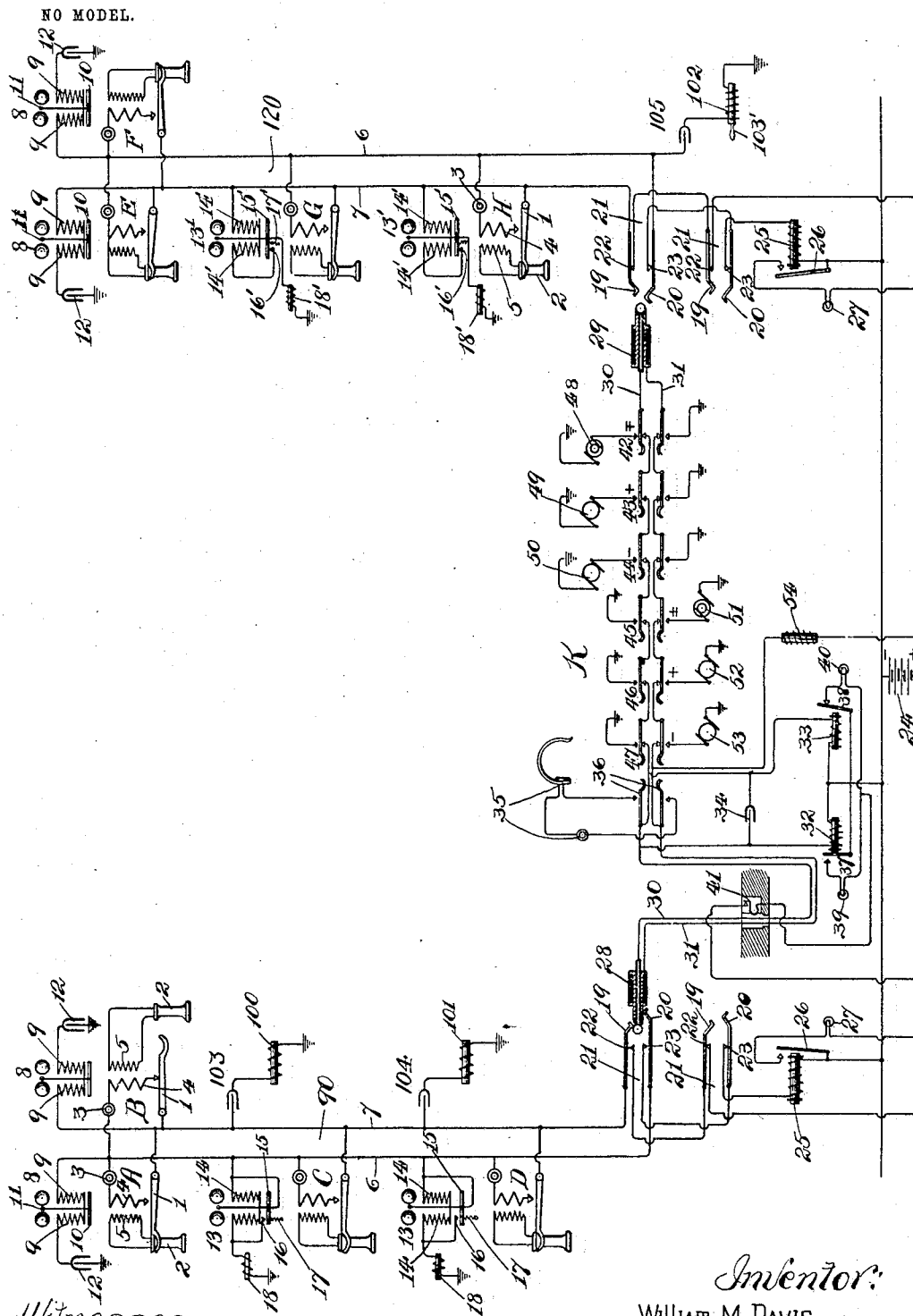


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W. M. DAVIS.
SELECTIVE SIGNALING SYSTEM.

APPLICATION FILED APR. 6, 1903.



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SELECTIVE SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 766,224, dated August 2, 1904.

Application filed April 6, 1903. Serial No. 151,249. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM M. DAVIS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Selective Signaling Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to selective signaling systems, and is particularly well adapted for use in connection with so-called "party-line" telephone systems.

The invention herein described and claimed is closely allied to an invention described in my copending application, Serial No. 149,786, filed March 27, 1903.

The principal objects of my present invention are to provide a system similar to that described in my said copending application except that I herein disclose means for balancing a telephone-line on which the number of substations connected between one of the two metallic line-limbs and ground is not equal to the number of substations connected between the other metallic line-limb and the ground.

A further object of my invention is to provide for a balanced party telephone-line in which there shall be no continuous current leakage.

My invention relates to a system of that type in which the selective apparatus at a number of stations is permanently connected and at all times similarly connected with an electric circuit and in which the signaling apparatus at any one of the substations may be actuated independently of the signaling apparatus at all the other substations connected with the same line.

These selective signaling devices employed are adapted to be actuated each by electric currents of a certain given peculiar nature. Thus I provide one signaling device adapted to be actuated only by an alternating current. A second signaling device is provided which is adapted to be actuated only by a direct cur-

rent in one direction—for instance, the positive direction—and a third signaling device is provided adapted to be actuated only by a direct current in the reverse or negative direction. Thus upon a single electric circuit there may be connected three signaling devices, each of which will be actuated by a suitable electric current independently of the other signaling devices connected with the same circuit.

A preferred embodiment of my invention comprises an arrangement in which the first signaling device consists of a polarized telephone-ringer serially connected with a condenser in bridge of the electric circuit employed. The second signaling device desirably consists of a polarized ringer in which a front contact of the ringer-armature when engaged by the armature when in its attracted position serves to close a low-resistance path in shunt of the ringer-coils, whereby the same are deenergized to permit the retraction of the ringer-armature. This rheotome-bell, adapted to be actuated by a direct current, may be polarized, if desired, in order that it may be actuated only by the passage of a direct current in a certain given direction. Serially connected with such a rheotome signal-bell in bridge of the line-circuit there is provided an impedance-coil adapted to check and largely prevent the flow of alternating currents through this signal-bell. It will be seen that the condenser associated with the first aforesaid signaling device prevents the passage of direct current through its associated bell-coils. A third signaling device may comprise apparatus similar to that described for the second signaling device except that in the case of the third instrument the armature is oppositely polarized, whereby the third signal-bell is actuated only by the passage of a direct current in the opposite direction to that adapted to actuate the second signal-bell.

It is now common practice in telephone installations to provide bimetallic circuits to each of the subscribers' substations. In connection with the use of bimetallic lines I find

it desirable to connect substation signaling apparatus between the ground and each of the bimetallic line-limbs. An operator at the central station by connecting between either
 5 of the line-limbs and the ground the terminals of a source of current adapted to supply either an alternating current or a direct current in either of two directions may signal any one of the substations whose signaling
 10 apparatus is connected with either of the bimetallic line-limbs. In signaling any one of these substations the apparatus at the other substations will not be affected to produce a signal.

15 My invention will be more clearly understood by reference to the accompanying drawings, in which I have illustrated two bimetallic telephone-lines 90 and 120, to each of which there are shown connected four substations, those connected with the line 90 being lettered A, B, C, and D and those connected with the line 120 being lettered E, F, G, and H. At each of the substations there is provided a telephone switch-hook 1, which
 25 when relieved of the weight of the receiver 2 causes the closure in bridge of the telephone-line of a circuit through a battery-transmitter 3 and the primary 4 of an induction-coil, whose secondary 5 is connected with the receiver 2. In addition to the telephone instruments each substation is provided with signaling apparatus, the signaling apparatus at substations A, B, E, and F being identical. The signaling apparatus at substations A and
 35 F are connected between the line-limbs 6 and ground, while those at substations B and E are connected between the line-limbs 7 and ground. The signaling apparatus at each of the substations A, B, E, and F comprises a well-known telephone-ringer 8, the alternative energization of whose electromagnet-coils 9 9, due to the passage of an alternating current therethrough, causes the vibration of the polarized armature 10 and the attached
 45 bell-clapper 11. There is included in the circuit through the coils 9 9 a condenser 12. This condenser is for the purpose of preventing the passage of direct currents through the electromagnet-coils 9 9. At substation C in addition to the telephone apparatus there is provided a call-bell 13, which comprises electromagnet-coils 14 14 and a polarized armature 15, adapted to be actuated thereby. In shunt of the coils 14 14 there is a low-resistance circuit adapted to be closed upon the
 55 attraction of the armature 15 into contact with the front contact 16. A retracting-spring 17 serves normally to retain the armature 15 in the position shown. This circuit also serially includes the impedance-coil 18, adapted to check and prevent the passage of alternating currents through the ringer 13. The polarization of the armature 15 prevents its attraction by the electromagnet-coils 14 14
 65 except upon the passage of a current in one

of the two directions. Thus the bell 13 may be supposed to be actuated only upon the passage of a direct current in the positive direction therethrough. The signaling apparatus at the substation D may be identical with that at the substation C except that its armature 15 is oppositely polarized, whereby the signaling apparatus at the substation D may be actuated by a current in the reverse direction from that necessary to actuate the signaling
 75 apparatus at the substation C. The signaling apparatus at substations G and H is identical, with the exception that the ringer-armatures are oppositely polarized. At each of these substations there is provided a ringer 13', which comprises electromagnet-coils 14' 14' and a polarized armature 15', adapted to be actuated thereby. The circuit through the coils 14' 14' includes the armature 15' and a back contact 16' therethrough. A retracting-spring 17' serves normally to retain the armature 15' in contact with the back contact 16'. This circuit also serially includes the impedance-coil 18', adapted to check and prevent the passage of alternating currents through the ringer 13'. The polarization of the armature 15' at substation G may be supposed to be such that it will be actuated only upon the passage of a direct current in the positive direction, while the armature 15' at
 85 substation H may be polarized in such a way as to be actuated only upon the passage of a direct current in a negative direction.

It will be apparent that by connecting the terminals of a source of alternating current
 100 between the line-limb 6 of line 90 and ground the call-bell 8 at substation A will be actuated. The bells 13 at the substations C and D will not be actuated, however, due to the prevention of the flow of the alternating current therethrough, due to the impedance of the coils 18. The connection of the terminals of a source of direct current between the line-limb 6 of line 90 and ground will when connected in one direction—for instance, the positive direction—cause the actuation of the signaling-bell 13 at the substation C. The connection of a source of direct current between the line-limb 6 of the line 90 and ground in the reverse direction will similarly cause the
 115 actuation of the signal-bell at the substation D. The connection of a source of direct current between the line-limb 6 and the ground will not cause the passage of any current through the bell 8 at the substation A, due to the interruption of the continuous circuit through the coils 9 9 by the condenser 12. In the same manner the connection of a source of alternating current between the line-limb 7 and ground will cause the actuation of the signal-bell at substation B. As it is possible and sometimes desirable to connect substations having signaling apparatus of any or all of the three types hereinbefore described connected between either of the line-limbs and
 120 130

ground, I find it desirable to provide at the central station means whereby the terminals of a source of alternating current or the terminals of a source of direct current in either direction may be connected between either line-limb and the ground.

In an installation such as that herein described in which there is connected between one of the line-limbs and the ground three sets of signaling apparatus and between the other line-limb and ground only one set of signaling apparatus I find it desirable to provide means for electrically and telephonically balancing the two line-limbs. The line-limbs may be balanced by connecting between the limb with which there is connected the smaller number of signaling apparatus and the ground an impedance or impedance-coils. Thus I have shown connected between the line-limb 7 of line 90 and the ground two impedance-coils 100 and 101. In this instance the impedance-coils may be located at points on the metallic line at substantially the same distance from the central station as the corresponding signaling apparatus are connected. Between the line-limb 7 of line 120 and the ground I have shown connected an impedance-coil 102, whose impedance may be varied by a suitable movement in or out of the winding of the core 103'. This impedance-coil is shown located at the central station, and its impedance may be varied to balance that of the instruments connected with the line-limb.

Aside from the provision of means whereby the signaling-currents of proper character may be connected with the line-circuits the central station apparatus may be identical with that employed in a great many systems now well known to those skilled in the art, and herein lies one of the principal advantages of my selective signaling system, that it may be employed in connection with any of the well-known exchange systems now in use.

In order to illustrate the method of associating my improved selective signaling system with a telephone system, I have shown line-limbs 6 and 7 for each of the telephone-lines 90 and 120 leading to the central exchange K, where they are respectively connected with tip and sleeve springs 20 and 19 of the line-jacks 21. Contacts 22 and 23 normally make connection with the jack-springs 19 and 20 and with suitable conductors, connecting line-limb 7 directly to the positive pole of the common battery 24. The line-limb 6 is connected, through a line-relay 25, with the negative pole of the common battery 24. This line-relay controls by its armature 26 a local circuit through the line signaling-lamp 27, the operation of which will be well understood by those skilled in the art.

The operator's cord-circuit may comprise the usual answering-plug 28 and the calling-plug 29, whose tip-contacts are normally connected through the tip-strand 30 and whose

sleeve-contacts are normally connected through the sleeve-strand 31. There are preferably included in the tip-strand circuit the supervisory signaling-relays 32 and 33, these relays being shunted by the condenser 34, whereby the transmission of voice-currents is improved. The usual operator's telephone set 35 may be included in bridge of the cord-circuit by manipulation of the listening-key 36. The supervisory relays 32 and 33 control, respectively, the armatures 37 and 38, which in turn control local circuits through the supervisory signaling-lamps 39 and 40. The continuity of the local circuits for the lamps 39 and 40 is controlled by a plug-seat switch 41, adapted upon the removal of the plug 28 from its seat to connect the positive pole of the battery 24 with one of the terminals of each of the lamps 39 and 40. The common terminal of the relays 32 and 33 is connected, as shown, with the negative pole of the battery 24. I have illustrated a series of six ringing-keys 42, 43, 44, 45, 46, and 47, each adapted to connect the terminal of a suitable source of current with one of the line-limbs 6 or 7 within the jack 21, associated with which the plug 29 has been inserted. The manipulation of the key 42 serves to connect a terminal of the alternating-current generator 48 with the tip-strand of the cord-circuit leading to plug 29. The manipulation of the key 43 connects a terminal—for instance, the positive terminal of the direct-current generator 49—with the tip-strand. The manipulation of the key 44 serves to connect the negative terminal of the generator 50 with the tip-strand. A manipulation of the key 45 connects one terminal of the alternating-current generator 51 with the sleeve-strand 31, leading to the plug 29. A manipulation of the key 46 connects the positive terminal of a direct-current generator 52 and with the sleeve-strand, and a manipulation of the key 47 connects the negative terminal of the direct-current generator 53 with the sleeve-strand. The other terminals of these various sources of current may be permanently connected with the ground, as shown. I find it desirable also to provide contacts on the ringing-keys, whereby the limb of the line which is not utilized for the transmission of a signaling-current may be connected with the ground. Thus the lower contacts for the keys 42, 43, and 44 are connected with ground, while the upper contacts of the keys 45, 46, and 47 are connected with ground. An impedance-coil 54 is connected between the positive pole of the battery 24 and the sleeve-strand 31.

The operation of a telephone system employing my invention may be described as follows: Any one of the subscribers—for instance, the subscriber at substation B on line 90—upon removing his receiver from the switch-hook causes the closure of a circuit,

which may be traced as follows: from the positive pole of the battery 24 through the line-limb 7, the switch-hook 1, a primary coil 4 at substation B, the transmitter 3, the line-limb 6, the line-relay 25, to the negative pole of the battery 24. The consequent energization of the relay 25 causes the attraction of its armature 26, whereby a local circuit is established to illuminate the line signal-lamp 27.

The central operator answers the line-signal by the insertion of her answering-plug 28 within a line-jack 21, associated with the line 90. The insertion of the plug 28 within the jack causes a spreading of the springs 19 and 20, whereby the closed circuit through the line-relay 25 is interrupted to cause its deenergization and a consequent extinction of the line signal-lamp 27. It will be seen that the removal of the answering-plug 28 from its seat will have caused the closure of the plug-seat switch 41, whereby the positive pole of the battery will be connected with terminals of the lamps 39 and 40. The armature 37 will have been attracted, however, by the energization of the supervisory relay 32 due to the flow of current through a circuit which may be traced as follows: from the negative pole of the battery 24, through the supervisory relay 32, the tip-strand 30 of the cord-connecting apparatus, the tip-spring 19 of a line-jack 21, line-limb 7, the subscriber's telephone apparatus, the line-limb 6, the sleeve-spring 20, sleeve-strand 31, and the impedance-coil 54, to the positive pole of the battery 24. The attraction of the armature 37 interrupts the otherwise completed local circuit through the supervisory signal-lamp 39, whereby the same is not illuminated. The supervisory signal-lamp 40, however, is illuminated, due to the flow of current through the armature 38, which has not been attracted by its relay 33.

The operator communicates with subscriber at substation B on the line 90 and ascertains the number of the subscriber's substation with which he desires communication. Assuming this to be substation G on line 120, she inserts her calling-plug 29 within one of the line-jacks 21, associated with line 120. She thereupon manipulates her ringing-key 43 to connect the terminals of the direct-current generator 49 with a circuit including the line-limb 7 and a ground-return. Current then flows from this generator over the line-limb 7 to ground, there being one path through the signaling apparatus at substation H. This signaling apparatus at substation H, however, is polarized in such a direction that the positive current from the generator 49 does not affect the actuation of the signal-bell 13'. The inclusion of the condenser 12 in circuit with the bell 8 prevents the passage of a direct current from the line-limb 7 to ground through this bell. There is another path for the current from the generator 49 through the bell 13' at substation G to ground. This bell, it will be remembered, is polarized in such a direction that the pas-

sage of a positive current causes the actuation of the armature 15'. Thus the signaling apparatus at substation G on line 120 is actuated to call the subscriber to his telephone. Answering the call the subscriber removes his receiver from the switch-hook, thereby establishing a circuit through the supervisory relay 33 to cause the attraction of the armature 38, whereupon the supervisory signaling-lamp 40 is extinguished.

The replacement of the receivers either at substation B on line 90 or at substation G on line 120 causes an interruption of the circuit through the supervisory relay 32 or 33, respectively, whereby the associated supervisory signaling-lamp is illuminated to indicate to the operator that the connected subscribers have finished their conversation. She thereupon removes the cord-connecting plugs from the line-jacks, whereupon the apparatus is restored to its normal condition. It will be apparent that if another of the subscribers connected with line 120 had been desired by the calling subscriber the manipulation of the proper ringing-key, as hereinbefore described, would have caused the signal at the proper substation. In like manner the rheotome signaling-bells, such as illustrated at substations C and D, may be energized and actuated by a direct current of suitable polarity controlled from the central station.

Unless the impedance between each line-limb and ground is perfectly balanced the telephonic conductivity and efficiency of the system will not be perfect, and interference will result from noises due to the unbalanced ground connections. As there are an unequal number of substations connected with each limb of a line, as herein described, such interference would result if provision were not made to balance the system, and the impedance-coils 100 and 101 are of such strength and placed at such a position as to balance the impedance between the line-limbs and ground, thus preventing disturbances to telephonic currents, also to prevent leakage from the battery 24 to ground through the impedance-coils connected therewith from both line-limbs. Condensers 103 and 104 are serially inserted in circuit with the impedance-coils 100 and 101, respectively, and serve in the same manner as the condensers 12 at substations A and B to prevent direct current-flow. Instead of using the impedance-coils at various parts of the line, impedance-coil 102 may be employed and also connected serially in circuit with a condenser 105. This impedance may be adjustable to enable the operator or station attendant to balance the party-line at any time.

While I have herein shown and described the preferred embodiment of my invention, it will be apparent to those skilled in the art that many modifications may be employed without departing from the spirit thereof,

and I do not, therefore, wish to limit myself to the precise disclosure herein set forth; but,

Having described my invention, I claim as
5 new and desire to secure by Letters Patent—

1. In a party-line telephone-exchange system, the combination with a central station, of a bimetallic telephone-line extending from said central station to a series of substations,
10 subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser
15 connected between each of said line conductors and said return-path, a rheotome signal-bell in a circuit of high impedance connected between one of said line conductors and said return-path, a variable impedance connected
20 between the other line conductor and said return-path to balance telephonically the bimetallic line, and means located at the central station adapted to connect the terminals of a source of alternating current between either
25 of said line conductors and said return-path and adapted to connect the terminals of a source of direct current between the return-path and that line conductor to which said rheotome signal-bell is connected.

2. In a party-line telephone-exchange system, the combination with a central station, of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of
35 said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a rheotome signal-bell in a circuit of high impedance connected
40 between one of said line conductors and said return-path, a variable impedance connected between the other line conductor and said return-path, and means located at the central station adapted to connect the terminals of a source of alternating current between either
45 of said line conductors and said return-path and adapted to connect the terminals of a source of direct current between the return-path and that line conductor to which said rheotome signal-bell is connected.

3. In a party-line telephone-exchange system, the combination with a central station,
55 of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a rheotome signal-bell in a circuit of high impedance connected
60 between one of said line conductors and said

return-path, an impedance connected between the other line conductor and said return-path to balance telephonically the bimetallic line, and means located at the central station adapted to connect the terminals of a source of alternating current between either of said line
70 conductors and said return-path and adapted to connect the terminals of a source of direct current between the return-path and that line conductor to which said rheotome signal-bell is connected.

4. In a party-line telephone-exchange system, the combination with a central station, of a bimetallic telephone-line extending from said central station to a series of substations,
80 subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser
85 connected between each of said line conductors and said return-path, a rheotome signal-bell in a circuit of high impedance connected between one of said line conductors and said return-path, an impedance connected between
90 the other line conductor and said return-path, and means located at the central station adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path and adapted
95 to connect the terminals of a source of direct current between the return-path and that line conductor to which said rheotome signal-bell is connected.

5. In a party-line telephone-exchange system, the combination with a central station,
100 of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in
105 bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a rheotome signal-bell in a circuit of high impedance connected
110 between one of said line conductors and said return-path, an impedance-coil connected between the other line conductor and said return-path, the impedance of said coil being substantially equal to the impedance of the circuit
115 through said rheotome signal-bell between the line conductor and the return-path, and means located at the central station adapted to connect the terminals of a source of alternating
120 current between said line conductors and said return-path and adapted to connect the terminals of a source of direct current between the return-path and that line conductor to which said rheotome signal-bell is connected.

6. In a party-line telephone-exchange system, the combination with a central station,
125 of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of
130

said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction connected between the same line conductor and said return-path, a variable impedance connected between the other line conductor and said return-path to balance telephonically the bimetallic line, means adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path, means adapted to connect the terminals of a source of direct current in a positive direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected, and means adapted to connect the terminals and the source of direct current in a negative direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected.

7. In a party-line telephone-exchange system, the combination with a central station, of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction connected between the same line conductor and said return-path, a variable impedance connected between the other line conductor and said return-path, means adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path, means adapted to connect the terminals of a source of direct current in a positive direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected, and means adapted to connect the terminals of a source of direct current in a negative direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected.

8. In a party-line telephone-exchange system, the combination with a central station,

of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limb, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction connected between the same line conductor and said return-path, an impedance connected between the other line conductor and said return-path to balance telephonically the bimetallic line, means adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path, means adapted to connect the terminals of a source of direct current in a positive direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected, and means adapted to connect the terminals of a source of direct current in a negative direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected.

9. In a party-line telephone-exchange system, the combination with a central station, of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction connected between the same line conductor and said return-path, an impedance connected between the other line conductor and said return-path, means adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path, means adapted to connect the terminals of a source of direct current in a positive direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected, and means adapted to connect the terminals of a source of direct current in a negative direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected.

10. In a party-line telephone-exchange system, the combination with a central station, of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction connected between the same line conductor and said return-path, impedance connected between the other line conductor and said return-path to balance telephonically the bimetallic line, means adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path, means adapted to connect the terminals of a source of direct current in a positive direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected, and means adapted to connect the terminals of a source of direct current in a negative direction between said return-path and that line-limb to which said polarized rheotome signal-bells are connected.

11. In a party-line telephone-exchange system, the combination with a central station, of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction connected between the same line conductor and said return-path, impedance connected between the other line conductor and said return-path, said impedance being substantially equal to the circuit of said rheotome signal-bells between the connected line conductor and the return-path.

12. In a party-line telephone-exchange system, the combination with a central station of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge

of said metallic line-limbs a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a rheotome signal-bell in a circuit of high impedance connected between one of said line conductors and said return-path, a variable impedance and a condenser connected between the other line conductor and said return-path to balance telephonically the metallic line, and means located at the central station adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path and adapted to connect the terminals of a source of direct current between the return-path and that line conductor to which said rheotome signal-bell is connected.

13. In a party-line telephone-exchange system, the combination with a central station of a bimetallic telephone-line extending from the central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a rheotome signal-bell in a circuit of high impedance connected between one of said line conductors and said return-path, an impedance and a serially-connected condenser connected between the other line conductor and said return-path to balance telephonically the bimetallic line, and means located at the central station adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path, and adapted to connect the terminals of a source of direct current between the return-path and that line conductor to which said rheotome signal-bell is connected.

14. In a party-line telephone-exchange system, the combination with a central station of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a rheotome signal-bell in a circuit of high impedance connected between one of said line conductors and said return-path, an impedance and a condenser serially connected between the other line conductor and said return-path, means located at the central station to connect the terminals of a source of alternating current between either of said line conductors and said return-path, and means located at the central station adapted to connect the terminals of a source of direct current between the return-path and that

line conductor to which said rheotome signal-bell is connected.

15. In a party-line telephone-exchange system, the combination with a central station of a bimetallic telephone-line extending from
5 said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs a common
10 return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a rheotome signal-bell in a circuit of high impedance connected
15 between one of said line conductors and said return-path, an impedance-coil and a condenser serially connected between the other line conductor and said return-path, the impedance of said coil being substantially equal
20 to the impedance of the circuit through said rheotome signal-bell between the line conductor and the return-path, means located at the central station adapted to connect the terminals of a source of alternating current between either of said line conductors and said
25 return-path, and means located at the central station adapted to connect the terminals of a source of direct current between the return-path and that line conductor to which said rheotome signal-bell is connected.

16. In a party-line telephone-exchange system, the combination with a central station of a bimetallic telephone-line extending from
35 said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs a common return-path to the central station, a polarized signal-bell and a serially-connected condenser
40 connected between each of said line conductors and said common return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction, connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction, connected between the same line conductor and said return-path, a variable impedance and a condenser serially connected between the other line conductor and said return-path to balance telephonically the metallic line, means adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path, means located at the central station adapted to connect the terminals of a source of direct current in a positive direction between said common return-path and that line conductor to which said rheotome signal-bells are connected, and means located at the central station adapted to connect the terminals of a source of direct current in a
65 negative direction between said return-path

and that line conductor to which said rheotome signal-bells are connected.

17. In a party-line telephone-exchange system, the combination with a central station of a bimetallic telephone-line extending from
70 said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs a common return-path to the central station, a polarized signal-bell and a serially-connected condenser
75 connected between each of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction, connected
80 between the same line conductor and said return-path, a variable impedance and a condenser serially connected between the other line conductor and said return-path located at the central station, means adapted to connect
85 the terminals of a source of alternating current between either of said line conductors and said return-path, means located at the central station adapted to connect the terminals of a source of direct current in a positive direction
90 between said return-path and that line conductor to which said rheotome signal-bells are connected, and means located at the central station adapted to connect the terminals of a source of direct current in a negative direction between the return-path and that line conductor to which said rheotome signal-bells are connected.

18. In a party-line telephone-exchange system, the combination with a central station of
105 a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs a common
110 return-path to a central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction, connected between the same line conductor and said return-path, an impedance and a condenser serially connected between the other line conductor and said return-path, means
125 adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path, means adapted to connect the terminals of a source of direct current in a positive direction between
130

said return-path and that line conductor to which said rheotome signal-bells are connected, and means adapted to connect the terminals of a source of direct current in a negative direction between said return-path and that line conductor to which said rheotome signal-bells are connected.

19. In a party-line telephone-exchange system, the combination with a central station of a bimetallic telephone-line extending from said central station to a series of substations, subscribers' telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs a common return-path to the central station, a polarized signal-bell and a serially-connected condenser connected between each of said line conductors and said common return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction connected between the same line conductor and said return-path, impedance serially connected through a condenser between the other line conductor and said return-path to balance telephonically the bimetallic line, means adapted to connect the terminals of a source of alternating current between either of said line conductors and said return-path, means adapted to connect the terminals of a source of direct current in a positive direction between said return-path and that line conductor to which said rheotome signal-bells are connected, and means adapted to connect the terminals of a source of direct current in a negative direction between said return-path and that line conductor to which said rheotome signal-bells are connected.

20. In a party-line telephone-exchange system, the combination with a central station, of a bimetallic telephone-line extending therefrom to a series of substations, subscribers'

telephone instruments at each of said substations adapted to be connected in bridge of said metallic line-limbs, a common return-path to the central station, a polarized signal-bell, and a serially-connected condenser connected between each of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a positive direction connected between one of said line conductors and said return-path, a polarized rheotome signal-bell in a circuit of high impedance adapted to be actuated by a direct current in a negative direction connected between the same line conductor and said return-path, and a variable impedance connected between the other line-limb and said return-path, said impedance being adjustable by the station operator to balance the impedance of the telephonic circuit.

21. In a party-line telephone-exchange system, the combination with a central exchange, of a bimetallic telephone-line extending therefrom to a series of substations, a source of current at the exchange normally connected between the limbs of said telephone-line, a polarized signal-bell connected between each of said line-limbs and ground, a condenser included serially in circuit with each of said signal-bells to prevent the passage to ground from said source of current at the central exchange, polarized rheotome-bells permanently connected between one line-limb and ground through a path of high impedance, and means connected with the other limb of said line for balancing the impedance of the telephonic circuit and for preventing current-flow to ground from said source at the central exchange.

In witness whereof I hereunto subscribe my name this 2d day of April, A. D. 1903.

WILLIAM M. DAVIS.

Witnesses:

LYNN A. WILLIAMS,
HARVEY L. HANSON