

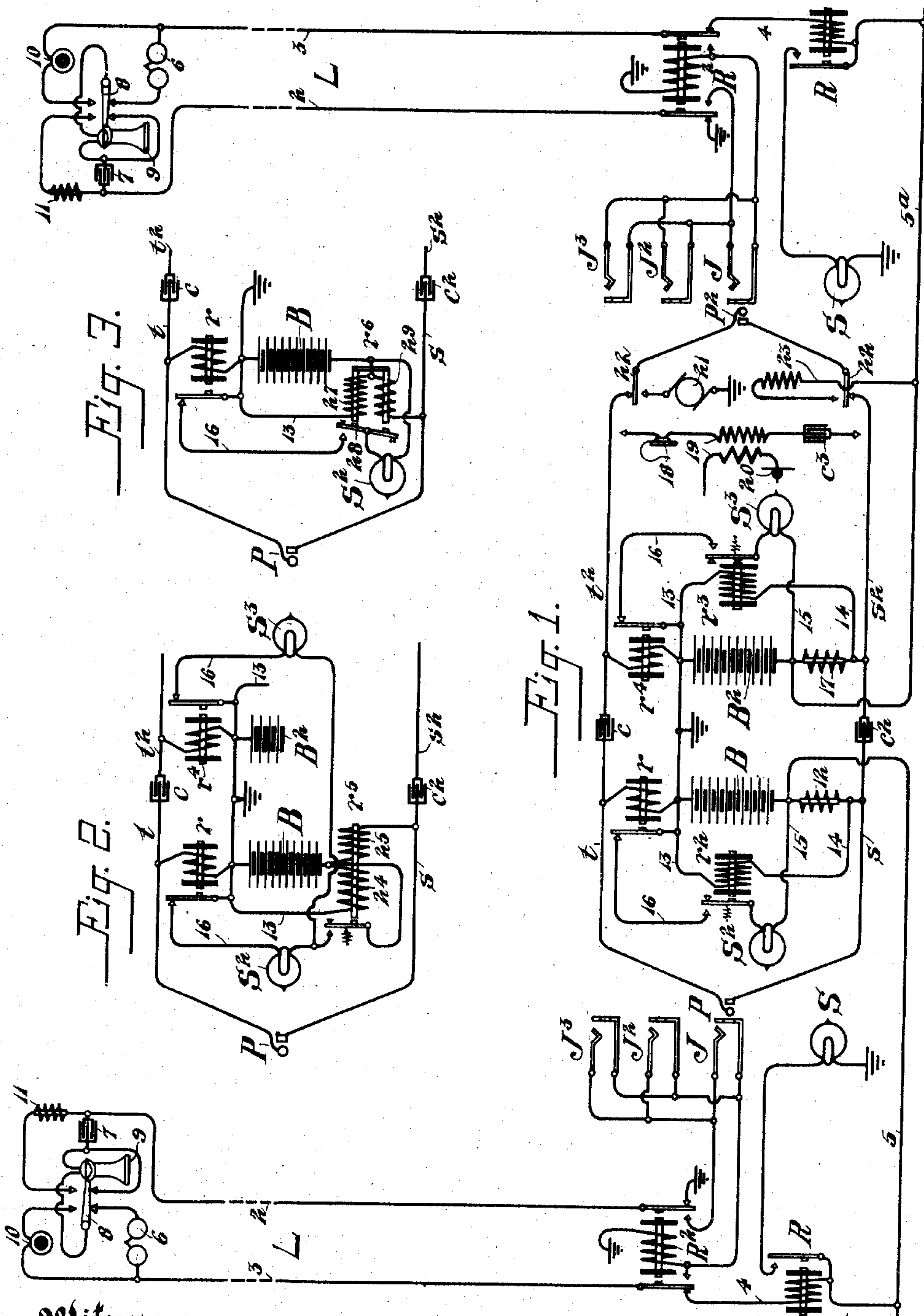
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W. W. DEAN.

SUPERVISORY SYSTEM FOR TELEPHONE LINES.

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Witnesses.  
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# UNITED STATES PATENT OFFICE.

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## SUPERVISORY SYSTEM FOR TELEPHONE-LINES.

No. 864,887.

Specification of Letters Patent.

Patented Sept. 3, 1907.

Application filed January 25, 1904. Serial No. 190,454.

*To all whom it may concern:*

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

My invention relates to improvements in supervisory signaling systems for telephone lines.

Supervisory signals are used in connection with operators' connective circuits to inform her at all times of the positions of the subscribers' telephones during connections for conversation. It is common to employ small incandescent lamps for such signals, and supervisory relays associated with the cord circuit are placed under the control of the subscribers as long as the cord plugs are connected with the subscribers' lines. These relays are arranged when energized to close the local circuits of the signals or to otherwise permit them to be operated to positively indicate to the operator when a conversation is terminated. Some means is usually provided or should be provided in connection with such signals so that when the connection is taken down their circuits will be again opened whereby the loss of current by their continuous operation when the cord circuit is not in use is prevented.

In my present invention I prefer to employ signaling lamps as heretofore for the supervisory signals, one for each plug of the cord circuit, and to associate with each end of the cord circuit a relay that is placed under the control of the subscriber when a connection is established with the subscriber's line and which is adapted to permit the operation of the associated signal when it is deenergized. In order to prevent the operation of the signals under normal conditions, I associate with either one or both ends of the cord circuit an additional relay which is actuated under normal conditions to open the circuit of the said signal or signals but which when the connection is established is deenergized or reversely actuated to permit the closing of the said circuit.

In carrying out my invention I preferably provide such relay or relays with high resistance windings which are preferably permanently included in circuit with the central common battery and which relay or relays are rendered inoperative or are at least reversed in action whenever connection is established with a telephone line to thereby close at one point the circuit or circuits of the signals.

My invention is illustrated in the accompanying drawing in which the same reference characters indicate like parts throughout and in which

Figure 1 is a diagram of a telephone system embodying my improvements; Fig. 2 is a diagram of a modification, and Fig. 3 is a diagram of still another modification.

Referring to Fig. 1, L and L<sup>2</sup> indicate two subscribers' lines extending in two limbs 2 and 3 from their respective substations to the central office, where they are fitted with the usual appurtenances including line signals S, the normally open circuits of which are controlled by the line relays R placed in the branch conductor 4 normally connected with the line conductor 3 and itself connected with the battery lead 5 extending to the live pole of the central common battery B. There is also provided an answering jack J and a plurality of multiple jacks such as J<sup>2</sup> and J<sup>3</sup> suitably distributed throughout the various sections of the multiple switchboard, and a cut-off relay R<sup>2</sup> whose winding is legged to ground from the sleeve side of the jack section of the line and which when operated serves to sever the normal connections of the line conductors 2 and 3 and bring them into connection with the said jack section. At each substation an ordinary signaling bell 6 and a condenser 7 are included in a bridge of the line conductors that is normally closed by the switch hook 8 due to the weight of the receiver 9 hung thereon, said hook 8 being adapted when the receiver is removed therefrom to suitably connect the transmitter 10 and retardation coil 11 in circuit with the receiver 9, the condenser 7 and the line wires 2 and 3.

Each operator is provided with a plurality of cord circuits of the type shown in the drawing, each cord circuit having an answering plug P and a calling plug P<sup>2</sup> provided with tip and sleeve contacts adapted to register with the corresponding contacts of the spring jacks. The tip contacts of these plugs are joined by the flexible strands *t* and *t*<sup>2</sup> and the interposed condenser *c* while their sleeve contacts are similarly united by the strands *s* and *s*<sup>2</sup> and the interposed condenser *c*<sup>2</sup>. Between the grounded pole of the battery B and the strand *t* is located the supervisory relay *r* which is placed under the control of the subscriber when the plug P is connected with a telephone line. A suitable retardation coil 12 is connected between the live pole of said battery and the strand *s*. The relay *r* and the retardation coil 12 may each have 100 ohms resistance. A second relay *r*<sup>2</sup> is provided in connection with the battery B and is connected therewith upon one side by the conductor 13 and upon the other side by conductor 14, the latter conductor being connected outside of the retardation coil 12. The circuit of this relay is preferably permanently closed and for this reason the relay should be of high resistance, preferably about 15000



ohms so that an undue waste of current will not result. The supervisory lamp  $S^2$  which is associated with the plug  $P$  is connected upon one side by conductor 15 with the live pole of the battery  $B$  and upon the other side with one of the normally open contacts of said relay  $r^2$ . A suitable conductor 16 extends between the other normally open contact of relay  $r^2$  and one of the normally closed contacts of the supervisory relay  $r$ , the other of the latter contacts being joined to the grounded pole of the battery  $B$ . Thus under normal conditions the relay  $r^2$  is energized by current from the battery  $B$  and serves to open the local circuit of the supervisory signal  $S^2$ , but when a connection is established with a telephone line, a path for current is established from the live pole of the battery  $B$  through the retardation coil 12, sleeve strand  $s$  of the cord circuit, the sleeve conductor of the jack section of the line and through the cut-off relay  $R^2$  to ground. The latter relay may have about 500 ohms resistance and under these conditions the relay  $r^2$  will be deprived of sufficient current to energize the same by being shunted by the lower resistance of the cut-off relay, and will permit its contacts to close together thereby completing at this point the local circuit of the supervisory signal  $S^2$ .

A second supervisory signal  $S^3$  is associated with the plug  $p^2$ , and is similarly controlled by the high resistance relay  $r^3$  and the supervisory relay  $r^4$  adapted to be placed under the control of the subscriber connected with the plug  $P^2$ . A retardation coil 17 is connected between the live pole of the battery  $B^2$  and the strand  $s^2$  of the cord circuit. It will be apparent that but one relay  $r^2$  or  $r^3$  may be utilized to temporarily close the circuits of both of the supervisory signals, though not with all the conveniences of operation as with both.

The operator's receiver 18, the secondary of her induction coil 19 and a suitable condenser  $c^3$  are adapted to be bridged across the calling end of the cord circuit through the medium of any suitable listening key, her transmitter 20 and the primary of her induction coil being charged from any suitable source of current and which may be either the battery  $B$  or  $B^2$ . A ringing generator 21 is adapted to be connected with the tip strand  $t^2$  by the depression of ringing key springs 22, the sleeve side of the cord circuit being at the same time connected with the live pole of the battery  $B^2$  by means of the lead  $5^a$  and conductor 23.

In the operation of the system, the subscriber desiring a connection takes up his receiver thereby completing the metallic circuit of his line over which current flows from the battery  $B$  via conductors 5, 4, and 3, through the substation devices back to the central office over the line conductor 2 and ground thereby operating the line relay  $R$  and lighting the signal  $S$ . Upon observing this signal the operator inserts the answering plug  $P$  of her cord circuit into the jack of the calling line thus completing a second path for current from the live pole of the battery  $B$  through retardation coil 12, strand  $s$ , sleeve side of the jack section of the line, and thence through the cut-off relay  $R^2$  to ground. The cut-off relay is thus actuated to cut off the line relay  $R$  and retire the line signal  $S$  and at the same time completing the line  $L$  for conversation. The insertion of this plug also provides a comparatively low resistance path around the normally energized relay  $r^2$ , which being shunted permits its armature to fall back to close

the local circuit of the supervisory signal  $S^2$  and which would now light were it not for the fact that the subscriber's telephone is off its hook and therefore current flows over the metallic line and strand  $t$  of the cord circuit through the supervisory relay  $r$  to energize said relay and open the circuit of the supervisory signal to prevent its operation. After learning the order of the calling subscriber, the operator tests the wanted line in the usual manner by lightly touching the tip of the calling plug to the test ring of the multiple jack of the wanted line before her. This test is carried out in the usual manner, the absence of a noise in her receiver indicating that the line is idle and the sound of a click therein indicating to her that the line is busy. Upon finding the line idle the calling plug is inserted in the jack and the ringing key depressed. This action permits current from the ringing generator 21 to flow out over the tip side of the line, through the signaling devices at the substation and back to the central office over the line conductor 3 and thence over strand  $s^2$ , conductors 23 and  $5^a$  and through the battery  $B^2$  to ground. At the same time steady current from the battery  $B^2$  flows through said conductors  $5^a$  and 23 and through the cut-off relay  $R^2$  to maintain the same actuated during ringing. After the subscriber has been called but before his response the high resistance relay  $r^3$  is deenergized for the same reasons explained in connection with relay  $r^2$  on account of being shunted by the cut-off relay  $R^2$  of line  $L^2$  and closes the local circuit of the supervisory signal  $S^3$  which is lighted to indicate the fact that the subscriber has not yet responded. Upon his response the supervisory relay  $r^4$  is energized by current in the metallic line and retires the said signal. The operator is thus informed that the subscribers are in communication. During conversation the batteries  $B$  and  $B^2$  are sending current out over the telephone lines to operate the subscribers' transmitters and to energize the supervisory relays  $r$  and  $r^4$ . The cut-off relays  $R^2$  of the telephone lines are simultaneously energized by current from said batteries. At the conclusion of the conversation, the return of the subscribers' receivers to their hooks deenergizes the said relays  $r$  and  $r^4$  in the cord circuit, which permits the completion of the circuits of the supervisory signals to light the same, thereby informing the operator that the conversation has terminated. Should either subscriber desire a reconnection, the attention of the operator may be obtained by slowly vibrating his switch-hook which serves to flash the corresponding supervisory signal. Upon observing the lighting of both the supervisory signals the connection is taken down and all parts restored to normal position.

In Fig. 2 in place of the high resistance relay  $r^2$  and the retardation coil 12, I employ a relay  $r^5$  which is provided with a high resistance winding 24 of about the same resistance as the relay  $r^2$  of Fig. 1 and serving normally to maintain said relay energized, and upon the same core I wind differentially with respect to said winding 24 a 100 ohm coil 25, these windings being so adjusted that when the connection is established by means of the plug of the cord circuit the current flowing in the winding 25 neutralizes the effect of the winding 24 upon the core of the relay  $r^5$ , and thereby permits its armature to fall or be drawn back by its tension springs to close the circuits of the supervisory sig-



nal. The winding 25 takes the place of the retardation coil 12 of the previous figure in preventing the passage of the voice currents. This figure also shows how one relay is sufficient to normally prevent the operation of the lamps  $S^2$  and  $S^3$ , all of which is readily understood.

In Fig. 3 a slightly different arrangement is shown in which a polarized relay  $r^6$  is provided. This relay has preferably also a high resistance winding 27 which assists the permanent polarization of the relay in such manner as to normally tip the armature 28 of said relay in a direction to open the local circuit of the signal, while a second winding 29 is so arranged that when a connection is established with the telephone line it overcomes the normal polarization of the relay as well as the effect of the coil 27 and to tip the armature 28 in the reverse direction so as to close the circuit of the supervisory signal.

It is thus apparent that my invention is susceptible of various embodiments and modifications and I do not therefore wish to be limited in all respects to the precise details so shown and described.

Having thus described the nature of the invention, what I claim and desire to secure by Letters Patent is:—

1. In telephone systems, the combination with telephone lines, of a cord circuit to connect with said lines for conversational purposes, a supervisory signal associated with the cord circuit, a relay normally actuated to prevent the operation of said signal, and means whereby when a connection is established with the line by said cord circuit a path around said relay is completed, said path containing a relay adapted to close the circuit of said signal to operate the same, substantially as described.

2. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections therewith for conversation, a supervisory signal associated with the cord circuit, a relay in a circuit of high resistance normally energized to prevent the operation of said signal, and means whereby when a connection is established with the line a portion of the current is shunted from said relay to suitably control it to permit the operation of the signal, substantially as described.

3. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections therewith for conversation, a supervisory signal associated with the cord circuit, a high resistance relay normally energized to prevent the operation of said signal, and means whereby when a connection is established with the line, a low resistance path around said relay is completed whereby said relay permits the operation of said signal, substantially as described.

4. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be connected therewith for conversational purposes, a supervisory signal associated with the cord circuit, a high resistance relay permanently connected in a circuit and serving normally to prevent the operation of said signal, and means whereby when a connection is established with the line a path of comparatively low resistance is established around said relay to deprive the same of operating current to thereby permit the actuation of said signal, substantially as described.

5. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, a supervisory signal therefor, a pair of relays to control the circuit of said signal, one of said relays being normally actuated to maintain said signal effaced, the latter being under the control of the operator and the other being under the control of the subscriber, substantially as described.

6. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be connected therewith for conversation, a central source of current associated with said cord circuit, a relay adapted at all times

to carry current from said source through its winding, means upon the connection of said cord circuit with said line to vary the current in said relay winding sufficiently to change its condition of actuation and a signal controlled thereby, substantially as described.

7. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be connected therewith, a pair of relays associated with said cord circuit, a signal circuit controlled by said relays, one of said relays being normally actuated to prevent the flow of current in said signal circuit and the other normally unactuated to permit the flow of current in said signal circuit upon a change in the actuation of the first relay, substantially as described.

8. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be connected therewith for conversation, a supervisory signal associated with said cord circuit, a source of current also associated therewith, a relay normally actuated by current from said source to prevent the display of said signal, means to alter the current through said relay to suitably change its condition of actuation to allow the display of said signal and a second relay to again open the circuit of said signal, substantially as described.

9. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be temporarily connected therewith for conversational purposes, a signal connected with said cord circuit, a source of current also associated therewith, a relay and a resistance normally in series with said source, whereby said relay is normally actuated to prevent the display of said signal, and means to increase the current through said resistance whereby the current is decreased through said relay to change its condition of actuation and allow the display of said signal, substantially as described.

10. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be connected therewith for conversational purposes, a signal associated with said cord circuit, a central source of current also associated therewith, a relay normally connected between one pole of said source and one limb of said cord circuit, a resistance connected between the other pole of said source and said limb of the cord circuit whereby said source is permanently connected with said relay, and means upon the connection of the cord circuit with a line for lowering the potential about said relay whereby its condition of actuation is changed to display said signal, substantially as described.

11. In a telephone system, the combination with a telephone line, of a cord circuit for establishing connections therewith, a supervisory signal for the cord circuit, a source of current, a pair of relays to control the circuit of said source through said signal, one of said relays being normally actuated and under the control of the operator, and the other of said relays being normally unactuated and under the control of the subscriber, substantially as described.

12. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, a supervisory signal, a pair of relays associated with the cord circuit and adapted to control the circuit of said signal, one of said relays being normally actuated and adapted to be released when the cord is connected with the line, whereby the signal is displayed, the other of said relays being adapted to be actuated when the subscriber's receiver is off his hook and the cord circuit is connected with the line, whereby the signal is effaced, substantially as described.

13. In a telephone system, the combination with a telephone line, of a switch at a sub-station of the line, a cord circuit to establish connections therewith, a source of current, a signal, a pair of relays to control the circuit of said source through said signal, each of said relays having back contacts, means to control the circuit of said relays, whereby the circuit of said signal is closed through said back contacts when the cord is connected with a line and the switch at the sub-station is open, and means for opening the circuit of said signal when the switch at the sub-station is closed, substantially as described.

14. In a telephone system, the combination with a tele-



phone line, of a cord circuit to establish conversational  
connections therewith, a source of current, a signal, a  
pair of relays for controlling the circuit of said source  
through said signal, said signal being displayed when both  
5 of said relays are in their unactuated conditions, and  
effaced when either of said relays is actuated, and means  
to control the circuits of said relays, whereby both are  
unactuated when the cord is connected with a line open at  
the sub-station, and whereby one of said relays will be  
10 actuated when the cord is connected with a line which is  
closed at the sub-station, substantially as described.

15. In a telephone system, the combination with a tele-  
phone line, of a cord circuit adapted to be connected with

the line for conversational purposes, a signal circuit, a  
pair of relays having contacts coöperating to control the  
signal circuit, one of said relays being normally actuated  
and under the control of the operator, and the other of  
said relays being normally unactuated and under the  
control of the subscriber when a connection is established  
with the line, substantially as described. 15 20

Signed by me at Chicago, county of Cook, State of Illi-  
nois, this 31st day of Dec., 1903.

WILLIAM W. DEAN.

Witnesses :

E. A. GARLOCK,

ROBERT LEWIS AMES.