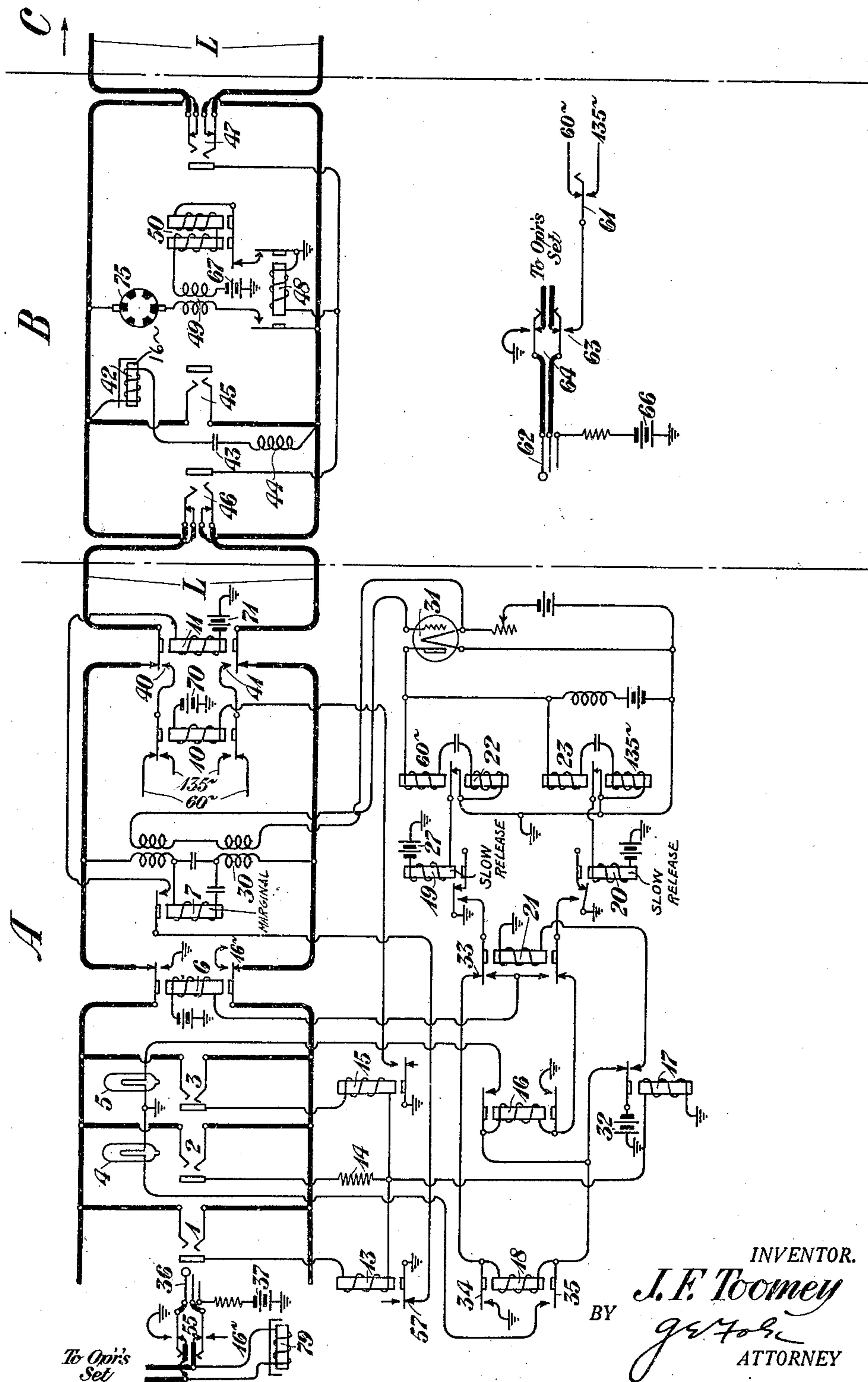


Dec. 26, 1922.

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J. F. TOOMEY.
SIGNALING APPARATUS AND CIRCUITS.
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UNITED STATES PATENT OFFICE.

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SIGNALING APPARATUS AND CIRCUITS.

Original application filed April 24, 1919, Serial No. 292,333. Divided and this application filed October 21, 1919. Serial No. 332,173.

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 and concerns particularly apparatus and circuits for signaling over telephone lines.

The present application is a division of my co-pending application, Serial No. 292,333 filed April 24, 1919, for "Signaling apparatus and circuits."

The present invention provides apparatus which, when a transmission line is in use from one office to an office intermediate its terminals, applies a "tone" current to the non-used portion of the line to indicate that the said other part thereof is busy. This tone current may be codified to identify the intermediate station using the line.

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 co-pending application of S. P. Shackleton, Serial No. 226,065, filed April 1, 1918, now Patent No.

1,411,385, granted 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 cycles 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 1 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 listen in on the line at any time to determine whether it is busy, or answer the call signal 42 and inquire which office, A or C, is calling, so that she may complete the connection by plugging in on a jack 46 or 47 according to the direction from which the call originates.

Jacks 46 and 47 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 cycle 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 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 combination, a telephone line, a source of tone current at an intermediate point thereof, means at said point for interrupting said line and associating an operator with the part of the line either way therefrom, and automatic means for associating said source with the other part of said line than that with which the operator is associated.

2. In combination, a telephone line, a source of tone current at an intermediate point thereof, means at said point for interrupting said line and associating an operator with the line either way from said point, automatic means for associating said source with the other portion of said line than the one with which the operator is associated, and means for codifying the current from said source.

3. In combination, a telephone line, a cord circuit, jacks intermediate said line for associating said circuit with one portion of said line or another, a source of tone current associated with said line, and a relay controlled by the jacks with which said cord circuit is associated for governing said source.

4. In combination, a telephone line comprising a plurality of sections, contacts normally associating said sections, an operator's cord circuit at a junction of such sections, means for at times interrupting said contacts and connecting said cord circuit on one side and a device actuated by said means for applying signaling current to a section on the other side.

5. In combination, a telephone line comprising a plurality of sections, a jack associated with each section, contacts and connections associated with said jacks for normally maintaining said line in conductive continuity, a cord for co-operating with said jacks, and means operative when said cord is associated with one of said jacks for causing the flow of signaling current into the section of the line associated with the other jack.

6. In combination, a toll line, terminal and intermediate offices associated therewith, means associated with the line for signaling selectively from a terminal office to

one of the other offices, and means actuated by the response of the operator at an intermediate office to indicate to the operator at the other terminal office that the portion of the line extending between said one terminal office and the said intermediate office is busy.

7. In combination, a telephone line comprising a short office section at an intermediate station, normally closed contacts at the ends of said short section, signaling means bridged across the section with a normally open switch in the bridge and means for opening the contacts on either side and simultaneously closing said switch.

8. In combination, a telephone line comprising a short intermediate office section, normally closed contacts at the ends of this section, signaling means, an operator's cord circuit and means for opening the contacts on one side and connecting said cord circuit to the line on that side and simultaneously connecting the signaling means across the said short section.

9. In combination, a telephone line, a

source of tone current at an intermediate point thereof, an operator's cord circuit, and means for interrupting the line and connecting the cord circuit to one side and simultaneously associating said source with the other side.

10. In combination, a telephone line, means for interrupting it and establishing a talking connection either way from the point of interruption and simultaneously applying signaling current the other way.

11. In a signaling system a telephone line, an intermediate office thereon, an operator's cord circuit set at said intermediate office, two jacks at said office, and means operated by the connection of the cord circuit with a jack to establish an operating connection with one end of said line and cut off the other end of said line and automatically apply a tone signal thereto.

In testimony whereof, I have signed my name to this specification this 20th day of October, 1919.

JOHN F. TOOMEY.