acting, does not deenergize at once, whereby for a short interval the generator *Gen'* is bridged across the tip and ring strands of the cord circuit as follows: Upper or tip strand of the cord circuit, armature 14 and its working contact, armature 17 and its resting contact, generator *Gen'*, resting contact of armature 16 and the said armature, and the working contact of armature 15 and the said armature to the lower or ring strand of the cord circuit. A flow of alternating current is thus set up over the line conductors of the trunk extending to the selector W to actuate the bridged alternating current relay 33. Upon energizing, the relay 33 closes a circuit for relay 26 as follows: Ground at $G^{12}$, contact and armature of relay 33, and upper winding of relay 26 to battery $B^{12}$. Relay 26, upon energizing closes a locking circuit for itself over the following path: Ground at $G^2$, working contact of armature 55 and the said armature, armature 78 and its resting contact, armature 66 and its working contact, and the lower winding of relay 26 to battery $B^{12}$. As a further result of its energization, relay 26 disconnects the bridged battery supply relay 28 from the windings of the repeating coil, and for the upper winding of the said relay 28 substitutes the slow acting relay 27, thereby preparing a signaling circuit which will be described later. Relay 26 also disconnects battery $B^{13}$ from the test wiper 91 at its armature 64.

We will return now to the connector H and consider its operation in response to the dialing of the two remaining digits in the desired number, whereby the connection is extended to the called line. When the operator turns the dial of her calling device for the next digit in the number, a series of interruptions is produced in the circuit of the line relay 29 of the toll second selector W as before. In response to these interruptions of its circuit, the line relay 29 deenergizes a corresponding number of times and at each deenergization interrupts the control circuit including the line relay 100 of the connector H. The line relay 100 is accordingly deenergized a number of times and at each deenergization sends an impulse to the vertical magnet 109 over the following path: Ground at $G^{12}$, armature 130 and its resting contact, armature 132 and its working contact, winding of low resistance relay 103, winding of the vertical magnet 109, and the side switch wiper 156, in first position, to battery $B^{14}$. In response to these impulses the vertical magnet 109 is oper-

ated to raise the switch shaft step-by-step, until the wipers 150, 151 and 152 arrive opposite the horizontal level of bank contacts in which are located contacts which are terminals of the line of substation A. The relay 103 is energized in series with the vertical magnet, and being slow-acting, retains its armature attracted during the series of impulses to close a circuit for the private magnet 158. At the end of the series of impulses, the relay 103 and the private magnet are deenergized the latter controlling the side switch wipers 156 and 157 to advance them to their second position in the usual and well known manner.

The operator may now call the final digit in the required number, resulting in another series of interruptions in the circuit of the line relay 29, which are repeated as before into the circuit of the line relay 100. Now however, the side switch 156 having been advanced to its second position, the line relay 100 transmits a series of impulses to the rotary magnet 110 over a circuit substantially the same as the one described in the case of the vertical magnet 109. Responsive to these impulses the rotary magnet 110 rotates the shaft of the switch until the wipers 150, 151 and 152 engage the bank contacts 153, 154 and 155 respectively, in which contacts the wanted line terminates. The slow acting relay 103 is energized as before during the final series of impulses and (assuming that the called line is idle) advances the side switch wipers to the third position through the medium of the private magnet as before.

When the side switch wiper 157 comes into engagement with its third position contact point, a circuit is completed for the cut-off winding 200 of the called line switch as follows: Ground at $G^{13}$, side switch wiper 157 in third position, private wiper 151, bank contact 154, and cut-off winding 200 of the line switch C to battery $B^{15}$. By the energization of the cut-off winding of the line switch, the armature 201 is actuated to disconnect the line of substation A from its ground and battery connections in the line switch. Ground $G^{13}$ also extends to multiples of contact 154 in the banks of the other connectors in the group, where by a ground potential on these contacts the line of substation A is made busy. A branch of the above traced circuit extends through the winding of the wiper switching relay 108 by way of side switch wiper 156 in its third position to battery $B^{14}$. The relay 108 is thereupon energized to extend the talking conductors of the connector through to the line wipers 150 and 152; and as a result of this operation, a signaling circuit for actuating the ringer 202 at substation A is completed as follows: Ground at $G^{14}$, generator $Gen^2$, contact of ringing interrupter IR, lamp $L^2$ resting contact of armature 140 and the said armature, resting contact of armature 136 and the said armature, armature 142 and its working contact, wiper 152, bank contact 155, through the ringer 202 at substation A, bank contact 153, wiper 150, working contact of armature 141 and the said armature, armature 134 and its resting contact, armature 137 and its working contact, trunk line conductor 120, bank contact 94, wiper 90, winding 79 of the repeating coil, armature 62 and its working contact, armature 65 and its working contact, and the winding of relay 27 to battery $B^{16}$. Relay 27, owing to the provision of a slug of copper on its core, is slow to energize and does not respond to alternating current in the above circuit.

Connection has now been established with the called line, and the substation bell is being rung to call the subscriber to the telephone. Having completed the connection the operator may restore her calling device key K' to normal position, thereby disconnecting the calling device CD and again connecting the supervisory relay 2 in series with the line relay 29 of the selector W. Relay 2 is therefore again energized to close the circuit of the supervisory lamp L.

It will be observed that interrupter IR operates to intermittently substitute the small battery B' for the generator $Gen^2$ in the ringing circuit in order to produce an intermittent ringing of the bell at the called substation. In case the called subscriber should respond while alternating current is on the line, the relay 27 at the toll second selector will be energized by current from the battery $B^{16}$ in series with the generator; but in case the receiver is removed during a silent period, the said relay 27 will be energized by current from the two batteries $B^{16}$ and $B^1$ in series. In any event, when the called subscriber takes off his receiver, relay 27 will be operated to open the locking circuit of relay 26, resulting in the deenergization of the latter relay with the following results: At armatures 65 and 67 the answering bridge 28 is bridged across the line circuit in series with windings 79 and 80 of the repeating coil, and at armature 64 battery $B^{13}$ is connected to the test wiper 91. The relay 107 of the connector H is now energized over the following circuit: Ground at $G^{10}$, armature 131 and its working contact, winding of relay 107, conductor 121, bank contact 95, wiper 91, armature 63 and its working contact, armature 64 and its resting contact and the resistance 77 to battery $B^{13}$. Upon energizing, relay 107 closes at its armature 139 a circuit through the lower windings of relay 106 for a purpose to be described later; and at its lower armature 140 disconnects the lead extending to the ringing apparatus and closes a contact in the talking circuit, whereupon the answering bridge relay 28 will become energized over the heavy line conductors extending to substation A. This circuit, being for the most part drawn in heavy lines, need not be traced in detail.

The energization of relay 28 has the following results: At armature 70 the alternating current relay 33 is disconnected from in bridge of the line conductors; at armature 69, the left hand windings of the repeating coil are connected to complete the talking circuit; at armature 68 ground $G^{16}$ is connected to the control circuit extending to the line relay 100 of the connector H as a substitute for ground $G^3$, removed an instant later by the deenergization of relay 29, as will appear shortly; and at armature 54 the conductor 52 is disconnected from the line relay 29 and is connected instead to the slow acting release relay 30. It should be mentioned at this point that the line relay 29 is of moderate resistance, preferably 250 ohms, while the release relay 30 should be of at least 1300 ohms resistance. The supervisory relay 2 at the cord circuit is marginally adjusted so that it will energize in series with the line relay 29 and will deenergize when connected in series with release relay 30. It follows then, that when the called subscriber answers and the answering bridge relay 28 is energized by the process already described, the resistance of the circuit including the supervisory relay 2 at the cord circuit will be sufficiently increased to cause the deenergization of the said relay and extinguishing of the supervisory lamp

L. The operator is thus notified that the called party has answered the telephone. The connection to the other subscriber may then be completed by means of the other plug (not shown) of the cord circuit in the usual manner, and conversation between the two connected subscribers may be held over the heavy line conductors. The subscriber at substation A is of course supplied with talking current through the windings of the answering bridge relay 28 of the toll second selector W; while the other subscriber may be supplied with talking current from connective apparatus associated with his line during the connection in any suitable or desired manner.

When the conversation is finished, the subscribers will replace their receivers. By the replacement of the receiver at substation A the relay 28 at the toll second selector is deenergized, whereby the line relay 29 is again connected in the circuit of the supervisory relay 2, and the latter relay is energized to illuminate the lamp L. Being informed by the lighting of the lamp that the conversation is terminated, the operator will take down the cord circuit, the removal of plug P from jack J being effective to break the circuit of the line relay 29 of the selector W. The consequent deenergization of line relay 29 is followed by the deenergization of the release relay 30, and results also in the breaking of the control circuit including the line relay 100 of the connector H. By the former operation ground $G^2$ is disconnected from conductor 51 whereby the busy lamp L' and its multiples are extinguished, and the circuit of the line switch relay 25 is broken to permit it to deenergize. At the same time a circuit is closed for the release magnet 36 of the selector over the following path: Ground at $G^3$, armature 57 and its resting contact, resting contact of armature 58 and the said armature, armature 59 and its resting contact, off normal springs 76, and the windings of the release magnet 36 to battery $B^{17}$. By the energization of the release magnet, the selector W is restored to normal position in the usual and well understood manner, the release magnet circuit being opened at the off normal springs 76 when the shaft reaches its lowermost position. At the connector H, the deenergization of the line relay 100 is followed by the deenergization of the release relay 101. When relay 101 retracts its armatures, ground $G^{10}$ is disconnected from the multiple test contacts in the selector banks and is connected instead to the release magnet 159, whereupon the connector H is restored to normal position in substantially the same manner as was described in the case of the second selector W. The circuit through the lower winding of relay 106 is provided to guard against a momentary ringing of the called subscriber during the release of the connector. This circuit is not broken until relay 107 deenergizes which occurs when the slow-acting release relay 101 deenergizes; and since relay 106 is made slow-acting it retains its armature until after the release magnet has restored the side switch wipers to normal position and the wiper switching relay 108 has deenergized.

In the operation of the system as just described the automatic ringing of the called subscriber is started immediately upon connection being completed to his line, and this is the usual operation. If the operator so desires however, she can call a subscriber without having the signaling operation start at once; and it is this option which the operator has of either automatically ringing the called party immediately upon connection being established, or of deferring the ringing operation until later, when it may be started at will, which is the principal feature of my invention. It occurs quite frequently that the operator in order to save time will find it convenient to establish the local connection over the service trunk while waiting for the party in the distant exchange to answer his telephone.

Not knowing the length of time which will be required for an answer to be obtained; and in cases where a particular person is wanted, not being at all certain that such a person will be immediately accessible by telephone, the operator will not wish to have the local party, with whom connection is established via the service trunk, signalled at once; for if he answered before the required distant connection was ready, it might be necessary to have him wait for an unreasonable length of time, or even to have him hang up his receiver again. In such cases as these then it is extremely desirable that the operator should be able to establish connection with a called line and defer the signaling operation until the desired toll connection is ready. When the operator desires to postpone the automatic ringing of the called subscriber she dials the number substantially as previously described, except that her listening key K is not actuated. It follows therefore, that when the calling device is operated there is no circuit closed for the relay 3 in the cord circuit, and no ringing impulse from the generator *Gen'* is projected over the trunk line conductors by the operation of relays 3 and 4 when the calling device returns to normal, as is the case when the listening key is in operated position. Consequently the alternating current relay 33 in the toll second selector W is not actuated to cause the energization of relay 26, the latter relay therefore remaining deenergized. The battery $B^{13}$ not being disconnected from the wiper 91, as soon as the connection is extended to the connector the relay 107 will be energized to disconnect the ringing apparatus, from which it follows that when the connection is completed no ringing operation will take place. Under these circumstances, when the operator gets ready to signal the local subscriber she will throw her key K to ringing position momentarily, thereby manually projecting an impulse of ringing current out over the trunk line. The alternating current relay 33 now responds as previously described to energize relay 26, resulting in the disconnection of battery $B^{13}$ from the circuit of relay 107 in the connector H. Relay 107 therefore, deenergizes and the signalling circuit is closed over the path previously traced.

It has been mentioned before that the toll second selector W is accessible also from distant exchanges through the medium of selector repeaters which have access to multiple sets of bank contacts associated with the selector W, one of these sets being shown immediately above the jack J in Fig. 1. Likewise it has been mentioned that the connector H is accessible to local second selectors in the exchange which have access to multiple sets of bank contacts associated with the connector H, one of which sets is shown at the upper left hand corner of Fig. 2. These trunking arrangements, together with the operation of the toll second selector and of the connector H when seized by a toll selector repeater and by a local second selector, respectively, have been de-

scribed fully in my prior application previously referred to.

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 called telephone line, operator controlled automatic switching mechanism for extending a connection to said line, automatic ringing equipment for signalling the called subscriber, and means actuated by the operator prior to the operation of said switching mechanism for starting the operation of said ringing equipment upon the completion of the connection.

2. In a telephone system, a called telephone line, operator controlled automatic switching mechanism for extending a connection to said line, automatic ringing equipment for signalling the called subscriber upon the completion of the connection, manual apparatus at the operator's position, and circuit connections whereby the starting of said ringing equipment is made dependent upon the position of said apparatus.

3. In a telephone system, means including an operator's cord circuit for connecting a calling and called line, means outside the cord circuit for signalling the called subscriber, comprising also means for automatically starting the signalling operation upon the completion of the connection, and means within the cord circuit operated prior to the establishment of the connection for determining whether or not said starting means will be operated.

4. In a telephone system, means including an operator's cord circuit for connecting a calling and called line, means outside the cord circuit for signalling the called subscriber, comprising also means for automatically starting the signalling operation upon the completion of the connection, means within the cord circuit operated prior to the establishment of the connection for determining whether or not said starting means will be operated, and means whereby if the said starting means is not operated at once it may be operated subsequently at the will of the operator.

5. In a telephone system, means comprising a selector switch and a connector switch for extending a connection to a called line, automatic ringing equipment individual to the connector switch for signalling the called subscriber, and a relay in the selector switch responsive to the removal of the receiver on the called line for stopping the signalling operation.

6. In a telephone system, means comprising a selector switch and a connector switch for extending a connection to a called line, automatic ringing equipment, a ringing relay in said connector having contacts for connecting said ringing equipment with a conductor of the said connection to the called line to form a signalling circuit, said circuit including a trunk conductor extending between said switches, and a relay in the selector also included in said circuit, and means for operating said ringing relay to cut off the ringing current from the called line.

7. In a telephone system, means comprising a selector switch and a connector switch for extending a connection to a called line, automatic ringing equipment, a relay in said connector having contacts connecting said ringing equipment with a conductor of the connected called line to form a signalling circuit, said circuit including a trunk conductor extending between said switches, a relay in the selector also included in said circuit, said last relay being responsive to the removal of the receiver on the called line, and a circuit for said first relay controlled by said last relay whereby upon the response of the called subscriber said first relay is controlled to disconnect the said ringing equipment.

8. In a telephone system, a trunk line, automatic switching mechanism for extending said trunk line into connection with a called telephone line, apparatus for automatically and intermittently signalling the subscriber on the called line, and a relay in bridge of the the conductors of said trunk line and responsive to currents projected thereover for starting the operation of said signalling apparatus, and a condenser in the energizing circuit of said relay in series therewith and with the source of current.

9. In a telephone system, a trunk line, automatic switching mechanism for extending said trunk line into connection with a called telephone line, apparatus for automatically and intermittently signalling the subscriber on the called line, means for projecting ringing current over the conductors of said trunk line, and an alternating current relay in bridge of said conductors and responsive to said current to start the operation of said signalling apparatus.

10. In a telephone system, a trunk line extending from an operator's cord circuit and terminating in an automatic switch, a calling device for producing current impulses in one conductor of said trunk line to operate said switch, and means in the cord circuit automatically controlled by the operation of said calling device to transmit ringing current over other conductors of said trunk line.

11. In a telephone system, a trunk line extending from an operator's position and terminating in an automatic switch, a calling device for producing current impulses in a conductor of said trunk line to operate said switch, and means effective each time the calling device is operated to automatically project ringing current over said trunk line, said means including a quick and a slow relay.

12. In a telephone system, a trunk line extending from an operator's position, automatic switching mechanisms operable in response to a plurality of operations of a dial for extending said trunk line to the line of a called subscriber, a calling device at the operator's position for controlling the operation of said switching mechanisms, and automatic means controlled in the operation of said calling device upon the first dial operation for projecting ringing current over said trunk line when all the dial operations are completed.

13. In a telephone system, means comprising selector switches and connector switches for extending connections to called lines, automatic ringing equipment individual to each connector switch for signalling the called subscribers, and a relay individual to each selector switch responsive to the removal of the receiver on the called line for stopping the signalling operation.

14. In a telephone system, a selector switch and a connector switch for connecting calling and called lines, a ringing relay in the connector for applying ringing current to the called line, a cut off relay in the selector operated when the called subscriber answers for controlling the operation of said ringing relay to cut off the ringing current to the called line.

15. In a telephone system, a selector switch having alternative sets of incoming terminals, means for seizing either set of terminals, and means operative according to the set of terminals seized to automatically project signaling current or not automatically project signaling current from said selector.

16. In a telephone system, a selector switch having alternative sets of incoming terminals, and means operative to effect automatic ringing control or not effect automatic ringing control by said selector according to the set of terminals connected with.

17. In a telephone system, an automatic switch which will function as a selector, a ringing current source, alternative sets of terminals leading in to the said switch, called lines, means for seizing the said switch through either set of terminals at will, means for directing the switch for seizing a called line, means operable when a specific one of the sets of said terminals is seized for causing ringing current to be projected on a called line, and means operable when a specific one of the said sets of terminals is seized whereby ringing current is not projected on a called line.

18. In an automatic telephone system, a switch which will function as a selector, alternative sets of incoming terminals for the switch, a source of signaling current in the switch, means for seizing either set of terminals by an antecedent switch, and means respectively operative according to the set of terminals seized to adapt the switch to project signaling current from the said source or not project signaling current to a connected line.

19. In a telephone system comprising a local trunking system for use by local subscribers and a toll trunking system for use by toll operators, a final connector switch common to both trunking systems, means for operating said switch to complete a local connection or a toll connection to a called line, automatic ringing equipment normally connected to automatically ring the called line connected with in either type of connection, means for automatically disconnecting said ringing equipment during the establishment of the toll connection while permitting the same to remain connected to start the automatic ringing at once when the local connection is established, and means brought into use during the toll connection for again connecting said ringing equipment under operator control to start the automatic ringing.

20. In a telephone system comprising a local trunking system for use by local subscribers and a toll trunking system for use by toll operators, a final connector switch common to both trunking systems, means for operating said switch to complete a local connection or a toll connection to a called line, automatic ringing equipment normally connected to automatically ring the called line connected with in either type of connection, means for automatically disconnecting said ringing equipment during the establishment of the toll connection while permitting the same to remain connected to start the automatic ringing at once when the local connection is established, and means controlled by an operator after the toll connection is established for disabling said ringing equipment disconnecting means in order to start the automatic ringing at will.

21. In a telephone system comprising a local trunking system for use by local subscribers and a toll trunking system for use by toll operators, a final connector switch common to both trunking systems, means for operating said switch to complete a local connection or a toll connection to a called line, automatic ringing equipment normally connected to automatically ring the called line connected with in either type of connection, means for automatically disconnecting said ringing equipment during the establishment of the toll connection while permitting the same to remain connected to start the automatic ringing at once when the local connection is established, means brought into use during the toll connection for again connecting said ringing equipment under operator control to start the automatic ringing, and means whereby the subscriber on the called line can stop the automatic ringing when he answers, regardless of whether the connection to his line is a toll or a local connection.

22. In a telephone system comprising a local trunking system for use by local subscribers and a toll trunking system for use by toll operators, a final connector switch common to both trunking systems, means for operating said switch to complete a local connection or a toll connection to a called line, automatic ringing equipment normally connected to automatically ring the called line connected with in either type of connection, means for automatically disconnecting said ringing equipment during the establishment of the toll connection while permitting the same to remain connected to start the automatic ringing at once when the local connection is established, means controlled by an operator after the toll connection is established for disabling said ringing equipment disconnecting means in order to start the automatic ringing at will, and means whereby the subscriber on the called line can stop the automatic ringing when he answers, regardless of whether the connection to his line is a toll or a local connection.

23. In a telephone system, a subscriber's line, a switch controlled by an operator for connecting with said line, a relay in said switch, a ringing circuit including normally closed contacts of said relay, means for automatically energizing said relay during the establishment of the connection to open said ringing circuit before the connection is completed, operator controlled means for deenergizing said relay to close said ringing circuit, and means controlled by the subscriber on the called line for again energizing said relay to open said ringing circuit.

24. In a telephone system, a subscriber's line, a switch controlled by an operator for connecting with said line, means for ringing the called line, ringing prevention means operated automatically during the establishment of the connection for rendering said ringing means ineffective, operator controlled means operable at any time after the connection is completed for restoring said ringing prevention means to cause the said ringing means to become effective to signal the called line, and means controlled by the subscriber on the called line for again operating said ringing prevention means to stop the signalling operation.

25. In a telephone system, a subscriber's line, an operator's switchboard, means including an automatic switch for extending a connection from said switchboard to said line, automatic ringing equipment, a relay energized during the establishment of the connection to prevent said equipment from signalling the called line when the connection is completed, means controlled by the operator at said switchboard for deenergizing said relay to cause said ringing equipment to

automatically signal the called line, and means controlled by the subscriber on the called line for again energizing said relay to stop the signalling operation when the called subscriber answers.

26. In a telephone system, a subscriber's line, an operator's switchboard, means including an automatic switch for extending a connection from said switchboard to said line, automatic ringing equipment, a relay in said switch energized before the operation of said switch is finished in order to prevent said equipment from signalling the called line when the connection thereto is completed, means controlled by the operator at said switchboard for deenergizing said relay to cause said ringing equipment to automatically signal the called line, and means controlled by the subscriber on the called line for again energizing said relay to stop the signalling operation when the called subscriber answers.

27. In a telephone system, a calling station, a telephone line involving near and remote sections thereof, a junction point of the sections, a first relay controlled from the remote section and a second relay controlled from the near section together operative to join the sections at the junction point, first and second signalling current sources, said first source being of a character to which a condenser is transparent, a third relay on the near section responsive to the first source applied over the near section to operate the second relay to apply the said second source to the remote section, selective switch mechanism, means for directively operating the selective switch mechanism to complete a connection from the calling station to include the line, means for initially applying the first source over the near section to operate the third relay to in turn operate the second relay to apply the second source to the remote section after the last directive operation has been transmitted to the selective switch mechanism, and a circuit connection made operative consequent to the operation of the second relay whereby the first relay will become in control of the remote section to join the sections.

28. In a telephone system, a calling station, a telephone line involving near and remote sections thereof, a junction point of the sections, a first relay controlled from the remote section and a second relay controlled over the near section together operative to join the sections at the junction point, first and second signalling current sources, said first source being of a character to which a condenser is transparent, the second relay responsive to the first source applied over the near section to apply the said second source to the line, and to prepare an operative circuit path for controlling the first relay for joining the sections, selective switch mechanism, means for directively operating the selective switch mechanism to complete a connection from the calling station to include the line, means for initially applying the first source over the near section after the last directive operation has been transmitted to the selective switch mechanism to apply the second source to the remote section and to prepare the said circuit path for the first relay, whereby the first relay will become in control of the remote section to join the sections.

29. In a telephone system, a calling station, a telephone line involving near and remote sections thereof, a junction point of the sections, a first relay controlled from the remote section and a second relay controlled over the near section together operative to join the sections at the junction point, first and second signalling current sources, the second relay responsive to the first source applied over the near section to apply the said second source to the line and to prepare an operative circuit path for controlling the first relay for joining the sections, selective switch mechanism, means for directively operating the selective switch mechanism to complete a connection from the calling station to include the line, means for initially applying the first source over the near section after the last directive operation has been transmitted to the selective switch mechanism to apply the second source to the remote section and to prepare the said circuit path for the first relay, whereby the first relay will become in control of the remote section to join the sections, and disconnect the said relays from the connection.

30. In a telephone system, a calling and a called line, automatic switch mechanism for connecting said lines, a source of signaling current for application to the called line, a source of inductive current, means for at will applying the inductive current over the calling line after the said lines are connected for applying the signaling current to the called line, and automatically applied means for maintaining the said application of the signaling current.

31. In a telephone system, a calling and a called line, automatic switch mechanism for connecting said lines, a source of signaling current for application to the called line, a source of inductive current, means for at will applying the inductive current over the calling line after the said lines are connected for applying the signaling current to the called line, and automatically applied means for maintaining the said application of the signaling current regardless of the termination of the application of the inductive current.

32. In a telephone system, a calling and a called line, automatic switch mechanism for connecting said lines, a source of signaling current for application to the called line, a source of inductive current, means for at will applying the inductive current over the calling line after the said lines are connected for applying the signaling current to the called line, automatically applied means for maintaining the said application of the signaling current regardless of the termination of the application of the inductive current, and means on the called line for terminating the application of the signaling current.

33. In a telephone system, a calling and a called line, automatic switch mechanism for connecting said lines, a source of signaling current for application to the called line, another source of current, means for at will applying the said another source of current over the signaling line after the said lines are connected but before any operation has thereafter occurred on the called line for applying the signaling current to the called line, and automatically applied means for maintaining the said application of the signaling current.

34. In a telephone system, a calling and a called line, automatic switch mechanism for connecting said lines, a source of signaling current for application to the called line, another source of current, means for at will applying the said another source of current over the talking conductors of the calling line after the said lines are connected but before any operation has thereafter occurred on the calling line for applying the signaling current to the called line, and auto-

matically applied means for maintaining the said application of the signaling current.

35. In a telephone system, a calling and a called line, automatic switch mechanism for connecting said lines, a source of signaling current for application to the called line, another source of current, means for at will applying the said another source of current over a talking conductor of the calling line after the said lines are connected but before any operation has thereafter occurred on the called line for applying the signaling current to the called line, and automatically applied means for maintaining the said application of the signaling current.

36. In a telephone system, a calling line, a called line, switching mechanism for extending a connection from the calling line to the called line, a source of signaling current for application to the called line, a source of current to which a condenser is transparent, operator directed means controlled over the calling line for operating the switching mechanism to extend a connection from the calling line to the called line, operator directed means for thereafter at will applying the second said source of current over the calling line effective to first apply first said source of current to the called line, automatically applied means for maintaining the application of current to the called line, and means controlled over the called line for disabling the said automatically applied means.

37. In an automatic telephone system, a called line, first and second calling lines, automatic switches for linking connections from the respective calling lines to the called line, a connective switch of said switches for completing connections to the called line common to connections from said calling lines to the called line, a selective switch of said switches for completing connections to the connective switch common to connections from the said calling lines to the called line, specific selector switches for completing connection from the respective said calling lines to the selective switch, and means involving one of said selector switches depending upon which said calling line is extended to the connective switch for determining what specific operation the connective switch will be enabled to thereafter perform.

38. In a telephone system, a called line, a first automatic switch having selective access to the called line, a second automatic switch having selective access to the said first switch, calling lines, switch elements for extending connection from a random one of said calling lines to said second automatic switch, the calling line determining which of said elements will be employed in the extension, means thereupon operable over the said extension from the random calling line applied through the concerned said element and said second automatic switch for selectively operating said first automatic switch to select the called line, and means the operation of which is determined by the particular said element employed in the extension to the said first automatic switch for determining what particular variable behavior said first automatic switch will be enabled to manifest.

39. In a telephone system, a called line, a first automatic switch having selective access to the called line, a source of signalling current for application to the called line, a second automatic switch having selective access to the said first switch, calling lines, switch elements for extending connection from a random one of said calling lines to said second automatic switch, the calling line determining which of said elements will be employed in the extension, means thereupon operable over the said extension from the random calling line and through the concerned said element and said second automatic switch for selectively operating said first automatic switch to select the called line, and means the operation of which is determined by the particular said element employed in the extension to the said first automatic switch for determining whether or not said source of signalling current will be applied to the selected called line responsive to said selection.

40. In a telephone system, a called line, a first automatic switch having selective access to the called line, a second automatic switch having selective access to said first switch, calling lines, means for extending connection from the respective calling lines to the said second switch in a different manner specific to the calling lines, means for extending connection from a random one of the calling lines to the called lines wherein the first and second switches are links in the connection, and means depending upon from which said calling line the connection is extended from for determining what behavior the said first switch will be enabled to manifest.

41. In a telephone system, a called line, a first automatic switch having selective access to the called line, a second automatic switch having access to the said first switch, a plurality of other switches having selective access to the said second switch, a plurality of leading-in paths to said second switch, means for extending connection over a random one of said plurality of paths to said second switch and for operating the latter said switch to effect connection to said first switch, means controlled over the call extension for directing the operation of the said first switch, and means depending upon the particular one of said plurality of paths to said second switch the call extension is made over for determining what behavior the said first switch will be enabled to manifest.

JOHN WICKS.