Feb. 8, 1938. D. F. JOHNSTON 2,107,754

TELEPHONE SYSTEM

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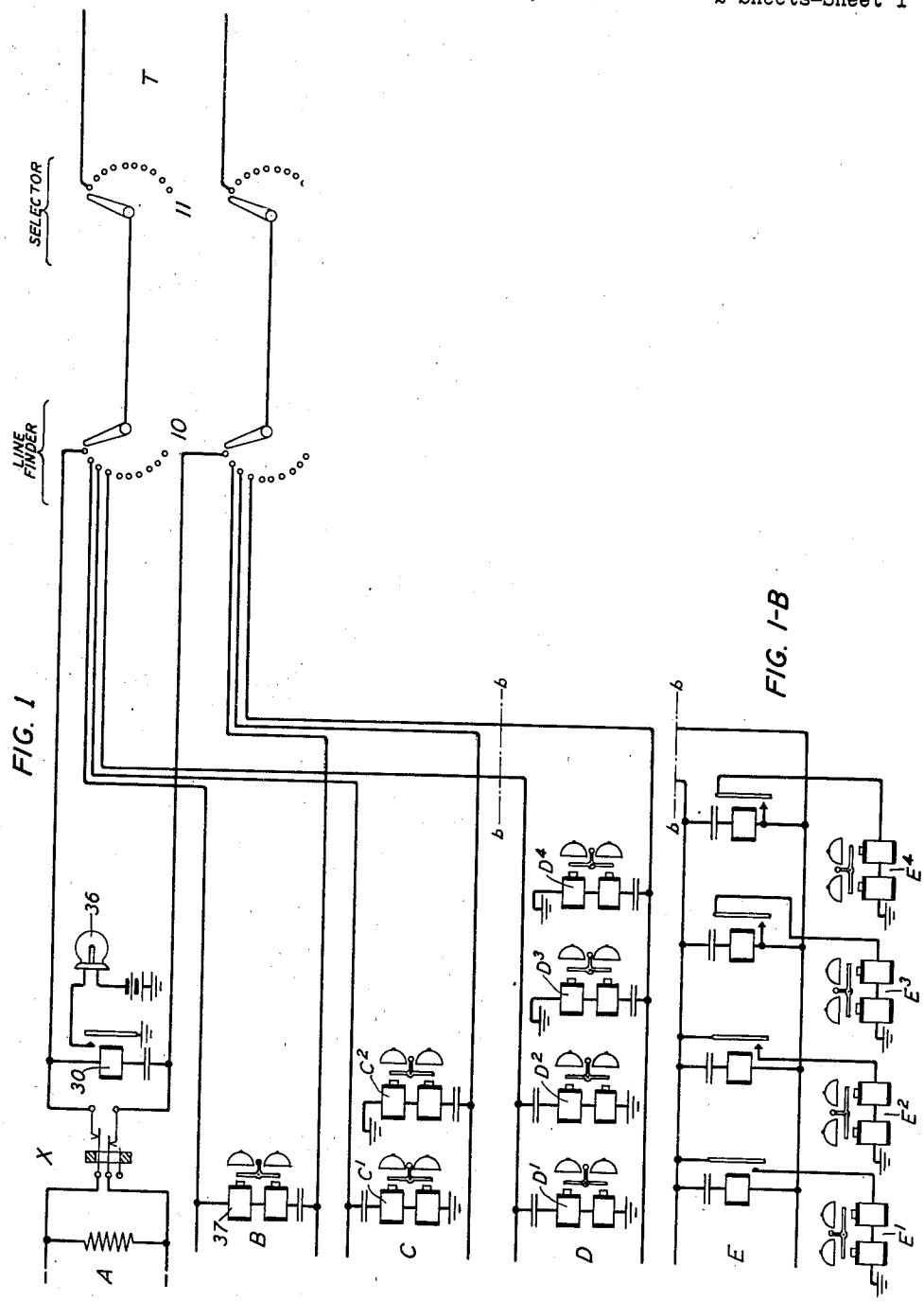

FIG. 1

FIG. 1-B

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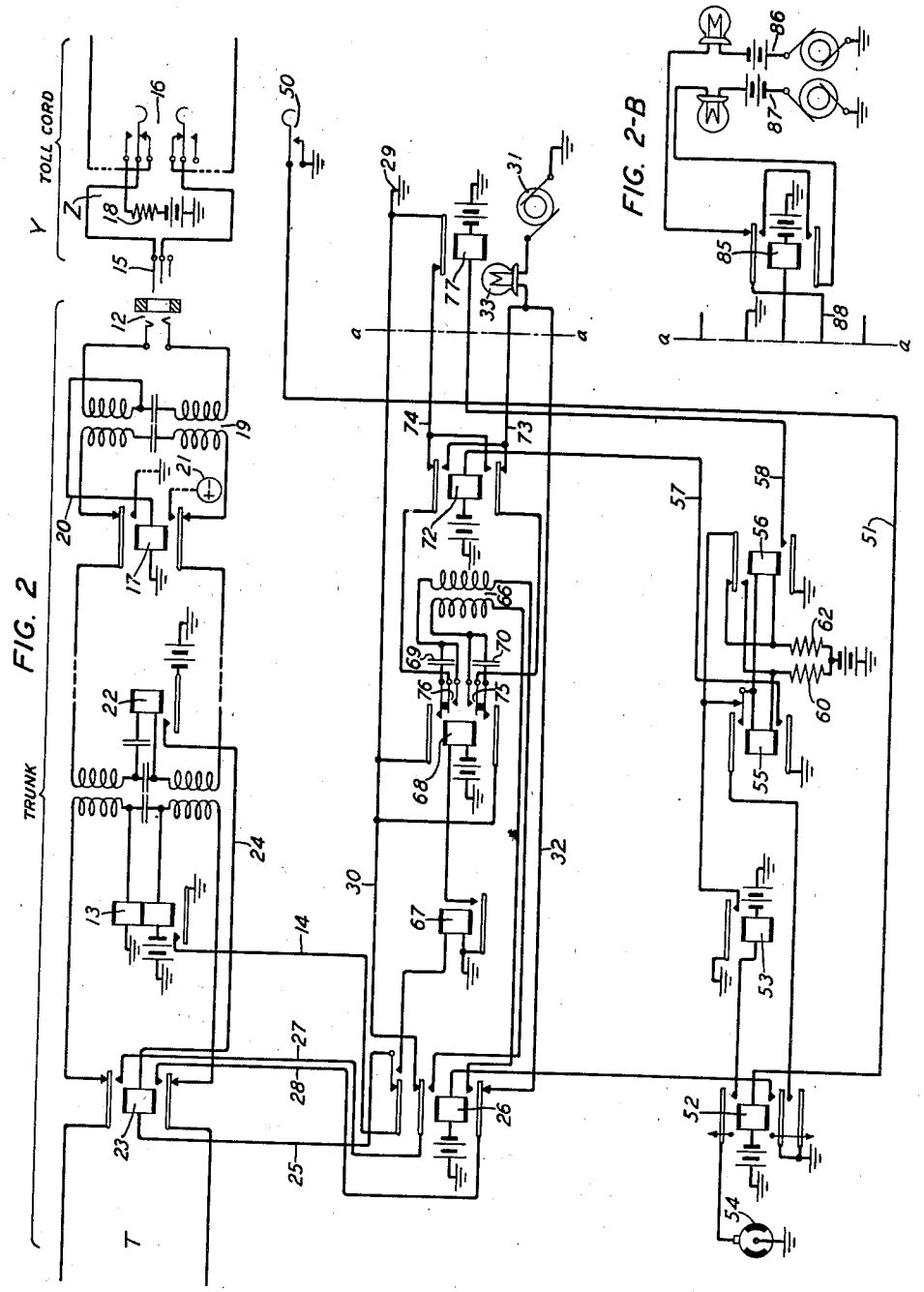

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TELEPHONE SYSTEM

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11 Claims. (Cl. 179—27)

This invention relates to telephone signaling systems and more particularly to emergency ring back signaling systems which render it possible for an operator, in an automatic telephone system, to locate a subscriber's station at which a call may have been initiated and subsequently abandoned before the calling subscriber or the calling line had been identified.

In automatic telephone systems a subscriber may secure the assistance of an operator, either in case of an emergency or for other reasons, by dialing "zero" on his dial. This act causes his line to be extended over a trunk circuit to an operator's position where the call is answered manually by the operator. In seeking the assistance of an operator in an emergency, such as to report a fire or burglary, the calling subscriber, either through excitement or haste, frequently fails to identify the line upon which he is calling and to give sufficient information to the operator to enable her to give the necessary details to the fire or police authorities. In such cases, the operator can be of no assistance unless she is provided with means for tracing the call.

In handling such a call the operator follows the usual procedure of connecting a cord circuit at her position with the trunk over which the call arrived. Heretofore, such cord circuits were equipped with a ringing key arranged to cause a ringing relay in the trunk circuit to connect ground to one side of the calling line and a grounded source of ringing current to the other side, usually the ring conductor, which will cause the operation only of that type of ringing equipment known as bridged type ringers, that is, ringers which are connected directly across the tip and ring conductors of the line and grounded ringers connected to the ringside of the line. Four party full selective ringers, which require superimposed direct current for their operation, would not, of course, be operated under this condition. In such instances the operator may ring back on the line and successfully locate the calling station should she find it necessary to do so. However, in automatic telephone systems, it is common practice to serve, at an automatic exchange, not only those lines which are equipped with bridged ringers or ringers actuated over the ringside of the line, but also lines that are arranged for selective signaling, such as two-party selective lines, four-party semi-selective lines and four-party full selective lines.

It is accordingly the object of this invention to provide means, in an automatic telephone system, for enabling an operator to signal all stations on party-lines arranged for selective signaling, in the event of an emergency call to her position having been abandoned before the calling line or party has been identified.

This object is attained in accordance with a feature of the invention by the provision of means at an operator's position and under the control of an operator, which functions to transfer the trunk circuit upon which a call has arrived, from the regular ringing current source to an emergency ringing supply. In this manner ringing current is transmitted back over the trunk in such a manner as to signal all the parties on the line utilized in making a call, whether the line be one that is provided with bridge type ringing equipment or is one arranged for party-line selective signaling.

The invention will be readily understood from the following detailed description made with reference to the accompanying drawings in which:

Figs. 1 and 2 when placed side by side, with Fig. 1 to the left of Fig. 2, show in schematic form a telephone system embodying the features of the invention, Fig. 1 illustrating a plurality of subscribers' lines of different characteristics which have access to a trunk leading to a toll operator's position at a telephone exchange and Fig. 2 disclosing a skeletonized trunk circuit and the emergency ringing equipment which may be associated therewith under the control of the toll operator;

To the right of line *a*—*a* (Fig. 1) is shown the ringing current source employed with two-party selective and four-party semi-selective lines; and

Fig. 2B discloses the ringing current source employed with four-party full selective lines, one of which is shown in Fig. 1B.

In Fig. 1, X identifies a private branch exchange station at which is located an operator's cord circuit A which may be utilized in establishing a connection to the toll operator's position at Y, at which the toll cord Z is located; B indicates a private line with which a bridge type ringer is associated; C illustrates a two-party line arranged for selective signaling; D represents a four-party line arranged for semi-selective signaling and E illustrates a four-party line arranged for full selective signaling.

It will be understood that the stations associated with the lines B, C, D and E as well as the cord X located at the private branch exchange are equipped with dialing equipment and other apparatus essential in initiating, and causing to be completed, a call to the toll operator's position Y (Fig. 2). It is deemed unnecessary, however, to show such equipment as it is well known in the art. Only that much of the equipment which is necessary for a complete understanding of the invention is illustrated.

In establishing an emergency call from any of the stations associated with the lines B, C, D and E, the calling subscriber lifts the receiver from its switchhook and listens for dial tone in accordance with well-known practice. The line-finder 10 operates automatically to seize the

calling line and extend it to the selector switch 11. The subscriber upon hearing the dial tone then actuates the calling dial to "zero" and releases it whereupon the calling line is extended to a trunk circuit, such as T, which terminates in jack 12 at a toll operator's position at the exchange Y. It is believed unnecessary to indicate how the operator at Y is apprised of the fact that a call is awaiting her attention on the trunk T since such is well known in the art and forms no part of the present invention. Suffice it to say that upon completion of the connection relay 13 operates over the established connection and connects ground to the conductor 14 for a purpose to be hereinafter explained.

Assuming the toll operator has inserted plug 15 of her toll cord into jack 12 and connected her telephone set (not shown) thereto in accordance with usual practice in answering the call, she would inquire the wants of the calling subscriber. The subscriber may then inform the operator of a burglary or fire, but before stating the location of such an occurrence, either through necessity or excitement abandons the call by dropping or hanging up the receiver. Under such circumstances the operator can be of no assistance in notifying the police or fire departments as to the whereabouts of the condition which prompted the telephone subscriber to initiate the emergency call unless she has facilities for signaling back on the line and locating the subscriber's station.

Ordinarily, had the call originated at the private branch exchange at which the cord A is located or at station B, the operator would proceed to ring back on the trunk T by actuating a key such as 16 associated with her cord which is now connected to the trunk over which the call arrived. Such an act, heretofore, would cause ringing current to be transmitted over the line to operate the ringing relay 35 or the ringer 37, as the case may be. The transmission of ringing current in this manner, that is over one of the conductors of the connection with the other conductor grounded would not, obviously, effect the operation of all the signaling equipment located at the station on line C, D, or E.

The operation of key 16 in the present system causes relay 17 to operate in a circuit extending from grounded battery, resistance 18 in the operator's cord upper alternate contacts of key 16, tip conductor of the cord Z, tip contacts of plug 15 and jack 12, upper right-hand winding of repeating coil 19, conductor 20 to ground through the winding of relay 17. Relay 17, operated, connects ground to its upper armature and the ringing current generator 21 to the lower armature whereupon relay 22 operates in an obvious circuit.

Relay 23 now operates in a circuit extending from grounded battery, armature and front contact of relay 22, conductor 24, winding of relay 23, conductor 25, back contact and upper armature of relay 26, conductor 14, front contact and armature of operated relay 13 to ground. In operating, relay 23 connects the tip and ring conductors of the selector end of trunk T to conductors 27 and 28, respectively, the former of which is connected to ground at 29 by way of the inner upper armature and back contact of relay 26 and conductor 30, and the latter to the grounded signaling current source 31 by way of the lower armature and back contact of relay 26, conductor 32 and resistance lamp 33.

Should the emergency call have originated at the private branch exchange at which the cord X is located, the ringing relay 35 would operate, in an obvious circuit, on current from the source 31 and cause the lamp 36 to be lighted as a ring-back signal. In like manner, had the call been initiated on line B, the ringer 37 would be actuated by current from the source 31, it being understood that in each of these cases, the ringing equipment is bridged across the line.

Had the call originated at station C^1 on line C, it would not be possible for the operator to ring back this station since the ringer located thereat is connected between ground and the tip conductor of the connection, whereas the tip conductor is grounded at 29 and the ringing generator 31 is connected to the ring conductor of the established connection. The signaling equipment at station C^2 being connected to the ring conductor would be actuated by current from the source 31. It is apparent from the foregoing that with the regular ringing equipment heretofore furnished in systems of the type described, only those stations whose signaling equipment is connected across the line conductors or between ground and the ring conductor of the line would be signaled should the toll operator attempt to ring back on the calling line. In like manner, should the abandoned emergency call have originated on the party line D and the toll operator signaled back on the calling line, only those stations, such as D^3 and D^4, whose ringers are connected to the ring conductor of the established connection would be capable of being located. None of the stations on line E could be signaled.

In order to render the ring-back feature of such systems all embracing, that is, capable of application to all stations of a party line designed for selective signaling as well as to all stations having bridge type ringers, the toll operator is provided with an auxiliary ringing key 50 which she actuates together with the regular ringing key 16 associated with the cord which is connected to the trunk circuit over which the emergency call arrived.

When the emergency ringing key 50 at the toll office is operated, ground is connected to the start lead 51 to cause the operation of relay 52 over an obvious circuit. Relay 52, operated, closes, at its upper armature and front contact, the winding of relay 53 to the 60 IPM lead of the interrupter 54. At its inner lower armature and front contact, relay 52 completes an obvious circuit to relay 26 and at its outer lower armature and front contact it prepares a locking circuit for relay 55.

Relay 53 operates and releases in synchronism with the closure and opening of the 60 IPM lead associated with the interrupter 54. The first operation of relay 53 causes relay 55 to operate in a circuit extending from grounded battery, resistance 60, winding of relay 55, normal make-before-break contacts of relay 55 to ground by way of the front contact and armature of relay 53. Relay 56, being short-circuited by its own upper armature and front contact at this time, does not operate. Relay 55, operated, locks to ground on the outer lower armature and front contact of relay 52, and at its lower armature connects ground to the lead 57 for a purpose to be described hereinafter.

When relay 53 releases at the end of a half second, the short circuit is removed from the winding of relay 56 and this relay operates in a circuit extending from grounded battery, resistance 62, winding of relay 56, make-before-break spring and upper armature of relay 55 to ground

on the outer lower armature and front contact of relay 52. Relay 56, operated, connects ground to conductor 58 for a purpose to be hereinafter described and at its upper armature, prepares a short circuit for the winding of relay 55 which is completed when relay 53 operates at the end of the next half cycle interval. Relay 55 accordingly releases and removes ground from the lead 57. Relay 56 remains operated under control of relay 53. The release of relay 53 at the end of the next half second releases relay 56 and the interrupter circuit is ready for another cycle of operation.

Normally, conductors 28 and 27 from the trunk circuit T are connected to the continuous 105 volt alternating current ringing current source 31 and ground 29, respectively. When relay 26 operates, as previously described, the leads 28 and 27 are transferred from the continuous ringing current supply 31 to the windings of repeating coil 66. Relay 26, operated, also transfers the trunk ringing relay 23 from direct ground at the armature and front contact of relay 13 to ground through the winding of relay 67. This transfer is effected without opening the circuit to relay 23 due to the make-before-break contacts of relay 26.

When the toll operator operates the ringing key 16, relay 67 operates in series with relay 23. Relay 67, operated, causes relay 68 to operate in an obvious circuit. Relay 68, operated, closes the windings of the repeating coil 66 to the ringing current supply 31 and ground at 29 after first closing ringing ground 29 to the condensers 69 and 70. The repeating coil 66 and condensers 69 and 70 act as a low pass filter to prevent the high frequency transients, incident to the connection and disconnection of ringing potential, from getting out on the trunk T.

Relay 72 whose winding is connected to the lead 57, reverses the leads 28 and 27 with respect to the conductors 73 and 74 to the ringing current supply 31 and ground 29, respectively. With relay 72 in its normal position, ringing current from source 31 will be supplied to the trunk T by way of the resistance lamp 33, lead 73, back contact and lower armature of relay 72, contacts 75 of relay 68, left-hand winding of repeating coil 66, front contact and lower armature of relay 26, lead 28 and the front contact and lower armature of relay 23 to the ring conductor of the trunk. The tip side of the trunk T is connected to ground at 29 by way of the upper armature and front contact of relay 23, conductor 27, inner upper armature and front contact of relay 26, right-hand winding of repeating coil 66, contacts 76 of relay 68, upper armature and back contact of relay 72, conductor 74 and the back contact of relay 77. When relay 72 operates under the control of relay 55, the circuits just traced will be reversed with respect to the tip and ring conductors of the trunk T. Thus, ringing current is applied alternately to each side of the trunk.

The operation of the interrupter circuits, that is, of relays 55 and 56 thereof may be summarized as follows: Upon the first operation of relay 53, relay 55 is operated and relay 56 released. Under this condition relay 72 operates to connect ringing current from source 31 to the tip side of the connection and ringing ground on the ring side. Any bridge type ringer, such as 37 on line B or the ringing relay 35 at the private branch exchange would be operated for one-half second at this time.

When relay 53 restored after its one-half second operation, relay 55 remains operated and relay 56 also operates. Under this condition both relays 72 and 77 operate so that ground is removed from the ring side of the trunk T by relay 77 and ringing current is maintained on the tip side by relay 72. Accordingly, any ringer connected to the tip side of the connection, such as the ringers at stations C', D' and D^2 would respond during the second half second.

When relay 53 is operated again, relay 55 restores its armatures and relay 56 remains operated. Under this condition relay 72 releases and relay 77 remains operated. Ringing ground is accordingly maintained disconnected and ringing current from source 31 is connected to the ring side of the connection with the result that, during the third one-half second, all ringers connected to the ring side of the connection, such as ringers C^2 D^3 and D^4 would be actuated.

When relay 53 again restored to normal, both relays 72 and 77 would be in their unoperated conditions, as shown in Fig. 2, with the result that ringing ground is reconnected to the tip side of the connection and ringing current to the ring side, the condition which prevailed just prior to the first operation of relay 53. The cycle of operations is repeated as long as the keys 16 and 50 are held actuated.

From the foregoing description, it is apparent that regardless of whether the emergency call originated on the private line B, the two-party selective line C, the four-party semi-selective line D, or at the private branch exchange, every station, regardless of the type of ringing provided for, would be signaled when the toll operator actuated the keys 16 and 50. In the case of line B the receiver must be on the hook in order to remove the low resistance shunt caused by the station receiver. In connection with the lines C and D the receiver at the calling station may be either on or off the switch hook.

In the event that the toll office serves four-party full selective lines, it is necessary that the equipment indicated at Fig. 2B be employed. In this case relay 85 functions in the same manner as does relay 77 hereinbefore described, that is, under control of relay 56 in the interrupter circuit. The equipment at Fig. 2B includes a source of direct current superimposed on a ringing current supply with means for reversing the polarity of the direct current. With relay 85 in its normal unoperated condition, the superimposed signaling sources indicated by the numerals 86 and 87 would be alternately connected to the lead 88 which corresponds to the lead 73 in Fig. 2 so that, depending upon the position of relay 72, that is, whether operated or released, negative and positive superimposed ringing current is connected alternately to the tip and ring conductors of the established connection to effect the actuation of the signaling equipment located at stations E_1, E_2, E_3 and E_4 on line E, it being understood that the ringers at stations E_1 and E_3 are polarized oppositely to the ringers at stations E_2 and E_4.

What is claimed is:

1. In a telephone system, a party line arranged for selective signaling, a central office, means including a trunk circuit for extending said party line to said central office, a single source of signaling current at said central office, and means at said central office for connecting said source of current to said line in such a manner as to cause the alternate operation of the signaling devices located at the stations on said party line.

2. In a telephone system, a party line having a plurality of signaling devices associated there-

with, certain of said devices connected to the ring side of said line and certain others connected to the tip side of said line, a central office, means including a trunk circuit for extending said party line to said central office, a single source of signaling current at said central office, and means controlled at said central office for connecting said source of current to the tip and ring conductors of said trunk circuit alternately to cause the alternate operation of the signaling devices associated with said line.

3. In a telephone system, a subscriber's line circuit, an operator's position, means including a trunk circuit having tip and ring conductors for extending said line circuit to said operator's position, a grounded source of signaling current, a grounded terminal, and means controlled by the operator at said position for connecting the ring conductor of said trunk circuit to said grounded source of signaling current and the tip conductor of said trunk circuit to said grounded terminal and causing the tip and ring connections to the source and terminal to be interchanged periodically.

4. In a telephone system, a subscriber's line circuit, a central office, means including a trunk circuit having tip and ring conductors for extending said line circuit to said central office, a grounded source of signaling current, a grounded terminal, switching means at said central office for connecting the ring conductor of said trunk circuit to said grounded source of current and the tip conductor of said trunk circuit to said grounded terminal, and means controlled at said central office for periodically reversing the connections effected by said switching means.

5. In a telephone system, a party line having a plurality of signaling devices associated therewith, certain of said devices connected to the ring side of said line and certain others connected to the tip side of said line, a central office, means including a trunk circuit for extending said party line to said central office, a source of signaling current at said central office, switching means at said central office, and means operated in response to a single actuation of said switching means for connecting said source of signaling current to the tip and ring conductors of said trunk circuit alternately to cause the alternate operation of the signaling devices associated with said line.

6. In a telephone system, a subscriber's line circuit, an operator's position, means including a trunk circuit for extending said line to said position, a source of grounded ringing current, means at said operator's position for connecting said source to one of the conductors of said trunk circuit and ground potential to the other conductor of said trunk circuit and other means controlled by the operator at said position for repeatedly interchanging the connections of said source and ground potential to the conductors of said trunk circuit.

7. In a telephone system, a subscriber's line circuit, a central office, means including a trunk circuit for extending said line circuit to said central office, a source of signaling current, means for connecting said source of current to the ring conductor of said trunk, switching means for opening the connection of said source of signaling current to the ring conductor of said trunk and connecting said source to the tip conductor of said trunk, and interrupter means for controlling the operation of said switching means whereby current from said source is alternately transmitted over the ring and tip conductors of said trunk and line circuits.

8. In a telephone system, a subscriber's line circuit, a central office, means including a trunk circuit for extending said line circuit to said central office, a source of signaling current a grounded terminal, means for connecting said source of signaling current to the ring conductor of said trunk and the grounded terminal to the tip conductor of said trunk, switching means for reversing the tip and ring conductors of said trunk with respect to said source of signaling current and said grounded terminal, other switching means for opening and closing a circuit to said grounded terminal and cyclically operating means for controlling both said switching means whereby said signaling current source is connected alternately to the tip and ring conductors of the trunk circuit both during the closed and open periods to said grounded terminal.

9. In a telephone system, a subscriber's line, a trunk circuit, an operator's position, means for extending said line over said trunk to said position, a cord circuit at said position adapted to be connected to said trunk circuit, a grounded source of ringing current, a ringing key in said cord circuit, a ringing relay in said trunk operated in response to the actuation of said key to connect said source to one side of said line and to connect ground to the other side, and auxiliary means common to said position and controlled by the operator effective when said ringing key is operated to alternately and automatically connect said source for short intervals to the two sides of the line first with and then without the connection of ground to the other side.

10. In a telephone system, an operator's position, a line extended thereto, a cord circuit at said position connected to said line, a grounded source of ringing current, a ringing key in said cord circuit adapted when operated to cause ground to be connected to one side of said line and said source of ringing current to the other side, and auxiliary means including an emergency ringing key located at said position effective when both of said keys are conjointly operated to alternately connect said source for short intervals to the two sides of the line first with and then without the connection of ground to the other side.

11. In a telephone system, a party-line arranged for selective signaling, a central office, means including a trunk circuit for extending said party-line to said central office, a grounded source of signaling current at said central office, a ground terminal at said central office, and switching means for periodically and alternately connecting each side of said trunk circuit to said ground terminal and said source of signaling current to each side of said trunk circuit alternately during both the connected and disconnected periods of the ground terminal to the trunk conductors.

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