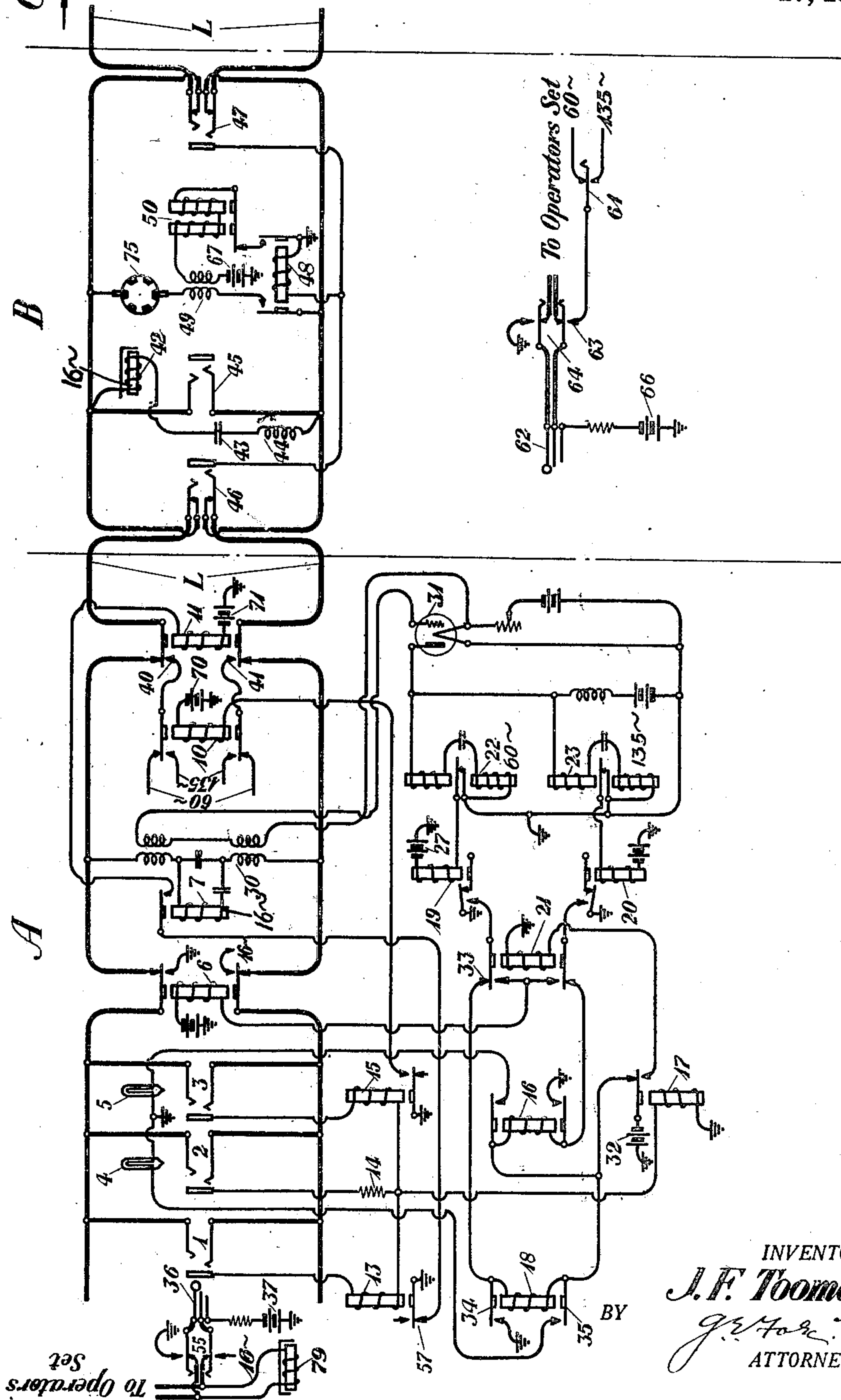


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 SIGNALING APPARATUS AND CIRCUITS.
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SIGNALING APPARATUS AND CIRCUITS.

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To all whom it may concern:

Be it known that I, JOHN F. TOOMEY, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Signaling Apparatus and Circuits, of which the following is a specification.

This invention relates to signaling apparatus and circuits, more particularly it relates to apparatus and circuits for selectively signaling over telephone lines.

In modern long distance telephone practice the central offices are generally so arranged that certain operators, known as the inward operators, handle all the calls coming into the office, while certain other operators, generally called the outward operators, attend to the calls for distance offices. The signal circuits of the telephone lines are so arranged that the inward operators receive all the signals from the distant offices. When, therefore, an operator at a distant office desires to communicate with the outward operator, she must first call the inward operator and then ask to be connected with the outward operator. This involves often considerable delay which is avoided by the present invention which provides apparatus and circuits whereby a distant operator may selectively signal directly to an inward or an outward operator or any other operator associated with the line, without first calling one of the other operators, or causing an operation of their call signals.

This invention, in a broad aspect, effects selection between the different operator's positions by use of signaling currents differing in certain characteristics, together with apparatus selectively responsive to currents of such characteristics. In the preferred form of the invention the characteristic difference between the signaling currents resides in the frequencies thereof. Jacks and associated apparatus are provided whereby different frequencies of signaling current may be sent over the line according to the jack used by the operator; frequency responsive apparatus associated with the line causes the signal to appear at that position only, which is being called.

This invention further provides apparatus which, when the line is in use from one office to an office intermediate its terminals, applies a "tone" current to the nonused por-

tion of the line to indicate that the other part thereof is busy. This tone current may be codified to indicate which intermediate station is using the line, in case more than one such station is associated therewith.

The above and various other features and objects of this invention will be readily understood from the following description when considered in connection with the accompanying drawing showing a diagrammatic view of one form and arrangement of apparatus embodying this invention.

In this drawing reference characters A and C designate the terminal offices of a long distance line L. The apparatus at office C is similar to that at office A, and has been omitted from the drawing in order to prevent unnecessary crowding. Intermediate to offices A and C is an office B, the apparatus of which will be described hereinafter.

At station A are answering lamps 4 and 5, the former being one of the inward answering lamps for calling an inward operator, and the latter being one of the outward answering lamps for signaling to an outward operator. Apparatus is provided at office A whereby lamps 4 and 5 are caused to respond to signaling current coming in on line L, which apparatus comprises a transformer 30, the primary of which is connected across the line, and the secondary of which is associated with the grid circuit of a vacuum tube amplifier 31, in accordance with the invention shown and described in the patent of S. P. Shackleton, No. 1,411,385, issued April 4, 1922, for signaling apparatus. The amplified signaling current flows through relays 22 and 23 connected in parallel in the output circuit of tube 31. These relays are of the frequency responsive type, relay 22 being responsive only to 60 cycle current and relay 23 to 135 cycle current, so that only one of these relays operates at a time, according to the frequency of the signaling current.

When, therefore, 60 cycle current is applied to the line by an operator at another office, in a manner described hereinafter, this current flows through transformer 30 and amplifier 31 to relay 22 which opens its contact and thus disconnects ground from the winding of a slow-release relay 19, normally energized by current from a battery

27. Relay 19 is thus de-energized and operates its contact to close the circuit of a lamp relay 18, which circuit extends from a battery 32 through the back contact of a cut-off relay 17, lamp relay 18, back contact 33 of relay 21 and the contact of relay 19 to ground. Relay 18 is thus energized and closes its front contact 35 which connects battery 32 with the inward answering lamp 4 so that this lamp gives the signal to the inward operator.

Relay 19 is re-energized as soon as the 60 cycle signaling current ceases to come in over the line, and in order to prevent the signal from disappearing at lamp 4 until answered by the operator, relay 18 is provided with a holding circuit extending from battery 32 through its own contact 34 to ground. This circuit holds relay 18 energized and thus causes lamp 4 to remain lit even after relay 19 has returned to its normal condition.

When the operator responds to lamp 4 by inserting the plug 36 of her cord into one of the jacks, say 2, the cord battery 37 sends current through the sleeve resistance 14 and cut off relay 17, so that this relay opens its back contact and disconnects battery 32 from lamp 4, and also from lamp relay 18. Lamp 4 is thus extinguished and relay 18 restored to its unenergized condition.

In case the distant operator for any reason now desires to signal again to the inward operator's position at station A, she will not be able to cause a renewed response of relay 18 and lamp 4 because both of these are disconnected from battery 32 by the cut-off relay 17. However, the relay 21 is now connected with battery 32 by relay 17. Relay 21 therefore holds its front contacts closed and thus connects at front contact 33 the circuit of a relay 6 with the back contact of relay 19. Consequently, when relay 19 connects ground to its back contact in response to a renewed 60 cycle ringing current, relay 6 is energized and connects a source of 16 cycle ringing current to the tip and ring of the answering jack, so that this current flows through the toll cord circuit and causes the toll cord supervisory signal 79 to respond. The inward operator is thus notified that the distant operator is again signaling to her.

The circuits and apparatus for the control of lamp 5 are similar to those of lamp 4, and need not be separately described. It is sufficient to point out that the relay 23 responsive to the 135 cycle current controls a slow release relay 20, which in turn controls a lamp relay 16 for governing lamp 5.

The apparatus of this invention thus selectively responds to 60 and 135 cycle current, so that one or the other position at a terminal office may be called according to the frequency of current sent over the line.

The manner in which the calling operator may apply currents of different frequencies to the line will now be described.

To operate the inward and outward signaling lamps of office C, there is provided at station A a source of 60 and a source of 135 cycle current. A relay 10 normally connects the 60 cycle source to the front contacts 40 and 41 of relay 11 and when operated by current from battery 70 it connects the 135 cycle source to these contacts. Front contacts 40 and 41 are normally open but are connected with the line L when relay 11 is energized.

To signal to the inward operator's position at office C, the operator inserts the plug of her toll cord into jack 2 and operates her ringing key 55 in the usual manner, so that 16 cycle ringing current is applied to the tip and ring of the jack and flows over the line conductors through transformer 30 and marginal relay 7. This relay being selectively responsive to 16 cycle current, operates its contact and thus closes the circuit of relay 11, which circuit extends from battery 71, through the winding of relay 11, through the contact of relay 7 and contact 57 of a relay 13 to ground. Relay 11 closes contacts 40 and 41 and thus applies 60 cycle ringing current to line L, which current flows over the line to the office C and there causes response of the inward answering lamp.

To signal to the outward operator's position at office C, the operator at A inserts plug 36 into jack 3 and manipulates her ringing key. As soon as the plug is inserted into the jack battery 37 causes the operation of the sleeve relay 15 connected in series with the cut-off relay 17, and the sleeve relay causes the energization of the relay 10 so that this relay applies 135 cycle current to front contacts 40 and 41. When, therefore, the operator manipulates the ringing key 55 and thus causes the operation of relay 11, current of a frequency of 135 cycle is sent out over the line to cause the response of the outward answering lamp at the office C.

Office A is further equipped with a jack for signaling to the operator's position at the intermediate office B, this position being equipped with a signal device responsive only to 16 cycle current, as will be described hereinafter. When the operator at office A inserts the plug of her cord into jack 1, the sleeve battery of the cord energizes the sleeve relay 13, connected in series with the cut-off relay 17, and thus opens at contact 57 of relay 13 the ground connection for relay 11. When the operator then manipulates her ringing key 55 and impresses 16 cycle current on the line conductors, relay 11 fails to respond to relay 7, so that the 16 cycle ringing current flows through the back contacts

of relay 11, over the line L to the intermediate station, where it causes response of the signaling apparatus as described below. It should here be noted that the 16 cycle current thus sent out from office A also reaches office C where it flows through the winding of a marginal relay corresponding to the relay 7 at office A. This relay is so adjusted, however, that it fails to respond to the current from office A, and this current consequently has no effect at office C. An operator at office A is thus enabled to call any one of the other operator's positions associated with the line by merely plugging into the jack corresponding to the position she desires to call, and operating the ringing key.

The signaling apparatus above referred to for calling an operator at the intermediate office B may be an annunciator 42, connected across the line conductors together with a condenser 43 and an inductance 44, so proportioned that the annunciator responds to 16 cycle current but not to current of the other signaling frequencies, i. e. 60 and 135 cycles. Any other suitable frequency responsive device may be used, however, when desired. A jack 45 is provided, whereby the operator may answer the call or listen in on the line at any time to determine whether it is busy.

The intermediate office B is equipped also with jacks 46 and 47, the former of which is provided for signaling to office A and the latter to office C. These jacks are provided with normally closed tip and ring contacts which interrupt line L only when an operator's cord is inserted therein. This cord is equipped with a master ringing key having a contact 61, which in its normal position connects a source of 60 cycle current to the contact 63 of the key 64 and in its operated position connects a source of 135 cycles to this contact. When, therefore, the operator inserts plug 62 into jack 46, say, and operates the key 64 she sends to station A 60 or 135 cycles ringing current according to the position of contact 61. The intermediate office operator may thus call the inward or the outward operator at station A or C, respectively, by using jack 46 or 47.

Connected across the line conductors at the intermediate station B is a transformer 49, the primary of which is connected in series with an interrupter 50. Both the primary and secondary circuits of the transformer 49 are normally held open by a relay 48, which is connected to the sleeves of jacks 46 and 47. When the operator at the intermediate station inserts plug 62 into one of the jacks, say 46, the relay 48 is energized by current from the sleeve battery 66 of the cord. The relay closes its contacts and current from battery 67 flows through the interrupter. This current is applied to the

line conductors by the secondary 49 and flows through the contacts of jack 47 over line L to office C, thereby indicating that the line beyond the intermediate station is in use.

In case there is more than one intermediate office on the line it is desirable to pass the current in the secondary of transformer 49 through a codifying device 75 which interrupts the tone current at regular intervals and thus breaks it up into telegraphic dots and dashes for the purpose of notifying the operators which of the intermediate offices is busy. In its present form the device 75 is a revolving commutator the segments of which differ for each intermediate office. Any other device may be used for rendering the tone current characteristic of the office at which it is applied to the line.

Although in the above-described form of embodiment of the invention, there are only three offices associated with the line it is to be understood that a greater or a smaller number of offices may be associated therewith as desired. The number of positions at each office selectively called from the other offices may likewise be changed to suit convenience, it being readily understood that for each additional position it is merely necessary to provide an additional source, differing in frequency from the other sources, with selective apparatus for applying current from this source to the line and selective signal apparatus for responding to current of this frequency, similarly as described herein. The frequencies of signaling current used herein are merely illustrative and any other suitable frequencies may be used when desired. The "inward" and "outward" positions of the terminal offices need not be adjacent to each other, but may be located in separate buildings when conditions of the service make this desirable.

Although only one form of apparatus and circuits embodying this invention is shown and described herein, it is to be understood that various changes and modifications may be made therein within the scope of the following claims without departing from the spirit and scope of this invention.

What is claimed is:

1. In a signaling system, a toll line extending between two offices and terminating at a plurality of positions at one of said offices, means whereby an operator at the other office may select any one of said positions, an intermediate office on said line, and means whereby an operator at the intermediate office may select any one of said positions.

2. In a signaling system, a toll line extending between two offices and terminating at a plurality of positions at one of said offices, an operator's signal at each position, means whereby an operator at the other

office may selectively operate any one of said signals, an intermediate office on said line and means whereby an operator at said intermediate office may interrupt said line and
5 make connection to the part thereof associated with the office having the plurality of positions.

3. In a signaling system, a toll line extending between two offices and terminating
10 at a plurality of operators' positions at one of said offices, an intermediate office on said line and means whereby an operator at the other end office or at the intermediate office may selectively call an operator at any
15 one of said positions.

4. In a signaling system, a telephone line extending between two offices and terminating at a plurality of positions at each of said offices, signals at each of said positions,
20 means whereby an operator at either office may selectively actuate a signal at any one of the positions at the other office, an intermediate office, and means at such intermediate office whereby an operator there
25 may interrupt said line and send different distinctive signals both ways.

5. In combination, a telephone line having two offices, each with a plurality of operators' positions associated with said line,
30 a signaling device for each position, and frequency responsive devices associated with said line for selectively controlling said signaling devices.

6. In combination, a telephone line, a
35 transformer and an audion amplifier with its input circuit connected to receive a voltage proportional to the voltage across the line due to the signaling currents therein, a plurality of devices associated with
40 the output circuit of said audion amplifier and selectively responsive to characteristically different currents therein, and an operator's signal device associated with each selective device.

7. In combination, a telephone line, a plurality of operator's positions associated therewith, a source of current, means other than said source for normally signaling selectively to said position, normally inoperative
50 means associated with said source for also signaling to said position, and a device for rendering said second-mentioned means operative when the operator answers the first-mentioned signaling means.

8. In combination, a telephone line, a jack associated therewith, a cord circuit, a signal associated with said circuit, a local source of current for actuating said signal,
60 a normally inoperative relay for controlling said source, and means for rendering said relay operative only when said cord circuit is associated with a jack, and means to operate said relay by current coming in over the line of a different frequency from
65 said local source.

9. In combination, a telephone line, a source of signaling current therefor at a station on said line, a second source of current at the same station, means normally unresponsive to signaling current in said line
70 for controlling said second source, a cord circuit, a jack associated with said line, and means operated when said cord circuit is associated with said jack for rendering said first-mentioned means responsive to said
75 signaling currents.

10. In combination, a telephone line, frequency responsive devices associated therewith, a relay controlled by each device, a lamp relay for each of said relays and controlled thereby, a signal lamp for each lamp relay and controlled thereby, a jack associated with said line, a cord circuit, a cut-off relay associated with said jack and
80 operated when said cord circuit is associated with said jack, and a circuit for controlling said lamp relays by said cut-off relays.

11. In combination, a telephone line, a plurality of signaling devices, a plurality of frequency responsive devices for selectively controlling the same, an operator's cord signal, a jack for associating said signal with said line, a source of signaling current, a relay for associating said source with said line to operate said cord signal,
95 and a second relay operated when said cord signal is associated with said line for causing said first-mentioned signaling devices to be unresponsive to said frequency responsive devices and to cause an operation of
100 said first relay in response to said frequency responsive devices.

12. In combination, a telephone line, a plurality of jacks, a source of current, a cord circuit for associating said source with one
105 of said jacks, a source of current differing in character from said first source, a relay for connecting one or the other of said sources to said line, and a circuit for controlling said relay according to the jack with
110 which said cord is associated.

13. In combination, a telephone line, a plurality of jacks, a cord circuit, a first relay associated with one of said jacks and operated when said cord circuit is associated
115 with said jack, a second relay, a plurality of sources of current differing in character, a third relay governed by said first relay selectively to associate one of said sources with the second relay, and means for controlling
120 said second relay to associate said source with the line.

14. In combination, a telephone line, a plurality of jacks, a cord circuit, a source of current associated therewith, a second source
125 of current differing from said first source in frequency, a relay normally associating said jacks with said line, and frequency responsive means operated when said cord is associated with a predetermined one of said
130

jacks for causing said relay to dissociate said jacks from said line and causing said second source of current to be connected therewith.

5 15. In combination, a telephone line, a source of current, a plurality of jacks for associating said source with said line, a plurality of sources of current differing in frequency from each other and from the first
10 mentioned source, a first relay for at times preventing said first source from being associated with said line and connecting instead one of said other sources with said line, a circuit for governing said relay according
15 ing to the jack with which said first mentioned source is associated and a second relay for selecting one of said second mentioned sources for connection with the line according to the jack with which said first-
20 mentioned source is associated.

16. In combination, a telephone line, a plurality of jacks, a cord circuit, a source of current associated therewith, a plurality of sources of currents differing in frequency

from each other and from said first-men- 25
tioned source, a first relay, a normally open circuit for controlling said relay, a second relay for closing said circuit when said first source is associated with any one of said
jacks, a third relay for preventing the clo- 30
sure of said circuit when said cord is associated with a predetermined one of said jacks, contacts controlled by said first relay dissociating said jacks from said line when
said circuit is closed and for connecting one 35
of said second mentioned sources to said line, a fourth relay for selecting one of the second mentioned sources of current for connection with the line, a fifth relay for governing
said fourth relay, and a circuit op- 40
erated when said cord circuit is associated with a predetermined jack for governing said fifth relay.

In testimony whereof, I have signed my name to this specification this 23rd day of 45
April, 1919.

JOHN F. TOOMEY.