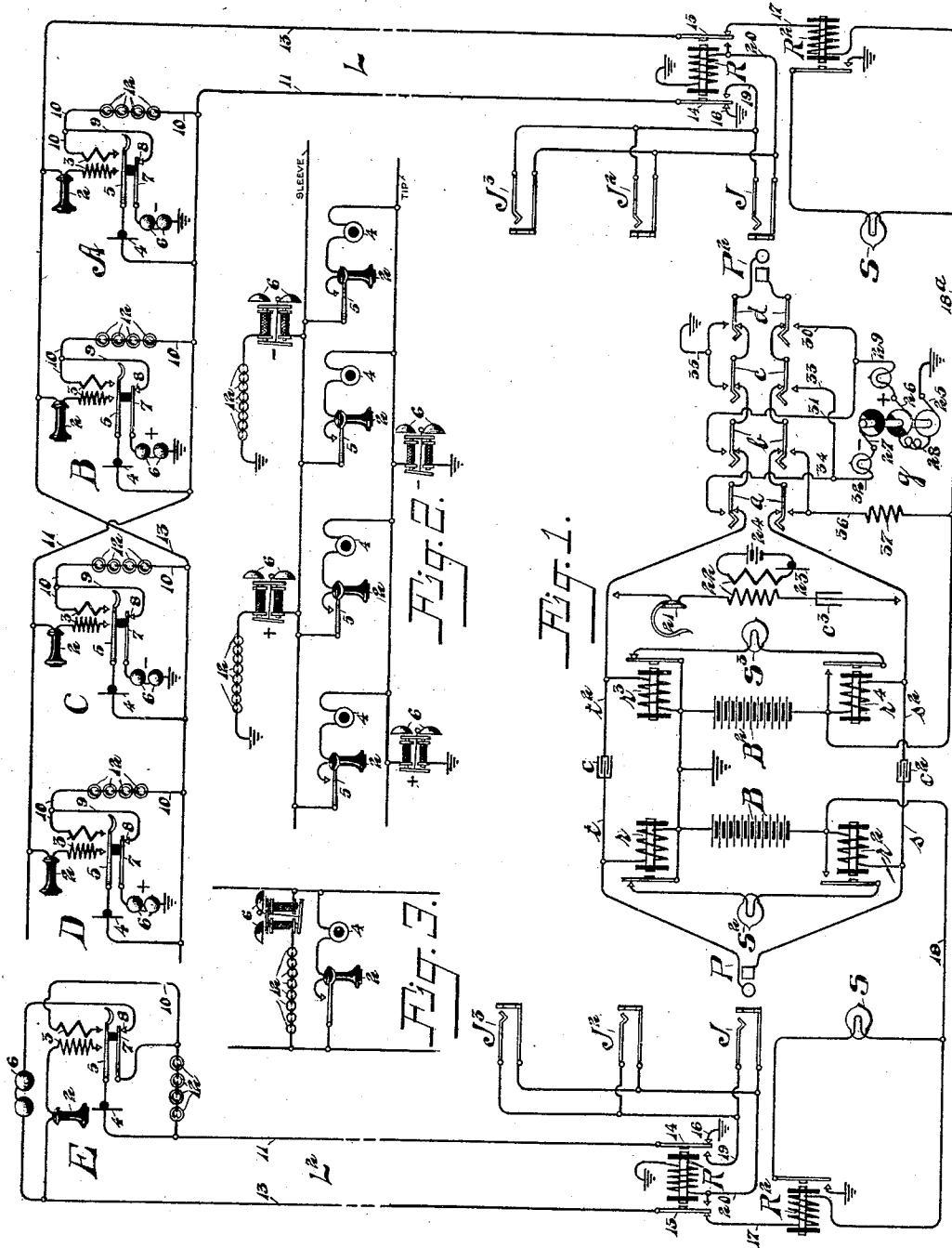


908,213.

Patented Dec. 29, 1908.



Witnesses.
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 908,213.

Specification of Letters Patent.

Patented Dec. 29, 1908.

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To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, and resident of Chicago, county of Cook and State of Illinois, have invented a new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to improvements in telephone systems, particularly of the party line type.

In the common up-to-date telephone exchange, a central source of current, which usually consists of a storage battery, is provided at the central office, and all of the radiating subscribers' telephone lines are connected therewith, so that normally it is only necessary for the subscriber to complete a path at his substation for current from said source to operate his individual signal or annunciator at the central office and thereby indicate his call, while at other times as during a connection with the line for conversational purposes, the said source furnishes current over the line to the substation for transmission purposes and at the exchange for the operation of the supervisory apparatus. It has also been found expedient for practical reasons to ground one pole of this central source of current, whereby under the conditions outlined a flow of current takes place from the said battery whenever the opposite line wires of the telephone line are connected together or whenever a ground connection is established with that one of the wires which is electrically joined with the live pole of the said battery.

In party-line work it is necessary to connect the bells or other calling devices in branches of the line, which branches extend either between the two sides of the line or between the sides and ground. This, as is evident, requires the employment of a steady current interrupter in each bell branch, or at least in those branches disposed in the path of the steady current, for otherwise the line signals would be operated, the supervisory and other apparatus would not work properly and an inoperative system as a whole might result. Such interrupters must at the same time permit the passage of the ringing current which is ordinarily alternating or pulsating in character. It has been attempted to employ for this purpose an ordinary condenser which prevents the passage of steady current but permits by induction

between its plates the flow of the varying ringing current, and the inclusion of such condensers in the bell branches therefore renders the branches opaque to the current from the central battery but transparent to the current from the ringing generator. It is often desired, however, to selectively operate the calling devices at the substations and which is usually attempted in the type of party-line mentioned by polarizing the bells or calling devices at the substations so that they respond only to pulsating current of a definite polarity or direction and then arranging said devices and the central office ringing apparatus so that the operator can readily impress upon the line any desired ringing current to selectively operate any bell.

In the case of a four party-line, two bells are usually connected between each line wire and ground, one of the two being biased to respond only to positive pulsating current and the other to respond only to negative pulsating current, so that it is apparently possible by the application of positive or negative ringing current to either line conductor to selectively operate the bells. Again, the bells may be similarly polarized and connected across the metallic line and likewise operated by impressing the proper ringing current upon the metallic line. This mode of selective calling is objectionable on account of the strength of the discharge current or back surge of current from the condensers, which is due in part to the fact that a condenser charges up to substantially the full voltage of the current impressed upon the line, whereby its discharge is correspondingly strong. In the case of the party-line, therefore, and when a pulsating ringing current of one polarity is impressed upon the line, all of the condensers in the path of the ringing current charge up to the full voltage and only the bell biased to respond to that current is sounded; but when the discharge takes place, which is, of course, of the opposite polarity, the neighboring bell that is oppositely biased from the one intended to be rung is now sounded, whereby instead of there being a selective calling in this system, both bells respond to ringing current of either direction.

One feature of my present invention is to provide a party line system of the general type mentioned in which means is provided

at the substations and in the bell branches to interrupt the flow of steady current to the desired extent and to permit the passage of the ringing current and this without the objectionable back-surge or reverse flow of current to such an extent as to molest or cause the undesired operation of other bells or devices elsewhere located on the same circuit. I accomplish this result by placing in the bell branches or otherwise properly locating a suitable electrolytic cell or cells which are of limited voltage and capacity and capable of quickly charging up to their full capacity. These cells are placed in the path of the steady current and immediately charge up to the potential of the steady-current source and stop the flow of current in the line; but when the ringing current is impressed upon the line, these cells owing to their limited voltage, which should be about that of the steady current source, are unable to charge up to the full potential of the ringing current, so that the discharge or back-surge of current is comparatively small and the undesired operation of the neighboring bell does not take place. These electrolytic or polarization cells, as they are sometimes called, are miniature storage cells, their construction being well known in the art and usually comprises electrodes of lead wire dipping into dilute sulfuric acid or acidulated material. One or more such cells may be employed according to the voltage of the particular cell employed and the total voltage desired. In some circuit arrangements, I prefer to use the said cells for talking purposes also and the device may be employed to advantage in any party line circuit relation where it is desired to stop the back-surge of current from condensers and permit the passage of the alternating or pulsating current. The cost is much less than condensers besides permitting the use of a much cheaper bell, an 80 ohm bell having been found suitable where heretofore 1000 ohm ringers had been required.

A further object of the invention is to so arrange the apparatus that although the cut-off relays of the lines are actuated over the talking circuits, and although the normal connection of the battery with the called lines is severed during ringing to prevent the ringing current from reaching the calling subscribers, the cut-off relays are still maintained actuated whereby the normally disconnected switchboard section of the lines, if such are employed, are retained in connection with the external line circuit and the line signaling devices are prevented from operating.

In the accompanying drawing in which the same reference characters are used to designate like parts throughout the several views, Figure 1 is a diagram of two telephone lines and a central office apparatus,

one of the lines being of the party line type; Fig. 2 is a diagram of a simplified arrangement of a party line, and Fig. 3 is a diagram of a subscriber's station on either a single or party line.

Referring particularly to Fig. 1, L and L² designate telephone lines extending from their respective sub-stations to the central office. Upon the line L a plurality of subscribers' stations A, B, C, and D are located, while upon the line L² but a single sub-station E is connected. At the station A of the line L, a receiver 2 together with an induction coil 3 and transmitter 4, all of the usual type are provided and are adapted to be connected across between the line conductors by a switch hook 5 when the receiver 2 is removed therefrom. A call bell 6 is connected in a ground branch from a contact 7, carried by but insulated from the hook 5, which when the hook is down, engages the contact 8 which is joined by a conductor 9 with a conductor 10 leading to the tip conductor 11 of the telephone line L. In the conductor 10 are placed the miniature storage cells 12 before referred to, and the primary winding of the induction coil 3 is connected in the same conductor leading to the upper contact of the hook switch 5. When the hook is depressed as by the weight of the receiver which is normally hung thereon, the branch containing the call bell is completed from the line conductor 11 to ground, but when the hook is raised as during conversation, the ground branch is opened at the contacts 7 and 8 of the switch hook and the circuits are completed through the primary and secondary windings of the induction coil and the receiver and transmitter. At the substation B the same apparatus and arrangement exists with the exception that the bell 6 is polarized so as to respond only to a positive pulsating or alternating current, while that at the station A is designed to respond only to negative pulsating or alternating current. At the station C like parts are located and are similarly arranged save for the fact that the branch 10 containing the miniature cells is legged off from the sleeve conductor 13 instead of the tip conductor 11. The bell at this station is intended to respond only to negative pulsating current while that at the station D at which the same arrangement exists as at station C responds only to positive pulsating current. At the single station E, the same apparatus is located and practically the same arrangement exists, but the branch containing the call bell 6 extends between the tip and sleeve line conductors and contains the normally closed switch-hook contacts 7 and 8 so that normally the bell and cells are located in a bridge of the telephone line but when the receiver is taken up the bell is cut out and the cells are connected up for talking.

At the central office, a cut-off relay R is provided for line L², the springs 14 and 15 of which are connected with the line conductors 11 and 13, the former spring being normally connected to ground by a conductor 16 and the latter spring being joined by conductor 17 with the line relay R² individual to the line and the opposite terminal of which is joined by a conductor 18 with the live pole of a common battery B. The line relay R² controls through its normally open contacts the circuit of the line signal S preferably in the form of a small incandescent lamp. An answering jack J and multiple jacks such as J², J³, in any desired number are provided for the line and are connected by conductors 19 and 20 with the forward contacts respectively of springs 14 and 15 of the cut-off relay R. The winding of the said cut-off relay is connected between the sleeve conductor 20 of the said jacks and ground. The line L is provided with similar apparatus except that an omnibus bar or lead 18^a extends from the live pole of another common battery B² to the line relay R².

The cord circuit shown at the central office is intended to typify the cord circuits used throughout the exchange, of which as usual each operator is provided with as many as desired, ordinarily about twelve. The batteries B and B² supply current for the whole exchange. The cord circuit is provided with an answering plug P and with a calling plug P², each having tip and sleeve contacts adapted to register with corresponding contact surfaces in the spring jacks of the line. The tip contacts of the two plugs are connected together by flexible strands *t* and *t*² and the interposed condenser *c*, while the sleeve contacts are likewise connected by the flexible strands *s* and *s*² and the interposed condenser *c*². Between the battery B and the strand *t* occurs the winding of supervisory relay *r*, and between the negative pole of the battery and the strand *s* is placed the cooperating supervisory relay *r*², these relays together controlling the local circuit of the supervisory lamp S², the former to cause a break in said local circuit when energized and the latter to close a break therein when energized. The calling end of the cord circuit is similarly provided with a pair of supervisory relays *r*³ and *r*⁴ controlling in like manner the local circuit of a supervisory signal S³, which like the two relays, is adapted to be energized from the battery B². The operator's receiver 21, the secondary of her induction coil 22 and a condenser *c*³ are connected in a bridge of the calling end of the cord circuit by any of the usual listening keys, preferably such as simultaneously open or close both contacts by means of a single lever. The primary of her induction coil,

together with her transmitter 23 are shown connected in a local circuit with the battery 24, although it will be understood that the battery B or B² may be employed if desired. The strands *t*² and *s*² are carried through the normally closed contacts of the ringing keys *a*, *b*, *c*, and *d*. These are arranged when operated to open the said contacts and to complete over their outer contacts suitable ringing circuits in order to selectively operate the bells located at the subscribers' stations. For this purpose, a ringing generator *g* is shown having one of its brushes 25 grounded, another of its brushes 26 connected to a semi conductive commutator arranged to deliver only positive pulsating current thereto, while a third brush 27 is connected with another similar commutator so as to receive only negative pulsating current, the armature of the generator being indicated at 28. A conductor 29 from brush 26 extends in parallel branches 30 and 31 to the sleeve and tip springs respectively of keys *d* and *b*, while the brush 27 is likewise connected by a conductor 32 terminating in parallel branches 33 and 34 leading to the outer contacts of the sleeve and tip springs respectively of keys *c* and *a*. The alternate contacts of tip springs *d* and *c* are grounded through conductor 35, while the alternate contacts of sleeve springs *a* and *b* are connected by a conductor 36 through a resistance coil 37 with the battery lead 18^a.

When a subscriber, say subscriber E, wishes a connection he takes up his receiver thereby closing a circuit at the substation between the line conductors 11 and 13, and through the line relay R² at the central office. This relay operates and closes the local circuit of the signal S, which is lighted to indicate the call to the operator. Upon observing the light, the answering plug P of the operator's cord circuit is inserted in the jack J and her listening key is manipulated to connect her telephone with the other end of the said circuit. The insertion of the plug P closes a conductive path from the live pole of the battery B through the sleeve supervisory relay *r*², over the sleeve strand *s* of the cord circuit, the sleeve conductor 20 of the jacks and through the winding of the cut-off relay R to ground. This operates the said cut-off relay which breaks the connection with the line relay R² to render the line signal inoperative and connects the switchboard section of the line with the external line circuit.

The operation of the sleeve supervisory relay *r*² closes the break in the local circuit of the supervisory signal S², but owing to the fact that the metallic circuit of the line L² is completed, the current from the battery B² is flowing thereover and the tip supervisory relay *r* is operated to open the break in the circuit of the supervisory lamp

S^2 which therefore remains dark. Upon learning that a subscriber upon the party-line L is desired, the operator tests the same to determine its idle or busy condition.

5 This busy test is accomplished by touching the tip of the plug P^2 to the test ring of the multiple jack of the line at the operator's position. If the line is idle, the test rings are entirely disconnected from any current

10 source, and inasmuch as the tip of the plug is connected with ground no click will be received; but if a connection has been established with the line at any other position, the test rings thereof are all connected through

15 the sleeve strand of the inserted cord circuit at such position with the live pole of either battery B or B^2 , whereby in testing in the manner described a complete circuit is established and current flows over the

20 tip strand of the testing cord circuit. This serves to change the potential between the two strands of the cord circuit with the result that a flow or surge of current takes place through the operator's receiver and

25 produces a click therein. Assuming, however, that the line is found idle, the plug P^2 is inserted thus establishing a path for current over the sleeve strand of the cord circuit from the live pole of battery B^2 ,

30 through the cut-off relay R, which is operated to electrically connect the switchboard section of the line to the external line circuit and to render the line signal inoperative. The subscriber is now called by depressing

35 one of the keys a , b , c , or d , corresponding to the substation A, B, C, or D wanted. Assuming for example that the station A is the one desired, the calling key a is depressed with the result that the tip spring is

40 connected by conductors 34 and 32 with the brush 27 of the generator and therefore receives negative pulsating current, while the sleeve spring of the ringing key is connected by conductor 36 through resistance

45 37 and the battery lead 18^a with the battery B^2 . Although the sleeve strand of the cord circuit is broken at the normal contact of the sleeve spring a , it is evident that a new path for the current from the battery is provided

50 through the said conductor 36, so that the cut-off relay remains actuated during the operation of the key and also to provide a return path for the ringing current around the sleeve supervisory relay r^4 in case

55 the subscriber responds before the operator releases the ringing key. The negative pulsating current flows out over the tip strand of the cord circuit, the tip conductor 11 of the telephone line, through the branch 10 containing the electrolytic cells 12, and conductor

60 9, the contacts 8 and 7 of the switch hook and through the signaling bell 6 to ground, which bell responds and indicates a call at the substation. At the same time, negative ringing current is flowing through the cells

12 at the station B but owing to the bias of the bell 6 at this station, it does not respond. At the stations C and D the bells do not respond since they are connected with the other line conductor. Owing to

70 the use of the cells mentioned, the back surge or discharge is not as strong as occurs with the use of condensers, whereby the bell located at the station B is not operated. The subscriber in responding to the call

75 closes the metallic circuit of the line. If the operator has not stopped ringing the subscriber before his response, a return path for current will be provided back to the central office over the sleeve conductor of the

80 line and through the conductors 36 and 18^a and the battery B^2 to ground. The passage of the ringing current through this bypath prevents chattering of the supervisory relay r^4 . When the calling key is closed and before

85 the response of the called subscriber, the sleeve supervisory relay is actuated and closes the circuit of the supervisory lamp S^3 which is lighted to indicate the fact of the non-response of the subscriber. When

90 the subscriber does respond, after the calling key is closed, a path for steady current over the metallic line is provided and the tip supervisory relay operates to indicate the fact of the response to the operator.

95 The operation of the calling key b would complete a ringing circuit from the positive brush 26 of the generator, through conductors 29 and 31, over the tip side of the line, and would operate the call bell located

100 at the station B, the cut-off relay being maintained actuated over conductor 36 as just explained in connection with the operation of the key a . Assuming that it is desired to call the station C, the operation of

105 the key c serves temporarily to connect the tip conductor 35 to the tip ringing spring, while the sleeve spring would be connected by conductors 33 and 32 with the negative brush 27 of the generator g . Under this

110 condition it will be observed that the negative pulsating current is delivered over the sleeve strand of the cord circuit, which is now disconnected from the battery B^2 , over the sleeve conductor to the sub-station. A

115 parallel path for this current is through the cut-off relay R^3 to ground, which owing to the sameness of direction of the pulsations of current responds thereto and is maintained actuated. The response of the called

120 subscriber before opening the calling key would provide a return path for current over the tip side of the line and through the ground 35. It is to be noted also that the direction of the pulsations is the same as that

125 of the direct current so that the magnetism of the cut-off relay is not reversed. The operation of the calling key d would likewise ground the tip spring but would connect the sleeve spring through conductors 30

130

and 29 with the positive brush 26 which would serve to ring the bell at the station D, and owing to the sameness of the direction of pulsations would maintain the cut-off relay R operated.

During conversation the batteries B and B² are furnishing current to the substations for transmission purposes and for the actuation of the supervisory and cut-off relays. At the substations the battery current finds a conductive path between the line conductors through the receiver, the secondary of the induction coil and the transmitter. The variations of resistance of the transmitter cause variations of the charge of the cell or cells 12 in parallel therewith which charge and discharge through the primary helix of the induction coil acts inductively upon the secondary helix, with the result that greater variations of current are sent out over the line than without the employment of the induction coil and cell. At the stations C and D, the cells are preventing the flow of battery current to ground. At the termination of the conversation and the return of the receivers to the hooks, the corresponding supervisory relays r and r^2 are de-energized with the attending result that the lamps S² and S³ are lighted to indicate the fact of the completion of the conversation to the operator. Upon observing these lights, the cord circuit is withdrawn and all parts are restored to normal condition.

Under normal conditions the cells 12 in the ground branches from the sleeve side of the line L² as at stations C and D prevent the flow of steady current from battery B², while on line L the presence of the cells 12 prevents a flow of current over the metallic line from battery B. These cells as heretofore explained quickly charge up to the same voltage as the central battery and therefore prevent a flow of current in the line. The number or arrangement of the cells may be varied as desired to suit the conditions of use.

In Fig. 2 I have indicated a simple arrangement of a party line in which the miniature cells 12 are employed for ringing only, and are accordingly located only in the sleeve grounded branches to prevent the normal flow of current therethrough, the transmitters and receivers being connected directly across the line during conversation to receive current direct from the central office, or any other desired arrangement of the receivers and transmitters may be provided.

Fig. 3 represents a single station employing the cells in series with the bell only, whereby the steady current is prevented from passing therethrough, but the alternating ringing current is permitted to pass. Or this figure represents how a plurality of stations may be located on a line, with bridg-

ing bells, and if two only were located on the line, they might be selectively operated by the plus and minus pulsating current method.

The several grounds mentioned at the central office are usually one and the same, or the grounds may be considered the equivalent of common returns. The dimensions of the various parts may be that ordinarily or preferably employed. Usually the source of steady current is 24 volts while that of the ringing generator is 100 volts.

I claim:—

1. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line calling devices one at each substation capable of responding only to ringing current of distinctive and different characters or signs, a source of steady current at the central office adapted to be connected with the line and having a comparatively high electromotive force for the operation of various apparatus associated therewith including a line signal normally and supervisory signals as well as the subscriber's transmitter during connections for conversation, a source of ringing current also at the central office adapted to be connected with the line to suitably operate said devices at the substation, and an electrolytic cell or cells in circuit with each said device in the path of the steady current and capable of quickly charging up to substantially the same voltage as said steady current source and opposing the same to thereby prevent the flow of said steady current, said electrolytic cell or cells at the same time permitting the passage of the distinctive ringing current whereby a selective calling system is secured without affecting the other calling devices of the line, substantially as described.

2. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line, call bells one at each substation capable of responding only to pulsating ringing currents of distinctive and different signs or directions, a source of steady current at the central office adapted to be connected with the line for the operation of various apparatus associated therewith, a source of ringing current also at the central office to selectively furnish pulsating current of the proper sign to operate said call bells at the substation, and an electrolytic cell or cells in circuit with each said bell in the path of steady current and serving to prevent the flow of steady current but to permit the flow of distinctive ringing current said electrolytic cell or cells being adapted to permit the bell of the proper selective calling device to sound without affecting the other bells of the circuit as the selective pulsating current ceases, substantially as described.

3. In a telephone system; the combination with a telephone line, of a plurality of substations located on the line, calling devices one at each substation capable of responding only to pulsating ringing current of distinctive and different directions, a source of steady current at the central office adapted to be connected with the line for the operation of various apparatus associated therewith, a source of ringing current also at the central office adapted to impress pulsating ringing current of the proper direction upon the line to operate said devices, and an electrolytic cell or cells in circuit with each device at the substations, said cell or cells serving to prevent the flow of steady current but to permit the passage of the distinctive ringing current, and to permit the proper selective calling device to sound while preventing the sounding of any of the other calling devices of the line as the ringing current ceases, substantially as described.

4. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line, polarized calling devices one at each substation capable of responding only to pulsating ringing current of a distinctive and different direction, a source of steady current at the central office adapted to be connected with the line for the operation of various apparatus associated therewith, a source of ringing current also at the central office and adapted to be connected with the line to operate said calling devices at the substations, and an electrolytic cell or cells in series with each said device that is located in the path of steady current, said cell or cells serving to prevent the flow of steady current and to permit the passage of the distinctive ringing current, to sound the proper calling device while preventing the sounding of any of the other calling devices of the line as the ringing current ceases, substantially as described.

5. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line, calling devices one at each of a plurality of substations connected in ground branches from the line and capable of responding only to ringing current of distinctive and different characters, a source of steady current at the central office adapted to be connected with the line and having a comparatively high electromotive force to send current over the line for the operation of various apparatus associated therewith including a line signal normally and supervisory signals as well as the subscriber's transmitter during connections for conversation, a source of ringing current also at the central office adapted to be connected with the line to suitably operate said devices, and an elec-

trolytic cell or cells in the ground branches with each said device that is located in the path of steady current from said source, said cell or cells being capable of quickly charging up to substantially the same voltage as said steady current source and opposing the same to thereby prevent the passage of steady current, said electrolytic cell or cells at the same time permitting the passage of the distinctive ringing current to the proper calling device, without affecting the other calling devices of the line as the ringing current ceases, substantially as described.

6. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line, calling devices one at each of the plurality of substations connected in ground branches from one side of the line and capable of responding only to pulsating ringing current of distinctive and different directions, a source of steady current at the central office adapted to be connected with the line to send current thereover for the operation of various apparatus associated therewith, a source of ringing current also at the central office adapted to be connected with the line to furnish pulsating current of the proper directions to operate said devices, and an electrolytic cell or cells in the said ground branches with each said device that is located in the path of steady current, said cell or cells serving to prevent the passage of the steady current and to permit the passage of the distinctive ringing current, whereby the proper selective calling device is sounded without affecting the other calling devices of the line as the ringing current ceases, substantially as described.

7. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line, calling devices one at each of the plurality of substations connected in ground branches from both sides of the line and capable of responding only to pulsating ringing current of distinctive and different directions, a source of steady current at the central office adapted to be connected with the line and to send current thereover for the operation of various apparatus associated therewith, a source of signaling current also at the central office adapted to be connected with the line to furnish pulsating current of the proper directions to operate said devices, and an electrolytic cell or cells in the said ground branches in series with each said device and serving to prevent the passage of steady current and permit the passage of the distinctive ringing current, whereby said devices may be selectively operated without disturbing or sounding any of the calling devices of

the line as the ringing current ceases, except the device selected substantially as described.

8. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line, a polarized calling device at each substation capable of responding to ringing current of a particular character, a source of steady current at the central office adapted to be connected with the line to operate the various apparatus associated therewith, a source of ringing current located at the central office and adapted to be connected with the line to operate said devices at the substations, and an electrolytic cell or cells at each substation to prevent the passage of steady current and permit the passage of the ringing current, said electrolytic cell or cells being adapted to prevent the sounding of all said sounding devices as the ringing current ceases, while permitting the sounding of the proper calling device while said current flows substantially as described.

9. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line, polarized calling devices at each substation capable of responding only to pulsating ringing current of different distinctive characters, a central source of current connected with the line at the central office to furnish current thereover, normally, for the operation of the line signaling devices and, during a connection, for talking; a source of ringing current at the central office adapted to be connected with the line to selectively operate said devices, an electrolytic cell or cells at each substation to prevent the flow of steady current and permit the flow of rapidly varying currents, whereby the proper selective sounding device is sounded, and the other selective devices of the line are prevented from sounding as said rapidly varying current is cut off and means to connect said cell or cells in the proper circuit relation to enable them to be used for both signaling and talking, substantially as described.

10. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line, polarized calling devices one at each substation in a ground branch from the line and capable of responding only to pulsating ringing current of distinctive and different characters, a central source of current connected with the line at the central office to furnish current thereover for the operation of the line signaling device and, during a connection, for talking purposes, a source of ringing current at the central office adapted to be connected with the line to operate said devices, an electrolytic cell or cells at each substation in the said ground branches to prevent the flow of steady current and permit the flow

of rapidly varying currents, said electrolytic cell or cells being adapted to reduce the discharge or back surge of current upon the line as the ringing current is cut off to a minimum, whereby the other calling devices are not sounded and a switch to connect said cell or cells in the proper circuit relations to enable them to be used both for talking and signaling, substantially as described.

11. In a telephone system, the combination with a telephone line, of a plurality of substations located on the line, polarized calling devices one at each substation in ground branches from the line capable of responding only to pulsating current of distinctive and different characters, a telephone set at each substation, a central source of current connected with the line at the central office to furnish current thereover normally for the operation of the line signaling device and during a connection for talking, a source of signaling current at the central office adapted to be connected with the line to selectively operate said devices, an electrolytic cell or cells at each substation to prevent the flow of steady current and permit the flow of rapidly varying currents, whereby appreciable back surge of current, as the signaling current is cut off, is prevented, and the ringing of the calling devices not selected is prevented and a hook switch to connect said cell or cells normally with the signaling device and during a connection with the telephone set for talking, substantially as described.

12. In a telephone system, the combination with a telephone line, a plurality of substations located thereon, the call bells at two of the substations being in the same current path from the central office and responsive only to pulsating ringing currents of opposite signs, a source of direct or steady current normally connected with the line at the central office for the operation of the line signal from the substation, said source being also connected with the line during connections for conversation for the operation of the substation transmitter, and the supervisory apparatus at the central office, a ringing current source at the central office adapted to be connected with the line to send out pulsating current of the proper sign to operate said bells at the substations, and a battery of electrolytic cells in circuit with each of said bells at the said two substations to prevent the passage of the steady currents from said central source and at the same time to permit the passage of the ringing current whereby said bells are selectively operated from said pulsating ringing source, said electrolytic cells preventing a back surge of current as the ringing current is cut off, whereby the bell or bells not selected are prevented from ringing substantially as described.

13. In a telephone system, the combination with a telephone line, of a plurality of substations on the line having each a polarized bell, the bells at two of the substations being legged to ground from one line conductor and those at two other substations similarly connected with the other line conductor, one bell on each side of the line being biased to respond only to positive pulsating ringing current and the other bell on the same side being biased to respond only to negative pulsating ringing current, a battery of electrolytic cells in series in each such bell branch to ground, a source of steady or direct current at the central office normally connected with the line for the operation of the line signal when the subscriber calls the central office, and connected therewith during connections to furnish current over the line to operate the subscriber's transmitter and to suitably control the supervisory apparatus at the central office, a ringing current generating outfit at the central office under the control of the operator to send out either positive or negative ringing current over either side of the line, said electrolytic batteries at the substations preventing the undesired passage of the steady current from said source, but permitting the passage of the ringing current from said outfit, said batteries also preventing appreciable back surge of current, as the ringing current is cut off, whereby the bells not selected are prevented from ringing substantially as described.

14. The combination with an operator's connecting circuit, of a telephone line having a plurality of subscribers' stations located thereon, a polarized bell for each of said stations a source of direct current at the central office for the operation of the transmitters of said line, a cut-off relay for the line to render the line signal inoperative actuated over a part of the talking circuit when the connecting circuit is connected therewith, a ringing apparatus at the central office, and means for sending current from said apparatus over different paths for selectively ringing said subscribers and means associated with said direct current source for maintaining said cut-off relay operated while sending ringing current over one path and means independent of said direct current source for maintaining said cut-off relay operated while sending ringing current over the other path, substantially as described.

15. The combination with an operator's connecting circuit, of a telephone line having a plurality of subscribers' stations located thereon, a polarized bell for each of said stations, a cut-off relay for the line to render the line signal inoperative actuated over a part of the talking circuit when the connecting circuit is connected therewith, a ringing

apparatus at the central office, and means for selectively ringing said subscribers by calling currents of different electrical character sent over different sides of the said line from said apparatus and at the same time maintaining one limb of said line above ground potential whereby said cut-off relay will be maintained operated, substantially as described.

16. The combination with an operator's connecting circuit, of a line having a plurality of subscribers' stations located thereon, a central battery to furnish current for the transmitters of said line, a polarized call bell at each of said stations legged to ground from the different limbs of the line, a cut-off relay for the line to render the line signal inoperative actuated over a part of the talking circuit when the connecting circuit is connected therewith, a ringing apparatus at the central office associated with the operator's circuit, a ringing key for connecting said apparatus between ground and either side of the connecting circuit to selectively call a subscriber, and means associated with said central battery for maintaining the cut-off relay operated during such ringing on one side of the connecting circuit and means independent of said battery for maintaining the cut-off relay actuated during such ringing of the other side of said connecting circuit, substantially as described.

17. In a telephone system, the combination with a telephone line, of a plurality of substations connected with the line, a source of direct current normally connected between a limb of said line and earth at the central office, a source of ringing current adapted to be temporarily connected with said limb of the telephone line at the central office, biased ringers normally connected between said limb of the line and earth at the substations, and an electrolytic battery normally connected in series with said biased ringers to permit said ringers to be selectively sounded by pulsating current from said ringing generator and to prevent the flow of direct current from said direct current source, substantially as described.

18. The combination with a telephone line having a plurality of subscribers' stations located thereon, an operator's connecting circuit, a cut-off relay for the line to render the line signal inoperative, actuated over one side of the talking circuit and a third conductor, a ringing apparatus at the central office associated with the said circuit, a ringing key to connect the same with either side of said circuit, said key serving to open the side of the circuit over which the cut-off relay is actuated when the apparatus is connected with the other side and to complete a new path for current through the cut-off relay to hold it energized, current from the

apparatus itself serving to actuate the cut-off relay when connected with the other side for ringing, substantially as described.

19. The combination with an operator's connecting circuit, of a line having a plurality of subscribers' stations located thereon, a polarized bell for each of said stations, a cut-off relay for the line to render the line signal inoperative actuated over one side of the talking circuit and a third conductor when the connecting circuit is connected therewith, a ringing apparatus at the central office for selectively ringing the subscribers and adapted to send pulsating current of one

direction over said side of the line to ring the proper subscriber's bell and to open the path for current through said cut-off relay, the pulsating current from the apparatus serving to maintain the cut-off relay operated during ringing, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 29th day of November 1902.

WILLIAM W. DEAN.

Witnesses:

GAZELLE BEDER,
ROBERT LEWIS AMES.