

No. 853,291.

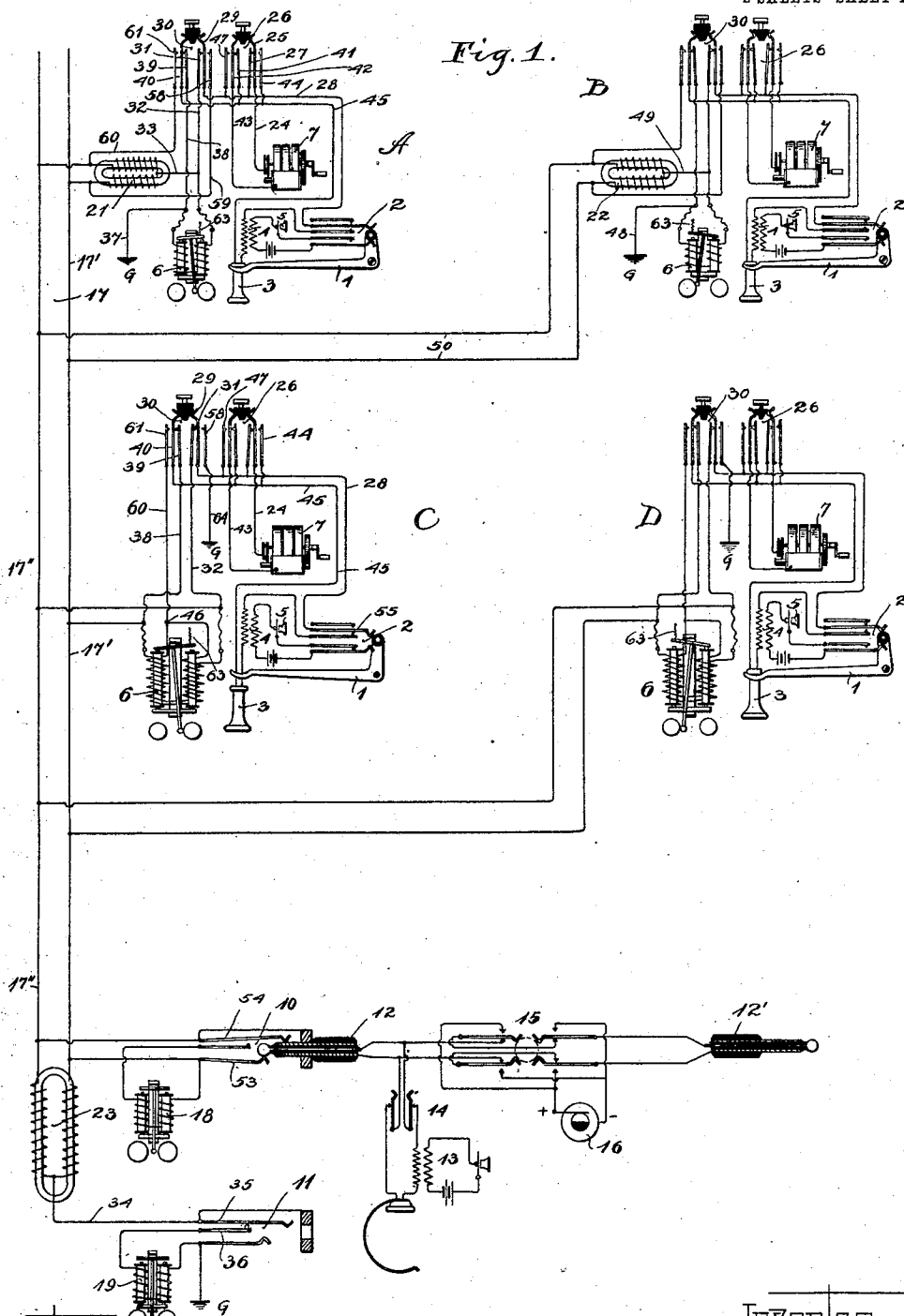
PATENTED MAY 14, 1907.

G. BABCOCK.

TELEPHONE SYSTEM.

APPLICATION FILED JULY 17, 1903.

2 SHEETS—SHEET 1.



WITNESSES

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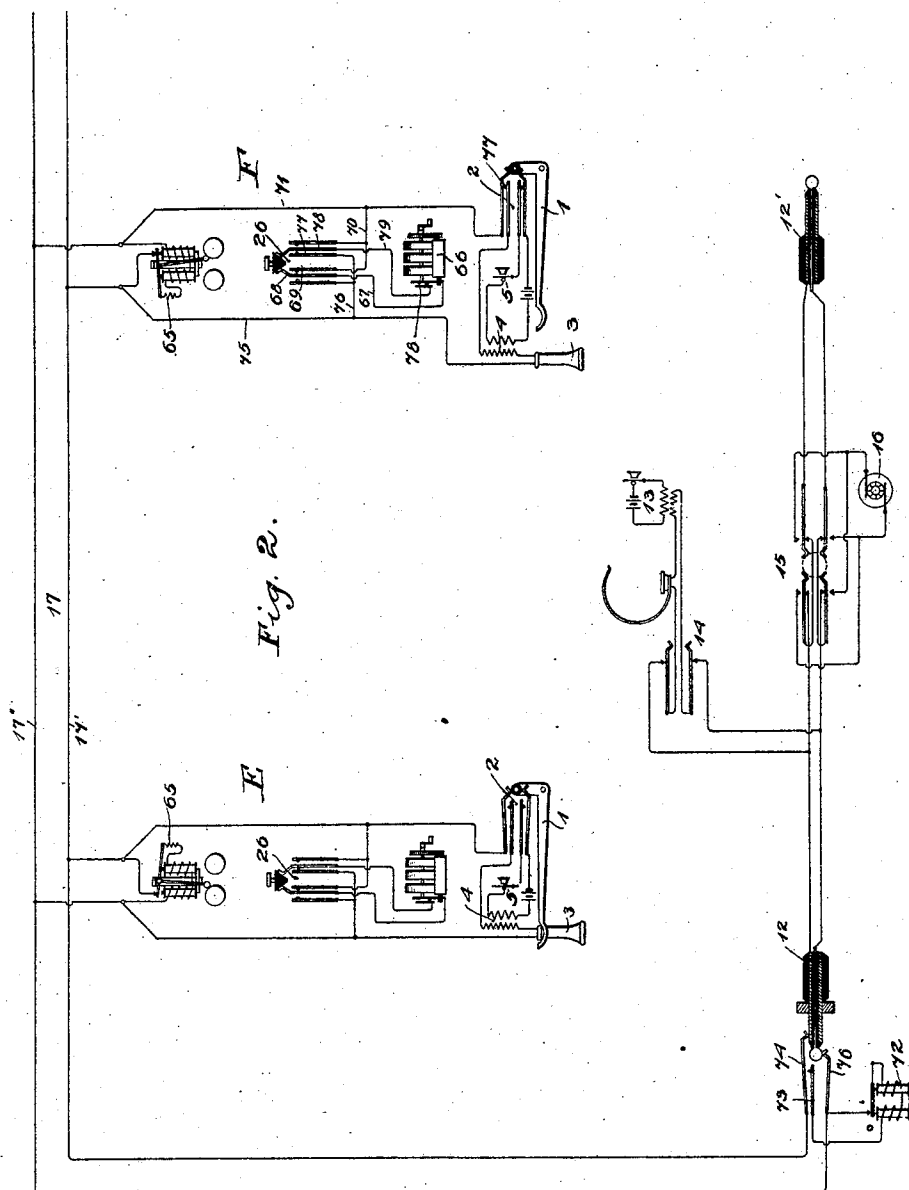
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UNITED STATES PATENT OFFICE.

GARRISON BABCOCK, OF CHICAGO, ILLINOIS, ASSIGNOR TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

No. 853,291.

Specification of Letters Patent.

Patented May 14, 1907.

Application filed July 17, 1903. Serial No. 166,026.

To all whom it may concern:

Be it known that I, GARRISON BABCOCK, 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 Telephone 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 telephone systems, and particularly to telephone party line systems, and has for its objects improved means whereby the central operator may independently and selectively signal any one of the subscribers on the party line, means whereby each subscriber may signal central independently of the other subscribers, and means whereby any one of the subscribers may select and connect himself for conversation with another subscriber independently of the exchange operator and of the other subscribers on the line.

My improved system is best adapted for selective signaling and conversation where there are four subscribers connected to one line, and I preferably employ two sets of circuits; one set of circuits being a metallic circuit including the metallic limbs of the telephone line, and free from ground connections; the other set of circuits having the earth as one conductor and having for the other conductor the two sides of the metallic line included in parallel.

I preferably provide two subscribers with one set of circuits, and I provide polarized bells for all of the subscribers' substations. The subscribers provided with the different sets of circuits are thus adapted to be selectively signaled, while the signaling to the subscribers having one set of connections is made further selective by the use of the polarized signal bells, which only respond to a certain direction of current flowing through their windings. The substations which are normally connected to ground and to the sides of the metallic line in parallel include substation apparatus consisting of a hand generator, a switch hook and suitable switching mechanism, and a polarized bell, the polarized bell at one substation of the set being spring adjusted to respond to signaling current in one direction, while the polarized bell

at the other substation is spring adjusted to respond to signaling current passing in an opposite direction. The bells of this set are normally bridged between the ground and the two sides of the metallic circuit. The substations provided with the other set of connections have the same substation apparatus as the substations of the first set, the signal bells, however, being normally connected in bridge of the metallic line. The ringer bells are also oppositely adjusted, and are provided with a compound winding for the purpose to be hereinafter explained.

At the central station I provide two sets of jacks: One set of jacks being connected in bridge of the metallic main line, and utilized when central wishes to signal the subscribers connected in bridge of the main line; the spring jacks in the other set are bridged between ground and the metallic sides of the main line in parallel, and are utilized for signaling to the subscribers normally bridged between ground and the metallic sides of the line.

Under normal conditions the subscribers are connected with each other and with central, so that an actuation of any subscriber's generator will signal only the subscriber's bell and central. The substation generators are preferably of the type adapted to generate a pulsating current, and at the central exchange there are normally bridged across the jack springs, signal bells responsive to pulsating currents flowing in either direction, currents flowing from the generators at the normally grounded substations actuating only the central signal bell which is normally grounded, while the currents flowing from the generators at the metallically connected substations actuate only the central exchange bell connected in bridge of the line.

To enable one subscriber on the line to signal and converse with another subscriber on the line, independently of the central operator, I provide means at each substation, whereby each subscriber may change his circuit conditions to conform with the circuit conditions at the substation desired. This means consists of a reversing switch connected between the subscriber's generator and the line, whereby the current from his generator may be reversed in order to actuate the polarized signal bell at the substa-

tion normally connected in the same set. Another switch enables him to change the circuits from the grounded condition to the metallic condition, whereby a subscriber
 5 normally provided with one set of connections may signal and converse with a subscriber normally provided with the other set of connections.

To perfectly balance the system to prevent
 10 interference from noises or other disturbances, I provide impedance means at each substation and at central. At the normally grounded substations I provide parallel
 15 wound coils of high impedance, the two parts of the coil being included in opposite limbs of the branch circuit leading to the substation. At the normally metallicly connected
 20 substations this impedance is included in the windings of the compound wound signal bells, the current under normal conditions flowing serially and cumulatively through
 25 the coils of the bell, but upon the substation circuits being changed to the grounded condition the current flows from the main line
 30 and includes the two parts of the windings in parallel relation. When a subscriber wishes to be connected to a subscriber on another
 35 party line he may employ a certain signal, as, for instance, two actuations of the substation generator, whereby the signal bell at
 40 the central exchange is actuated two times to notify the operator that connection is desired with some other line. If a subscriber wishes to talk to a party subscriber he may
 45 cause only one actuation of the station signal bell, which indicates to the operator that she is not desired.

I shall explain my invention more fully by referring to the accompanying diagrams
 40 in which, in

Figure 1 I have shown four substations connected with a central exchange; and in
 45 Fig. 2 I have shown a modification of the invention.

I shall designate the subscribers as A, B, C and D, and the substation apparatus consists of a switch hook 1, switch springs 2,
 50 receiver 3, induction coil 4, transmitter 5, signal bell 6, generator 7, a reversing key 26, and a circuit changing key 30.

The generators are preferably designed to generate a uni-direction current. At the central exchange are located spring jacks 10
 55 and 11, and an operator's cord circuit consisting of plugs 12 12', an operator's talking set 13, adapted to be bridged across the strands of the cord circuit by means of a
 60 listening key 14, and a reversing switch 15, by means of which current emanating from the generator 16 may have its direction of flow reversed. The spring jack 10 is bridged
 65 across the metallic sides of the line 17, and the spring jack 11 is bridged between ground and the two sides of the line 17. A signal bell 18, responsive to current in either direc-

tion, is normally bridged between the long and short springs of the jack 10, and the signal bell 19, also responsive to currents in
 70 either direction, is normally bridged between the long spring of the jack 11 and ground G.

At substations A and B impedance coils 21 and 22 are bridged across the sides of the line 17, and at the central exchange the windings of an impedance coil 23 are bridged
 75 across the sides of the line 17, being interposed between the spring jack 11 and the main part of line 17.

Supposing that subscriber A wishes to attract the central operator to call for a connection with some other line. He gives the pre-
 80 determined number of actuations of the generator 7, the current therefrom flowing as follows: From the generator 7, to conductor 24, to the middle spring 25, of the reversing
 85 key 26, the inner spring 27, to conductor 28, to the middle spring 29, of circuit changing key 30, to the inner spring 31, to conductor 32, conductor 33, the current here dividing,
 90 part passing equally and parallelly through the two parts of the impedance coil 21, to the line 17 including the conductors of line 17 in parallel relation; thence parallel through
 95 the windings of impedance coil 23, to conductor 34, to jack spring 35, jack spring 36, through the signal bell 19, to ground, back to substation A, through the ground conductor 37,
 100 to conductor 38, inner spring 39, middle spring 40 of the circuit changing switch, to the inner spring 41 of the reversing switch, to the middle spring 42, through conductor 43, and
 105 back to the generator 7. Current from generator 7 also flows through the windings of bell 6 in such direction as to cause actuation thereof and through the following circuit: Generator 7, conductor 24, springs 25 and 27,
 110 conductor 28, springs 29 and 31, through the windings of the bell, conductor 38, springs 39 and 40, conductor 45, springs 41 and 42 and through conductor 43 back to the generator. Upon receiving the signal the central
 115 operator inserts the plug 12, into jack 11, and ascertains the line desired, thereupon inserting the opposite plug of the cord circuit into the jack of the desired line.

The current flowing from generator 7 is in
 120 such direction as to prevent actuation of the spring adjusted polarized bell at substation B and will not actuate the bells at substation C or D as these substations are free from ground in their normal conditions, the central
 125 exchange operator being the only one outside of the calling subscriber himself to receive a signal.

Should subscriber A, however, wish to converse with subscriber B he need only actuate
 130 the reversing key 26 to reverse the flow of current into the line from his generator 7, and the circuit established will be as follows: From generator 7, to conductor 24, to middle spring 25, to the outside spring 44, to con-

ductor 45, to middle spring 40, to inner spring 39, to conductor 38, to conductor 37, to ground; from thence to the ground conductor 48 at substation B, through the bell 6 at said substation, to conductor 49, the current here dividing and passing parallelly through the windings of impedance coil 22, parallelly through the conductors 50, to the line 17, parallelly through the windings of impedance coil 21 at substation A, through conductor 33, to conductor 32, inner spring 31, middle spring 29, outer spring 47 of the reversing key, middle spring 42, back to the generator. The current, thus passing in the proper direction, operates the signal bell at substation B, and upon removal of the receivers from the hooks conversation may be had between subscribers A and B. While this conversation is going on subscribers C and D are free to converse with each other or to signal and converse with central independently of the subscribers A and B.

In Fig. 1 I have shown subscriber C in conversation with the central operator. The talking circuit may be traced as follows: From the receiver 3, to conductor 45, middle spring 40 of the circuit changing switch, inner spring 39, conductor 38, to the conductor 17' of the line 17, to the short spring 53, of spring jack 10, and through the tip of plug 12, through the operator's talking circuit, to the sleeve of the plug 12, to jack spring 54, to conductor 17'' of line 17, to conductor 32, inner spring 31, middle spring 29, conductor 28, through the switch contact 55, and back to the receiver 3.

Under normal conditions an actuation of the generator at substation C will cause actuation of only the substation bell and the signal at central, the signal bell 6 at substation D being irresponsive to the current from the generator at substation C on account of the adjustment of the polarized bell at substation D; however, upon an actuation of the reversing key 26 at substation C signal bell 6 at substation D will be actuated.

Suppose subscriber A wishes to signal and converse with subscriber C. In this case the reversing key 26 at substation A is left in its normal position, while circuit changing key 30 is depressed, whereby the circuit conditions at substation A will be changed to correspond to the conditions at substations C and D. The signal current from generator 7 at substation A will now take the following path: From generator 7, through one side of the reversing key 26, to conductor 28, to middle spring 29 of the circuit changing key 30, to the outside spring 58, to conductor 59, to conductor 17' of the line 17, through the windings of the bell 6 at substation C, to the conductor 17'' of the line 17, to conductor 60, to outside spring 61, middle spring 40, and through the other side of reversing key 26, back to the generator. The direction of

the current thus generated is adapted to actuate the polarized bell at substation C and not the bell at substation D. Should A desire to call substation D he would press his reversing key 26, whereupon the direction of current flow would be reversed, and instead of the substation bell at C being actuated the signal would be received at substation D. In the same manner the subscriber at either one of the substations may reverse the current flowing from his generator, and so change the circuit conditions that any one of the other party subscribers may be selectively and independently signaled and conversed with.

Should the operator desire to call either substation A or B she inserts the ringing plug 12' into the normally grounded jack 11 and manipulates her reversing key to actuate either the polarized bell at substation A or at substation B. If she desires to signal either substation C or D she inserts the plug 12' into the metallically connected jack 10 and by properly adjusting the direction of current from generator 16 she may actuate the polarized signal bell either at substation C or at substation D.

It will thus be seen that subscribers A and B, and subscribers C and D may both use the metallic line 17 for connection through central without interfering with each other. In the same manner should subscriber A, for instance, be connected through central with another line and subscriber B should desire connection through central, subscriber B need but actuate his circuit changing key whereupon to establish the metallic circuit conditions, his call being manifested by signal bell 18 at central, and connection be made to the desired line and conversation had therewith without interfering with the conversation carried on by substation A whose circuits are in the grounded condition. In the same manner any party subscriber, upon finding the metallic circuit or the grounded circuit already occupied he need but actuate his circuit changing key to establish a circuit condition other than the one in use.

The signal bells employed at the substations are of the ordinary spring adjustable polarized type, the spring 63 being applied to that side of the ringer armature dependent upon the direction of current flow it is desired should actuate the bell. The signal bells 18 and 19 at the central exchange, however, are not provided with a spring, but are free to operate independent of the direction of current flow through their windings.

It will be seen that, to establish the grounded condition of circuits, the sides of the line 17 must be connected together. It becomes necessary, therefore, to provide means to prevent short-circuiting paths for the talking current when the sides of the line 17 are in-

cluded serially in circuit. I, therefore, provide impedance coils 21 and 22 at substations A and B, respectively, and impedance coil 23 at the central exchange.

5 When the line 17 is used metallically, as when substation C or D is talking, these impedance coils are included serially in a bridge circuit between the sides of the line 17. The
10 impedance of the coils when thus connected serially is so high that the talking currents are prevented from being short-circuited and are confined to the talking circuit. When
15 substation A or B is normally connected for signaling or for conversation, the impedance coils are connected in circuit to mutually counteract the inductance and offer very little resistance to the signaling or talking circuit. To accomplish this I preferably include an equal part of the windings in each
20 side of the bridge circuit containing them, the current thus dividing and passing differentially through the coils, whereby the resistance offered to current flow is reduced to one-fourth of that existing when the coils are included serially in circuit and the inductance is neutralized.

It will be seen that, under normal conditions, the windings of the signal bells at the subscribers' stations and also at central are bridged across the talking circuit, the impedances of the windings, however, are so high that short-circuiting of the talking or signaling circuits is prevented.

30 I provide the signal bells at substations C and D with a compound biased winding, this winding, under normal conditions, being bridged serially between the sides of the line 17. Upon actuation of the circuit changing key at either of these substations, however,
40 the grounded condition is established and the signal bell windings are traversed parallelly by the current flowing through the sides of the line 17 in parallel, the windings thus performing the same functions as the impedance coils 21 and 22 at substations A and B, respectively, the impedance being neutralized.

45 In order that substation C may signal substation A, actuation of reversing key 26 and circuit changing key 30 at substation C is
50 necessary, the circuit being traced as follows: From the generator 7 at substation C, to conductor 24, through the outside spring 44, to conductor 45, outside spring 61, conductor 60, to a point 46, the current at this point
55 subdividing and passing equally and parallelly through the windings of the signal bell 6, and thence to the line 17, passing parallelly through the sides of 17' and 17'' and parallelly through the windings of impedance
60 coil 21, the current meeting in conductor 33, passing from there through the windings of the signal bell 6 at substation A, through conductor 37 to ground, from thence to ground conductor 64 at substation C, through the
65 outer spring 58, to conductor 28, through

outer spring 47, to conductor 43, and back to the generator. Upon the subscribers A and C removing the receivers from the hooks the circuit will include the receivers 3 at the substations, instead of the generators 7, which
70 normally are included in open circuits.

In Fig. 2 a modification in circuit arrangements is shown, in which I employ rheotome bells. I have shown subscribers E and F bridged across the sides 17' and 17'' of the
75 metallic line 17. These bells may be polarized and provided with adjusting springs 65, whereby the bells may be adjusted to respond only to a current flow in a certain direction through the windings of the bell.

80 I also provide a reversing key 26 at each of the substations E and F, whereby either of these subscribers may reverse the direction of current flowing from his generator to actuate the signal at the other substation.

85 I have shown the central operator in talking connection with subscriber F, which subscriber has previously signaled the central operator through the following circuit: from generator 66 at substation F, through conductor 67, to middle spring 68, inner spring 69, conductor 70, conductor 71, to the side 17'' of the line 17, through the signal bell 72 at central, through jack springs 73 and 74, to the side 17' of the line 17, to conductor 75,
90 conductor 76, inner spring 77, middle spring 78, and conductor 79, back to the generator.

Upon receiving the signal at central the operator inserted her plug 12 in the jack and actuated her listening key 14 to establish the
100 following talking circuit: from receiver 3 at substation F, to conductor 75, side 17', jack spring 74, through the sleeve of the plug 12, through the operator's talking set, back through the tip of the plug 12, to jack spring
105 76, to side 17'', conductor 71, through the contact 77, back to the receiver 3. The generator 66 is normally open at the contact 78 and is not included in the talking circuit. Actuation of the generator with the reversing
110 switch 26 in its normal position will not actuate the signal bell at substation E, the spring 65 being adjusted to prevent actuation upon such current flow.

115 Should subscriber F desire to signal substation E he actuates his reversing key 26, whereupon actuation of the generator will actuate the signal bell at substation E.

The subscribers may thus signal and converse with each other independently of the
120 central operator. The signal bell 72 at the central exchange, however, is not polarized, but is responsive to current flowing through its windings in either direction. A signal code may be arranged, for instance, the operator may respond to two actuations of the
125 central signal bell, disregarding single actuations, the single actuation indicating to her that subscribers wish to signal each other.

In the same manner the central operator, 130

upon insertion of the ringing plug 12' into the jack may signal either subscriber E or F, depending upon the direction of current caused to flow through the line 17 upon actuation of the ringing key 15 connected with the source of ringing current 16.

In order to better actuate bells of the rheotome style, I preferably employ a generator having means for commutating the current. The signal bells 18, 19 and 72 at the central exchange may also be replaced by a visual or other indicating device without interfering with the operation of the system.

Many other changes may also be made without in any way departing from the spirit and scope of the invention: and I do not, therefore, wish to be limited to the precise arrangement and construction shown; but

I claim as new and desire to secure by Letters Patent:

1. In a telephone system, the combination with a central exchange, of a permanently continuous telephone line extending therefrom, a plurality of subscribers connected with said line, means whereby the exchange operator may selectively signal any one of said subscribers, means whereby any subscriber may independently signal the exchange operator, and means whereby any subscriber may selectively signal any other of the party subscribers independently of the exchange operator, substantially as described.

2. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of subscribers connected with said line, a common conductor for said subscribers and the central exchange, some of the substations being normally adapted for connection in a circuit serially including the sides of the metallic circuit and disconnected from the common conductor, the other substations being normally adapted for connection in a circuit including said common conductor and the sides of the metallic telephone line in parallel, a springjack at the central exchange connected with said metallic line, whereby the central operator may connect herself with the metallically connected subscribers, and an additional springjack at the central exchange connected with the common conductor and the metallic sides of the line, whereby the operator may connect herself with the subscribers normally connected in circuit with the common conductor, substantially as described.

3. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of party subscribers connected with said line, two sets of circuits for connecting said subscribers with each other and with the central exchange, one set of circuits serially including the sides of the telephone line and free

from ground connections, the other set of circuits including the ground and the sides of the metallic line in parallel, means at the central exchange, whereby the exchange operator may connect with the metallically connected substations or with the grounded substations, and further means at each of the substations, whereby substations provided with one set of connections may selectively signal each other, substantially as described.

4. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of party subscribers connected with said line, two sets of circuits for connecting said subscribers with each other and with the central exchange, one set of circuits serially including the sides of the telephone line and free from ground connections, the other set of circuits including the ground and the sides of the metallic line in parallel, means at the central exchange, whereby the exchange operator may connect with the metallically connected substations or with the grounded substations, means at each of the substations, whereby substations provided with one set of connections may selectively signal each other, and further means, whereby substations provided with one set of connections may selectively signal subscribers provided with the other set of connections, substantially as described.

5. In a telephone system, the combination with a central exchange, of a permanently continuous telephone line extending therefrom, a plurality of party subscribers connected with said line, and switching means at each substation, whereby any subscriber may selectively connect himself with any other subscriber on the line independently of a central exchange operator, substantially as described.

6. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of subscribers connected with said telephone line, two sets of circuits for selectively connecting said subscribers with each other and with the central exchange, one set of circuits normally serially including the sides of the metallic line, the other set of circuits normally including the sides of the line in parallel and including the ground, and means at each substation, whereby any subscriber may change the substation circuit connections from the metallic to the grounded condition, substantially as described.

7. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of subscribers connected with said telephone line, two sets of circuits for selectively connecting said subscribers with each other and with the central exchange, one set of circuits normally serially including the sides of the

metallic line, the other set of circuits normally including the sides of the line in parallel and including the ground, and switching mechanism at each substation, whereby any subscriber may change the substation circuit connections from the metallic to the grounded condition, substantially as described.

8. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of subscribers connected with said line, some of the substations being normally adapted for connection in a circuit serially including the sides of the metallic circuit and free from ground connection, the other substations being normally adapted for connection in circuit connected with ground and including the sides of the metallic line in parallel, polarized signal bells at each of the substations, a generator at each of the substations, and a reversing switch at each substation for reversing the direction of current flow sent from the substation generator into the line, substantially as described.

9. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of subscribers connected with said line, some of the substations being normally adapted for connection in a circuit serially including the sides of the metallic line and free from ground connection, the other substations being normally adapted for connection in circuit connected with ground and including the sides of the metallic line in parallel, polarized signal bells at each of the substations, a generator at each of the substations, a reversing switch at each substation for reversing the direction of current flow sent from the substation generator into the line, and means at each substation, whereby the subscriber may adapt the substation circuit conditions for the metallic or the grounded condition, substantially as described.

10. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of substations connected with said line, some of the substations being normally adapted for connection in a circuit serially including the sides of the metallic line and free from ground connection, the other substations being normally adapted for connection in circuit connected with ground and including the sides of the metallic line in parallel, polarized signal bells at each of the substations, a generator at each of the substations, a reversing switch at each substation for reversing the direction of current flow sent from the substation generator into the line, and a circuit changing switch at each substation, whereby the subscriber may adapt the substation circuit conditions for the metallic or the grounded condition, substantially as described.

11. In a telephone system, the combination with a telephone line, of party subscribers connected thereto, signaling apparatus at each substation including a polarized spring adjusted bell and a generator, the signal bells being oppositely adjusted, whereby to respond to currents flowing in but one direction, and a reversing switch at each substation, whereby the current sent into the line from the generator may have its direction of flow changed to actuate the adjustable signal bell at the other substation, substantially as described.

12. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of substations connected with said line, some of the substations being normally adapted to signal the central exchange through a circuit serially including the sides of the metallic line and free from ground connection, the other substations being normally adapted to signal the central exchange through a circuit parallelly including the sides of the metallic line and the ground, and impedance coils at the normally grounded substations and at the central exchange whereby short-circuiting of currents is prevented when the metallic line is serially included in circuit, substantially as described.

13. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, two substations connected with said line, the circuits through said substations being normally free from ground and serially including the sides of the metallic line, means at each of said substations for changing the circuit conditions so that the circuits through the substations include the ground as one conductor and the sides of the metallic line in parallel, and means at the central exchange whereby the operator may independently connect with either the metallic circuit or the grounded circuit, whereby both substations may converse with or through the central exchange independently of each other, substantially as described.

14. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, two substations connected with said line, the circuits through said substations being normally free from ground and serially including the sides of the metallic line, means at each of said substations for changing the circuit conditions so that the circuits through the substations include the ground as one conductor and the sides of the metallic line in parallel, means at the central exchange whereby the operator may independently connect with either the metallic circuit or the grounded circuit, whereby both substations may converse with or through the central exchange independently of each other, impedance wind-

ings at each of said substations normally serially included in a circuit connected across the metallic line, said windings, upon change at the substations from the metallic to the grounded circuit condition, being included 5 parallelly and differentially in circuit, substantially as described.

15. In a telephone system, the combination with a central exchange, of a bimetallic 10 telephone line extending therefrom, two substations connected with said line, the circuits through said substations being normally free from ground and serially including the sides of the metallic line, means at each of said substations for changing the circuit conditions 15 so that the circuits through the substations include the ground as one conductor and the sides of the metallic line in parallel, means at the central exchange whereby the operator may independently connect with either the 20 metallic circuit or the grounded circuit, whereby both substations may converse with or through the central exchange independently of each other, and a polarized adjustable bell at each substation, the windings of said bell being normally serially included in a circuit bridging across the sides of the telephone line and included parallelly and differentially in circuit upon change at the substation from the metallic to the grounded circuit condition, the windings being of high impedance, whereby to prevent short circuiting of currents passing serially through the sides of the telephone line, substantially as described. 35

16. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, two substations connected with said line, the circuits 40 through said substations being normally free from ground and serially including the sides of the metallic line, means at each of said substations for changing the circuit conditions so that the circuits through the substations include the ground as one conductor 45 and the sides of the metallic line in parallel, springjacks at the central exchange, means at the central exchange whereby the operator may independently connect with either the metallic circuit or the grounded circuit, 50 whereby both substations may converse with or through the central exchange independently of each other, a polarized adjustable bell at each substation, each bell adapted to respond to a current flow in only one direction, an operator's cord circuit at the central exchange, a reversing key included in said circuit, and a source of ringing current connected with said key, substantially as described. 60

17. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, two substations connected with said line, the circuits

through said substations being normally free 65 from ground and serially including the sides of the metallic line, means at each of said substations for changing the circuit conditions so that the circuits through the substations include the ground as one conductor 70 and the sides of the metallic line in parallel, a springjack at the central exchange, a signal associated with said springjack adapted to respond to signaling current flowing serially through the metallic line, an additional 75 springjack, a signal associated therewith to respond to signaling current flowing through ground and parallelly through the sides of the metallic line, an operator's plug for engaging said springjacks, a cord circuit uniting said plugs, a reversing key included in said cord circuit, a source of ringing current adapted for connection with said cord circuit by means of said key, and a polarized signal bell at each substation adjusted to respond 85 to currents flowing in but one direction, the operator, upon insertion of the plug into the proper jack, being enabled to selectively signal the substations whether they be included in the metallic circuit or in the grounded circuit, substantially as described. 90

18. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, two substations connected with said line, the circuits 95 through said substations being normally free from ground and serially including the sides of the metallic line, means at each of said substations for changing the circuit conditions so that the circuits through the substations include the ground as one conductor 100 and the sides of the metallic line in parallel, a springjack at the central exchange, a signal associated with said springjack adapted to respond to signaling current flowing serially 105 through the metallic line, an additional springjack, a signal associated therewith to respond to signaling current flowing through ground and parallelly through the sides of the metallic line, an operator's plug for engaging said springjacks, a cord circuit uniting said plugs, a reversing key included in said cord circuit, a source of ringing current adapted for connection with said cord circuit by means of said key, a polarized signal bell 115 at each substation adjusted to respond to currents flowing in but one direction, the operator, upon insertion of the plug into the proper jack, being enabled to selectively signal the substations whether they be included 120 in the metallic circuit or in the grounded circuit, a ringing generator at each substation normally adapted upon actuation to cause only the central exchange signal to respond, and a reversing key at each substation associated with the substation generator, whereby the current flowing into the line from the generator may have its direction of flow re- 125

versed so as to actuate the signal bell at the other substation on the line, substantially as described.

19. In a telephone system, the combination with a central exchange, of a telephone line extending therefrom, a plurality of subscribers connected with said telephone line and adapted for selective interconnection, signal receiving means at the central exchange, a source of signaling current at each substation, and means whereby current emanating from one of said sources may be allowed to actuate only the corresponding substation signal receiving means and the signal receiving means at the central exchange, substantially as described.

20. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of party subscribers connected with said line, two sets of circuits for connecting said subscribers with each other and with the central exchange, one set of circuits normally serially including the sides of the telephone line and free from ground connections, the other set of circuits normally including the ground and the sides of the metallic line in parallel, means at the central exchange whereby the exchange operator may connect with the metallically connected substations or with the grounded substations, and means whereby two of said subscribers may converse with or through the central exchange independently of each other, substantially as described.

21. In a telephone system, the combination with a bimetallic telephone line, two sets of party subscribers connected with said line, two sets of circuits for connecting said party subscribers with each other, a set of circuits for one set of subscribers normally serially including the sides of the telephone line and free from ground connections, another set of circuits for the other set of subscribers normally including the ground as one conductor and the sides of the metallic line in parallel, and means at each substation for changing the circuit conditions whereby conversation may be carried on between two subscribers in one set independently of conversation carried on at the same time between two subscribers in the other set, substantially as described.

22. In a telephone system, the combination with a bimetallic telephone line, two sets of party subscribers connected with said line, two sets of circuits for connecting said party subscribers with each other, a set of circuits for one set of subscribers normally serially including the sides of the telephone line and free from ground connections, another set of circuits for the other set of subscribers normally including the ground as one conductor and the sides of the metallic line in parallel, and means at each substation for adapting

the substation connections for either the metallic or the grounded condition, whereby subscribers of one set may converse with subscribers of the other set at the same time and independently of each other, substantially as described.

23. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a plurality of party subscribers connected with said line, two sets of circuits for connecting said subscribers, both for signaling and conversation with each other and with the central exchange, one set of circuits serially including the sides of the telephone line and free from ground connections, the other set of circuits including the ground and the sides of the metallic line in parallel, means at the central exchange whereby the exchange operator may connect with the metallically connected substations or with the grounded substations, and means at each of the substations whereby substations provided with one set of connections may selectively signal each other.

24. In a telephone system, the combination with a bimetallic telephone line, of a plurality of subscribers connected therewith, two sets of circuits for selectively connecting said subscribers with each other, one set of circuits normally serially including the sides of the metallic line, the other set of circuits normally including the sides of the line in parallel and including the ground, and means at each substation whereby any subscriber may change the substation circuit connections from the metallic to the grounded condition.

25. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a substation connected with said line, said substation being normally adapted for connection in a circuit serially including the sides of the metallic line, means at the substation for disconnecting the substation from the metallic line and for connecting said substation in a circuit including the ground and the metallic sides of the line in parallel, and means at the central exchange whereby the operator may independently connect with either the metallic circuit or the grounded circuit.

26. In a telephone system, the combination with a central exchange, of a bimetallic telephone line extending therefrom, a substation connected with said line, said substation being normally adapted for connection in a circuit serially including the sides of the metallic line, means at the substation for disconnecting the substation from the metallic line and for connecting said substation in a circuit including the ground and the metallic sides of the line in parallel, means at the central exchange whereby the operator may independently connect with either the metallic

circuit or the grounded circuit, and an impedance coil at the substation for preventing short circuiting of the currents passing serially through the sides of the line.

5 27. In a telephone system, the combination with a central exchange, of a metallic telephone line extending therefrom, a substation connected with said line, the circuits through said substation being normally free
10 from ground and serially including the sides of the metallic line, means at the substation for changing the circuit conditions so that the circuit through the substation includes the ground as one conductor and the sides of the
15 metallic line in parallel, means at the central exchange whereby the operator may independently connect with either the metallic circuit or the grounded circuit, and a signal bell at the substation, the windings of said bell
20 being normally serially included in a circuit across the sides of the telephone line and included parallelly and differentially in circuit upon change at the substation from the metallic to the grounded condition, said windings being of high impedance whereby to prevent short circuiting of currents passing
25 serially through the sides of the telephone line.

28. In a telephone system, the combination with a central exchange, of a bimetallic
30 telephone line extending therefrom, two substations connected with said line, said substations being normally adapted for connection in a circuit serially including the sides of the metallic line and free from ground, means
35 at each substation for disconnecting the substation from the metallic connection and connecting said substation in a circuit including the ground and the metallic sides of the line in parallel, a spring jack at the central ex-
40 change connected only with the metallic sides of the line, and an additional spring jack at the central exchange connected to ground and to both metallic limbs of the line whereby the exchange operator may independently connect
45 with either the metallic circuit or the grounded circuit and whereby both the subscribers may converse with or through central independently of each other.

In witness whereof, I hereunto subscribe
50 my name this 13th day of July A. D., 1903.

GARRISON BABCOCK.

Witnesses:

LYNN A. WILLIAMS,
HARVEY L. HANSON.