Aug. 27, 1929. J. DAVIDSON, JR., ET AL 1,725,753

OFFICE SELECTING MEANS FOR TELEPHONE TRUNK CIRCUITS

Filed April 4, 1928 2 Sheets-Sheet 1

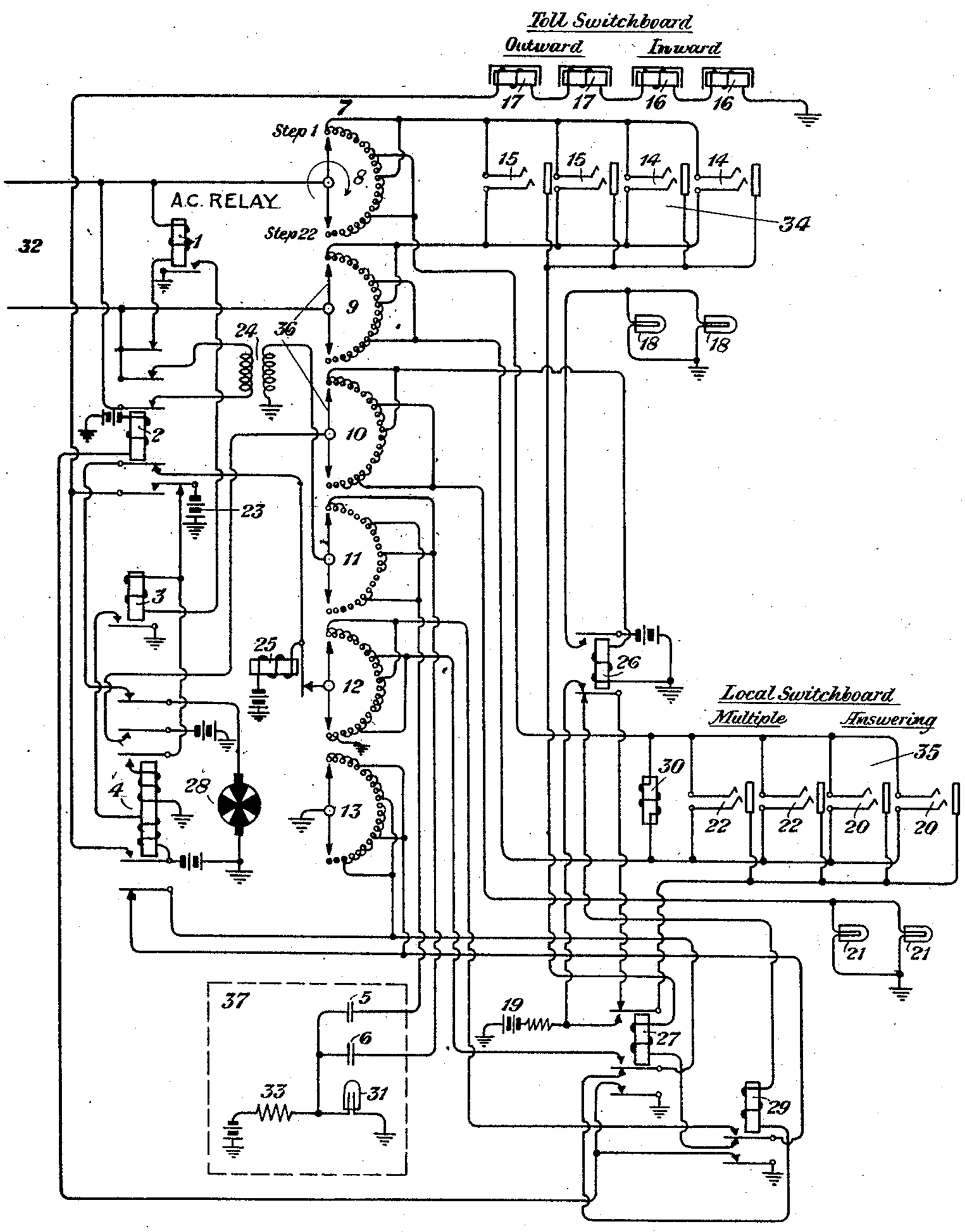

Fig. 1

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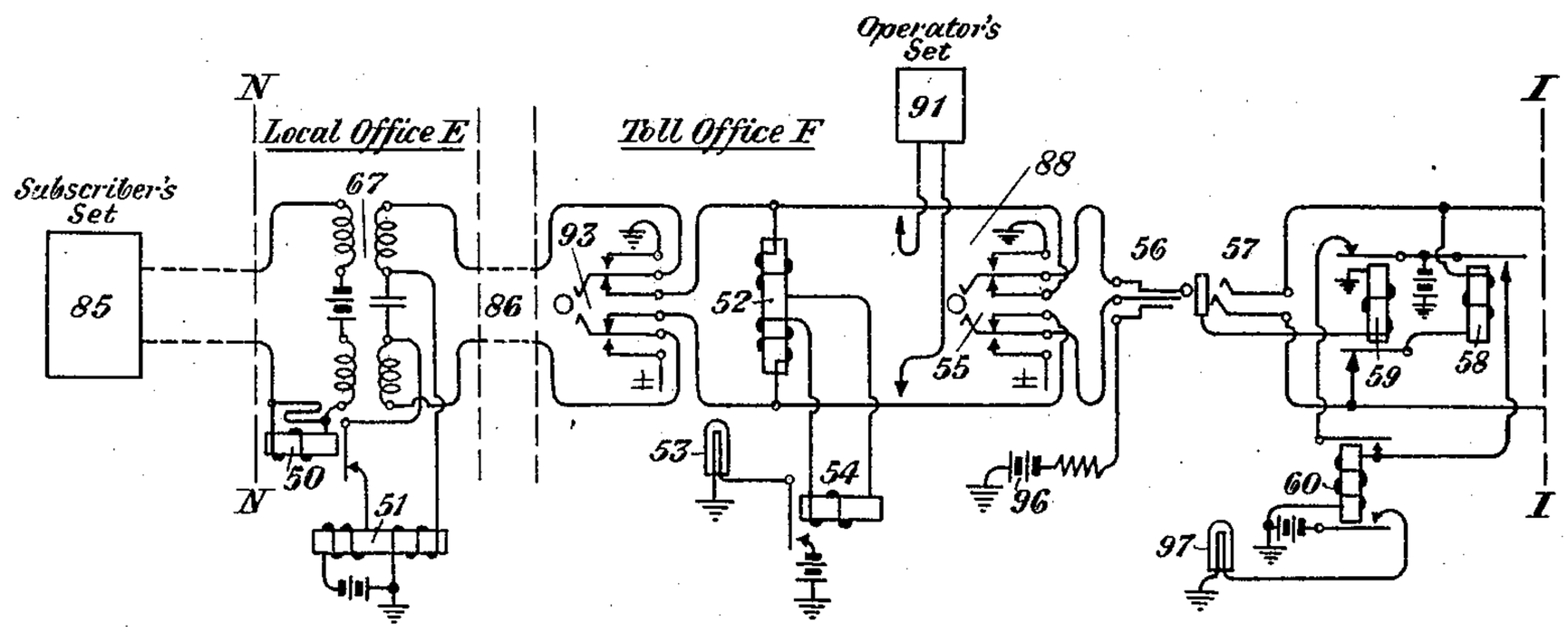

Fig. 2

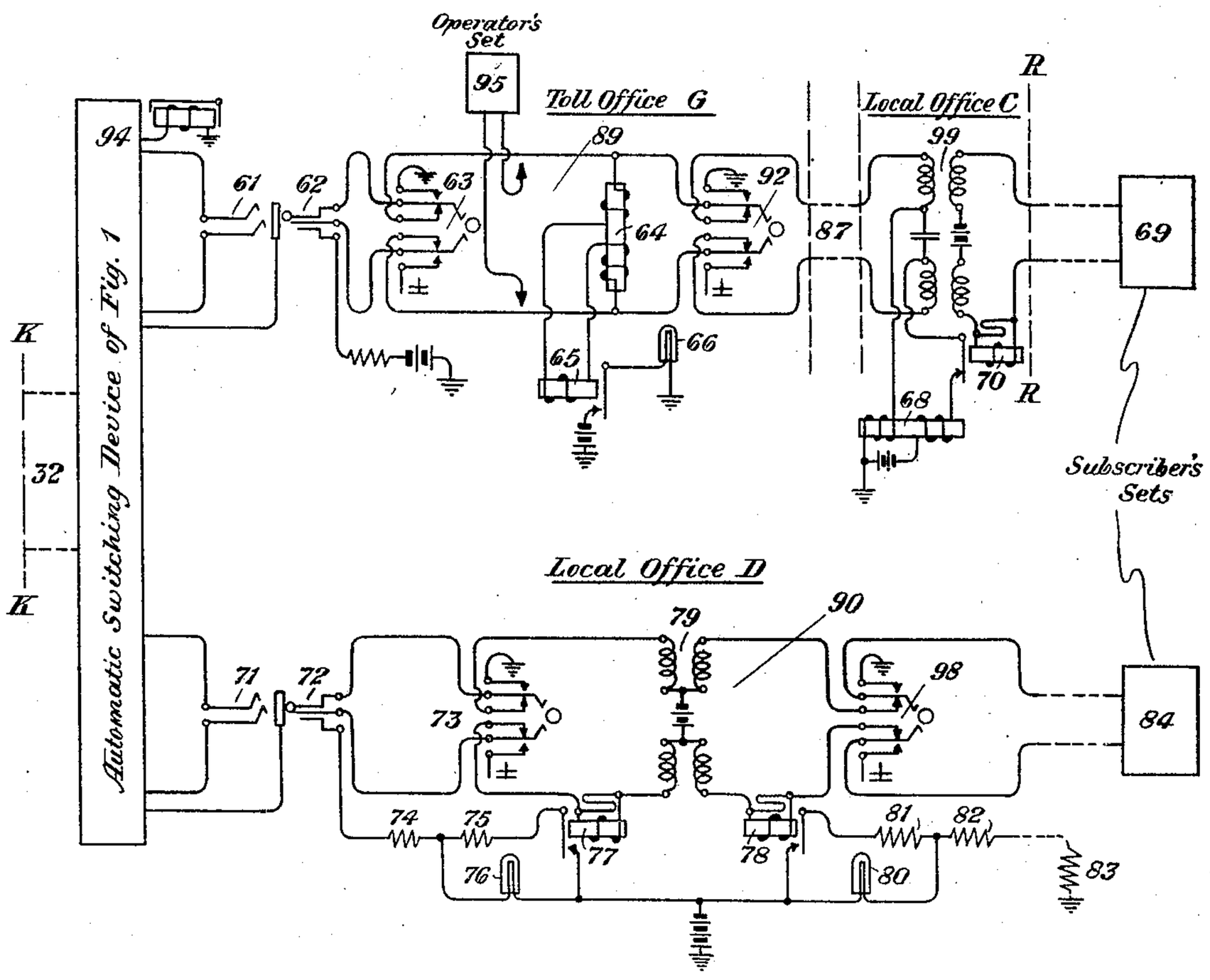

Fig. 3

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UNITED STATES PATENT OFFICE.

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OFFICE-SELECTING MEANS FOR TELEPHONE TRUNK CIRCUITS.

Application filed April 4, 1928. Serial No. 267,424.

This invention relates to telephone systems and more particularly to long distance telephone circuits and provides means whereby an operator located at one point may be connected over a given long distance line directly to any one of a plurality of offices located at a distant point.

For certain types of long distance service, it is desirable that long distance lines extending between two points appear on the switchboard of certain local offices in addition to the switchboards of the toll office located at one or both of such points. As an example, of this, take the usual case where the toll office is located in the business section of a city so that a local office serving the business section is located in the same building with the toll office, or in a building close by. Since a large number of toll calls from a given distant point will terminate in this business section, a saving in time and cost of service could be obtained by arranging toll lines from such distant point to appear on the switchboard of the local office in question, thus enabling the distant operator to establish a connection directly with the local office and in this way avoid the time and expense consumed in establishing the usual type of toll connection via toll office and over a toll switching trunk to the local office. At the same time, in order to serve the local offices located some distance from the toll office, or to establish through toll connections between distant points, it would be necessary to have toll lines from the distant point terminate at such toll office. For calls to such outlying local offices, a toll connection would be established in the usual manner over a toll switching trunk.

In general, it would be uneconomical to have a group of toll lines from the distant point to the toll office and a separate group of toll lines from the distant point to the local office. On the other hand, if the same group of toll lines were permanently connected to the switchboards of both the local and toll offices, signaling difficulties would be encountered, for upon the distant operator ringing on a given toll line, signals would appear before both the local and toll operators with resultant confusion and loss of time before the particular type of operator desired was determined and connection to her established. Special circuits could be utilized for signaling purposes, but such procedure would be expensive.

The object of the present invention is to avoid the above mentioned difficulties while at the same time providing an economical and efficient method whereby a given toll line extending between a first and a second point can be utilized to establish a connection between the toll switchboard located at the first point and either the toll or a local switchboard located at the second point, the establishment of such connection at the second point being automatically accomplished in accordance with signals transmitted from the first point. This result is accomplished by terminating a given toll line extending from the first point upon a pair of contact arms of a selector switch at the second point. Certain groups of contact points over which the switch arms pass are wired to a group of multiple jacks on the toll switchboard, while certain other groups of such contact points are similarly wired to a group of multiple jacks on the local switchboard, the arrangement being such that as the switch arms pass over the contact points in succession, the toll line is connected alternately to the toll and local switchboard multiples. The stepping magnet of the selector switch is connected to an interrupter which periodically completes the operating circuit for this magnet, in this way causing the contact arms of the switch to be stepped slowly around, making contact with each set of contact points in turn. Thus, when the toll line is idle, it is automatically and continuously connected to one answering multiple and then to the other, and distinctive tones are sent out to the distant terminal to inform any operator who may take up the line there to which office the line is connected at that moment. The distant operator waits until the proper tone tells her that the desired office is connected to the toll line and then rings. This stops the automatic switching mechanism and lights the proper line lamp signals. There is a silent interval between tones so that the operator will not ring just as the switch is made and reach the wrong answering position. On calls to the distant point over the toll line in question, the switching mechanism is arranged to quickly connect the toll line to the switchboard of the office which originates the call.

Having thus outlined the invention in general terms, the detailed circuit operation will now be given. Referring to the drawings, Figure 1 shows a detailed circuit embodying the invention, comprising one end of a toll telephone circuit, together with switching means to connect said line alternately to a toll and a local switchboard; Fig. 2, reading from left to right, shows more or less schematically a subscriber's telephone circuit, a toll switching trunk, a toll cord circuit, and the distant end of the toll circuit, the near end of which is shown in Fig. 1. Fig. 3 shows schematically the circuit of Fig. 1 and, in addition, the upper part of the drawing shows a connection from the toll switchboard to a subscriber's circuit through a toll cord and over a toll switching trunk, while the lower portion of the drawing shows a connection from the local switchboard through an "A" cord to a subscriber's circuit. Figs. 2 and 3 taken in order shows schematically how a connection is established from a distant subscriber over the toll line and through the switching mechanism to a subscriber through either the toll or the local switchboard at the near end.

Referring to Fig. 1, when the circuit is in its idle or normal condition, interrupted ground 28 is connected to the stepping relay 25 of the selector switch 7 causing this relay to operate periodically. The circuit is traced from battery through the winding of relay 25, lower inner back contact of relay 2, upper outer back contact of relay 4 to ground through interrupter 28. The operation of relay 25 slowly rotates the shaft on which the contact arms of the selector switch are mounted. A pair of these switch arms are designated 36, but all arms are the same and all are mounted rigidly on the same shaft so that for each operation of relay 25 the switch arms make contact with the next succeeding set of contacts on the arcs 8 to 13, inclusive, of the selector switch.

During the first five contact steps of the selector switch 7, the toll line 32 is connected to the group of toll board multiple jacks 34 through arcs 8 and 9 of the selector switch. From steps 6 to 10, inclusive, the toll line is connected to the local switchboard multiple jacks 35 through arcs 8 and 9 of the selector switch. Similarly, from steps 11 to 15, the toll line is again connected to the toll board and from steps 16 to 20 to the local board. When the selector switch reaches the last two steps, ground is connected to stepping magnet 25 through arc 12 of the switch, causing the magnet to be rapidly stepped around to its initial position. This avoids loss of time while the switch is passing over that part of its cycle which is too small to furnish a proper interval for terminating the toll line at one of the switchboard positions. It will thus be seen that as the selector switch rotates, it connects the toll line alternately to the toll and local switchboards.

During a portion of each such switchboard connection a source of tone 37 is applied across the toll line through transformer 24, the secondary winding of which is connected across the toll line through the pair of upper inner back contacts of relay 2, while the primary winding is connected from ground to the source of tone through arc 11 of the selector switch. Any source of tone might be used for this purpose. That shown utilizes a two electrode low pressure gaseous discharge tube in which the bulb is filled with some inert gas such as neon. The oscillator circuit consists of battery connected through a high resistance 33 to a gaseous discharge tube 31 and ground, and in shunt with the tube, a condenser of suitable capacity such as 5 or 6. An oscillating circuit of this type is described in the "Proceedings of the Physical Society of London," vol. 36, page 269, June 15, 1924. The frequency of oscillation is determined within limits by the magnitude of the capacity connected in shunt with the tube.

Referring now to arc 11 of the selector switch, it will be noted that contacts 1 to 3 and 11 to 13 are wired to condenser 6, while contacts 6 to 8 and 16 to 18, inclusive, are wired to condenser 5. Condenser 5 is of different capacity from 6, thus furnishing two tones of different frequencies dependent upon the capacity connected across the tube at a given time. Considering the wiring scheme of arc 11 in conjunction with that of arcs 8 and 9, it will be seen that during a part of each interval that the toll line is connected to the toll board, one source of tone is transmitted over the toll line to the distant end, while during a portion of each interval that the toll line is connected to the local board, a different source of tone is applied to the toll line, owing to the change in capacity connected across the tube 31 during the respective intervals.

Contact points 4 and 5, 9 and 10, 14 and 15, and 19 to 22 inclusive, of arc 11 are open; hence, while the contact arms are on such steps, no tone is transmitted over the toll line. These silent intervals, it will be observed, occur just prior to a disconnection of the toll line from one switchboard and its subsequent connection to the other, the change being accomplished as the arms of the selector switch pass from 5 to 6, 10 to 11, 15 to 16 and 20 back to 1. The silent intervals thus serve to warn the distant operator that a change in switchboard connection is being made so that she will not attempt to establish connection with a switchboard dur-

ing such interval; otherwise in a number of instances she would be connected to the wrong office.

Assume now that the toll operator at office F of Fig. 2 desires to establish a connection between subscribers' sets 85, Fig. 2 and 69, Fig. 3, the latter being reached through the toll office G. She establishes connection with subscriber's set 85 in the usual manner by connecting toll cord 88 to toll switching trunk 86 and instructs the operator at local office E to connect the incoming end of such switching trunk to subscriber's set 85. Upon connection of toll cord 88 to switching trunk 86, battery supplied through retard coil 51 at office E sends current out over the toll switching trunk and through retard coil 52 and relay 54 in the toll cord circuit 88. Relay 54 operates and lights lamp 53 which lamp remains lighted until the subscriber at 85 answers.

Meantime the operator at office F connects plug 56 of the toll cord to jack 57 of the toll line. Battery supplied from the sleeve of the toll cord operates relay 59 which in turn disconnects relay 58 from across the toll line. The operator at office F connects her telephone set 91 across the toll cord and listens on the circuit until she hears the tone transmitted from the automatic switching device 94, Fig. 3, corresponding to the toll office connection and rings on the circuit by operating ringing key 55. This ringing current upon arriving at the switching device 94 flows through and operates relay 1, refer here to Fig. 1. The operation of relay 1 in turn furnishes ground to operate relay 3 over a circuit from battery through the lower outer back contact of relay 2 through the winding of relay 3 to ground at relay 1. The operation of relay 3 in turn connects ground to the lower winding of relay 4, causing it to operate. Relay 4 immediately locks up through its upper winding on a circuit from battery 23 through the lower outer back contact of relay 2, upper inner front contact of relay 4, through the upper winding of the latter relay to ground. The operation of relay 4 opens the circuit from interrupter 28 to stepping relay 25 at the upper outer back contact of relay 4. This prevents further operation of stepping relay 25 and maintains the toll line connected to the desired switchboard multiple. The operation of relay 4 also causes the busy drops 16 and 17 over the toll board multiple jacks to be operated on a circuit from battery through the lower front contact of relay 4 through the busy drops 16 and 17 to ground. Relay 4, upon operating, also causes the lighting of line lamps 18 at the toll board inward positions. The circuit is traced from battery through the upper intermediate front contact of relay 4, through arc 10 of the selector switch through the winding of relay 26 to ground. The consequent operation of relay 26 connects battery through its upper front contact to light lamps 18. Referring for a moment to arc 10 of the selector switch, it will be noted that relay 26 is connected to the contact points of all steps on selector switch 7 for which a connection between toll line and toll board is established through arcs 8 and 9. Furthermore, for all steps establishing a connection to the local board, the contacts of arc 10 are wired directly to lamps 21 over the local board answering jack. Relay 26, upon operating, also connects battery 19 through its lower front contact, through the upper back contact of relay 27 to the sleeve circuit of the local board multiple, thus furnishing a busy test signal at the local board.

Soon after lamps 18 are lighted in the manner described above, a toll operator at office G, Fig. 3, answers by connecting plug 62 of toll cord 89 to jack 61. Jack 61 of Fig. 3 represents any one of the groups of jacks 14 and 15 of Fig. 1. For convenience, only one such jack 61 is shown in Fig. 3. Battery supplied from the sleeve of the toll cord 89, Fig. 3, flows through the sleeve circuit of jacks 14 of Fig. 1, through relay 27, lower inner back contact of relay 29, to ground through arc 13 of the selector switch causing relay 27 to operate. Arc 13 of the selector switch is wired to furnish ground to relay 27 for all selector switch steps connecting the toll line to the toll board, and is similarly wired to furnish ground for relay 29 for all selector switch steps connecting the toll line to the local board. Relay 29 will be referred to later.

The operation of relay 27 connects ground through its lower outer front contact to the winding of relay 2 causing its operation. The operation of relay 2 disconnects the secondary winding of tone transformer 24 at the upper inner back contacts of relay 2, and opens the operating circuit of relay 1 at the upper outer back contact of relay 2. In addition the operation of relay 2 releases relay 3, if still operated, by disconnecting battery therefrom at the lower outer back contact of relay 2. The operation of relay 2 opens the holding circuit for relay 4 by disconnecting battery 23 from the upper winding of relay 4 causing its release. The release of relay 4 disconnects battery from its upper intermediate front contact causing the release of relay 26, which in turn disconnects battery from lamps 18 causing their extinction. The release of relay 26 does not remove the busy test from the local board sleeve circuit since upon the operation of relay 27, battery 19 is connected directly to the local board sleeve multiple through the upper front contact of relay 27 in anticipation of the release of relay 26. The operation of relay 2 supplies battery through its

lower outer front contact to hold the busy drops 16 and 17 operated after relay 4 is released. Furthermore, relay 2, upon operating, opens at its lower inner back contact the operating circuit of relay 25, thus holding the selector switch stationary after the release of relay 4 has closed the operating circuit of relay 25 at the contacts of relay 4. This completes the cycle of operations of the selector switch mechanism of Fig. 1 for the time being and leaves the circuit ready for speech.

Referring now to Figs. 2 and 3, the toll operator at office G after obtaining the called number from the operator at office F, establishes a connection to subscriber's set 69 in the usual manner by connecting toll cord 89 to toll switching trunk 87 and instructing the operator at local office C to connect the incoming end of the switching trunk to the subscriber's line. Upon the connection of toll cord 89 to trunk 87, relay 65 operates as shown on battery supplied from office C through retard coil 68 and retard coil 64 at office G. Relay 65 upon operating closes the circuit to light lamp 66, which lamp remains lighted until the subscriber at 69 answers. The operator at office G upon receiving a signal that trunk 87 is connected to subscriber's set 69, operates ringing key 92 to ring on the subscriber's circuit 69. When the subscriber at 69 answers, relay 70 operates and opens the operating circuit for relay 65 at office G which releases and extinguishes lamp 66. Meantime the operator at office F operates ringing key 93 to ring in the subscriber at 85. Upon answer of the latter subscriber, relay 50 operates causing lamp 53 at office F to be extinguished.

When the call is complete and the subscribers hang up, relays 50, Fig. 2 and 70, Fig. 3 release, causing lamps 53 and 66 to relight. The operator at office F, upon noting the lighted lamp 53, disconnects toll cords 88 from the switching trunk and toll line. The disconnection of the toll cord from the switching trunk furnishes a signal, not shown, to the operator at office E who thereupon disconnects the switching trunk from the subscriber's line. The disconnection of the toll cord from the toll line releases relay 59. In a similar way, the operator at office G upon noting the lighted lamp 66, disconnects toll cord 89 from the switching trunk, thus causing the operator at office C to disconnect the switching trunk from subscriber's line 69. The disconnection of plug 62 from jack 61 starts a cycle of operations which restores the selector mechanism of Fig. 1 to its normal condition.

Referring to Fig. 1, the removal of the toll cord from jack 14 removes battery from the sleeve circuit, and thus causes the release of relay 27. The release of relay 27 disconnects battery from the sleeves of the local board jacks 20 and 22 at the upper front contact of 27 and removes ground from the winding of relay 2 at the lower outer front contact of 27 causing the release of relay 2. The release of relay 2 connects relay 1 across the toll line and restores the signal tone supplied through transformer 24 to the toll line. In addition, the release of relay 2 disconnects battery from busy drops 16 and 17, causing their release, and closes the circuit from interrupter 28 to stepping relay 25, whereupon the latter relay resumes operation in accordance with the current pulses supplied from the interrupter.

Had the operator at office F, Fig. 2, wished to connect the subscriber's set 85 to subscriber's set 84 instead of to 69, her procedure would be the same as that outlined above with the exception that she would ring on the toll line by operating key 55 when she heard the tone telling her that toll line 32 of Fig. 2 was connected to the local office D. Referring now to Fig. 1, in this case the ringing current would again operate relay 1, which in turn would cause the operation of relays 3 and 4. The busy drops 16 and 17 would be operated from relay 4. The current for the stepping relay 25 would be opened at the contacts of relay 4 when the selector switch was on a step connecting the toll line to the local switchboard 35. Battery supplied from the upper intermediate front contact of relay 4 operates lamps 21 through arc 10 of the selector switch. The local operator upon noting the lighted lamp, connects plug 72, Fig. 3, of an "A" cord circuit 90 to jack 71. Jack 71 of Fig. 2 represents any of the jacks 20 or 22 of Fig. 1. Battery supplied from the sleeve of the "A" cord circuit 90 furnishes a busy test for the sleeve circuit of jacks 20 and 22 and sends current through the "A" cord lamp 76, Fig. 2, through the upper back contact of relay 27, Fig. 1, lower back contact of relay 26 through the winding of relay 29, lower inner back contact of relay 27 to ground through arc 13 of the selector switch. Lamp 76, Fig. 2, does not light, due to the fact that it is shunted out by resistance 75 being connected across it upon the operation of relay 77. An operating circuit for the latter relay is completed through retard coil 30 of Fig. 1. Relay 29, Fig. 1, operates over the circuit described above and connects ground at its lower outer front contact to operate relay 2, the operation of which in turn releases relays 1, 3 and 4 and disconnects tone transformer 24 from the toll line.

Meantime the operator at F, upon receiving a signal that trunk 86 is connected to subscriber's set 85, rings on the subscriber's line 85 as described above, and when the subscriber answers lamp 53 is extinguished. The operator at office D, Fig. 3, proceeds to connect the "A" cord 90 to subscriber's line

84, and then operates ringing key 98. Upon connecting the "A" cord to the subscriber's line, lamp 80 lights from battery to ground over the sleeve circuit of the subscriber's line. When the subscriber at 84 answers, relay 78 operates and extinguishes lamp 80. When the call is completed and the subscribers hang up, lamps 53 and 80 relight and the operators at offices F and D disconnect their respective cord circuits. The effect of disconnecting toll cord 88 was described above. Upon disconnection of plug 72 from jack 71, Fig. 2, relay 29 of Fig. 1 releases, in turn releasing relay 2. The release of relay 2 restores the circuit of Fig. 1 to its normal condition as described above.

On a call to the distant subscriber's circuit 85, Fig. 2, either the toll or the local operator at the near end of the toll line Fig. 3 can obtain access to said toll line by connecting a cord circuit to jacks 61 or 71, as the case may be. Assume that the toll operator wishes to use the line. She connects plug 62 to jack 61, thus furnishing battery to the sleeve circuit. Referring to Fig. 1, battery on the sleeve circuit of multiple 34 operates relay 27 irrespective of the position of the stepping magnet at the moment the toll cord is connected. If at that moment the toll line is connected to the toll board, the operating circuit of relay 27 would be from battery on the sleeve of multiple 34, through the winding of relay 27, back contact of relay 29, to ground through arc 13 of the selector switch. If at the moment of inserting the toll cord, the toll line were connected to the local board, the operating circuit for relay 27 is from battery on the sleeve through 27, back contact of relay 29, lower outer back contact of relay 4 to ground through arc 13 of the selector switch. In either case relay 27 operates and connects ground to operate relay 2. The operation of relay 2 disconnects tone transformer 24 and relay 1 from the toll line, operates the busy drops at the toll board and opens the interrupter circuit to relay 25. The operation of relay 27 also connects battery 19 to the sleeves of jacks 20 and 22 for a busy test and opens the circuit of relay 29 at the lower inner back contact of relay 27 to prevent relay 29 from operating should a plug be inadvertently inserted in a local board jack while the line is held at the toll board.

If at the moment the toll cord is connected to the toll board multiple the selector switch is on a step connecting the toll line to the toll board, the cycle of operations is complete as described above. If, however, at the moment of such connection the toll line is connected to the local board, a circuit is closed upon the operation of relay 27 which operates the stepping relay 25 and causes this relay to step the selector switch rapidly around until the toll line is connected to the toll board multiple. To see how this circuit operates, suppose that at the moment the toll operator plugged into jack 15 the selector switch was on step 6. In that event a circuit would be traced from battery, through the winding and back contact of relay 25, through arc 12 of the selector switch, lower inner front contact of relay 27, to ground through arc 13, since the contact arm of this arc is also on step 6. This circuit, it will be seen, is closed until the selector switch passes on to step 11. Consequently, the stepping relay 25 will operate and rapidly step the selector switch around until the switch arms rest on step 11. When this occurs, the circuit will be traced from the stepping relay through arc 12 to an open circuit at the lower inner front contact of relay 29, which will prevent the further operation of relay 25 and thus maintain the toll line connected to the toll switchboard.

The toll operator at office G of Fig. 3 now rings on the line by operating the ringing key 63. This ringing current arriving at office F of Fig. 2 flows through relay 58 causing it to operate and connect battery through its front contact to operate relay 60. Relay 60 immediately locks up on a circuit from battery through the upper back contact of relay 59, upper front contact of relay 60, to ground through the relay winding. The operation of relay 60 lights the line lamp 97 associated with the distant end of the trunk. The toll operator at office F, on noting the lighted lamp, connects plug 56 to jack 57. Current supplied from battery 96 thereupon flows through relay 59, causing its operation. The operation of relay 59 disconnects relay 58 from across the toll line, releases relay 60 and thus extinguishes lamp 97. From this point on the circuit operation is the same as that described above on a call from subscriber's set 85 to set 69.

Had the call originated at the local office D, plug 72 would be connected to jack 71. Referring to Fig. 1, battery on the sleeve of multiple 35 would operate relay 29 to ground through arc 13 of the selector switch if at the moment of connection the toll line were connected to the local board, otherwise the circuit would be traced through the lower outer back contact of relay 4 to ground at arc 13. In either case relay 29 would operate and furnish ground to operate relay 2 with the results described above for a call originating at the toll office G.

The cycle of operations would thus be complete if at the moment of connecting the cord circuit the toll line is connected to the local board. If not, a circuit is closed to step the selector switch rapidly around until this is accomplished. Assume that when the cord is inserted the selector switch is on step 1. A circuit is traced from battery through relay 25 and arc 12, lower inner front contact of

relay 29 to ground through arc 13. This circuit operates 25 until the selector switch passes on to step 6, when the circuit is traced from battery through relay 25, and arc 12, to an open circuit at the lower inner front contact of relay 27, thus preventing the further operation of relay 25.

It should be added here that in the present instance when relay 29 operates it opens the operating circuit for relay 27 to prevent the operation of this relay in case a cord is inadvertently connected to the toll board jacks during the holding period. The circuit operation from this point on has been described immediately above.

In the explanation given above, the specific case is considered where one end only of a toll line is connected alternately to the toll board and one local board multiple. It can easily be seen, however, that by means of minor circuit modifications the same scheme could be used for connecting the toll line to the toll board multiple and to any desired number of local board multiples in order, or to a plurality of toll board and local board multiples, or to a plurality of switchboard mutiples in general. Furthermore, the scheme is not restricted to one end of a toll line only but can be applied at both ends so that an operator at either end may select any one of a number of offices at the distant end to which she desires the toll line in question to be connected.

What is claimed is:

1. In a telephone system in combination, a telephone trunk circuit extending from a first to a second point, a telephone switchboard located at such first point in which the telephone circuit terminates, a plurality of switchboards located at the second point, switching means at such second point to connect automatically and periodically the telephone circuit in progression to telephone circuit multiples individual to each of the switchboards at such second point, means for automatically transmitting over the telephone circuit from the second to the first point during a portion of each switchboard connection at the second point a signal which is different for each such connection, means controlled from the first point for causing the disconnection of the signal means last mentioned from the telephone circuit and for arresting the further operation of the automatic switching means to hold the telephone circuit connected to a predetermined switchboard at the second point, means upon such arrestment for operating signaling means at the switchboard thus connected, means controlled from the switchboard thus connected for causing the telephone circuit multiples at the plurality of switchboards at the second point to appear busy and for extinguishing the signaling means at the switchboard connected to the telephone circuit, means controlled from the switchboard thus connected to the telephone circuit at the second point for starting anew the progression of the automatic switching means which connects the telephone circuit to the plurality of switchboards, and means controlled from any switchboard at the second point for causing the telephone circuit to be quickly connected to such switchboard and for arresting the progression of the automatic switching means thereafter until released at such switchboard.

2. In a telephone system in combination, a telephone trunk circuit extending from a first to a second point, a plurality of telephone switchboards located at the first point, a plurality of telephone switchboards located at the second point, means at the first point to connect automatically and periodically the trunk circuit in progression to telephone circuit multiples individual to each of the plurality of switchboards at such point, switching means at the second point to accomplish a similar result at such point, means for transmitting from the first to the second point during a portion of each switchboard connection at the first point a signal different for each switchboard connection, means for similarly transmitting signals from the second to the first point during a portion of each switchboard connection at the second point, means controlled from the second point for stopping the transmission of signals to such point and for simultaneously arresting the operation of the automatic switching means at the first point to hold the telephone circuit connected there to a predetermined switchboard, means controlled from the first point to accomplish similar results at the second point, means upon such arrestment of the automatic switching means at either point for operating signals at the switchboard thus connected to the telephone circuit during arrestment, means controlled from the switchboard thus connected to cause the telephone circuit multiples of the plurality of switchboards at such point to appear busy, said means further operating to extinguish the signal means at the switchboard connected to the telephone circuit, means controlled from the switchboard thus connected to the telephone circuit for starting anew the progression of the automatic switching means at such point and for again transmitting signals to the distant point, and means controlled from any switchboard at either point to cause the trunk circuit to be quickly connected to such switchboard and thereafter to arrest the progression of the automatic switching means under control of the switchboard thus connected.

3. In a telephone system in combination, a toll telephone circuit extending from a first to a second city, a toll switchboard at

the first city in which the toll circuit is terminated, a toll switchboard and a local switchboard at the second city each equipped with a plurality of trunk multiple calling and answering jacks, switching means at such second city to connect automatically and periodically the toll circuit alternately to said local and toll switchboard multiple jacks, means for transmitting from the second to the first city during a portion of each switchboard connection at such city a characteristic tone different for each switchboard connection, means at the second city controlled by ringing current transmitted from the first city for disconnecting the signal tones from the toll circuit and for arresting the operation of the automatic switching means at such second city to hold the toll line connected to a predetermined office at such city in accordance with the switchboard connection established at the moment when the ringing current is applied, means at the second city upon such arrestment for operating busy drops associated with said trunk multiple jack on said toll switchboard, means upon such arrestment for lighting line lamps at said answering jacks on the switchboard connected to the toll line, means for extinguishing such line lamps and for connecting a busy test to the sleeve circuits of said multiple jacks at both the local and toll switchboards upon connection of a link circuit to one such answering jack, means for starting anew the operation of the automatic switching means and for reapplying the signal tones to the toll line upon disconnection of the link circuit from the answering jack, and means at the second city for quickly connecting the toll circuit to the multiple of a switchboard which originates a call and for arresting the operation of the automatic switching means in that position upon connection of a link circuit to such switchboard multiple and for renewing again the progression of the switching means upon disconnection of such link circuit.

4. In a telephone system in combination, a toll telephone circuit extending from a first to a second city, a toll office at the first city in which the toll circuit is terminated, a toll office and a plurality of multiple offices located in the second city, switching means at the second city to connect automatically and periodically the toll circuit in progression to the toll office and the plurality of local offices, means for automatically transmitting from the second to the first city during a portion of each period that the toll circuit is connected to an office at such city a characteristic tone different for each office connection, means at the second city controlled by ringing current transmitted from the first city for disconnecting the signal tones from the toll circuit and for arresting the operation of the automatic switching means at the second city to hold the toll circuit connected to a predetermined office in accordance with the moment at which the ringing current is applied, means upon such arrestment to operate busy drops associated with the toll line multiple jacks at the toll board, means upon such arrestment for operating signals at the answering positions of the office to which the toll line is thus connected, means for extinguishing the signals at the answering positions and for connecting a busy test to the sleeve circuits of the toll line multiple jacks at the plurality of offices upon connection of a link circuit to one such toll line answering jack, means for again connecting the signal tones to the toll circuit and for starting anew the progression of the automatic switching means upon removal of such link circuit from the answering jack, and means at the second city for quickly connecting the toll circuit to any of the plurality of offices at the second city upon connection of a link circuit to the toll circuit multiple at such office and for suspending the further operation of the automatic switching means during the period that the link circuit is thus connected at such office.

5. In a telephone system in combination, a trunk circuit extending from a first to a second point, a telephone switchboard located at the first point in which said trunk circuit terminates, a plurality of switchboards located at the second point, switching means at the second point to connect automatically and periodically the telephone circuit in progression to each of the switchboards at the second point, means for automatically transmitting over the telephone circuit from the second to the first point during a portion of each switchboard connection at the second point a signal which is different for each switchboard connection, means controlled from the first point for causing the disconnection of the signal means last mentioned and for arresting the further operation of the automatic switching means to hold the telephone circuit connected to a predetermined switchboard at the second point, means controlled from the switchboard thus connected to the trunk circuit at the second point for releasing said trunk circuit and for starting anew the progression of the automatic switching means, and means controlled from any switchboard at the second point for causing the telephone circuit to be quickly connected to such switchboard and for arresting the progression of the automatic switching means thereafter until released at such switchboard.

6. In a telephone system in combination, a telephone trunk circuit extending from a first to a second point, a switchboard at the

first point in which said trunk circuit terminates, a plurality of switchboards at the second point, switching means at the second point to connect automatically and periodically the telephone circuit in progression to each of the switchboards at the second point, a variable source of tone at the second point comprising in series connection a source of direct current voltage, a resistance of predetermined magnitude and a two-element low pressure gaseous discharge tube, a plurality of condensers each of a different predetermined capacity to furnish a different tone when connected in shunt with said discharge tube, a tone output circuit connected to said telephone trunk circuit and switching means for automatically connecting in shunt with said gaseous discharge tube during a portion of each switchboard connection a series circuit consisting of a condenser different for each switchboard and said tone output circuit, means for arresting the progression of the automatic switching device to hold the trunk circuit connected to a predetermined switchboard at the second point upon reception of a signal transmitted from the first point, means controlled from said switchboard thus connected at the second point for releasing said trunk circuit and starting anew the progression of the automatic switching means, means controlled from any switchboard at the second point for quickly connecting the trunk circuit to such switchboard and for arresting the further progression of the automatic switching means until released at such switchboard.

7. In a telephone system the combination with a circuit for automatically connecting a telephone circuit in progression to a plurality of switchboards substantially as described in the specifications of a variable tone source comprising in series connection a source of direct current potential, a resistance of predetermined magnitude and a two-element low pressure gaseous discharge tube, a plurality of condensers each of a different predetermined capacity to produce a desired tone, a tone output circuit connected to said telephone circuit, and automatic switching means adapted during a portion of each switchboard connection to connect in shunt with the gaseous discharge tube a series circuit consisting of a condenser different for each switchboard and the tone output circuit.

8. In a telephone system, in combination, a line extending from a first to a second point, a plurality of circuits at the second point, switching means thereat to connect automatically and continuously said line in progression to said plurality of circuits for predetermined intervals, means for automatically transmitting over said line to the first point during a portion of each such connection a distinctive signal, different for each said circuit connection, means responsive to signals from the first point for disconnecting said distinctive tone and for arresting the progression of said switching means at a desired circuit connection, and means controlled from said circuit thus connected for starting anew the automatic progression of said switching means.

9. In a telephone system, in combination, a line extending from a first to a second point, a plurality of circuits at the second point, switching means thereat to connect automatically and continuously said line in progression to said plurality of circuits for predetermined intervals, means for automatically transmitting over said line to the first point during a portion of each such connection a distinctive signal, different for each said circuit connection, means responsive to signals from the first point for disconnecting said distinctive tone and for arresting the progression of said switching means at a desired circuit connection, means controlled from said circuit thus connected for starting anew the automatic progression of said switching means, and means controlled from any said circuit at the second point for causing said line to be quickly connected thereto and for arresting the further progression of said switching means.

In testimony whereof, we have signed our names to this specification this 3rd day of April, 1928.

JOHN DAVIDSON, JR.
HENRY E. PHELPS.