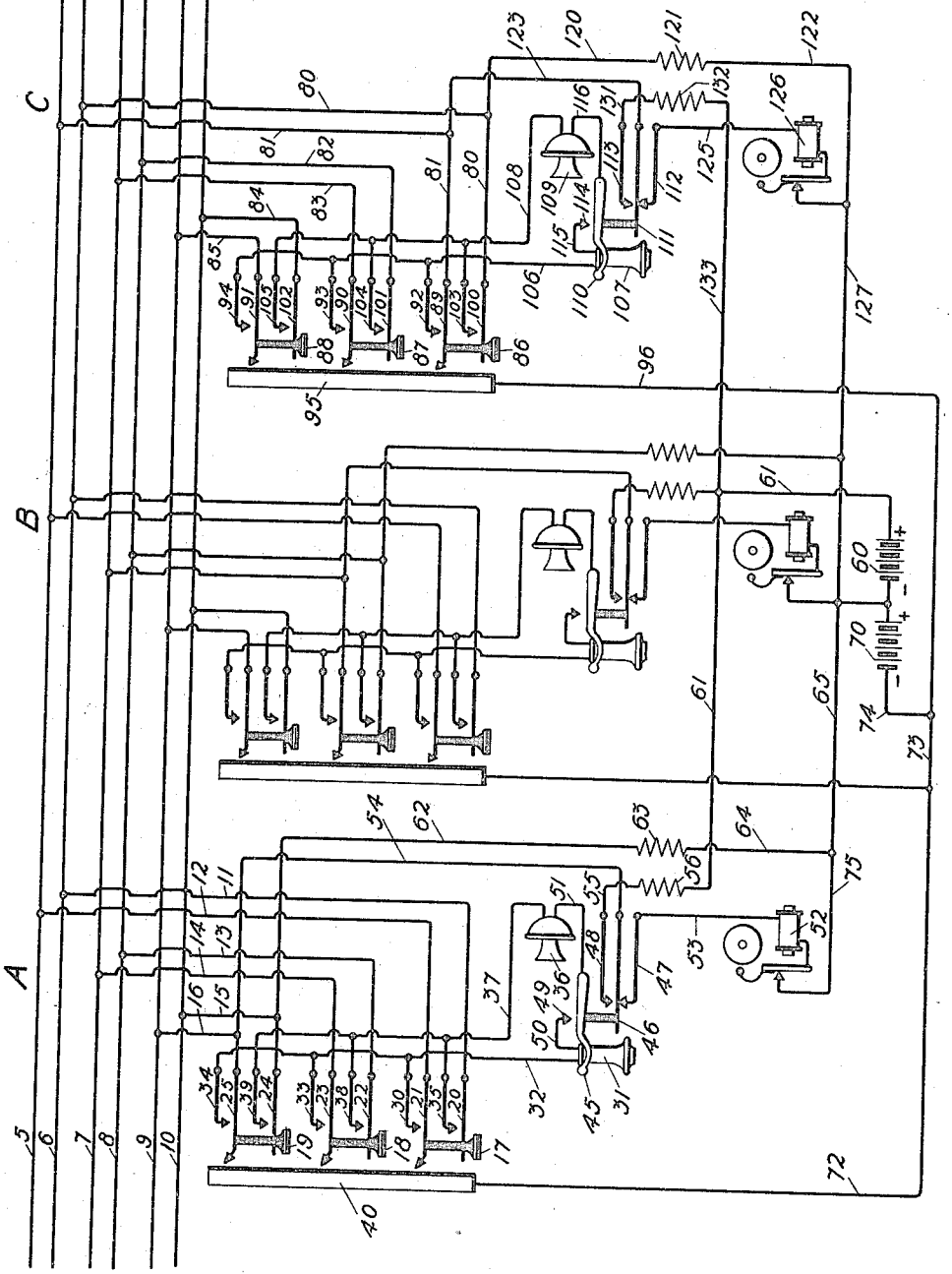
A. E. LUNDELL.

TELEPHONE SYSTEM.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,222,879. Specification of Letters Patent. Patented Apr. 17, 1917.

Application filed April 17, 1913. Serial No. 761,807.

To all whom it may concern:

Be it known that I, ALBEN E. LUNDELL, a citizen of the United States, residing at New York, in the county and State of New York, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and more particularly to that class of telephone systems wherein each subscriber may independently communicate with any other subscriber, or those systems commonly known as "intercommunicating systems".

The object of this invention is to provide an improved system of the above type which will eliminate objectionable features of the present systems and which will be reliable and efficient in operation.

In accordance with one feature of this invention, means are provided for applying a "busy test" to a line with which connection is desired; a second feature relates to means for entirely excluding battery current from the circuit of all signals except at the time a signal may be operated; a third feature relates to means for preventing talking battery on the individual metallic circuits, which form the interconnecting line circuits, until the called party has answered; and a fourth feature relates to a circuit arrangement for preventing disagreeable clicks in the telephone receiver at the time a "busy test" is being applied.

This invention will be fully understood from the following description taken in connection with the accompanying drawing in which the novel features of the invention are shown embodied in a diagrammatic representation of the preferred circuit arrangement.

Three subscribers' stations A, B and C are connected in multiple to three pairs of interconnecting line conductors 5—6, 7—8 and 9—10. For the sake of clearness and convenience, only three stations are shown, but it is to be understood that as many stations as desired may be interconnected without departing from the novel features of this invention. At station A the pairs of wires 5—6, 7—8 and 9—10 are joined by suitable pairs of conductors 11—12, 13—14 and 15—16 to the lever contacts or contact springs of keys 17, 18 and 19 respectively, there being one key at each station for every station in the system. The conductors 11—12 lead to lever contacts or contact springs 20—21 respectively of the key 17, conductors 13—14 to springs 22—23 of key 18, and conductors 15—16 to springs 24—25 of key 19. Contact spring 30, of key 17, which is adapted to make contact with lever contact 21 when the key is depressed is joined to a telephone receiver 31 by a conductor 32. A spring 33 of the key 18 and spring 34 of key 19 are joined to the conductor 32. A second contact spring 35 of the key 17 adapted to make contact with the lever contact 20 when the key is depressed is joined to a transmitter 36 by conductor 37. Spring 38 of key 18 and spring 39 of key 19 are connected to conductor 37.

The keys 17, 18 and 19 are adapted to be depressed into two different positions, during the first of which contact is made between springs 30, 33, 34, 35, 38 and 39 and the corresponding key lever contacts or contact springs 21, 23, 25, 20, 22 and 24, respectively. The key lever contacts 21, 23 and 25 are positioned to engage a common bar 40 when the corresponding key button is completely depressed, closing a signaling circuit as hereinafter described. When the key is released the contact between bar 40 and lever contact 21, 23 or 25 is broken and the signaling circuit is opened. The key which has been so depressed and released is, however, locked in a position such that the key lever contacts and contact springs remain in engagement, holding the speech receiving and transmitting means in operative relation to the corresponding line conductors.

A switch hook 45, of the usual form, is provided with a contact lever or spring 46 and a spring 47 normally making contact therewith, but adapted to be separated therefrom when the switch hook is elevated. The switch hook is also supplied with a spring 48 positioned to make contact with the contact lever 46 when the hook is elevated, but normally separated therefrom, and a contact point 49 which engages the switch hook 45 when the same is elevated, but which is normally separated therefrom. A conductor 50 connects one terminal of the receiver 31 with the contact point 49 and a conductor 51 joins one terminal of the transmitter 36

to the switch hook 45. The contact spring 47 is connected to a suitable signal means 52, which may be of the usual direct current vibrating type, by a conductor 53, and the lever contact 46 is joined to the lever contact 25 of key 19 by a conductor 54. Spring 48 is connected by a lead 55 to one terminal of an inductive resistance 56, the other terminal of which is connected to a battery 60 by means of conductor 61. The lever contact 24 of key 19 is joined by a conductor 62 to one terminal of a second inductive resistance 63, the other terminal of which is joined to battery 60 through conductors 64 and 65.

Two sources of current are preferably used, one for the purpose of signaling and one for the transmission of speech. In the accompanying drawing, source 60 furnishes the current for the transmitters of all the stations, while source 70 is used for the purpose of operating the signal means. Bar 40 is joined by conductors 72, 73 and 74 to one terminal of source 70, to the other terminal of which is connected the signal 52 by means of conductors 65 and 75. One terminal of the batteries 60 and 70 is connected together, preferably as shown, in order to provide a signal whereby the calling station may be advised that the signal of the called station is being operated. The manner in which this signal is produced will be hereinafter explained.

At station C the same circuit conditions obtain as those found at station A. The leads 80, 81, 82, 83, 84 and 85 extend, in pairs, from the interconnecting pairs of conductors 5—6, 7—8 and 9—10 to the keys 86, 87 and 88. The lever contacts or springs 89, 90 and 91 to which the leads 81, 83 and 85 extend are adapted to make contact with springs 92, 93 and 94 respectively during the first stage of the depression of the keys, and with bar 95 upon their complete depression into the signaling position. The bar 95 is connected by conductor 96 to the same terminal of battery 70 as the bar 40 at station A. The leads 80, 82 and 84 extend to lever contacts 100, 101 and 102 which are adapted to contact with springs 103, 104 and 105 when the corresponding key is depressed. Conductor 106 joins the contact springs 92, 93 and 94 to one terminal of the receiver 107, and conductor 108 connects springs 103, 104 and 105 to one terminal of the transmitter 109. Switch hook 110 is provided with contact or spring lever 111, spring 112, normally in contact therewith, spring 113 normally separated therefrom, and contact point 114. Conductor 115 joins contact 114 to receiver 107 and conductor 116 connects transmitter 109 to switch hook 110. The spring 112 of the switch hook 110 is joined by conductor 125 to one terminal of a signaling device 126, the other terminal of which is joined to the common lead between the batteries by conductor 127. Conductor 80 has a branch circuit to battery through conductor 120, inductive resistance 121 and conductors 122 and 127; and conductor 81 has a branch circuit 123 to the lever contact 111 of the switch hook 110. The spring 113 of the switch hook 110 is connected to the talking battery 60 by means of conductor 131, through inductive resistance 132 and conductors 133 and 61.

The apparatus and the system of connections at the other stations are similar to those at stations A and C, it being noted that the receiver and transmitter at each station are connected to a different key from that used by the other stations. The key to which the transmitter and receiver at each station are connected may be termed the "home key" since it is used only on incoming calls.

Assuming that station A wishes to call any other station as, for example, station C, the button corresponding to the desired station is depressed to its lowest position after the receiver has been removed from the hook. In the case assumed, key 17 is depressed. Current flows from battery 70, conductors 73 and 72, bar 40, key spring 21 of key 17, conductor 12, line 5, conductors 81 and 123, lever contact 111 of switch hook 110, contact spring 112, conductor 125, signaling means 126, conductor 127, and back to battery 70. The signal 126 at station C is therefore actuated as long as key 17 is held in its lowest position.

A branch circuit is also closed for battery 70 through contact spring 30 of key 17, conductor 32, receiver 31 at the calling station, conductor 50, contact 49, switch hook 45, conductor 51, transmitter 36, conductor 37, contact springs 35 and 20, conductor 11, line 6, conductors 80 and 120, resistance 121, conductors 122 and 127 to battery 70. This shunt circuit is for the purpose of giving a tone in the receiver 31 due to the interruptions in the signaling circuit by the signaling device 126. In the calling position with key 17 fully depressed, the receiver 31 becomes a tone detector and signal 126 becomes a tone producer. By listening, the calling party will know that the station called is not busy and that the signal is operating when tone is present in the receiver. The absence of tone accordingly indicates that the station wanted is busy. It will also be noted that it is not necessary to remove the receiver from the switchhook at the calling station in order to operate the signal at another station, as the tone-detecting circuit is entirely independent of the circuit through a distant signal; also that the operation of disconnecting the signal circuit at the called station, by removing the receiver from the switchhook, does not dis-

connect the tone-detecting circuit, which may be retained by means of the switch 17 at the calling station.

When the calling party releases the key 17, battery is entirely cut off from the lines and the signal 126 ceases to operate.

Upon the called party removing his receiver from the switchhook 110 and pressing the "home button" 86 a talking connection is established between the calling and called stations as follows: talking battery 60, conductors 61 and 133, resistance 132, conductor 131, contact springs 113 and 111, conductors 123 and 81, line 5, conductor 12, contact springs 21 and 30, conductor 32, receiver 31, conductor 50, contact 49, switchhook 45, conductor 51, transmitter 36, conductor 37, contact springs 35 and 20, conductor 11, line 6, conductors 80 and 120, resistance 121, conductors 122 and 127, back to battery 60. A branch circuit is also provided for the transmitter and receiver at station C through conductor 80, contact springs 100 and 103, conductor 108, transmitter 109, conductor 116, switchhook 110, contact 114, conductor 115, receiver 107, conductor 106, contact springs 92 and 89 and conductor 81.

In the talking circuit just traced, it will be noted that the transmitter at each station is connected in bridge on the pair of conductors forming the "home" line of the called station, and that the talking battery is connected in bridge to this line circuit or disconnected therefrom by means of the switchhook at the called station, irrespective of the position of the switching devices or telephone set circuits at the calling station. Economy of the talking battery current is thereby effected in connection with metallic circuit working.

What I claim is:

1. In a telephone system, in combination a plurality of line conductors, a plurality of stations interconnected thereby, a source of signaling current and a source of talking current common to said stations, a signal for each of said stations, a tone-producing circuit including the signal for each of said stations, a telephone set for each of said stations, a tone-detecting circuit including a receiver for each of said stations, and switching means at each of said stations for connecting said signal and said receiver in parallel circuits and in bridge on said source of ringing current.

2. In a telephone system, in combination a plurality of line conductors, a plurality of stations interconnected thereby, a source of signaling current and a source of talking current common to said stations, a tone-producing circuit including a signal for each of said stations, a telephone set for each of said stations, a tone-detecting circuit including a receiver for each of said stations, switching means at each of said stations for including said signal and said receiver in parallel circuits and in bridge on said source of ringing current, and means for disconnecting said tone-producing circuit independently of said tone-detecting circuit.

3. In a telephone system, in combination a plurality of line conductors, a plurality of stations interconnected thereby, a source of signaling current and a source of talking current common to said stations, a tone-producing circuit including a signal for each of said stations, a telephone set for each of said stations, a tone-detecting circuit including a receiver for each of said stations, switching means at each of said stations for including said signal and said receiver in parallel circuits and in bridge on said source of signaling current, and means for excluding said tone-detecting circuit from said source of signaling current without disconnecting said tone-producing circuit.

4. In a telephone system, in combination a plurality of line circuits each comprising a pair of wires, a plurality of stations interconnected thereby, a source of signaling current and a source of talking current common to said stations, a signal for each of said stations, a telephone set for each of said stations, switching means at each of said stations for including said telephone set in bridge on said line circuit pairs, switching means at each of said stations for applying said source of signaling current to the signal of another station, and switching means at a responding station constituting a sole means for including said source of talking current in bridge on a line circuit pair irrespective of the position of the circuits at the station calling.

In witness whereof, I hereunto subscribe my name this 14th day of April A. D., 1913.

ALBEN E. LUNDELL.

Witnesses:
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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."